ISBN: 978-81-937815-0-0

PROCEEDINGS-CUM-ABSTRACT BOOK

International Web Conference
on
Biodiversity in Vegetable Crops for Healthier Life and Livelihood

27-28 August, 2020

Editors:
Dr. S.S. Solankey
Dr. D.P. Saha
Dr. Shyama Kumari
Dr. Shirin Akhtar
Dr. V.B. Jha
Dr. R. K. Sohane
Dr. R.R. Singh

Organized by
Bihar Agricultural University
Sabour, Bhagalpur – 813210 (Bihar)

Proceedings-cum-Abstract Book

International Web Conference

on

Biodiversity in Vegetable Crops for Healthier Life and Livelihood

27-28 August, 2020

Editors

Dr. S.S. Solankey

Dr. D.P. Saha

Dr. Shyama Kumari

Dr. Shirin Akhtar

Dr. V.B. Jha

Dr. R. K. Sohane

Dr. R.R. Singh

Bihar Agricultural University,

Sabour, Bhagalpur – 813210 (Bihar)

Chairman

Dr. Ajoy Kumar Singh

Vice Chancellor

Bihar Agricultural University, Sabour

Editors

Dr. S.S. Solankey
Dr. D.P. Saha
Dr. Shyama Kumari
Dr. Shirin Akhtar
Dr. V.B. Jha
Dr. R. K. Sohane
Dr. R.R. Singh

Cover Design

Mr. Brajesh Kumar Tiwari

Technical Support

Mr. Ishwar Chandra

Mr. Anjum Hashim

ISBN: 978-81-937815-0-0

BIHAR AGRICULTURAL UNIVERSITY, SABOUR

BHAGALPUR - 813210 (BIHAR)

Dr. Ajoy Kumar Singh
Vice Chancellor

Phone : 0641-2452606 (O)
: 0641-2452605 (R)
Fax : 0641-2452604
Patna : 0612-2222267 (O)
Fax : 0612-2225364
Mob. No. : +91-8902750693
Email Id : vcbausabour@gmail.com
URL : www.bausabour.ac.in

FOREWORD

Biodiversity is the natural heritage of the planet and is one of the key factors of sustainable development. It is the backbone of crop improvement and has importance not only for the environmental aspects of sustainability but also for the social and economic ones. Vegetable biodiversity helps ensure not only a stable and sustainable supply of sufficient quantities of food, energy and protein but also plays a major role in ensuring its quality. A direct product of crop diversity is itself considered desirable by nutritionists. Besides, the supply of vital nutrients of vitamins and minerals can be enhanced through the efficient use of genetic diversity. New varieties can be developed with improved nutritional quality, with respect to vitamins, minerals, better quality protein, essential elements and reduced anti-nutritional or toxic factors.

On this context the two day International web conference on "Biodiversity in Vegetable Crops for Healthier Life and Livelihood" was an excellent platform to exchange concepts and opinions. The web conference was attended by more than two thousand and three hundred participants across the India and from different countries. I am happy to learn that, several important recommendations were emerged through a critical discussion during the said web conference. I hope the Proceedings-cum-Abstract book of this web conference will be quite useful for scientific communities, education stakeholders and policymakers involved in vegetable research and production. I congratulate the organizers of the web conference and the editorial team for their commitment and active participation and wish you all the success.

(Ajoy Kumar Singh)

CONTENTS

Theme-I: Present status, challenges and future prospects of vegetables at national and global perspective

Theme-II: Recent techniques for enhancing the productivity and quality of vegetables crops

Theme-III: Impact of climate change on vegetable crops and its mitigation strategies

Theme-IV: Vegetables as immunity booster and for nutritional security

Theme-V: Role of Vegetables in Enhancing Nutritional and Livelihood Status

About the Web Conference

The loss of biodiversity is one of the biggest challenges of our time. Species loss driven by human activities is 1,000 times faster than under natural circumstances. Many ecosystems which provide us with essential resources are at risk of collapsing. The vegetable crops biodiversity is supported by genetic diversity, which includes species diversity, cultivated varieties, and also the diversity of natural and agro-ecosystems. Unfortunately, genetic diversity of vegetable crops in several parts of the globe has been eroded due to various factors like, deforestation and urbanization, rural areas abandonment, farming population ageing and failure to transfer information to the next generations, which can differ in relation to the type of location and genetic resource. Besides these, traditional knowledge about these diverse vegetables has also reduced in the youth influenced by urbanisation. Worldwide diversity of vegetable is about 400 species, out of which 80 species of major and minor vegetables have originated in India. Various major and minor vegetables species provide several useful products like food, medicines and raw materials. Thus they are powerful tools in the present battle for enhancing immunity as well as malnutrition worldwide. This International Web Conference was focused on present status, improvement, nutraceutical properties, value addition and the possibilities as well as opportunities of various vegetables worldwide.

Thematic Areas:

- **Present status, challenges and future prospects of vegetables at national and global perspective.**
- **Recent techniques for enhancing the productivity and quality of vegetables crops**
- **Impact of climate change on vegetable crops and its mitigation strategies.**
- **Vegetables as immunity booster and for nutritional security.**
- **Role of vegetables in enhancing nutritional and livelihood status.**

This proceedings-cum-abstract book contains the summary of keynote lectures delivered by eminent speakers and participant's extended summary as well as abstracts submitted during the International Web Conference held on 27-28 August, 2020. The outcome of this web conference in a form of proceedings and recommendation has been included at the end of this book.

Keynote Articles

K-01 UNDERUTILIZED CROPS AND HIGH-TECH HORTICULTURE FOR FOOD AND NUTRITIONAL SECURITY OF URBAN AND PERI-URBAN POPULATION: A PREVIEW

M.L. Chadha

Former Director, AVRDC-The World Vegetable Center

Chairman Madan Chadha Safe Healthy Vegetable Foundation

**Corresponding author e-mail: madanchadha75@gmail.com*

Introduction:

Horticulture has traditionally provided food security and a way of life for millions of smallholders in developing countries. However, the role of horticulture is changing rapidly in the context of global and local trends, as a result of increasing population, rapid urbanization and in response to economic pressures and new market opportunities. Resource-poor communities are increasingly using their skills in horticulture as a means to increase cash income and, more broadly, to improve their livelihoods by supplying fruits and vegetables, fresh or processed, to high-value local, urban and international markets. The national research and development has also identified supporting this process as a promising entry point for efforts to improve the livelihoods of resource poor people (Anonymous, 2018). In this process, underutilized horticultural species, especially in home gardening, are gaining importance and Urban along with peri-urban horticulture are contributing a lot to food and nutrition security.

To define what is an underutilized plant species is ambiguous. A wide range of terms are used interchangeably, which include minor, neglected, orphan, abandoned, traditional, lost, forgotten, niche, promising, underdeveloped, alternative, unexploited. The most accepted and most frequently used in the scientific community is the term “underutilized”, which refers to the species with an underexploited potential for contribution to food security, health (nutritional and /or medicinal), income generation and environmental services (Hoeschle-Zeledon and Jaenicke, 2007).

The common features of underutilized horticultural species are that they have local importance in consumption and production systems. They are represented mostly by wild species, ecotypes, and landraces, and are highly adapted to agro-ecological niches/marginal areas. Little attention is given in National Policies, R&D are poorly documented (distribution, biology, cultivation, uses.) and there is non-existent/poorly organized marketing. Their cultivation and utilization depends on indigenous knowledge. These species are scarcely represented in *ex situ* germplasm collections, maintained mainly through *in situ/* on farm conservation, and characterized by non-existent/fragile seed supply systems as well by multiple uses.

Underutilized horticultural crops/species are important because of potential crops for improving nutrition and food security, high medicinal values. They also play significant role in diversification and are an important source of farm income as well as of aesthetic value.

Opportunities and Challenges of Underutilized Crops:

International trade is changing rapidly and underutilized horticultural crops (UHC) have great scope. Domestic markets may offer better prospects for commercialization of UHC, increasing urbanization, and impacting production and supply of fresh and processed vegetables and fruits and other horticultural goods. The growing demand for UHC products in urban centres offers new opportunities for underutilized horticultural crops to enter niche markets and thus creating income and jobs in rural areas. Many underutilized horticultural plant species are considered to be hardier, better adapted to extreme environmental conditions and are more resilient. UHC provide a complimentary asset that allows producers to diversify into new business areas and consumers to increase their choice of food. Urbanization covers prime agricultural land, thus increasing pressure on the remaining agricultural areas on which more produce of higher quality has to be grown. The production and consumption of underutilized fruits and vegetables, is still hampered by a general lack of awareness about their benefits in all sectors of society and a lack of necessary capacity within the scientific community. In this paper, illustration/examples of 108 UHC have been included and explained.

The process of transition, from low-input, largely subsistence horticulture to a more intensive, market-oriented version, presents many challenges. Communities seek to develop horticulture within a complex web of social, cultural and demographic constraints - which researchers and development practitioners must try to understand if they are to provide effective support. Individuals and households may have diverse livelihood strategies and aspirations, in which horticulture provides only a part of the solution. Major technological and organizational innovations are needed to tackle the immense challenges posed by evolving horticultural value chains in developing countries. These innovations, as well as the means to promote their adoption, will be quite different depending on the community's situation, ranging from urban or peri-urban to rural and remote. These complexities suggest the need for multi-disciplinary and integrated approaches, as well as participatory models of engagement.

Understanding - urban and peri-urban horticulture (UPH):

UPH helps to grow greener cities by contributing to food security, employment, waste management and community well-being.

Urban and peri-urban horticulture (UPH) includes all horticultural crops grown for human consumption and ornamental use within the immediate surroundings of cities as well as in the cities. Of India's population, about 35 percent of people currently live in cities. This proportion is expected to increase by more than 40% by 2030 and shall be more than 65 % by 2050. According to the United Nations, India has the highest (2%) annual change regarding urban population. It is estimated that 854 million people will live in Indian cities by 2050. In this decade (2011-20), India has added 95 million people to its already dense urban fabric.

Urban and peri-urban horticulture has already focused attention, not only for fruits and vegetables, but for environmental services and health care. It has further advocated for zero land utilization, interior and exterior landscaping, vertical gardens, and roof & terrace cultivation of fruits, vegetables, flowers and mushroom culture. The overall objective of urban and Peri-Urban horticulture is to promote health and quality of life by increasing the amount and distribution of locally grown food, especially vegetables and fruits. Opportunities are emerging in urban area for horticulture as demand for fresh fruits and vegetables are increasing, resulting in various activities. The broad diversity of horticultural crops allows year-round production, employment, income and has a considerable yield potential up to 50 kg of fresh produce per m² per year, especially in home gardens. Leafy vegetables are particularly perishable and post-harvest losses can be reduced significantly when production is located close to consumers. Mushroom centers, hydroponics and aeroponics, which do not need land, can be a most promising activities in cities.

Urban and peri-urban horticulture can turn waste into a productive resource and offer it to citizens as compost for home gardens, which help prohibit chemical fertilizer in cities. Using wastewater for horticulture results in vegetables grown with untreated wastewater and can cause gastrointestinal ailments and even cholera. But, when appropriately treated for agricultural re-use, wastewater from domestic sources can supply most of the nutrients needed to grow quick growing fruit trees, vegetables and ornamental plants. It would be beneficial to introduce low-cost treatment units that allow residents to irrigate gardens and orchards with the grey water discharged from kitchens and showers. An important factor affecting both land use and the cropping pattern is access to transport network for linkage with the urban market. The unemployed educated rural youth can be trained for gainful employment and increased production. Protected cultivation of horticultural crops for high quality and off season cultivation can be promoted with the improved techniques. The concept of organic farms can be established, and recycled waste from cities and mandis can be used as organic manure. As a result environmental pollution and health hazards will be reduced, while soil health will be improved. There has been inadequate attention towards post-harvest management and market places are either absent or negligible. UPH expands the economic base of the city through production, processing, packaging, and marketing of consumable products. This also provides the opportunity for women to be part of the informal economy of a city, as well as improving the livelihood of people living in and around cities.

Constraints: are mainly related to:

a) Resource scarcity (water, land, labor and access to other inputs). In all cases, these scarce sources need to be used efficiently and with precaution.

b) Pollution

Environmental pollution: the main pollutants of horticultural crops are heavy metals, pesticide residues, and biological contaminants. Such pollution presents a risk to the consumers.

Heavy metals: The main causes of soil pollution from heavy metals (including lead, cadmium, chromium, zinc, copper, nickel, mercury, manganese, selenium and arsenic). Toxicity from heavy metals can directly affect plant physiology and growth.

Pollution by horticultural practices:–The intensive use of agrochemicals (fertilizers, pesticides, fungicides) may lead to residues in crops, surface water or groundwater. The development of new technologies, such as integrated pest management and biological control, can help in reducing pesticide use.

Food Safety: The effect of environmental pollution of the air, soil and water, which potentially compromises the quantity, quality and safety of food produced in urban and peri-urban areas. To use waste water for irrigation without careful treatment and monitoring can result in the spread of diseases among the population.

However, a concerted Urban and Peri-Urban Horticulture development program can enhance the quality of the urban environment by leading to greening of cities. Although crops have always been grown inside the city, the practice is expanding and gaining more attention. The products of UPH include a large variety of vegetables, cereals, flowers, ornamental trees, aromatic vegetables and mushrooms. These are the main species cultivated in peri-urban horticultural systems and, more specifically, those presented in this paper.

Generally, the types of crops cultivated vary according to the area and are influenced by culture as well as tradition. In cities, short-cycle crops are preferred, while in the surroundings of the city, crops with longer cycles are cultivated, such as orchards. Crops are grown in small gardens or larger fields, using traditional or high-tech and innovative practices. The major production systems and practices of UPH are described in this paper, together with the major constraints.

Some new techniques that have been adapted to the urban situation and tackle the main city restrictions are also documented. These include horticultural production on built-up land using various types of substrates (e.g. Home garden, roof top, organic production, protected and hydroponic production), water saving in highly populated areas, the production of pesticide-free vegetables year-round with a low content of heavy metals and human pathogens, and control of wastes and leaching (fertilizers, pesticides, organic matter, water) in the urban environment.

Hydroponics is the growing of plants in systems isolated from the soil, and fed with the total water and nutrients required. Systems can be either recirculating or non-recirculating and do not necessarily use a growing medium. Another, perhaps better term, is soilless culture. Many people use hydroponics as a hobby. Hobby systems can be great fun as well as being educational and rewarding, and the enjoyment and satisfaction of growing your own produce can be easily achieved through this practice. However, to go from a hobby scale to commercial production is a major step as there are substantially different requirements for the two. A commercial enterprise must not only produce reliably, but must give an acceptable financial return as well. When using a hydroponic technique, additional skills are needed to manage the system. And, of course, once you've produced the crop you have to be able to sell it for a reasonable price.

Protected cultivation offers the best choice for diversification from traditional production systems to this modern technology for a number of reasons. Production of crops under protected conditions has great potential in augmenting production and quality of vegetables, in main and also during off season. This also maximizes water and nutrient use efficiency under varied agro climatic conditions of the country (Singh and Solanki, 2015). This technology has very good potential, especially in peri-urban agriculture, since it can be profitably used for growing high value horticultural crops like vegetables and flowers. It can also encourage healthy and virus free seedling production. A large number of farmers around the NCR region and from other rural and peri-urban areas can successfully diversify their traditional agriculture by using various levels of protected cultivation, looking to availability of resources, availability of emerging markets of usual and unusual off season vegetable crops, and year round demand of high value vegetables and flowers. All kind of protected technologies may not be economical and suitable to various groups of farmers, because of their very high initial and running and maintenance cost. But, some protected technologies are low cost, simple and highly profitable for rural and peri-urban areas which can be adopted by the farmers for production of different high value vegetable crops, flowers and nursery raising in profitable agri/horti-business models. Some of the technologies like low pressure drip irrigation and low cost nursery raising technologies are highly suitable for livelihood security and can be expanded

In general, eating a wide variety of fresh, whole (unprocessed), foods has proven favorable for one's health compared to monotonous diets based on processed foods. In particular, the consumption of whole-plant foods slows digestion and allows better absorption, and a more favorable balance of essential nutrients per calorie. This results in better management of cell growth, maintenance, and mitosis (cell division), as well as better regulation of appetite and blood sugar. Regularly scheduled meals (every few hours) have also proven more wholesome than infrequent or haphazard ones. There are six major classes of nutrients: carbohydrates, fats, minerals, protein, vitamins, and water. These nutrient classes can be categorized as either macronutrients (needed in relatively large amounts) or micronutrients (needed in smaller quantities). The micronutrients are minerals and vitamins. The introduction of new fortified crops, such as vegetable soybeans and mung bean sprouts, can help to overcome macro and micronutrient needs.

Good Agricultural Practices (GAPs) can improve product quality and safety. Producers also use standard cleaning and sanitizing practices to reduce sources of microbial contamination on their products. Washing, rinsing, and sanitizing may appear to increase costs, but they enhance product quality, ensure more visually appealing produce to customers, and increase product shelf life when spoilage organisms are removed.

Expanding urban and peri-urban activities:

Horticultural tourism holds nearly all aspects of tourism. Apart from its importance to sustainable growth and environmental development, horticulture tourism is related to various aspects of gardening and its development for creating value from natural resources. Therefore, it is necessary to collect all related aspects of gardening which are directly related to tourism development. For example, work area such as a role of horticulture and gardening help us understand more about the development of the horticultural and natural gardening resources of a tourist destination. Besides, work areas like marketing and business help us understand the promotion and marketing of horticultural product. For instance, the development of crop cafeterias which are directly related to farmer’s fields. The study of geography based crop production and the particular crop for the particular region provides information on the cultivation resources of a destination and opportunities to develop it as a complete horticultural destination.

India has a major opportunity to exploit the potential of horticultural tourism to promote development and increase its participation in the sustainable tourism development. In addition, horticultural tourism creates opportunities for the farmers in India and provides revenues for horticultural products and environmental preservation.

Urban and peri-urban cultivation systems differ from rural systems by their proximity to cities and by the constraints of space, which often lead to greater intensification of production.

References:

Anonymous (2018). XXX. International Horticultural Congress, 12 – 16 August, 2018, Istanbul – Turkey, https://www.ihc2018.org/en/

Hoeschle-Zeledon, I. and Jaenicke, H. (2007). A strategic framework for global research and development of underutilized plant species: a contribution to the enhancement of indigenous vegetables and legumes. *Acta Hortic*., 752: 103-110, DOI: 10.17660/ActaHortic.2007.752.13.

Singh, Balraj and Solanki, R (2015). Protected Cultivation Technologies for Vegetable Cultivation Under Changing Climatic Conditions (In: Climate Change: The Principles and Applications in Horticultural Science, Vol. I, (Editors: M.L. Chaudhary, V.B. Patel, M.W. Siddiqui and S.S. Mahdi). ISBN: 9781771880312, CRC Press, USA) Pp. 106-114.

***

K-02 BIODIVERSITY AND SUSTAINABLE NUTRITION WITH REFERENCE TO TOMATO, BRINJAL AND POTATO

Pranab Hazra

Professor, Department of Vegetable Science and

Dean, Post Graduate Studies

Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal

**Corresponding author e-mail: hazra.pranab05@gmail.com*

Hunger, malnutrition and hidden hunger:

At the beginning of this new millennium, we are still facing an alarming challenge. One billion poor people still suffer from hunger and malnutrition while about 2 billion show under-nutrition and micronutrient deficiencies (FAO, 2011). At the same time, about 2 billion are overweight and/or obese, a steadily increasing number in all countries in the world (WHO, 2011). This double burden is found in both poor developing countries as well as in Brazil, Russia, India and China. It is noteworthy that an important fraction of the population in industrialized countries is suffering from poverty too and inadequate food and nutrient intakes. The recent trends for these patterns are quite alarming (CDC, 2011) thus highlighting the overall inadequacy of food supply and dietary patterns during the last decades and present time worldwide. While there is a welcome decline from the 2009 level, the number of hungry people remains unacceptably high. Furthermore, this number does not reflect all the dimensions of malnutrition. Micronutrient deficiencies, for instance, affect an estimated two billion people. Responding properly to the hunger and malnutrition problems requires urgent, resolute and concerted actions.

Hunger and malnutrition refers to the lack of macronutrients like carbohydrates and protein in the diet. Hidden hunger, unlike the usual forms of hunger like Protein Energy Malnutrition (PEM), is a disorder because of the lack of essential micro-nutrients in the diet that are absorbed by the body (Uchendu and Atinmo, 2010). Micronutrients refer to vitamins and minerals essential for the body's physical and mental development, immune system functioning and various metabolic processes (Burchi, *et al.*, 2011). Vitamins are organic compounds needed to maintain health and sustain life. Minerals are inorganic micronutrients needed for metabolic reactions (Chavez *et al.*, 2006). People suffering from hidden hunger may appear healthy and it is considered "hidden" due to the absence of the classic symptoms of hunger (i.e. starvation, "skin and bones" look, protruding abdomen) and to the "invisible" quantity of vitamins and minerals in the food people eat (Uchendu and Atinmo, 2010; Burchi, *et al.*, 2011).

Malnutrition hidden hunger affects more than half of the world's population, especially women and preschool children in developing countries (UNSSCN, 2008). Even mild levels of micronutrient malnutrition may damage cognitive development, lower disease resistance in children and increase the incidence of childbirth mortality and diminish quality of life (Pfeiffer and McClafferty, 2007). The clinical and epidemiological evidence is clear that selected minerals (iron, calcium, selenium, and iodine) and a limited number of vitamins (folate, vitamins E, B6, and A) play a significant role in the maintenance of optimal health and are limiting in diets and fortification of foods by the addition of specific micronutrients has high potential to provide health benefits (DellaPenna, 2007). It calls for united efforts by all relevant sectors and at all levels.

Food and nutrition:

Improvement of nutritional quality of vegetable crops appears to be a rewarding activity for vegetable breeders in the 21st century. People are beginning to consume more healthful foods that can alleviate problems related to "diseases of overabundance" and diet-related chronic diseases, such as some types of obesity, heart disease, and certain types of cancer. "Hidden hunger" or micronutrient deficiency is a pernicious problem around the world particularly in the under-developed and developing countries that is caused by a lack of vitamins and minerals such as vitamin A, iodine and iron in the human diet and affects the health of about three billion people worldwide (Dias and Ortiz, 2012).

Vegetable, the functional food:

Vegetables are considered essential for well-balanced diets since they supply vitamins (C, A, B1, B6, B9, E), minerals, dietary fibre and phyto-chemicals (Dias and Ryder, 2011). In the daily diet, they have been strongly associated with improvement of gastrointestinal health, good vision, and reduced risk of heart disease, stroke, chronic diseases such as diabetes, and some forms of cancer. A high vegetable diet has been associated with lower risk of cardiovascular disease in humans (Mullie and Clarys, 2011). Some phyto-chemicals of vegetables are strong antioxidants and are thought to reduce the risk of chronic disease by protecting against free radical damage by modifying metabolic activation and detoxification of carcinogens or even by influencing processes that alter the course of tumour cells.

Crop genetic diversity: a critical resource:

Plant genetic resources have been defined as the "Genetic material of plants, which is of value as a resource for the present and future generations of people" (IPGRI, 1993). A wide range of genetic variation is needed within species to help them adapt to changing environment conditions and new pests and diseases. The plants we use as crops (either directly as food or as fodder for animals) are dependent in terms of resilience and adaptability, on the broad genetic base of variation that exists both in the crops developed over millennia of farmer experimentation, and from their wild relatives (Maxted, 2003). The foundation of the current world food supply is based on thousands of years of crop selection and improvement carried out on traits of wild species (Mc Couch, 2004). Modern plant breeders and biotechnologists rely on genetic variation in landraces, primitive cultivars, obsolete cultivars, spontaneous mutants, induced mutants and crop wild relatives to produce better adapted, high yielding and high quality crop varieties. Almost all modern varieties of crops have been improved using genetic diversity derived directly from a wild relative. Over 75 years ago, Vavilov drew attention to the potential of crop relatives as a source of genes for improving crop performance (Vavilov, 1940 as cited by Tanksley and Mc Couch, 1997).

Diversity among individual plants and animals, species and ecosystems provides the raw material that enables human communities to adapt to change - now and in the future. However, genetic diversity is not evenly distributed throughout the world and it is, in fact, concentrated in tropical and sub-tropical areas, where the majority of developing countries are located.

Within the Plant Kingdom, around 3,50,000 species have been classified (Groombridge, 1992), out of which only about 10 per cent have ever been evaluated for their agricultural or medicinal potential (*Prance,* 1997). In the course of history, mankind has utilized about 7,000 of these plant species for food. However, today, only 150 plant species are cultivated and of these, the so-called major crops can be contemplated in about 30 plant species which are producing about 95% of the world's calories and proteins. Today, it is widely stated that just nine crops (wheat, rice, maize, barley, sorghum/millet, potato, sweet potato/yam, sugar cane and soybean) account for over 75 per cent of the plant kingdom’s contribution to human dietary energy (Shand, 1993).

Biodiversity of vegetable crops:

Biodiversity is the natural heritage of the planet and is one of the key factors of sustainable development, due to its importance not only for the environmental aspects of sustainability but also for the social and economic ones. Intensive agriculture has generally determined a higher productivity, but also a decrease in agro-biodiversity, whose preservation represents a key-point to assure adaptability and resilience of agro-ecosystems to the global challenge (to produce more and better food in a sustainable way). Many components of agro-biodiversity would not survive without human interference, but human choices may also represent a threat for agro-biodiversity preservation (Elia and Santamaria, 2013).

Study by Bioversity International in collaboration with the FAO revealed that a total 1,097 vegetable species, with a great variety of uses and growth forms, are cultivated worldwide. Of the total of 1,097 vegetable species cultivated worldwide, 495 species are used for leaves (leafy green and salad crop); 227 species are used for multiple vegetative parts (bulb, root tuber, stem, leaf, etc); 204 species are used for roots (root crops); 90 species are used for fruits or seeds and 80 species are used for other plant parts like flowers, inflorescences and stems. But hardly, 80 species (less than 7% of the total species) are more familiar to us. However, from the point of view of major share in the market and variety/hybrid development hardly 25 vegetable crops *viz*., potato, tomato, brinjal, chillies, sweet pepper, cabbage, cauliflower, onion, muskmelon, watermelon, cucumber, pumpkin, bitter gourd, bottle gourd, sweet corn, carrot, radish, beet, French bean, peas, spinach, lettuce, sweet potato, vegetable amaranthus and okra are important in the world.

Classification of Biodiversity:

The biodiversity in vegetable crops is underpinned by genetic diversity, which includes species diversity (inter-specific diversity), the diversity of genes within a species (intra-specific diversity) that refers to the cultivars, and by the diversity of agro-ecosystems (agro-biodiversity). Intra-specific diversity is abundant in vegetable crops and is not reflected, at least not at the same extent, in other groups of crops.

Farmers' variety: vital resource for Global food security:

Hard toil given by the farmers over centuries of selection has led to the creation of a plurality of local varieties starting from the domestication of wide agro-biodiversity forms, a precious heritage both from a genetic and a cultural-historical point of view. Therefore, the agro-biodiversity related to vegetable crops has assumed very articulated connotations. It is also important to specify that a "local variety" (also called a landrace, farmer's variety, or folk variety) is a population of a seed- or vegetative-propagated crop characterized by greater or lesser genetic variation, which is however well identifiable and which usually has a local name (Elia and Santamaria, 2013). There are, still many millions of small farmers, particularly in the marginal agricultural environments unsuitable for modern varieties, who practice traditional agriculture by cultivating large number of indigenous varieties and land races (Farmers' varieties or Folk varieties) in wide variety of vegetable crops. The genetic diversity represented in these "Farmers' varieties" remains a vital resource for global food security and economic stability. More than 80 % indigenous, tropical and tropicalized vegetable crops are grown in India with the farmers' varieties. Some Farmers' varieties or heirloom varieties have a higher quality nutritional and taste value than improved varieties and hybrids.

Crop wild relatives: the donor for quality traits and resistance to biotic stress:

A crop wild relative is a wild plant taxon that has an indirect use derived from its relatively close genetic relationship to a crop. Given the many threats associated with crop genetic diversity however, there is clearly a need, at least from the perspective of conservation, to define the relationship between a crop and its close wild relatives to allow the objective prioritisation of taxa for study (Meilleur and Hodgkin, 2004).

Breeding vegetable crops resistance to pathogens and insects has become the most important crop improvement programme and in most of the cases resistance has been identified in wild species. There is probably no crop into which pathogen resistance has not been widely introduced using genes obtained from the international *ex situ* germplasm collections. In potato, high levels of resistance to the green peach aphid (*Myzus persicae*) has been identified in about 6% of examined accessions of wild *Solanum* species, but in 0% of over 360 accessions of *Solanum tuberosum* and other cultivated *Solanum* species (Flanders *et al.*, 1992). The pattern is similar for resistance to other insect pests of potatoes. In cultivated tomato (*Solanum lycopersicum*) insect resistance is rare, but it is more prevalent in wild accessions of *Solanum lycopersicum* var. *cerasiformae* (Eigenbrode *et al.*, 1993) and common in more distantly related *Solanum habrochaites* (Farrar and Kennedy, 1992).

In tomato, three genes cause anthocyanin expression in fruit - *Anthocyanin fruit* (*Aft*) from *S. chilense*, *Aubergine* (*Abg*) from *S. lycopersicoides*, and *atroviolacium* (*atv*) from *S. cheesmanii*, (Georgiev 1972; Rick *et al.* 1994). Inclusion of *Aft* gene in the breeding programmes will be an approach to improve the nutritional value of tomato fruit (Balacheva *et al.*, 2012). The lycopene enhancing mutant gene "*dg*" and Anthocyanin fruit gene "*Aft*" has been stacked in one genotype by conventional breeding approach to develop "Purple tomato" rich in both lycopene and anthocyanin content (Hazra *et al*, 2018). Single dominant gene, *B*, from the wild relative *Solanum cheesmanii* conditions the accumulation of high levels of β carotene in the fruit at the expense of lycopene, resulting in orange-coloured fruit with β-carotene contents up to 2.39 mg /100 g fresh as against the average range of 0.25-0.50 mg/100 g fresh weight in normal cultivated tomato genotypes (Stommel and Haynes, 1994).

Mutant genes for enhancement of nutritional quality of vegetables

Mutant stocks in different crops allow the researchers to conduct both forward (systematic phenotypic screening) and reverse genetics (such as TILLING, or Targeting Induced Local Lesions in Genomes) experiments aimed at understanding the genes involved in various traits. Thus, mutant stocks are very important for gene discovery and creating novel variability. Some mutant genes for enhancement of nutritional quality of different vegetable crops are mentioned.

In tomato, nine classically defined genetic loci (with a total of 15 alleles) have large effects on the flesh colour of ripe tomatoes. These loci include: *old gold crimson* (og^c) and it's allele *Beta-carotene*; *apricot*; *Delta*; *diospyros*; *green flesh*; *green ripe*; *high pigment-1 (hp-1)*; *high pigment-2* (*hp-2*); *dark green* (*dg*); *Intense pigment*; *modifier Beta-carotene*; *red colour in yellow fruit*; *sherry*; *tangerine*; and *yellow flesh* (Rick and Chetelat, 1993; Van Tuinen *et al.*, 1997; Levin *et al.*, 2003). Few widely utilized genes, which result in enhanced carotenoid accumulation in tomato, are *high pigment* (*hp-1*, $hp\text{-}1^w$, *hp-2*, $hp\text{-}2^j$, $hp\text{-}2^{dg}$ and *hp-3*), *old gold crimson* (og^c) and *dark green* (*dg*). Tomato fruit carotenoid concentrations and colour might be influenced by other genes, different from *hp*, og^c, and *B*, such as *tangerine* (*t*), *yellow flesh* (*r*), *sherry* (*sh*) (Causse *et al.*, 2007; Stommel, 2007).

Biodiversity and sustainable nutrition:

In the International Scientific Symposium, "Biodiversity and Sustainable Diets: United against Hunger", jointly organized by FAO and Bioversity International as a contribution to the 2010 International Year of Biodiversity. For the first time, the concept of "biodiversity" was linked with the emerging issue of "sustainable diets" in exploring solutions for the problems of malnutrition in its various forms, while addressing the loss of biodiversity and the erosion of indigenous and traditional food cultures. The purpose was to promote the development of new sustainable food production and consumption models.

The alarming pace of food biodiversity loss and ecosystem degradation, and their impact on poverty and health makes a compelling case for re-examining food-agricultural systems and diets. Globalization, industrial agriculture, rural poverty, population pressures and urbanization have changed food production and consumption in ways that profoundly affect ecosystems and human diets, leading to an overall simplification of diets. High-input industrial agriculture and long-distance transport increase the availability and affordability of refined carbohydrates and fats, leading to an overall simplification of diets and reliance on a limited number of energy-rich foods.

It is time to face the evidence of a worldwide unsustainable food system. Its complexity makes it extremely fragile to any climatic, socio-economic, political or financial crisis. Thus, we urgently need appropriate understanding and new strategies to really accommodate present and future population needs and well-being. In that context, we need sustainable diets, with low-input, local and seasonal agro-ecological food productions as well as short distance production-consumption nets for fair trade.

The drastic changes that recently occurred and presently occur in most countries seem to originate in the erosion of the traditional ways of life and culture as the new "Western/North American" food model and system spreads over the world. This "modern" trend is now clearly facing the challenge of sustainability, both in terms of land use for food production, farmers' income and poverty, water availability, pollution of the environment by chemicals and pesticide residues, fossil energy decline and cost, environment and biodiversity degradation, climate change and global warming. Despite an apparent opulence, the complexity of the present food supply system makes it extremely fragile to any climatic, socio-economic, political or as recently financial crisis (Brinkman *et al*., 2010).

The urgency of Global genetic conservation:

The world's biodiversity are under siege. There is an urgent need to collect, document and better use crop biodiversity including crop wild relatives, not least because they hold the genetic secrets that enable them to resist heat, drought, floods and pests. New and better-adapted crops derived from genetic diversity can offer more nutritious and healthier foods for rural and urban consumers, and provide opportunities to generate income and contribute to sustainable rural development. Now more than ever, there is a greater need to strengthen linkages among institutions dealing with plant diversity and food security, and with other stakeholders, at global, regional, national, and local levels. Far greater efforts are required to counteract the effects of longstanding underinvestment in agriculture, rural development and food security.

A human population nearing 6 billion places unprecedented pressures on the biosphere. Approximately 95% of the terrestrial surface is now occupied by human settlements or ecosystems managed for food and materials production. As a result, natural ecosystems are destroyed and fragmented, species are destroyed or doomed, and global genetic diversity is diminished. The scale of this destruction directly threatens human civilization, which is dependent in numerous ways on biological diversity (Ehrlich and Wilson, 1991).

It is particularly important to evaluate the wide array of farmer's varieties and characterize the preferred traits in the theme of community-based management of crop biodiversity. It is necessary to locate and conserve underutilized species and types, often known as indigenous vegetables Indigenous vegetables including species that are native to a particular region or introduced historically to a region from other areas. The North Eastern region of India comprising of eight states namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim, is one of the richest reservoirs of different underutilized vegetable crop species. Wide range of *Solanum* species viz., *S. macrocarpon* L., *S. indicum* L., S. *gilo* Raddi., *S. khasianum* Clarke, *S. sisymbrifolium* Lam. etc. is found in various parts of this region . The local tribal people of Arunachal Pradesh grow a vegetable having red tomato like fruits slightly bitter in taste belonging to the genus *Solanum*. In Manipur, another kind of brinjal, having round fruit and intermediate in appearance between tomato and brinjal, is grown. Wide variability of tree tomato (*Cyphomandra betacca*), a perennial shrub producing red tomato like fruits and used as tomato, different legume species like, *Vigna vexillata,* Tree bean (*Parkia roxburghii* G. Don.), *Cucumis hardwickii*, the likely progenitor of cultivated cucumber and Cho-Cho (*Sechium edule*) is found In this region.

Conservation strategy: in situ and ex situ:

Conservation and utilisation of plant genetic resources for food and agriculture are inextricably linked. Plant genetic resources should be made more easily available and useful to plant breeders and farmers for further improvement**.** Modern plant breeders and biotechnologists rely on genetic variation in landraces, primitive cultivars and wild forms to produce better adapted and higher yielding crop varieties. Therefore, it is vital that a wider range of germplasm is conserved, both *ex-situ* and *in-situ*, so that it will be available in the future as a resource for adapting crops to new and changing environmental conditions and to sustain agricultural production and development.

With regard to the germplasm of vegetable crops, *in-situ* conservation strategies involving farmers more directly need to be considered, particularly for populations of Farmers' varieties, wild crop relatives in the areas where they are found naturally. Home gardens in many parts of the world are examples of on-farm germplasm conservation efforts which deserve to be given greater support.

In situ genetic reserves can help conserve wider genetic variation less expensively than *ex situ* conservation because the costs of germplasm storage are eliminated. Additionally, while *ex situ* collections are genetically static or may even erode, genetic variation of *in situ* populations should be maintained by natural processes or indigenous cultural practices. The advantages of *in situ* genetic conservation are widely recognized, but efforts in this area are just beginning. In fact, just how to accomplish effective in situ genetic conservation is still an area of study. Arrangement of financial benefit from the Governmental level to the "custodian" farmers may be a viable option for *in situ* genetic conservation.

References:

Balacheva, E., Kartzeva, T., Atanassova, B. and Tomlekova, N. 2012. The diversity in tomato colours – potential for diversity in tomato nutritive quality. Acta Hort., **960**: 31-36.

Brinkman, H.J., de Pee, S., Sanogo, I., Subran, L., Bloem, M.W.(2010). High food prices and the global financial crisis have reduced access to nutritious food and worsened nutritional status and health. Journal of Nutrition, 140(1):153S-61S.

Burchi, F., Fanzo, J. and Frison, E. 2011. The role of food and nutrition system approaches in tackling hidden hunger: Review. *Intern. J. Environ. Res. Public Health*, **8**: 358-373.

Causse, M., Damidaux, R. and Rousselle, P., 2007. Traditional and enhanced breeding for quality traits in tomato. In: *Genetic improvement of Solanaceous. V. 2. Tomato* (Eds. Razdan, M. and Mattoo, A.K.). Science Publishers, USA, pp.153-192.

Centre for disease control and prevention (CDC). 2011. United States Department of health and human services, USA.

Chavez, L. L., de Leon, S. Y. and Claudio, V. S. 2006. Basic foods for Filipinos, 4th edn.. (Ed. Jamorabo-Ruiz, A.), Merriam and Webster Bookstore, Manila, Philippines.

DellaPenna, D., 2007. Biofortification of plant-based food: Enhancing folate levels by metabolic engineering. *Proc. Nat. Acad. Sci., USA*, **104**: 3675-3676.

Dias, J.S. and Ortiz, R. (2012). Transgenic vegetable crops: progress, potentials and prospects. *Plant Breed. Rev*. 35:151–246.

Dias, J.S. and Ryder, E. (2011). World vegetable industry: production, breeding, trends. *Hort. Rev*. 38:299–356

Eigenbrode, S. D., Trumble, J. T. and Jones, R. A. 1993. Resistance to beet armyworm (*Spodoptera exigua* [Hubner]), hemipterans, and *Liriomyza* spp. in *Lycopersicon*. *J. Amer. Soc. Hort. Sci.,* **118**: 525-530.

Elia, A. and Santamaria, P. 2013. Biodiversity in vegetable crops, a heritage to save: The case of Puglia region. Ital. J.Agron. 8: 21-34.

Ehrlich, P. R., Wilson, E. O. 1991. Biodiversity studies: science and policy. *Science* , **253**: 758-253.

Farrar, R. R. and Kennedy, G. G. 1992. Sources of insect and mite resistance in tomato in *Lycopersicon* s. In: *Genetic improvement of tomato* (ed. Kalloo, G.), Springer-Verlag, Berlin, pp. 121-142.

Flanders, K. L., Hawkes, J. G., Radcliffe, E. B. and Lauer, F. I. 1992. Insect resistance in potatoes: sources, evolutionary relationships, morphological and chemical defenses, and ecogeographical associations. *Euphytica,* 61: 83-111.

Food and Agricultural Organization (FAO). 2011. United Nations, Rome.

Georgiev, C., 1972. Anthocyanin fruit (*Af*). Rep. Tomato Genet. Coop., **22**: 10.

Groombridge, B. 1992. *Global Biodiversity: Status of the Earth's Living Resources*, WCMC with Chapman and Hall, London.

Hazra, P., Longjam, M. and Chattopadhyay, A. 2018. Stacking of mutant genes in the development of "purple tomato" rich in both lycopene and anthocyanin contents. *Scientia Horticulturae*, **239**: 253-258

IPGRI. 1993. *Diversity for development*, International Plant Genetic Resources Institute, Rome.

Levin, I., Frankel, P., Gilboa, N., Tanny, S. and Lalazar, A., 2003. The tomato dark green mutation is a novel allele of the tomato homolog of DEETIOLATED1 gene. *Theor. Appl. Genet*., **106**: 454-460.

Maxted, N. 2003. Conserving the genetic resources of crop wild relatives in European Protected Areas, *Biol. Conserv*., 113: 411-417.

Mc Couch, S.R. 2004. Diversifying selection in plant breeding. *PLOS Biol*., 2: *e347*. doi:10.1371/journal.pbio.0020347.

Meilleur, B. A. and Hodgkin, T. 2004. *In situ* conservation of crop wild relatives: status and trends, *Biodiver. Conserv*., **13:** 663–684

Mullie P. and Clarys, P. (2011). Association between cardiovascular disease risk factor knowledge and lifestyle. *Food Nutr. Sci.* 2:1048-1053

Pfeiffer, W.H. and McClafferty, B., 2007. Harvest Plus: breeding crops for better nutrition. *Crop Sci.*, **47**: S88-S105.

Prance, G.T. 1997. *Floristic Inventory of the tropics*: Where *do we stand*? *Ann. Miss. Botanical Garden*, **64**: 659-684.

Rick, C.M. and Chetelat, R.T., 1993. TGRC stock lists. *Rep. Tomato Genet. Coop.*, 43: 53-56.

Rick, C.M., Cisneros, P., Chetelat, R.T.and Deverona, J.W. 1994. *Abg*, a gene on chromosome 10 for purple fruit derived from *S. lycopersiciodes*. *Rep. Tomato Genet. Coop.*, **44**: 29-30.

Shand, H. 1993. *Harvesting Nature's Diversity*. Food and Agriculture Organization of the United Nations, Rome, Italy.

Stommel, J. R. 2007. Genetic enhancement of tomato fruit nutritive value. In: *Genetic improvement of Solanaceous. V. 2. Tomato* (Eds. Razdan, M. and Mattoo, A.K.). Science Publishers, USA, pp. 193-238.

Stommel, J.R. and Haynes, K.G. 1994. Inheritance of Beta Carotene Content in the Wild Tomato species, *Lycoporsicon cheesmanii* . *The Journal of Heredity*, 85(5): 401-404

Tanskley, S.D. and Mc Couch, S.R. 1997. Seed banks and molecular maps: Unlocking genetic potential from wild. *Science*, 277: 1063–1066.

Uchendu, F.N. and Atinmo, T. (2010). The silent and neglected crisis of malnutrition: scientific evidence for taking decisive action. *Global J. Health Sci.*, **3**: 193-202.

United States Department of Agriculture (USDA). 2008. *National Nutrition Database for Standard Reference*. Maryland, USA

Van Tuinen, A., Cordonnier-Pratt, M.M., Pratt, L.H., Verkerk, R., Zabel, P. and Koorneef, M., 1997. The mapping of phytochrome genes and photomorphogenic mutants of tomato. *Theor. Appl. Genet.*, **94**: 115-122.

World Health Organization (WHO). 2011. United Nations, Geneva, Switzerland.

***

K-03 FRESH VEGETABLES FOR HEALTH AND BOOSTING IMMUNITY

Ranjit Chatterjee

Department of Vegetable and Spice Crops,

Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India

**Corresponding author e-mail: ranchat22@rediffmail.com*

Introduction:

Vegetables are the group of herbaceous plant where different plant parts-roots, stems, leaves, flowers, fruits, seeds etc are consumed as fresh or after cooking. Since ancient time plant-based foods are used for nutrition as well as medicine. Several old literatures from Greek, Roman, China and India have clearly mentioned that vegetables are the valuable source of medicine. In the developing countries particularly Africa and Asia a lot of children, women and even adults are suffering from malnutrition due to inadequate intake of essential nutrients in the daily diet like protein, vitamin A ,vitamin C and essential micro nutrients like iron, zinc, iodine. As a result most of the undernourished children, women are suffering from stunted growth, under weight, week immunity system and are very prune to infection to multiple diseases and disorders. The adults who were malnourished at early stages of life increasing the risk of diabetes and cardiovascular disease in the later stage of life. Human mortality is common due to nutrient deficiency mediated diseases and disorders. Again in case of developed countries like USA, UK, France, Germany people are suffering from over nutrition which lacks the essential nutrients in diet that promote steady increase in body weight and obesity. The lifestyle diseases like cardiovascular disease, blood sugar, diabetes, hypertension, obesity are increasing at faster rate results in human mortality (Helieh, 2017). In both the cases proper balance nutrition has a major role to play. Diverse group of vegetables can supply essential nutrients and protect our body from infection and poor health, which can minimizes the human mortality throughout the world.

Importance of vegetables in daily diet:

Fresh vegetables are the cheaper source of all the essential nutrients namely carbohydrate, protein, fat, minerals, vitamins, water and dietary fibres (Thamburaj and Singh, 2001). Most of the root vegetables namely potato, sweet potato, cassava, colocasia etc. are rich source of carbohydrate. Leguminous vegetables (garden pea, French bean, cowpea etc.), drum stick, agathi flower, fenugreek leaves etc. are excellent source of vegetable protein. Leaves of drum stick, *Colocasia*, *Portulaca* are natural sources of fat. Leafy greens such as spinach, palak, amaranths, basella, fenugreek, coriander etc are reservoir of essential minerals like calcium, zinc, phosphorus, iron as well as rich source of powerful antioxidants, flavonoids, carotenoids and different vitamins. Altogether protects against cellular damage.Vegetables such as carrot, pumpkin, cabbage, tomato, chilli etc are loaded with different vitamins.

Most of the fresh vegetables are loaded with infused water. Vegetables like tomato, cucumber, watermelon, radish contains more than 90% water. The structural water hydrates our body and maintains water balance of the body as well as promotes smooth digestion and maintains our skin soft and smooth. Vegetables such as okra, ridge gourd, sponge gourd and most of the leafy greens are the valuable source of dietary fibre, which adds bulk to the intestinal content and help digestion and prevent constipation (Watson, 2001). In general, vegetable are alkaline in nature. Consumption of sufficient vegetables in diet neutralizes the acid formed during digestion of first class protein food like fish and meat and high energy food. Otherwise the recurring acidity will lead to inflammation to the body.

Lot of vegetables are rich source of different bioactive compounds. These bioactive compounds are basically the secondary metabolites. Plant produces these chemicals for their defence mechanism. In bitter gourd momordicin and charantin**,** in sprouting broccoli sulphoraphone, in case of cabbage and cauliflower different indole compounds, in tomato and watermelon lycopene, in lettuce lactucarium and lactucin and in radish isothiocyanate. All these bioactive compounds have specific role to promote good health, build immunity and prevent different human diseases. Several vegetables are very good source of natural antioxidants (Alice, 2015). The antioxidants are the substances that prevent or neutralize the free oxygen radicals that are produced in the body due to oxidative stress or environmental factors and directly linked to stoke, heart disease and diabetes. The antioxidants are called free radical scavengers. Most of the coloured vegetables like coloured bell pepper, coloured cauliflower, colourful carrots, garden beet, knol khol are very good source of natural antioxidant. A group of vegetables have anti-inflammatory effect they reduce the inflammation of different parts of the body and very useful for joints, lung inflammation, sore throat and irritable bowel syndrome. Sprouting broccoli, garlic, spinach and romaine lettuce have potential to fight Inflammation.

A majority of the fresh vegetables are relatively low in glycemic Index and rich in dietary fibres, antioxidant and phyto-chemicals that minimise the chances of increasing blood glucose level and reduce the risk of developing Type 2 diabetes. Again fresh vegetables are low in saturated fat that prevents the rising of blood cholesterol. Regular consumption of fresh vegetables can reduce the risk of developing cardio vascular disease and certain types of cancer. Journal of American heart Association, Stokes and other reputed journal have published a number of research paper which clearly stated that plant based diet especially vegetable crops can be used as phyto-medicine to fight the malnutrition as well as over nutrition to lower the risk of all causes of human mortality.

Fresh vegetables in Human health:

Improves bone health:

Fresh vegetables contribute an important role in our bone health. Most of the dark green leafy vegetables - spinach, palak, mustard green, amaranths, basella, kale, fenugreek, coriander etc are excellent source of phosphorus, calcium and magnesium and different essential vitamins which contribute to bone health. Vitamins A, K, and C plays vital role in collagen production which initiate the bone formation process. Vitamin A helps in the development of new bone cells where as vitamin K helps to build cartilage and the connective tissues. Vitamin C fights the bone depletion with aging. Presence of vitamin K also improved calcium absorption and support good bone health. Vitamin K-1 is mostly available from plant sources where as animal foods are the source of vitamin K-2. Even vitamin D is very important for bone health.Sufficient intake of these vitamins enhances the bone strength and helps in delay osteoporosis, a condition in which the bones becomes brittle and fragile from loss of tissues. Insufficient availability of calcium, vitamin K and vitamin D can lead to osteopenia (reduced bone mass) and increased fracture risk. Again excess consumption of protein rich diet like meat, fish, egg etc generates acidity in our body which mostly promotes calcium losses from the body. Fresh vegetables are alkaline in reaction which creates an alkalizing effect on the body and neutralizes the acidity which has beneficial influence of our bone health.

Promotes eye health:

A number of vegetables are rich source of carotenoids, specifically beta-carotene such as carrot, pumpkin, sweet potato, green leafy vegetables. After entering into the body the beta-carotene converted and assimilated into vitamin A in our body. These vegetables significantly contribute the dietary requirement of vitamin A of our body. Several studies showed that vitamin A boost eye health and prevent cataracts and other eye diseases. It also protects our retinas from the damage of aging. Again vegetables like pumpkin, carrot, bell pepper, sprouting broccoli, spinach kale, parsley etc good source of the powerful antioxidants- Lutein and zeaxanthin which defend our body against free radicals and reduces the risk of chronic eye diseases progression of age-related macular degeneration and cataracts. It also protects the retina from direct sunlight. Only green plants can produced the Lutein and zeaxanthin and we fulfil the need by consuming the green plants.

Improves gut microbiome health:

Healthy gut results in healthy digestive system and healthy body. In the digestive system the different food particles are broken down into small pieces and enter into the bloodstream and distributed the nutrients throughout the bodies. A healthy gut can result a healthy digestive system. The different microflora that lives in the digestive tract are known as microbiome. The gut microbiome plays an important role in gut health. They help in digestion and absorption of nutrients. A healthy gut contains good balance of microflora which protects the guts from infection of harmful bacteria, viruses and fungi. A healthy gut regulates overall health, immune system, metabolism, energy, body weight, mental health, heart health, risk of diabetes and many more. It also communicates with the brain through nerves and hormones, which helps maintain general health and well-being. An imbalance in gut microorganism has been found to contribute the chronic diseases such as irritable bowel syndrome, diabetes, cholesterol levels and obesity links to mental health and depression. A number of vegetables possess certain types of indigestible fibres or resistant starches known as prebiotics. The prebiotic fibres act as food for probiotic gut bacteria. The prebiotic and probiotic work together to create a good balance of gut environment. The play a major role in keeping our gut micro flora in balance and boost the gut health. Vegetables with a high prebiotic content include chicory, asparagus, onions, chicory, garlic, leeks, broccoli, brussels sprouts, mustard green, kale, mushrooms, and sea vegetables like seaweed, spirulina and other marine algae.

Boost brain health:

Most of the green and coloured vegetables are packed with essential minerals and vitamins as well as phyto-nutrients that can boost our cognitive function and promote better memory. Vegetables rich in vitamin K, lutein, folate, beta carotene, flavonoids, unsaturated fat etc are the brain healthy nutrients that delayed cognitive decline and support brain health. Anti-inflammatory and antioxidant effects of vegetables also help to keep the brain active for longer period. Several reports suggested that regular consumption of diverse group of vegetables can slow down the Alzheimer disease. Choice of vegetables in the development stages of children has a great influence on cognitive skill and brain function. Parents should have the knowledge about the nutritional quality of different vegetables they are purchasing and offering their family members.

Assist in weight loss:

Our present day life style excessive consumption of junk food and processed food gradually leads to overweight and obesity, which is very common among children, young and middle aged man and women. Obesity is directly linked with hypertension, diabetes and even cardio vascular disease. Most of the vegetables crops contains lot of nutrients but are low in calories and stored very little fat in the body, just opposite of the junk foods which provide very little nutrition for the many calories. Crops like lettuce, bell pepper, cucumber, summer squash, celery, spinach etc contains very low amount of carbohydrates. Most of the vegetables are cholesterol free, fat free and fat deposition is very rare. Additionally vegetables are rich in dietary fibres and water. Consumption of sufficient vegetables may increase the eating volume without an increase in calories. A person can satisfy his appetite without consuming much carbohydrate and fat resulting in weight loss. Some people have the tendency to gain weight with the advancement of age, but regular consumption of vegetables in salad or in juice form will help to decrease the risk of becoming obese. High water content of vegetables help to satire hunger and feeling of fullness more quickly prevent much calorie intake leads to better weight control.

Decrease the risk of life threatening diseases:

Regular consumption of fresh vegetables may reduce the risk of developing different life style diseases and human mortality.Hypertension, or high blood pressure, can cause blood vessel damage and leads to heart disease, kidney disease and stroke. Hypertension is sometimes called the silent killer. Several research finding suggested that regular consumption of diverse type of vegetables- fruit vegetables, root vegetables and leafy vegetables can help to lower blood pressure (Lea, 2016). The benefits come from the dietary fibres, vitamins, minerals such as potassium and magnesium and less saturated fat. The potassium balances the negative effect of salt, which helps to lower blood pressure. Most of the vegetable are relatively lower in glycemic Index and rich in dietary fibre, antioxidant and phyto-chemicals that minimize the chances of increasing blood glucose level and reduce the risk of developing type 2 diabetes. Glycemic index is a value or number assign to the carbohydrate containing foods. It gives an idea how fast our body can convert the carbohydrate in food into glucose and increase the blood sugar level. Low glycemic index foods slowly increased the blood sugar level and prevent obesity and diabetes. Unlike animal foods, vegetables are low in saturated fat that prevents the rising of blood cholesterol. Harmful inflammation in different body parts has been shown to increase the risk of cardiovascular disease by accelerating atherosclerosis (Hyunju, 2019; Ambika, 2017). Again kidney disease, non-alcoholic fatty liver disease and neuro-degeneration are either triggered by or associated with inflammation.Most of the coloured vegetables are excellent source of antioxidants like bell pepper, carrot, garden beet, cauliflower as well as sprouting broccoli, spinach and Romaine lettuce can neutralize the free oxygen molecules and fight inflammation. The risk of cardio vascular disease decreases with adequate consumption of anti oxidant like carotenoids, anthocyanins, chlorophyll, vitamin C etc rich vegetables. These vegetables helps to inhibit the cholesterol synthesis and stokes thereby protect against cardiovascular disease. The American Cancer Society recommends eating more broccoli and other cruciferous vegetables like cabbage, cauliflower, kale, mustard green etc because they contain photo-chemicals such as sulphoraphone, indoles and sinigrin compounds which have the potentiality to reduce the risk of certain types of cancer.

Emerging problems of fresh vegetables:

Vegetable crop produced large amount of biomass within very short period of time. To generate enormous amount of biomass, ample amount of chemical fertilizers and water are applied to the plants. Due to excess use of readily available nutrients, plants become succulent and easily get infected by different types of insects and diseases. To prevent the insect attack, higher amount of pesticides are applied to the plants. Different research findings suggested that regular use of harmful pesticides like organo-phosphorus, organo-chlorine, synthetic pyrethroids in fresh vegetables may carry pesticide residue. Upon consumption of such contaminated vegetable in daily diet, the residue will enter into the blood and gradually promoting different kind of health problems stating with skin irritation, respiratory trouble, oxidative stress, hypertension, liver and kidney function and brain activity. Reports of birth defect, behaviour and development problem among children and increasing risk of different types of cancer diseases are increasing rapidly.

Excess use of nitrogenous fertilizer may cause nitrate toxicity particularly for infant and children. After ingestion the nitrate converts to nitrite which is carcinogenic to our body. It reduces the oxygen carrying capacity of hemoglobin and deprives oxygen to the body, the skin turn blue grey discoloration known as methemoglobinemia. The nitrate toxicity is a major concern for leafy vegetables like lettuce, cabbage, spinach etc as they are mostly consumed as raw form in salad.

Some of the vegetable farmers are injecting oxytocin in different vegetable crops like bottle gourds, bitter gourds, ash gourd, cucumber, tomato etc to look fresher, bigger and greener. This is a hormone which increases the size of the vegetable but have a very harmful effect on our health.

Overcome the problems:

Make a habit of eating organic vegetables:

Organic vegetables are produced by using animal and plant manures, crop residues recycling, legume crop rotation etc without the help of chemical fertilisers, synthetic pesticides, synthetic growth regulators, antibiotics etc. Organic vegetables are safe and healthy, have true nutrition and better taste. They are free from harmful fertilizers and pesticides residues. They are also free from heavy metal toxicity due to lead, mercury, cadmium etc. Several research findings suggested that organic vegetables contain more amounts of minerals like calcium, magnesium, iron as well as vitamin C content and protective phyto-chemicals. Such vegetable contains higher amount of dry matter and are free from nitrate toxicity. They also possess superior sensory attributes like appearance, taste, colour etc which increases the eagerness to eat more. It also creates awareness in the direction of environment safety, feel more responsible towards the ecosystem.

Grow your own vegetables:

In recent time, more and more people are showing interest to grow the required vegetables at their own house. Cultivation of diverse vegetables in the home garden as a supplemental source of food, nutrition and livelihood security is a long tradition in different parts of India. Healthy fresh vegetables free from pesticide residues can be harvested whenever required by the family. The local vegetables and their cultivars can be better preserved and conserved in home garden to prevent extinction.

Conclusion:

Diet rich in starch-based food are generally low in protein, macro and micronutrients. Over dependence of starch-based foods increases the risk of multiple micronutrient deficiencies, infection and subsequently augment the danger of disease attack, lead to premature death and human mortality. Apart from essential nutrients, fresh vegetables are packed with powerful minerals, vitamins, dietary fibres, phyto-chemicals and anti-oxidants that promote healthy body, mind and overall well being. Research evidence suggested that consumption of sufficient amount of fresh vegetables is associated with a lower risk of developing obesity, hypertension, blood sugar, cholesterol, cardio vascular disease, cancer etc which have the possibility to reduce the chance of mortality due to chronic diseases. Habit of eating diverse group of vegetables as well as coloured vegetables will boost the immunity system which will increase the infection fighting ability of our body. We should exclude the pesticides and fertilizers contaminated fresh vegetables and make a habit of eating organic vegetables from the early stages of life. Healthy vegetables are not only source of nutrition but full of health promoting substances which have massive impact on our working ability as well as mental and emotional health. A healthy body will prevent infection and reduce disease attack and subsequently will curtail the increasing burden of health care system.

References:

Alice H Lichtenstein.2015. Fruits and vegetables get a golden halo once Again is there more to the story? *Circulation*,132:1946-1948 (DOI: 10.1161/AHA.115.019326).

Ambika Satija, Shilpa N, Bhupathiraju, Donna Spiegelman, Stephanie E Chiuve, JoAnn E Manson, Walter Willet, Kathryn M Rexrode, Eric B Rimm and Frank B Hu. 2017. Healthful and unhealthful plant-based diets and the risk of coronary heart disease in U.S. adults, *Journal of the American College of Cardiology*, 7 0 (4) (DOI: 1 0. 1 0 1 6 / j a c c . 2 0 1 7 . 0 5 . 0 4 7).

Helieh S Oz. 2017. Nutrients, infectious and inflammatory diseases, *Nutrients*,9: 1085 (DOI:10.3390/nu9101085).

Lea Borgi, Isao Muraki, Ambika Satija, Walter C Willett, Eric B. Rimm and John P Forman. 2016. Fruit and vegetable consumption and the incidence of hypertension in three prospective cohort studies, *Hypertension*, 67: 288-293 (DOI: 10.1161/HypertensionAHA.115.06497).

Thamburaj S and Singh N. 2001.Textbook of Vegetables, tuber crops and spices. ICAR Publication. New Delhi. 2001; pp. 1-451.

Watson RR. 2001. Vegetables, fruits and herbs in health promotion. CRC Press, London, New York, Washington D C.

***

K-04 GENETIC DIVERSITY AND IMPROVEMENT IN CHILLIES (*CAPSICUM* SPECIES)

Rajesh Kumar* and Ashutosh Rai

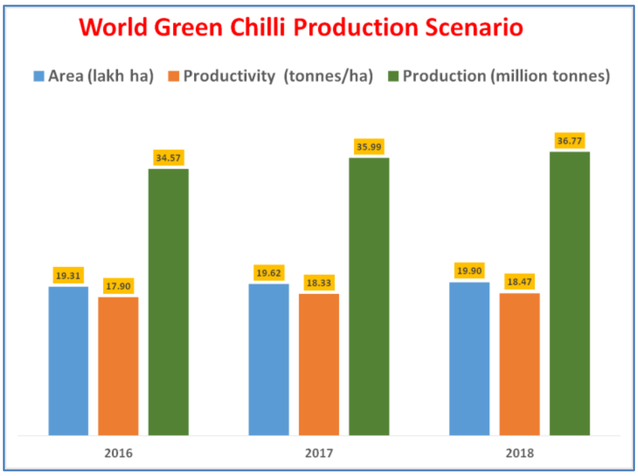
ICAR- Indian Institute of Vegetable Research, Varanasi, U.P., India

**Corresponding author e-mail: rajes74@gmail.com*

Introduction:

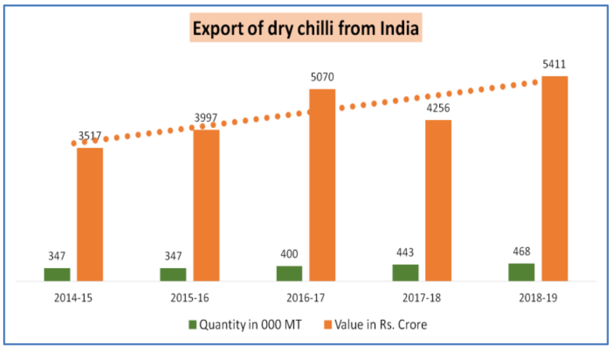
Chilli (*Capsicum* spp.) is a highly diverse vegetable-cum-spice crop grown throughout the World. It is also known as '*wonder spice*' belongs to family solanaceae. Chillies are basically a rich source of vitamins (A & C) and antioxidants. We are using chillies as fresh vegetables, spices, condiments, processed (sauces and pickles) as well as in defence (capsaicin spray). Oleoresin and capsaicin is important volatile compound found in chillies fruits that are commercially extracted for medicinal/ industrial uses.

India is major producer, consumer as well as exporter of chillies in the world and contributes for around 25% of world dry chilli production. In India practically all the states in India grow chilli resulting in arrivals round the year in which Andhra Pradesh is a leading producer of commercial grade of chilli. Chilli contributes for 22% of world spices trade in terms of volume. Beside India other major producers are China, Pakistan, Morocco, Mexico, Spain and Turkey.



Chilli: scenario of India:

India ranks first among chilli growing countries of the world with annual dry chilli production of 2.1 million tonnes of dry fruits (FAOSTAT, 2018). As per the 3rd Advance estimates of NHB (2018-19) India occupied 7.21 lakh ha dry chilli area with 16.90 lakh tons production. During 2018-19 India exported Rs 5411 crores of chillies to other parts of the World.



Origin and distribution:

India is Secondary centre of diversity of chilli. However, south-central part of South America is known as the primary centre of diversity for *Capsicum* species. Primary centre of origin for domesticated *Capsicum annuum* is in semi-tropical Mexico, while the four other domesticated species are usually believed to have originated in South America.

Distribution of *Capsicum* species:

Chilli is a native to South and Central America and distributed globally (Table 1) as well as part of human diet for 9000 years. As estimated it has more than 30 known species worldwide, with diploid in nature and having chromosome number of 12 (sometimes 13). Chillies are predominantly self-fertilized; however, cross-pollination between *Capsicum* accessions may vary from 2 to 90% (Tanksley, 1984; Pickersgill, 1997).

Table 1. Distribution of *Capsicum* species globally

Species	**Known or probable natural distribution**
C. annuum	Southern USA to Colombia
C. frutescens	Western Amazon (Colombia to Peru)
C. baccatum	Peru, Bolivia, Paraguay, Argentina and Brazil
C. chinense	Northern) Amazonian South America
C. pubescens	Bolivia to Colombia
C. buforum	southern Brazil
C. cardenasii	Northeastern Bolivia
C. chacoense	Argentina, Paraguay and Bolivia
C. coccineum	Bolivia and Peru
C. dimorphum	Colombia
C. eximium	Bolivia and northern Argentina
C. flexuosum	Argentina, Brazil and Paraguay
C. galapagoense	Galapagos Islands (Ecuador)
C. lanceolatum	Honduras, Guatemala and Mexico
C. parvifolium	Northeastern Brazil, Venezuela and Colombia
C. tovarii	South-central Peru
C. Campylopodium, *n = 13*	Southern Brazil
C. ciliatum, *n = 13*	Mexico to Peru
C. mirabile, *n = 13*	Southern Brazil
C. schottianum, *n = 13*	Southern Brazil, Paraguay and Argentina

Source: Modified from http://www.oecd.org/ehs/

Existence of unique chillies diversity in India:

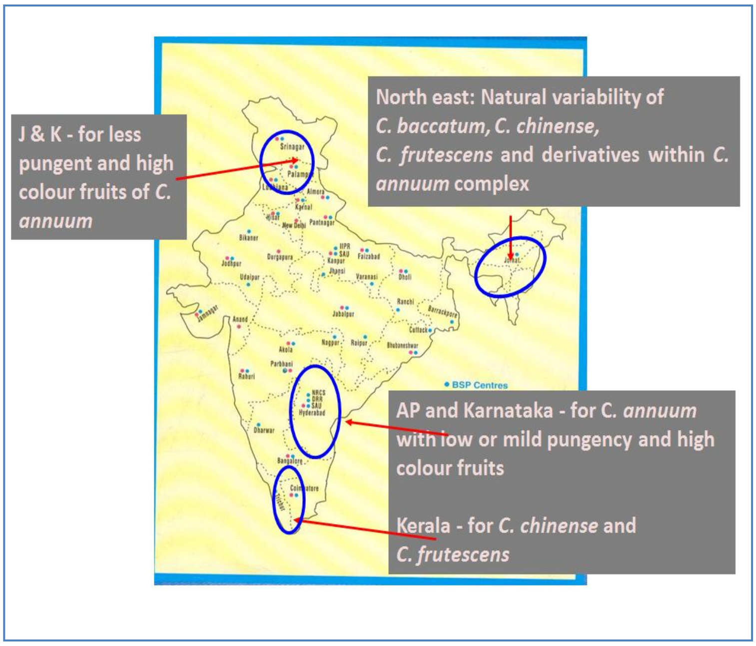
Chillies were spread by Portuguese traders in Europe and Asia and it is said that Vasco-da-Gama brought to India during 16th century. From a long time it was a principal ingredient of Indian dishes and we can say that our foods are incomplete without the dynamism of chillies.

The Northeast Himalayan (NEH) region of India has long been known as a hot spot of hot pepper biodiversity *(Purkayastha et al. 2012).* In a study it was found that, because of different morphology of several landraces and parental species were found to be genetically distinct from all the *C. annuum* accessions from within and outside the region, the NEH landraces are believed to have originated in the region from sympatric domestication (evolution of a new species from a surviving ancestral species while both continue to inhabit the same geographic region) in the past, it is excluded for their chances of introduction from elsewhere *(Rai et al., 2013).*

In the *Capsicum* evolutionary studies, for the second time, a naturally occurring allo-tetraploid (2*n* = 48) pepper has been discovered in the region (South Sikkim) *(Jha et al., 2012*).

Diversity and landraces of chillies in India:

In Jammu and Kasmir the less pungent (low capsaicin) and high coloured (high capsanthin) chillies are dominant while in North east Himalayan region highly pungent chillies *viz., C. baccatum, C. chinense, C. frutescens* and derivatives within *C. annum* complex are grown.



In South Indian states, Andhra Pradesh and Karnataka *C. annum* with low or mild pungency and high coloured fruits are cultivate moreover, in Kerala *C. chinense* and *C. frutescens* are predominated.

Major types of chillies in India:

In India there are eight major types of chillies are grown as described in Table 2.

Table 2. Major chillies types grown in India

Types	Features
Bhut Jolokia	Hottest chilli in the world in the Guinness Book in 2007; an interspecific hybrid (*Capsicum Chinese* and *Capsicum frutescens*), cultivated in North Eastern States
Kashmiri Chillies	Most favorite red chilli in India for its colour; less pungent as compared to the other variants in India. Cultivated in UT of J&K.
Guntur Chilli	Guntur is the main producer and exporter of most varieties of chillies and chilli powder from India to countries like Sri Lanka, Bangladesh, Middle East, South Korea, UK, USA and Latin America. Guntur Sannam, for example,

	cultivated in Andhra Pradesh and MP.
Jwala Chilli	Also known as finger hot-pepper, pungent in taste & flavour, cultivated in Gujarat and other north-western parts.
Kanthari Chilli	This chilli is grown in Kerala and some parts of Tamil Nadu. It is also known as bird eye chilli of Kerala and becomes white when matures. It adds heat and lends good flavour to dishes
Byadagi Chilli	It is a famous variety of chilli-Paprika, mainly grown in Karnataka. It is named after the town of Byadagi, (Haveri district) of Karnataka. Known for its colour and low pungency.
Ramnad Mundu/ Gundu Chilli	Almost spherical in shape, this chilli has a very shiny skin and is orange red in colour, grown in the Ramnad district of Tamil Nadu. Particularly used to add flavour to cuisine
Dhani Chilli	This chilli is grown in Manipur and is available up to Kolkata. It has strong pungent smell and heat, it is deep red in colour.

***Capsicum* spp. complexes based on crossability relationships**

There are three Capsicum complexes i.e., *C. annuum* complex, *C. baccatum* complex and *C. pubescens* complex. These capsicum complexes comprises of 5 cultivated species (*C. annuum*, *C. frutescens*, *C. chinense*, *C. baccatum*, *C. pubescens*) and 25 wild species as detailed in Table 3.

Table 3. *Capsicum* spp. complexes based on crossability

Complex	Species
C. annuum complex	*C. annuum**, *C. frutescens**, *C. chinense**, *C. chacoense*, *C. galapagoense*
C. baccatum complex	*C. baccatum**, *C. praetermissum*, *C. tovarii*
C. pubescens complex	*C. pubescens**, *C. cardenasii*, *C. eximium*

*cultivate species

Genetic diversity in *Capsicum*:

Genetic relationship among a set of 48 *Capsicum* accessions was elucidated using SSR and RAMPO markers (Rai *et al.*, 2013). These genotypes originated from 9 countries, included 4 species (*C. annuum*, *C. frutescens*, *C. baccatum*, *C. chinense*) and natural interspecific derivatives. Genetic variation within non-annuum genotypes was greater than the *C. annuum* genotypes. Distinctness of interspecific derivative landraces grown in northeast India was validated; natural crossing between sympatric *Capsicum* species has been proposed as the mechanism of origin of natural interspecific hybrids.

Genetic diversity of chilli landraces from north eastern India:

From different areas NE region 53 chilli accessions have been evaluated for genetic diversity using various morphological characters and 50 simple sequence repeat markers (*Yumnam et al. 2012)*. It was reported that erect and campanulate fruit types were grouped in separate clusters. Moreover, variation among populations was 34%, within individuals of population 57.9 % and within individuals was found 8.05 %, indicating diversity in the landraces sampled. In this research SNP markers were also identified through allele mining across *acyltransferase* 3 (*AT3*) gene in a set of landraces.

In another research conducted by Lopez Castilla *et al.* (2019) regarding structure and genetic diversity of nine important landraces of *Capsicum* species cultivated in Yucatan Peninsula, Mexico. The Yucatan Peninsula region of southern Mexico is an important area of diversification of *Capsicum annuum;* specifically, in the western Yucatan Peninsula, three of the five domesticated species of *Capsicum* (*C. annuum*, *C. chinense* and *C. frutescens*) have been reported. The level of genetic diversity was moderate and distributed mainly among accessions. The ISSR markers detected a high level of polymorphism and allowed the genetic differentiation of the *C. annuum* complex. The results indicated that the accessions collected in the western Yucatan Peninsula constitute a valuable genetic resource that can be used in genetic improvement and conservation programs.

Cultivated chilli species in India and major market types:

Among 5 cultivated species of chilli, 4 species (*C. annuum, C. chinense, C. frutescens, C. baccatum*) are commercially grown by farmers for Indian markets except *C. pubescens* as detailed given in Table 4.

Table 4. Cultivated Chilli species in India on the basis of major market types

Species	Cultivar type	Harvesting stage	Consumption pattern	Preferred fruit type/size	Degree of pungency
C. annuum, *C. chinense*, *C. frutescens*	Landraces, improved populations and hybrids	Red ripe fruits	Green, dried & powder	Cayenne fruits (10-12 x 2-3 cm)	High colour retention and highly pungent
C. annuum, *C. chinense*, *C. frutescens*	Landraces, improved populations and hybrids	Green fruits	Fruits & sauce	Cayenne fruits (6-8 x 2-3 cm)	Mild to highly pungent

C. annuum	Landraces (e.g. Tomato Chilli, Bayadgi Kaddi etc.)	Red ripe fruits Paprika[1]	Oleoresin extraction	Cayenne fruits with very less capsaicin and high oleoresin	High oleoresin with no pungency
C. annuum	Landraces	Red ripe fruits	Pickle formation	Jalapeno type fruits, but with thin pericarp	Mild pungent
C. baccatum	Landraces (e. g. Dello of North-East region)	Red ripe fruits	Specific flavour	Typical bell shaped with distinct flavour	Regional preferences

[1]In international market Paprika with high oleoresin and less pungency is preferred.

[*]The landraces/ecotypes of *C. chinense*, *C. frutescens* and *C. baccatum* are in cultivation in limited scale

The most pungent chilli of India: *Bhut Jolokia*:

As India is rich in chillies diversity and especially northeast region is known for highly pungent chillies (*C. chinense*). In northeast region so many chilli landraces are known for its highly pungent frits, in which the most common and popular landrace is *Bhut Jolokia*. So far to know about its pungency (capsaicin/ SHU) relationship with different locations and soils several workers have performed various experiments (Table 5). In their results, it was observed that under hot humid climate with alluvial derived soil the pungency was highest however, under Warm to hot dry to moist sub-humid climate with brown forest and podzolic soils the pungency was lowest.

Table 5. Variation in pungency of Bhut Jolokia in different climatic localities of India and North East India (Purkayastha *et al.*, 2012)

Locality	**Climate and soil**	**Latitude, longitude and altitude(M)**	**Capsaicin (% w/w)**	**Pungency (SHU)**	**Reference**
Tezpur	Hot humid climate with alluvial derived soil	26°38′N/92°48′E/157	4.28	855,000	Mathur *et al.* 2000; Tiwari *et al.* 2005
Pithoragarh	Warm to hot dry to moist sub-humid climate with brown forest and podzolic soils	29°35′N/80°13′E/1525	0.97	254,896	Pandey *et al.* 2009

Imphal	Warm to hot humid climate with red and yellow soils	24°44′N/93°58′E/790	2.06	329,100	Sanatombi and Sharma 2008
Gwalior	Semi-arid climate with mixed red and black soils	26°14′N/78°15′E/205	1.5	NA	Tiwari *et al.* 2005

Conclusion:

Based on above facts and figures, the characterization and documentation of Indian Chilli cultivars are utmost important for breeding and other point of views. Moreover, utilization of wild relatives (embryo rescue or development of bridge crosses) and markers development including marker assisted breeding approach for evolving of high yielding, location/ region specific, consumers preference based, insects and disease resistance varieties/ genotypes for Indian as well as global markets.

References:

Bosland, P. W., & Baral, J. B. (2007). 'Bhut Jolokia'—The world's hottest known chile pepper is a putative naturally occurring interspecific hybrid. *HortScience*, 42(2), 222-224.

Bosland, P. W., Votava, E., & Votava, E. (2000). Peppers: Vegetable and Spice Capsicums CABI. Wallinford, UK.

Dash, S. S., Kumar, S., & JN, S. (2001). Cytomorphological characterization of a nuclear male sterile line of chilli pepper (*Capsicum annuum* L.). *Cytologia*, 66(4), 365-371.

FAOSTAT, 2018. http://faostat.fao.org/default.aspx.

Ince, A. G., Karaca, M., & Onus, A. N. (2010). Genetic relationships within and between Capsicum species. *Biochemical Genetics*, 48(1-2), 83-95.

Jha, T. B., Dafadar, A., & Ghorai, A. (2012). New genetic resource in Capsicum L. from Eastern Himalayas. *Plant Genetic Resources*, 10(2), 141.

Kumar, S., R. Kumar, and J. Singh (2006a). Cayenne/American pepper (*Capsicum species*). In: Peter K.V. (ed), Handbook of Herbs and spices, Vol.3, Woodhead Publishing, Cambridge, U.K. pp. 299-312.

Kumar, S., S. Kumar, M. Singh, A. K. Singh, and M. Rai (2006b). Identification of host plant resistance to pepper leaf curl virus in chilli (*Capsicum* species). *Sci.Hortic*. **110**, 359-361

Kumar, S., Singh, V., Singh, M., Rai, S., Kumar, S., Rai, S. K., & Rai, M. (2007). Genetics and distribution of fertility restoration associated RAPD markers in inbreds of pepper (*Capsicum annuum* L.). *Scientia Horticulturae*, 111(3), 197-202.

López Castilla, L. D. C., Garruña Hernández, R., Castillo Aguilar, C. D. L. C., Martínez-Hernández, A., Ortiz-García, M. M., & Andueza-Noh, R. H. (2019). Structure and Genetic Diversity of Nine Important Landraces of Capsicum Species Cultivated in the Yucatan Peninsula, Mexico. *Agronomy*, 9(7), 376.

Mathur, R., Dangi, R. S., Dass, S. C., & Malhotra, R. C. (2000). The hottest chilli variety in India. *Current Science*, 79(3), 287-288.

Meléndez, A. A., P. L. Morrell, M. L. Roose, and S. C. Kim, 2009: Genetic diversity and structure in semiwild and domesticated chiles (Capsicum annuum; Solanaceae) from Mexico. *American Journal of Botany*, 96 (6), 1190-1202.

Minamiyama, Y., M. Tsuro, and M. Hirai, 2006: An SSR-based linkage map of *Capsicum annuum*. *Mol. Breed*. 18, 157-169.

Pandey, J., Singh, J., Singh, A. K., Rai, M., & Kumar, S. (2009). Promising Lines for Qualitative Traits in Chilli (*Capsicum Annuum* L.). *Vegetable Science*, 36(3s), 390-392.

Pickersgill, B. (1997). Genetic resources and breeding of *Capsicum* spp. *Euphytica*, 96(1), 129-133

Purkayastha, J., Alam, S. I., Gogoi, H. K., Singh, L., & Veer, V. (2012). Molecular characterization of' Bhut Jolokia'the hottest chilli. *Journal of Biosciences*, 37(4), 757-768.

Rai, V. P., Kumar, R., Kumar, S., Rai, A., Kumar, S., Singh, M. & Paliwal, R. (2013). Genetic diversity in Capsicum germplasm based on microsatellite and random amplified microsatellite polymorphism markers. *Physiology and Molecular Biology of Plants*, 19(4), 575-586.

Sanatombi, K., & Sharma, G. J. (2008). Capsaicin content and pungency of different Capsicum spp. cultivars. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*, 36(2), 89-90.

Tanksley, S. D. (1984). Linkage relationships and chromosomal locations of enzyme-coding genes in pepper, *Capsicum annuum*. *Chromosoma*, 89(5), 352-360.

Tiwari, A., Kaushik, M. P., Pandey, K. S., & Dangi, R. S. (2005). Adaptability and production of hottest chilli variety under Gwalior agro-climatic conditions. *Current Science*, 88(10), 1545-1546.

Yumnam, J. S., Tyagi, W., Pandey, A., Meetei, N. T., & Rai, M. (2012). Evaluation of genetic diversity of chilli landraces from North Eastern India based on morphology, SSR markers and the Pun1 locus. *Plant Molecular Biology Reporter*, 30(6), 1470-1479.

***

K-05 BREEDING TOMATOES FOR RESISTANCE TO DISEASES

A.T. Sadashiva*, Ashish Kaushal, Amarjeet Kumar Rai and Vinod Jatav

Division of Vegetable Crops, ICAR-IIHR, Bengaluru, Karnataka, India

*Director (R & D), Nethra Crop Sciences, Bengaluru, Karnataka, India

**Corresponding author e-mail: atsbrs@gmail.com*

Introduction:

Tomato (*Solanum lycopersicum* L.) is one of the leading vegetable crops across the world. In India the popularity of tomato comes just after potato where tomato is grown in an area of 778 thousand hectares with production of 19,397 thousand tonnes and productivity of 24.93 t/ha (Anonymous, 2019). Crop improvement programme on tomato was initiated at ICAR-IIHR, Bengaluru during 1970 with the objective of developing fresh market tomato varieties & F_1 hybrids for high yield and good fruit quality attributes as a result two fresh market varieties *viz;* Arka Vikas & Arka Saurabh were developed through pure line selection & identified for release at National level during 1987. Pure line selection from exotic tomato varieties also resulted in development of two processing varieties *viz;* Arka Ashish & Arka Ahuti during 1990. Two high yielding F_1 hybrids *viz.*, Arka Vishal & Arka Vardan were also developed through heterosis breeding and both were recommended for release at National level during 1993 & 1995 respectively. A rainfed variety Arka Meghali was also developed through pedigree method & was recommended for release at state level of Karnataka during 1996.

Production constraints in tomato:

Low productivity of tomato in India is due to several biotic and abiotic stresses. Among the biotic stresses, Tomato leaf curl disease (ToLCD), bacterial wilt (*Ralstonia solanacerum*), early blight (*Alternaria solani*) and late blight (*Phytophthora infestans* Mont. de Bary) are major production constraints causing yield loss ranging from 25 to 100 per cent (Table 1).

Table 1. Yield loss in tomato due to mmajor diseases.

S.N.	Diseases	Yield loss (%)	References:
1	Tomato leaf curl disease (Begomoviruses)	Up to 100	Saikia and Muniyappa (1989), Pico et.al. (1996), Polston et.al., (1999), Varma and Malathi (2003)
2	Bacterial Wilt (*Ralstonia solanacerum*)	11-93	Ramkishun, (1987)
3	Early blight (*Alternaria solani*)	Up to 79	Datar and Mayee (1981) , Yadav and Dabbas (2012)
4	Late Blight (*Phytophthora infestans* (Mont.) de Bary	41-100	Nowicki *et al.*, (2012)

Breeding for resistance to bacterial wilt (BW) Disease:

Bacterial wilt caused by *Ralstonia solanacerum* is one of the serious soil borne diseases in major tomato growing states in the country. Disease incidence is more severe under hot & humid climate including coastal regions. Bacterial wilt disease causes yield loss ranging from 70 to 100 per cent. Race 1 & 3 biovar III have been reported to cause bacterial wilt in Indian sub-continent. If the soil concentration of bacteria reaches thresh hold level of 1 $x10^3$ c.f.u /g of soil which makes it BW sick soil, where in the susceptible genotypes of tomato start expressing typical disease symptoms of sudden wilting at flowering & fruiting stage and browning of xylem vessels. It can be further confirmed by the ooze test.

Sudden wilt –typical symptom of bacterial wilt

Bacterial wilt sick soil (1 x 10^3 cfu/g)

Browning of xylem vessels

Bacterial ooze

Table 2. Identification of stable sources of resistance to BW.

SN	Lines	Source	Pedigree	Reaction
1	IIHR-2610	WVC	Hawaii-7996	HR
2	IIHR-2296	WVC	CLN-1463	HR
3	IIHR-2867	IIHR	38-10	HR
4	Arka Alok	IIHR	CL114-5-1-0	R
5	Arka Abha	IIHR	VC-8-1-2-1	R
6	IIHR-2826	IIHR	TLBR-1	R
7	IIHR-2828	IIHR	TLBR-4	R
8	IIHR-2657	IIHR	TLBR-6	R

9	IIHR-2197	WVC	CLN-2116DC1 F1-180-31-9-11-12	R
10	IIHR-2200	WVC	CLN-2116DC1FC1-180-31	R
11	IIHR-2201	WVC	CLN-2116DC1 F1-180-31-10-25-22	R
12	IIHR-2761	OUAT	BT - 218	R
13	IIHR-2834	IIHR	TLBER 12-21-43-1	R
14	IIHR-2920	IIHR	ToLCVR F3-38-1-1	R
15	IIHR-2888	IIHR	TLBER-38-7-41-43	R
16	IIHR-2042	WVC	EC-357846	R

Breeding for BWR at ICAR-IIHR, Bengaluru: Breeding for resistance against bacterial wilt was initiated during 1987 and the following bacterial wilt resistant (BWR) varieties & F_1 hybrids were bred.

Variety / F_1 hybrid	Salient features	Photograph
Arka Abha (BWR-1)	Bacterial wilt resistant variety developed by pure line selection from IIHR-663-12-3-SB-SB-SB (VC-8-1-2-1) from AVRDC, Taiwan. Fruits oblate with light green shoulder having stylar end scar with average fruit weight of 75g. Develops deep red color on ripening.. Yields 43 t/ha 140 days. Recommended for release at state level of Karnataka during 1990.	
Arka Alok (BWR-5)	Bacterial wilt resistant variety developed by pure line selection from IIHR-719-1-6 (CL-114-5-1-0) from AVRDC, Taiwan. Fruits on the lower clusters are round, large (120g) and in later clusters oblong, medium (80g) firm fruits with light green shoulder. Resistant to bacterial wilt. Bred for fresh market. Yields 46 t/ha in 130 days. Recommended for release at state level of Karnataka during 1990.	
Arka Shreshta (BRH-1)	High yielding bacterial wilt resistant F_1 hybrid developed by crossing 15 SB SB x IIHR-1614 (E-6203) Fruits medium large (70-75g.), round with light green shoulder. Deep red, firm fruits. Suitable for both fresh market and processing. Yields 76 t/ha. in 140 days. Recommended for release at state level of Karnataka during 1996.	

Arka Abhijit (BRH-2)	High yielding bacterial wilt resistant F_1 hybrid developed by crossing 15 SB SB x IIHR-1334. Fruits medium (65-70g.), round with green shoulder. Deep red, firm fruits Suitable for fresh market. Resistant to bacterial wilt. Yields 65 t/ha. in 140 days. Recommended for release at National level during 1998 Recommended for release at National level to zone VII (Dapoli & Jabalpur).	

Breeding for resistance to Tomato Leaf Curl Disease:

Tomato Leaf Curl Disease (ToLCD):

ToLCD is one of the most devastating diseases of tomato from a long time and it is caused by Begomoviruses that are easily transmitted by white fly (*Bemisia tabaci*). This disease causes up to 100 per cent yield loss if the crop is infected at initial stage (before 20 days), however if the disease infection occurs at 35 days after transplanting, then it causes 74.1 per cent yield reduction. Moreover, if the disease infection occurs at 50 Days after transplanting then it causes 28.9 per cent yield loss (Malathi, 2013). So far, the initial infection can cause the huge loss to tomato growers.

ToLCD Symptoms

Disease Symptoms:

The different symptoms associated with this disease are reported by various workers e.g., leaf curling, leaves puckering, yellowing of veins, stunting plant growth, bushy plant, discolouration of leaves from pale yellowing to deep yellowing and small leaves size.

Disease Scoring in ToLCD:

Disease Severity Index (DSI) & Percent Disease Index (PDI) have been estimated on 0-4 scale as described by Lapidot *et al.*, (2007) at 30, 45, 60, 75 & 90 days after transplanting. Based on the intensity of symptoms observed both DSI & PDI were estimated by adopting the following formulae.

$$\text{DSI (\%)} = \frac{\text{Sum of all ratings x 100}}{\text{Total no. of plants x maximum rating on scale}}$$

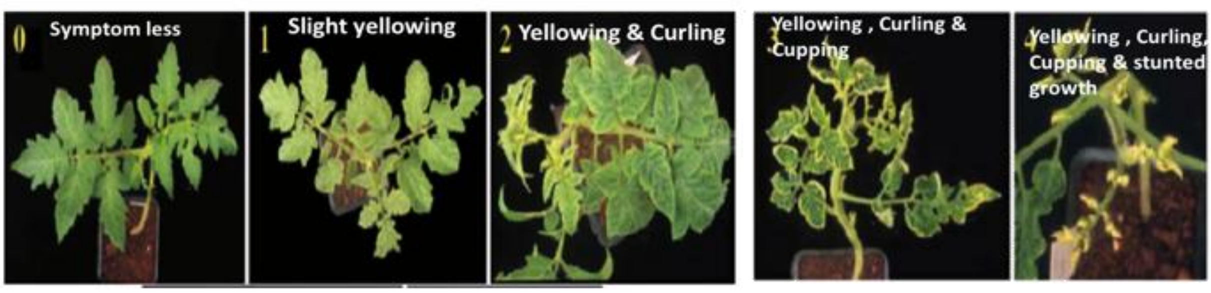
$$\text{PDI (\%)} = \frac{\text{Number of diseased plants x 100}}{\text{Total number of plants observed}}$$

Scale	DSI (%)	Symptoms	Response
0	0	no visible symptoms	HR
1	1 - 15	very slight yellowing of leaflet margins on apical leaf;	R
2	16 - 25	some yellowing and minor curling of leaflet ends;	MR
3	26 - 50	a wide range of leaf yellowing, curling, and cupping, yet plants continue to develop;	S
4	> 50	very severe plant stunting and yellowing, pronounced cupping and curling, plants stop growing	HS

Identification of sources of resistance to ToLCD:

Seven lines viz; IIHR-2101 (*S habrochaites-LA 1777*), IIHR-2195 (CLN-2114), IIHR-2611 (TV-55), IIHR-2413 (FLA-496-11), IIHR-2406 (FLA-456), IIHR-2205 (FLA-744) & IIHR-1970 (*S. peruvianum*) were resistant to ToLCBV on artificial screening.

Disease Scoring for ToLCD on the basis of intensity of symptoms observed



Breeding for Combined Resistance to ToLCD + BW in Tomato:

H-24 (ToLCVR) x 15 SB SB (BWR)

↓

F_1 x 15 SB SB ⟶ **BC_1F_7 (TLBR-4, 5 & 6)**

↓

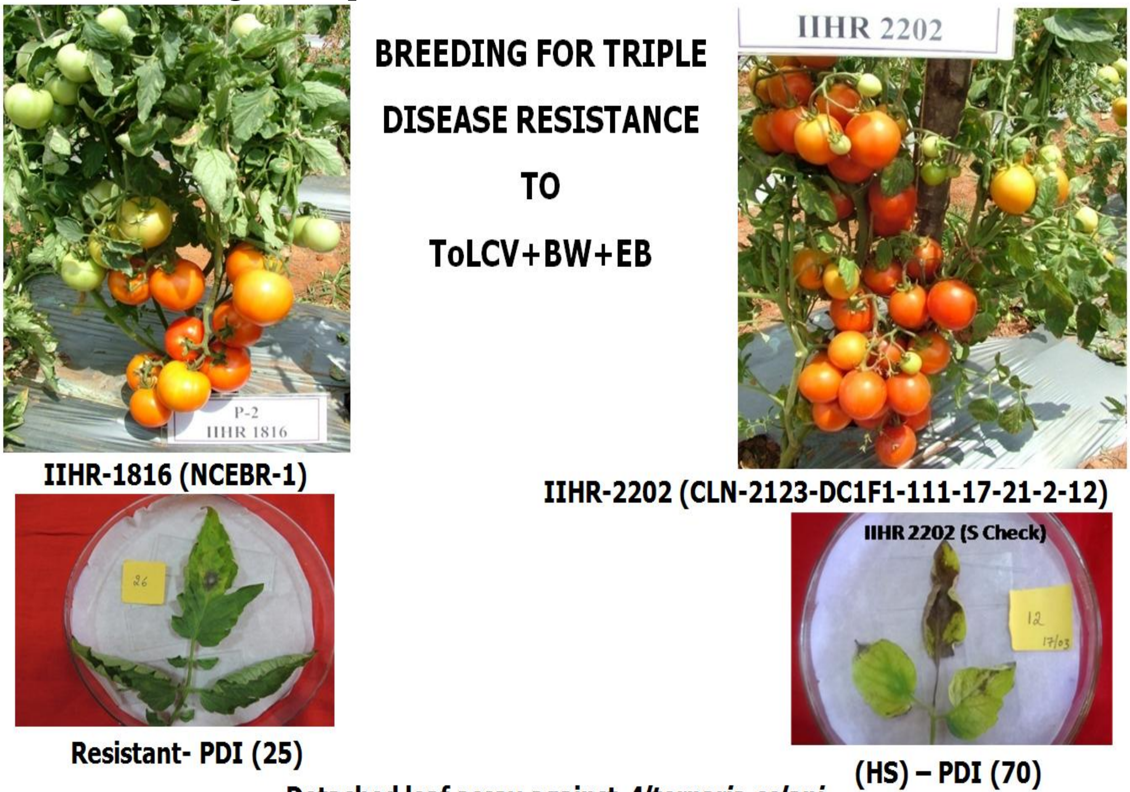
F_7 (TLBR-1,2 & 3)

196 F_1 hybrids produced by 14 x 14 full diallel (6 TLBR + 8 TLBR)

3. Early Blight (EB) Disease:

Early Blight (*Alternaria solani*) is a severe fungal disease that occurs on tomatoes throughout India and causing upto 79 per cent yield loss. The infected plants display collar rust on the stems, infected older leaves, and fruits that crack at the stem end. The circular spots on leaves and pitted fruits are characteristic symptom of this injurious disease.

Breeding for Triple Resistance to ToLCD + BW + EB in Tomato:



Detached leaf assay against *Alternaria solani*

Development of Triple Disease Resistance (ToLCD + BW + EB) in Tomato:

IIHR-2202 (ToLCV + BW) (Ty-2 based) x IIHR-1816 (NCEBR-1) (MR to EB)

↓

F_1 x IIHR-1816

↓

BC_1F_1

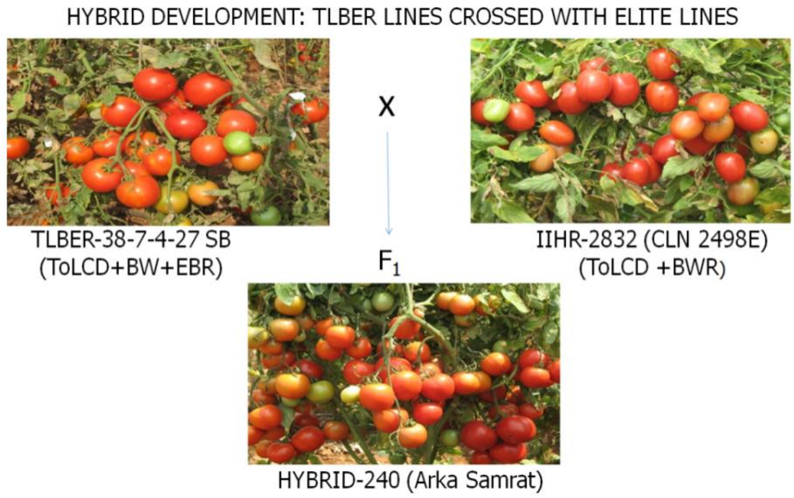
(ToLCV+BW+EB resistant plants selected under artificial conditions and advanced)

↓

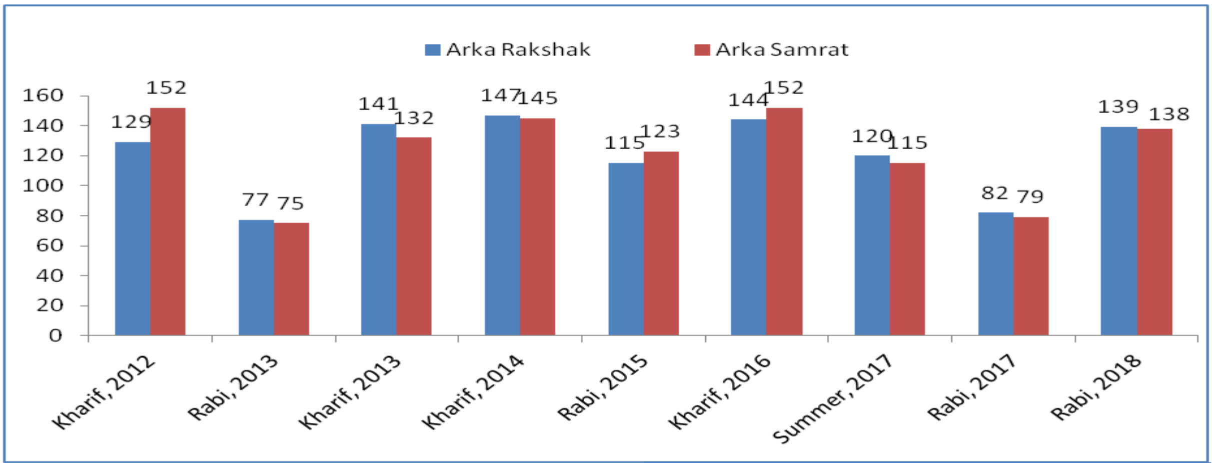
BC_1F_7

TLBER-7-12-15-28, 7-12-15-29, 7-4-11-29, 7-4-11-34, 38-7-4-27, 38-7-41-43 & 12-21-43-1 with triple resistance were selected EB scoring (Pandey *et al.*, 2003): I (0-5%), HR (5.1-12), R (12.1-25), MR (25.1-50), MS (50.1-75) and S >75%

Achievements of Triple Disease Resistance (ToLCD + BW + EB) in Tomato:

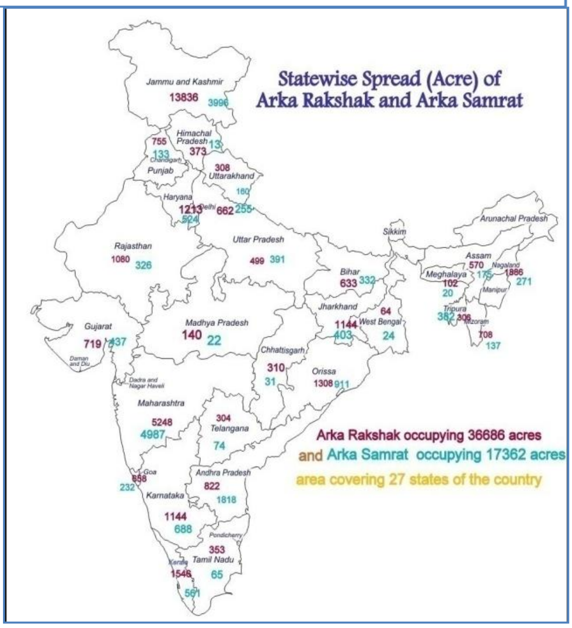


Performance of Arka Samrat and Arka Rakshak at ICAR-IIHR, Bengaluru (Estimated yield in Demo t/ha)



4. Late Late Blight (LB) Disease:

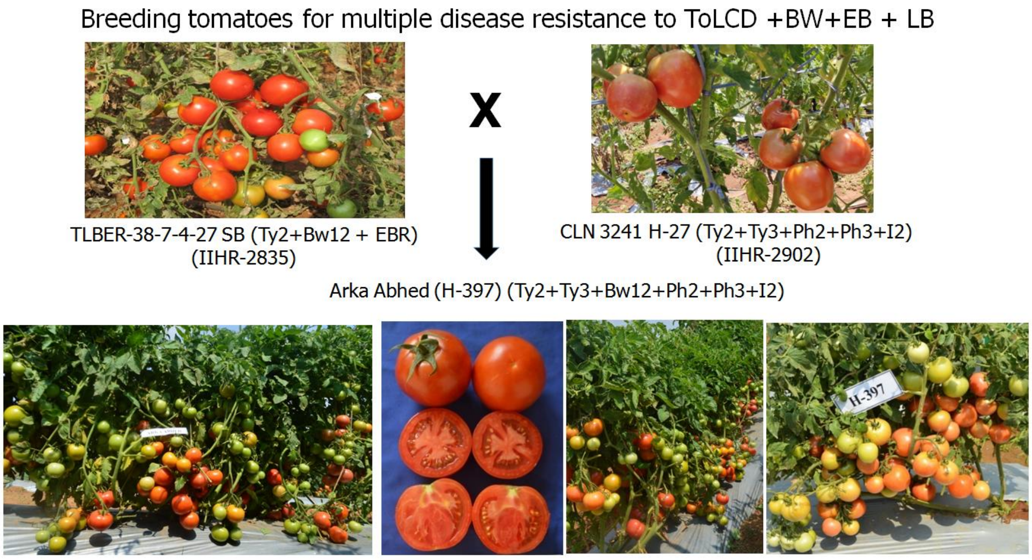
Late blight ((*Phytophthora infestans* Mont. de Bary) is a potentially devastating disease of tomato as well as potato. This disease damages all aerial plant parts of tomato i.e., leaves, stems and fruits. The disease spreads speedily in fields and can cause 41-100 per cent yield loss in tomato. We can predict its damages by knowing about Irish potato famine of the late 1840s. The characteristic symptom of this disease is firm, deep brown, irregular spots grow to cover large parts of leaves, stems and fruits. The patches may become mushy as secondary bacteria invade. In cool along with high humid conditions, thin



The revolutionary tomato hybrid Arka Rakshak covering 27 states of the country

powdery white fungal growth appears on infected leaves, fruit and stems. The cool, wet weather are promoting condition for this disease and under this situation entire fields turn brown and wilted as if hit by frost.

Development of Multiple Disease Resistance (ToLCD + BW + EB + LB) in Tomato:



Achievements of Multiple Disease Resistance (ToLCD + BW + EB + LB) in Tomato:

IIHR-2202 (ToLCV + BW) (Ty-2 based) x IIHR-1816 (NCEBR-1) (MR to EB)

↓

F_1 x IIHR-1816

↓

BC_1F_1

(ToLCV+BW+EB resistant plants selected under artificial conditions and advanced)

↓

BC_1F_7

TLBER-7-12-15-28, 7-12-15-29, 7-4-11-29, 7-4-11-34, 38-7-4-27, 38-7-41-43 & 12-21-43-1 with triple resistance were selected EB scoring (Pandey *et al.,* 2003): I (0-5%), HR (5.1-12), R (12.1-25), MR (25.1-50), MS (50.1-75) and S >75%

Arka Abhed (H-397):

- Major disease resistance against tomato leaf curl disease (*Ty2*), bacterial wilt, early blight and late blight
- Plants are semi-determinate with dark green foliage.
- Fruits are firm, oblate round and medium large (90-100g).
- Suitable for summer, *kharif* and *rabi* cultivation.
- Bred for fresh market and yields 70-75 t/ha in 140-150 days.

Arka Aditya (H-331):

- High yielding F_1 hybrid with triple disease resistance to tomato leaf curl disease (*Ty2+Ty3*), bacterial wilt and early blight.
- Plants are semi-determinate with dark green foliage.
- Fruits are firm, deep red, oblate round, medium large (90-100g).
- Suitable for summer, *kharif* and *rabi* cultivation.
- Bred for Fresh market and yield potential 60 to 70 t/ha in 140-150 days.
- Identified at National level during 2019 for Zone VIII

Development of Triple Disease Resistance (ToLCD + BW + EB + LB) in Processing Tomatoes:

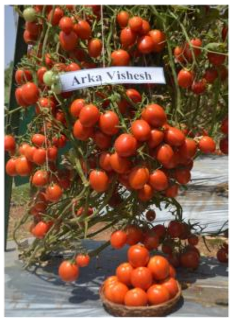
IIHR, Bengaluru has recently developed (2019) two promising F_1 hybrids of processing tomatoes namely, Arka Apeksha and Arka Vishesh. The significant characters of these varieties are tabulated below:

Characters	Arka Apeksha (H-385)	Arka Vishesh (H-391)
Plant Type	Semi-determinate	Semi-determinate
Avg. Fruit Weight	90-100g	70-80g
Fruit Appearance	Oblong, deep red, firm, jointless for MH	Oblong, deep red, firm, jointless for MH
TSS	4.0-4.7 ^{0}Brix	4.0-4.6 ^{0}Brix
Lycopene Content	11 mg/100g	8-10 mg/100g
Yield Potential	> 120t/ha	> 100t/ha

IIHR-2834 (TLBER-12-21-43-1 SB) {ToLCD (Ty2)+BW (Bw12) +EBR} X IIHR-2918 (ToLCVRES4-F3-21-9-1) {ToLCD (Ty1) + BW (Bw12)}

Arka Apeksha (H-385)
(Ty1/Ty2 + Bw12+EBR)
VTIC (2019)

IIHR-2834 (TLBER-12-21-43-1 SB) {ToLCD (Ty2)+BW (Bw12) +EBR} X IIHR-2917 (ToLCVRES4-F3-188-1-1) {ToLCD (Ty1) + BW (Bw12)}



Arka Vishesh (H-391)
(Ty1/Ty2 + Bw12+EBR)
VTIC (2019)

Acknowledgements:

DG (ICAR)
DIRECTOR (ICAR-IIHR)
Dr. Peter Hanson, The Word Vegetable Center, Taiwan
Project Co-PI's & Collaborators
PhD Students, SRF's & Field Staff
Seed Unit, ICAR- IIHR.
DBT & NPTC
Web conference Organizers

References:

A Varma and VG Malathi. 2003. Emerging geminivirus problems: a serious threat to crop production. *Annals of Applied Biology*. 142 (2) 145-164.

Anonymous (2019). N.H.B. Database.

B Picó, MJ Díez and F Nuez 1996. Viral diseases causing the greatest economic losses to the tomato crop. II. The tomato yellow leaf curl virus—a review: - *Scientia Horticulturae*: 67 (3-4): 151-196

Datar VV and CD. Mayee 1981. Assessment of losses in tomato yield due to early blight. *Indian Phytopath*. 34:191-195.

JE Polston, RJ McGovern and LG Brown. 1999. Introduction of tomato yellow leaf curl virus in Florida and implications for the spread of this and other geminiviruses of tomato. *Plant Disease*.83 (11): 984

M Lapidot, G Weil, L Cohen, L Segev, V Gaba. 2007. Biolistic inoculation of plants with Tomato yellow leaf curl virus DNA. *Journal of Virological Methods*. 144 (1-2): 143-148

Marcin Nowicki, Majid R. Foolad, Marzena Nowakowska and Elznieta U. Kozik. 2012. Potato and Tomato Late Blight Caused by *Phytophthora infestans*: An Overview of Pathology and Resistance Breeding. Plant Disease: 96 (1)

Ramkishun 1987. Loss in yield of tomato due to bacterial wilt caused by *Pseudomonas solanacearum*. *Indian Phytopathology*. 40 (2): 152-155

Saikia AK and Muniyappa V. 1989. Epidemiology and control of tomato leaf curl virus in Southern India. *Tropical Agriculture (Trinidad)* 66: 350–354

Yadav, O. P. and Dabbas, M. R. 2012. Efficacy of fungicides in the management of early blight of tomato (*Alternaria solani*). *International Journal of Plant Protection*. 5 (2): 413-416.

***

K-06 INDIGENOUS PERENNIAL FRUITS AS VEGETABLES IN ALLEVIATING HUNGER AND MALNUTRITION

V.B. Patel[1,*] and S.S. Solankey[2]

[1]*Division of Fruits and Horticultural Technology, ICAR- Indian Agricultural Research Institute, New Delhi, India.*

[2]*Department of Horticulture (Vegetables and Floriculture), Bihar Agricultural University, Sabour (Bhagalpur), Bihar, India*

**Corresponding author e-mail: patelvb7@gmail.com*

Abstract

India is known as one of the richest biodiversity region for many plant species. It is estimated that 250,000 flowering plants species are found at global level, in which about 3,000 are considered as food source and only 200 species have been domesticated by human being. Global biodiversity in vegetable crops are about 400 species, wherein 80 species of major and minor vegetables have been primarily originated in India. Indigenous perennial vegetables can be classified into three broad categories on the basis of fruits utilized as vegetables, plant parts utilized as vegetables and traditional perennial vegetables. Indigenous and traditional plant species provide a variety of products e.g., food, medicines, raw materials as well as renewable energy. In Indian subcontinent about 2,500 plant species are used in traditional treatment and food sources. Many perennial fruit vegetables are consumed widely specially in rural India that have a huge potential for alleviating hunger, malnutrition and improving health, thereby making a difference in livelihoods. The present utilization of several plants species by the rural and tribal populations is limited in their originated areas, however it is now popularise among the urban areas also. Many of the perennial fruits/ vegetables are known for its high nutritional and medicinal values are discussed in this manuscript.

Key words: Indigenous, perennial vegetables, fruits as vegetables, tree vegetables, nutrition.

Introduction:

Indigenous or traditional vegetables are those vegetables species that are probably originated in Indian subcontinent and locally important for the sustainability of health and wealth as well as social systems but that needs to be attain global recognition to the same extent like major vegetables (brinjal or okra). Though, with the advent of *Jhoom* agriculture practice and green revolution, the biodiversity of many indigenous vegetables are declining at a faster rate. Excessive grazing, deforestation and excess and non-judicial exploitation of native genetic resources have eroded the biodiversity of many indigenous vegetables from this unique ecosystem.

As per the estimation 250,000 flowering plants species are found at global level, among which approximately 3,000 are considered as food source and 200 species have been domesticated by human being. Global biodiversity in vegetable crops are about 400 species, wherein 80 species of major and minor vegetables have been primarily originated in India.

Moreover, about 2,500 plant species are used in traditional treatment and food sources in Indian subcontinent. Several perennial fruit vegetables are eaten widely mainly in rural India that have a enormous potential for alleviating hunger, malnutrition and nutritional security.

The most common major indigenous vegetables are brinjal, okra, sweet potato, chillies, onions, bottle gourd, etc are commercially cultivated across the globe. While, the other important plants whose fruits or plant parts are also consumed as vegetables like bread fruit, jackfruit, monkey jack, mahua, ker, karonda, lasora, elephant apple, aonla, kokum, banana, tree bean, khejri, pomegranate, tamarind, etc. In addition some important perennial plants whose flowers/ fruits/ leaves/ roots are predominantly used as vegetables are bamboo, Indian spinach, drumstick, curry leaf, agathi, etc. are not getting much popularity like major vegetables particularly in urban India.

In many cases indigenous vegetables are highly nutrient rich for both vitamins and minerals. Indigenous vegetables are major genetic resource for crop biodiversity in horticulture because it is consumed and utilized for its medicinal properties and also generate profitably in both rural and urban environments. However, many indigenous horticultural crops species have obtained very limited scientific attention. Indigenous plant species have a huge potential because they provide a variety of products like food, medicines, raw materials in addition to renewable energy. In addition to this the indigenous vegetables have the potential to be a powerful tool in the present battle against COVID-19 and enhance our immunity system and decreased malnutrition problem worldwide. So far, significant efforts in research and development of these neglected vegetables would likely to produce gratifying results, as productivity increases in these indigenous crops are simpler to realize as compare to major crops. A number of known indigenous perennial plants which are being utilized as vegetables in many areas as well as have significant nutritional and economical impact also are discussed here.

A. Indigenous perennial fruits which are consumed as vegetables:

Sl. No.	Common Name(s)	Botanical Name and Family	Native	Growing Areas	Used As
1.	Bread fruit	B.N.: *Artocarpus altilis* Perk. Family: Moraceae	Indo-Chinese and Indonesian region of Pacific Island.	Hot and humid tropical regions of India like U.P., Bihar, West Bengal, Jharkhand and South India	The fruits are prominently used for culinary purposes and are carbohydrates rich that consumed in combination with grated coconut meat or coconut.
2.	Jackfruit	B.N.: *Artocarpus heterophyllus* Lamk. Family: Moraceae	Western Ghats of India.	Bihar, Assam, Jharkhand, Western Ghats and West Bengal.	Fruits and seeds both are mostly used for culinary purpose especially in NE India; however, it is consumed as table, culinary and pickling purposes in other parts of the country.

3.	Monkey jack or *Barhal*	B.N.: *Artocarpus lakoocha* Roxb. Family: Moraceae	India and sub Himalayan region.	Hot and humid environment.	Immature fruits and pistillate flower spikes are utilized for vegetable, chutney and pickle purposes.
4.	Mahua	B.N.: *Bassia latifolia* Roxb. Family: Sapotaceae	India	U.P., M.P., Maharashtra, Bihar, Orissa, A.P. and Gujarat.	The corolla (also called as flower) and fruits are intake after cooking as vegetable in addition to other dishes.
5.	Ker	B.N.: *Capparis decidua* (Forsk) Edgew. Family: Capparaceae	India	Arid and semiarid areas of Rajasthan, Gujarat, Madhya Pradesh, Haryana, Punjab, Uttar Pradesh, Delhi and Southern part of Deccan peninsular areas.	Fruits are rich in protein and mineral. Unripe and tender fruits are consumed as vegetables as well as used for preparation of pickles. Moreover, during off-season dehydrated immature fruits are used for preparation of sole or mixed vegetable dishes. Its fruits are also used as traditional medicines for curing of many diseases.
6.	Karonda	B.N.: *Carissa carandas* L. Family: Apocynaceae	India	Bihar, West Bengal, Rajasthan, Chhattisgarh, Maharashtra, Orissa and Southern parts of India.	Fruits are rich in vit. C and Fe and primarily used for preparing pickles, chutney as well as many other value added products. Fruits are useful to cure anaemia because of antiscorbutic properties.
7.	Lasora or Gonad or Indian cherry or Desert cherry	B.N.: *Cordia myxa* L. Family: Boraginaceae	India	Arid and semi arid regions of Rajasthan, Gujarat, Madhya Pradesh, Punjab, Haryana, Uttar Pradesh, , Chattisgarh, Maharashtra, Assam and Meghalaya	Immature fruits are eaten as vegetable and used for making pickles, moreover ripe fruits are eaten fresh and also used for making country liquor. It is also used as preparation of traditional medicines.
8.	Elephant apple or Chalta	B.N.: *Dillenia indica* L. Family: Dilleniaceae	India	Orissa, West Bengal and North Eastern region of India	Used in preparation of pickles.
9.	Aonla	B.N.: *Emblica officinalis* Gaertn. Family: Euphorbiacea	India	U.P., Rajasthan, Gujarat, M.P., Bihar, Maharashtra, Tamil Nadu, Andhra	Fruits are very rich in Ascorbic Acid and are used in traditional medicines. Fruits are used for making of candy, pickles, chutney

		e		Pradesh and Karnataka	and beside these fruits are used for making of around 150 value added products.
10.	Kokum	B.N.: *Garcinia indica* (Thouars) Choisy Family: Clusiaceae	Western Ghats of India.	Maharashtra, Goa, Karnataka, Kerala, West Bengal, Gujarat and NE region (Khasi and Jantia hills)	Used as common spice. Dried rind is used like tamarind in vegetables as well as making of curries. It is also an important ingredient for making of pickles chutney, rinds, etc are. It also has many pharmaceutical properties as well as Kokam butter is valuable edible fat extracted from its seeds.
11.	Banana and plantains	B.N.: *Musa* spp. L. Family: Musaceae	India	Maharashtra, U.P., Bihar, West Bengal, etc.	Immature fruits are used as vegetable. Plantains var. Nendran are eaten after boiling as breakfast and commercially used for making of banana chips.
12.	Tree bean or Youngchak or Youtak	B.N.: *Parkia roxburghii* G.Don. Family: Mimosaceae	India	NE region of India like Assam, Mizoram, Manipur, Nagaland and Tripura	Immature, tender pods are rich in fibre, protein, vitamin C, phosphorus and Fe. Fully opened flowers and young shoots are used as salads and making of curries. In Manipur it is an important ingredient of daily diet..
13.	Khejri	B.N.: *Prosopis cineraria* (L.) Druce. Family: Leguminosae	Sahara Desert of India	Arid regions of Rajasthan, Gujarat, Haryana, Madhya Pradesh, Maharashtra and Karnataka.	Being a leguminous crop pods are rich in crude protein, carbohydrates and minerals. The immature tender green pods, dried mature pods and fully ripe pods all used as vegetables.
14.	Pomegranate	B.N.: *Punica granatum* L. Family: Punicaceae	Iran and Western to outer Himalayas in India.	Jammu, Kashmir, Karnataka, Tamil Nadu, Maharashtra, Rajasthan and Gujarat	Seeds are popularly used as condiment in culinary preparations.
15.	Tamarind	B.N.: *Tamarindus indica* L. Family: Leguminosae	Tropical Africa	Tamil Nadu, Maharashtra, Andhra Pradesh and Chhattisgarh	Fruit pulp is used as an important ingredient for preparing chutneys, souring curries and other dishes.

B. Indigenous perennial plant parts which are consumed as vegetables:					
1.	Bamboo	B.N.: *Bambusa* spp. Family: Poaceae	Southeast to Eastern Asia and South America.	North Eastern region of India	Edible emerging bamboo shoots are low in fat and calories as well as rich in fibre, potassium and other minerals. Shoots are also rich in lignins and phenolic acids, as well as have several pharmaceutical properties like, anticancer, antibacterial, antifungal and antiviral.
2.	Indian spinach or Poi	B.N.: *Basella alba* L. Family: Chenopodiaceae	India and South Asia	Eastern and Southern part of India	Leaves are succulent, slightly mucilaginous and consumed after boiled, fried as well as used for preparation of many dishes.
3.	Drumstick or Horse Radish tree or Moringa	B.N.: *Moringa oleifera* Lam. Family: Moringaceae	North-West region of India	Southern part of India	Moringa pods are rich in carotene and ascorbic acid, calcium, phosphorus and iron. It is known as highly nutritious vegetable, whose all aerials plant parts including, leaves, flowers and immature or half-mature pods are used to make various vegetable dishes. It is also used for preparation of moringa pickle, dehydrated moringa and moringa powder. Moreover, it has many medicinal properties also.
4.	Curry leaf	B.N.: *Murraya koenigii* (L.) Swreng. Family: Rutaceae	*Tarai* region of Uttar Pradesh, India	U.P., Bihar, West Bengal, Sikkim, Assam, Tamil Nadu and Kerala	Leaves are rich in carotene, protein and fat, which make it superior from other vegetables. The leaves are used for seasoning and flavouring the many vegetable dishes. It is also used in indigenous traditional medicines.
5.	Agathi	B.N.: *Sesbania grandiflora* L. Family: Fabaceae	South Asia	Delhi, Punjab, West Bengal, Assam, Kerala, Tamil Nadu, Andaman & Nicobar Islands	It is rich in vitamin A and many minerals. Its leaves, flower and tender fruits are used for preparing vegetables, curries, salads. It has value in traditional drug for curing of bruises,

					headaches, fevers, sore throat, smallpox and stomatitis.
C. Indigenous tradition perennial vegetables which are getting popularity:					
1.	Ivy gourd	B.N.: *Coccinia indica* Wight & Arn../*C. cordifolia* (L.) Cogw. Family: Cucurbitaceae	India	West Bengal, Bihar, Uttar Pradesh, Chhattisgarh and Karnataka	Fruits are very healthful and are used as vegetables. Leaves are used in Ayurvedic and Unani medicines especially for diabetes.
2.	Kheska or Kakrol	B.N.: *Momordica cochinchinensis* (Zour.) Spreng. Family: Cucurbitaceae	India	Assam, the Garo Hills of Meghalaya, West Bengal, U.P., Bihar, Maharashtra, M.P., Gujarat, Kerala, T.N., Andaman & Nicobar Islands.	Immature tender green fruits are used as vegetables. Moreover, fruits curing properties of digestive problems, ulcers, piles, cough and sores.
3.	Kartoli or Spine gourd	B.N.: *Momordica dioica* Roxb. Family: Cucurbitaceae	India	West Bengal, Assam, Meghalaya, Maharashtra, Gujarat, U.P., Bihar, M.P., Andaman & Nicobar Islands.	Green tender immature fruits are popularly used as vegetables.
4.	Chekkurmanis	B.N.: *Sauropus androgynus* Meeril Family: Euphorbiaceae	Indo-Burma region	Sikkim, Kerala, Tamil Nadu	Leaves are rich in nutrition so far called as multivitamin greens i.e., rich in vitamins (A, B, C) and protein. Both green leaves and tender apical shoots are consumed either raw or after steam cooked as well as in curry making.
5.	Pointed gourd	B.N.: *Trichosanthes dioica* L. Family: Cucurbitaceae	India	Bihar, U.P., West Bengal, Orissa, Jharkhand, Assam, M.P., Andhra Pradesh, Tamil Nadu and Gujarat,	Green tender immature fruits are popularly used as vegetables. In North India fruits are used for making of high valued and delicious sweets.

Conclusion and future needs:

Here 25 perennial crop species which are principally used as vegetables as well as traditional medicines in different parts of our country have been described. These indigenous plants species have distinct role in alleviating hunger and malnutrition as well as treating many ailments. These indigenous perennials fruits like, banana, jack fruit, bread fruit and karonda are very rich in carbohydrates; while, drumstick, bamboo, agathi and tree beans are rich in dietary fibres. Moreover, chekkurmanis, agathi, ker, khejri are rich in proteins; curry leaves, agathi, jack fruit, drumstick are rich in carotene; aonla, drumstick and agathi are rich in ascorbic acid (vitamin C). These perennial vegetables are also loaded at some extent in minerals/ micronutrients like, Ca (agathi, curry leaves, drumstick), P (chekkurmanis, drumstick, agathi), Iron (karonda, aonla) as well as Na, K and Mg.

There is huge scope for exploiting these indigenous plants in pharmaceutical industries. Moreover, these crops have wider biodiversity and needs intensive survey, exploration, conservation and utilization for vital traits. These minor crops have few or none of the released varieties till date for commercial production. Moreover, scientific production technologies of most of these perennial vegetables are not standardized that needs to be standardised. Here more attention to be given on the research and development activities of these indigenous perennial vegetables alongwith its genetic conservation and utilisation. These perennial vegetables are rich in several phytochemicals and popularly used in several traditional, ayurvedic and unani medicines. So we can say that these indigenous perennial fruits are significantly used as vegetables as important natural treasures for alleviating hunger and malnutrition.

References:

Abod, S.A. and Siddiqui, M.T. (1997). Chekkurmanis is a multivitamin green. *Indian Hort*., 42:3-15.

Indira, P. and Peter, K.V. (1987). Under exploited tropical vegetables, KAU, Mannuthy, p. 8-11.

K.L. Chadha and V.B. Patel (2007). Prospect of Indigenous Perennial Plants as Source of Vegetable. Proc. I[st] IC on Indig. Veg. and Legumes, Eds. M.L. Chadha *et al., Acta Hort*., 752, ISHS 2007. Pp. 49-54.

Kumar, S.K., Suresh, V.R., Nagachen, S.V. and Singh, T.R. (2002). Tree bean a potential multipurpose tree. *Indian Hort*., 47(3):10-11.

M.L. Chadha (2009). Indigenous Vegetables of India with Potentials for Improving Livelihood. Proc. IS on Underutilized Plants, Eds.: Jaenicke *et al*., *Acta Hort*., 806, ISHS 2009, Pp. 579-585.

Ram, D., Kalloo, G. and Banerjee, M.K. (2002). Popularizing kakrol and kartoli: The indigenous nutritious vegetables. *Indian Hort*., 47:6-9.

Sarnik, D.A., Sharma, G.L. and Verma, S.K. (2001). Ivy gourd a perennial remunerative vegetable. *Indian Hort*., 46:22-23.

***

Extended Summary

E-01 ANTIOXIDANTS RICH VEGETABLES AS IMMUNITY BOOSTER FOR HEALTHIER LIFE

S.S. Solankey[1,*], Meenakshi Kumari[2], Shirin Akhtar[3], B. N. Saha[1] and Randhir Kumar[3]

[1]Dr. Kalam Agricultural College, Kishanganj, Bihar Agricultural University, Sabour (Bhagalpur), Bihar, India

[2]Department of Vegetable Science, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P.) India

[3]Bihar Agricultural College, Sabour, Bihar Agricultural University, Sabour (Bhagalpur), Bihar, India

**Corresponding author e-mail:shashank.hort@gmail.com*

Abstract

At present everyone wants to improve their immunity. Actually immunity can be boosted by so many herbs sometime due to vitamins, minerals and by phyto-chemicals. Among all herbs, vegetables are the cheapest source of nutritional power and immunity booster. A number of vegetables contain high amount of antioxidants which may be helpful for enhancing the immune system and preventing cough and fever, these are characteristic symptoms of COVID-19. The Corona virus causes COVID-19 and is mainly transmitted by droplets generated when an infected person coughs, sneezes, exhales and touch the surface with infected hands which have their saliva. Developing a safe vaccine which can be mass produced is going to be a time consuming as well as the new race evolution is also a big problem. Hence enhancing our immunity play a key role against COVID-19. As we know that nutritional deficiencies can impair with immune function, increasing both the risk and severity of the infection. Antioxidants are loaded with several nutrients that can counteract unstable molecules called free radicals that damage DNA/ RNA, cell membranes, and other parts of cell. Antioxidants basically neutralize free radicals of our body by giving up some of their own electrons. Vegetables like tomato, chillies, cole crops and leafy vegetables are the cheapest and rich source of antioxidants (vitamins, carotenoids and phenolics compounds). Tomato have one of the strongest antioxidant *i.e.* lycopene and chillies are rich in vitamin C and capsaicin that are very much helpful against cough and have the ability to enhance the immunity power of our body. Beside these the cole vegetables like broccoli has detoxifying antioxidants, particularly rich source of kaempferol and isothiocyanates, both anti-inflammatory phytonutrients. The leafy vegetables are rich in carotene and ascorbic acid that have also medicinal properties for boosting the immunity against viral diseases. Moreover, the processed products of tomato and chillies have a wide range of health benefits. Beside these, antioxidants properties, of these vegetables show an array of biological effects including cardioprotective, anti-inflammatory, antimutagenic and anticarcinogenic activities.

Key words: Antioxidants, COVID-19, Immunity, Vegetables.

Introduction:

COVID-19 is a new challenge for all of us and presently our country is facing the community transmission phase. Developing a vaccine is uncertain and time consuming job as well as continuously new race evolution is also a challenging issue for us. It is a proven fact that nutritional deficiencies can impair with immune function, increasing both the risk and severity of the infection. Among all herbs, vegetables are easily available and cheapest source of nutritional power as well as immunity booster. Antioxidants are well known immunity booster that neutralize free radicals of our body and are loaded with several nutrients that can counteract unstable molecules called free radicals that damage DNA/ RNA, cell membranes and other parts of cell. A diet high in antioxidants rich vegetables like, tomato, chillies, onion and leafy vegetables may boost the immunity that reduce the risk of COVID-19 and many diseases, including heart disease and certain cancers. Beside these, vegetables, especially kale, broccoli and mushrooms, have been shown to improve immune function of human body against various viral diseases.

Vegetable Based Sources of Antioxidants:

1) **Lycopene** – Tomatoes, watermelon and red carrots.
2) **Vitamin A** –Pumpkin, carrots and spinach.
3) **Vitamin C** – Parsley, Broccoli, spinach and capsicum.
4) **Anthocyanins** – Red cabbage, Brinjal, black carrots.
5) **Sulphur compounds** – Leeks, onions and garlic.
6) **Cryptoxanthins** – Red capsicum and pumpkin.
7) **Flavonoids** – Onion.
8) **Isoflavonoids** – Soybeans and garden peas.
9) **Indoles** – Broccoli, cabbage and cauliflower.
10) **Lignans** – Legume vegetables.
11) **Lutein** – Spinach and sweet corn.
12) **ß cyanins & ß xanthins** – Beet root.

***Source*:** https://www.betterhealth.vic.gov.au/health/healthyliving/antioxidants

Antioxidant composition of various vegetables:

Vegetables	Total Chlorophylls (mg/100g)	Total Carotenoids (mg/100g)	Total Tocopherols (mg/100g)	Total Vitamin C (mg/100 g)	Total Polyphenols (mgGAE/100 g)	Total Anthocyanins (mg/100g)
Tomato	-	4.26	0.54	13.70	80.00	-
Chillies	8.70	2.18	0.37	80.40	160.00	-
Cabbage	2.75	0.10	0.15	32.0	44.50	-
Carrot	-	13.86	0.66	5.94	35.00	-
Cauliflower	-	0.04	0.21	48.22	93.00	-
Cucumber	-	0.11	0.03	2.88	29.00	-

Eggplant	-	0.6	0.30	6.00	63.00	85.7
Green bean	8.40	2.09	0.41	12.20	92.00	-
Melon	-	0.06	0.02	18.00	56.00	-
Onion	-	0.02	0.02	7.38	27.00	-
Parsley	182.00	10.62	0.75	133.00	77.00	1.50
Potato	-	0.01	0.01	19.73	163.00	-
Radish	-	0.02	-	14.80	79.00	-
Red cabbage	-	1.02	0.11	68.00	231.00	322 .0
Red lettuce	-	6.22	0.14	3.57	111.00	2.2
Spinach	108.00	11.50	2.03	28.00	205.00	-

Disease-fighting Antioxidants:

- A diet high in antioxidants may reduce the risk of many diseases, including heart disease, asthma and certain cancers.
- Antioxidants scavenge free radicals from the body cells, and prevent or reduce the damage caused by oxidation.
- For instance, men who eat plenty of the antioxidant lycopene (tomatoes and water melon) may be less likely than other men to develop viral infections.
- Parsley and Chillies are rich in ascorbic acid that protect us from cough and cold and may be helpful against COVID-19.

Conclusion:

Developing a safe vaccine is a time consuming as well as the new race evolution is also a big problem. Hence enhancing our immunity will play a key role against COVID-19 and other diseases. Antioxidants are loaded with several nutrients that can effectively increase our immunity. Vegetables like tomato, chillies, cole crops and leafy vegetables are the cheapest and rich source of antioxidants (vitamins, carotenoids and phenolics compounds) and immunity-boosting benefits.

References:

Ezgi Dogan Comert, Burçe Ataç Mogol, Vural G€okmen (2020). Relationship between color and antioxidant capacity of fruits and vegetables. *Current Research in Food Science*, 2: 1–10.

https://www.betterhealth.vic.gov.au/health/healthyliving/antioxidants

https://www.indiatoday.in/mail-today/story/eat-right-in-the-fight-against-covid-19-1666393-2020-04-13.

https://www.ukiahdailyjournal.com/2020/04/02/coronavirus-plant-foods-can-help-fight-viruses/

***

E-02 MICRO-IRRIGATION TECHNIQUES FOR VEGETABLES-A BRIEF REVIEW

Priyanka Suryavanshi[1] , Munish Sharma[2] and Dipender Kumar[3]

[1]CSIR-Central Institute of Medicinal and Aromatic Plants, Lucknow, Uttar Pradesh

[3]CSIR-Central Institute of Medicinal & Aromatic Plants, Research Centre,

Purara (Bageshwar), Uttarakhand-263641

[2]Krishi Vigyan Kendra, S.A.S. Nagar (Mohali)
Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab

**Corresponding author e-mail:priyankaagrios@gmail.com*

Abstract

The most urgent need today is to increase the production of nutritious food in a sustainable manner and improve farm income to ensure household food and nutritional security, while conserving the natural resource base. Vegetables are the vital sources of minerals, vitamins and dietary fibres and play an important role in supplying nutrition to human health. Vegetables require comparatively larger quantities of irrigation water to grow. As India is facing one of its major and most serious water crisis, there is an urgent need to conserve irrigation water through various on-farm water conservation practices in vegetable production. Flood irrigation has been reported for utilizing more water compared to low-volume, pressurized irrigation systems. During the past two decades, many researchers have worked on innovative irrigation practices that can enhance water efficiency, gaining an economic advantage while also reducing environmental burdens. Increasing water crisis has impelled the scientific community to develop precise irrigation technologies for scheduling irrigation by most efficient methods of irrigation, especially drip and sprinkler irrigation. Looking at the present crisis, futuristic challenging scenarios and national aspirations, it is pertinent to have a relook on relevant water management technologies developed across the country for vegetable crops for increasing water use efficiency.

Key words: Vegetables, water management, irrigation methods & schedules, micro-irrigation

Introduction:

Water is considered as the most critical resource for sustainable vegetable production worldwide. Irrigated areas will increase in forthcoming years, while fresh water supplies will be diverted from agriculture to meet the increasing demand of domestic use and industry. Furthermore, the efficiency of irrigation is very low, since less than 65 % of the applied water is actually used by the crops. A considerable effort has been devoted over time to increase water efficiency based on micro-irrigation techniques. Earlier researchers targeted their efforts to reduce irrigation costs by developing efficient irrigation methods for various vegetable crops, which is reviewed in this paper.

Effect of different methods of irrigation on crop yield attributes and yield:

Pawar and Dingre (2014) revealed that the advanced methods of irrigation such as sprinkler, microsprinkler and drip produced higher tuber yield in potato (21.87, 19.57 and 15.90 tonnes ha^{-1} respectively) as compared to conventional method of irrigation (14.11 tonnes ha^{-1}). It was observed that, the potato yields were 54.86, 38.63 and 12.59 per cent more in sprinkler, microsprinkler and drip method respectively than that of conventional method. These findings are in accordance with Name Singh *et al* (2012) who reported better performance of sprinkler irrigation in potato crop as compared to drip irrigation system, and recorded higher yield. Haulm yield was significantly higher in sprinkler than surface irrigated plots however, under micro sprinkler, drip and surface irrigation the haulm yields were at par with each other. Himanshu *et al* (2013) also revealed that the marketable yield of primary flowers of broccoli was slightly higher (2%) in drip irrigation as compared with micro sprinkler, whereas surface irrigation method resulted in considerably lower yield (24%) due to poor water distribution. Drip and micro- sprinkler methods resulted in significantly higher irrigation production efficiency. Both drip and micro-sprinkler irrigation methods resulted in almost same marketable yield and irrigation production efficiency whereas; surface irrigation method resulted in considerably low marketable yield and irrigation production efficiency of broccoli.

Effect of different methods of irrigation on water productivity of crops:

Surveys conducted in Punjab and Sindh provinces of Pakistan indicated savings in IW use of 60–70 per cent in drip, 50–60 per cent in sprinkler, and 45–75 per cent in center pivot sprinkler compared to surface irrigation (Ali *et al* 2012). Al-Jamal *et al* (2001) determined the irrigation efficiency, irrigation water productivity (IWP) and water productivity (WP), under sprinkler, furrow, and drip irrigated onions. The maximum IWP (0.084 t ha^{-1} mm^{-1} of water applied) was obtained using the sprinkler system, in which water applied to the field was limited to the amount needed to replace the onion's ET requirements. The lower IWP values obtained under subsurface drip and furrow irrigation systems compared with sprinkler irrigation was due to excessive irrigation under subsurface drip and higher evaporation rates from fields using furrow irrigation.

Effect of different methods of irrigation on economics:

Kumar *et al* (2006) concluded that microsprinkler was the most appropriate method and had gave significantly higher net returns than both furrow and drip irrigation systems in potato. Drip irrigation did not improved net return due to high initial cost of instatallation instead of higher gross returns. Okunade *et al* (2009) reported that the irrigation system affected operating costs. The sprinkler system had the highest pumping cost and basin irrigation the least. Labour cost was highest for furrow and basin irrigation systems, due to construction of dykes/ridges in addition to the cost of running the system. The cost-benefit ratios were 1.24, 1.41, 1.01, and 1.52 (okra) and 1.50, 1.78, 1.22, and 1.55 (amaranth) for sprinkler, drip, basin, and furrow irrigation, respectively. Basin irrigation had the lowest cost-benefit ratio followed by sprinkler irrigation, which had a marginal return of Rs 1.24 and Rs 1.52 ha^{-1} for okra and amaranth, respectively. Drip irrigation had the highest cost benefit rate for amaranth, with a return of Rs 1.78 and Rs 1.41 ha^{-1} for amaranth and okra, respectively.

Conclusion:

Micro-irrigation should be encouraged, but not restricted to high value crops, as it can be used for many conventional types of crops like onion, tomato and potato leading to high water saving, improvement in crop quality, increase in yield, reduction in agronomical costs. The rationale of the paper is to appraise micro-irrigation along with efficient irrigation schedules as an innovative technology for vegetable production in India and its significant impact on water productivity and nutritional food security.

References:

Ali, H., Ahmad, S., Mehmood, M. J, Majeed, S. and Zinabou, G. (2012) Irrigation and Water productivity in South Asia. Global Development Network, New Delhi.

Al-Jamal, M, S., Ball, S. and Sammis, T. W. (2001) Comparison of sprinkler ,Trickle and Furrow irrigation efficiencies for onion production. Agric. Water Management 46: 253-66.

Himanshu, S. K., Singh, A. K., Kumar, S. and Kalura, P. (2013) Response of Brocolli to irrigation scheduling and methods under drip, sprinkler and surface irrigation. Int. J. Engin. Adv. Technol. 2(4).

Kumar, S., Mandal, G., Asrey, R. and Singh, R. (2006) Influence of irrigation and fertigation on yield, production efficiency and economic returns of drip irrigation potato under semi-arid environment. Potato J. 33(3-4): 126-30.

Name, S., Sood, M. C., Singh, S. P. (2012) Water need and nutrient movement in potato based cropping systems under drip, sprinkler and furrow methods of irrigation. Annals. Hort., 5(1): 74-79.

Okunade, D. A. , Olanusi, O. A. and Adekalu, K. O. (2009) Growth, Yield, and Economics of Okra and Amaranth Production Under Irrigation'. Int. J. Veg. Sci. 15:1, 29-44.

Pawar, D. D. and Dingre, S. K. (2014) Water production functions for potato (Solanum tuberosum) under different irrigation methods. Ind. J. Agric. Sci. 4(2).

***

C-03 BIODIVERSITY IN VEGETABLE CROPS IN BIHAR

Kumari Ragni[1,*], Nitu Kumari[2] and Prabhat Kumar[3]
[1]Young Professional-II, [2]Research Scholar,
Universitydepartment of Botany & Biotechnology, L.N.M.U, Darbhanga, Bihar
[3]SMS (Agromat), Krishi Vigyan Kendra, Araria, Bihar

**Corresponding author e-mail: k.ragnidbg@gmail.com*

Abstract

The biodiversity in vegetable crops is compressed by the genetic diversity, as interspecific and as intraspecific diversity that is referring to the grown varieties of vegetables & by the diversity of agro- biodiversity. Vegetables are good source of vitamin A & C, niacin, thiamin & riboflavin. Major and minor vegetables species also provide several beneficial products such as medicines, food, row materials etc. It also supplies essential minerals like iron & calcium besides of carbohydrates and protein. Biodiversity of vegetable crops in several parts of the planet has been decreases due to various factors such as urbanization, deforestation, farming population aging & failure to transfer of information to one generation to another generation, which can totally differ in relation to the type of genetic resources and several locations. However, biodiversity in vegetable crops has been decreased, mainly due to the adoption of modern varieties. The demand for organic products especially for raw materials of organic origin is increasing worldwide. The supply of organic products is growing strongly and demand is also expending noticeably. The several expressions of biodiversity in vegetable are the major key source for genetic improvement programs, to produce innovative vegetables with improved quantitative characteristics. In order to understand the role of biodiversity in vegetable crops in ecosystems offend to promote its utility in the development of superior vegetable crop varieties that contribute to better human health & nutrition and they also capable of giving very high yields and very high economic returns to the vegetable growers or farmers.

Key words: Biodiversity, vegetable crops, organic farming

Introduction:

Biodiversity is the natural Phenomenon of the Planet & biodiversity in vegetable crops is one of the major key factors of sustainable development, due to importance of it's in the environmental aspects, genetic, crop productions. Biodiversity plays animportant role in resilience of crop maintenance. Diversity of vegetable in worldwide is about 400 species & out of which is about 80 species of major vegetables & minor vegetables have originated in India. The biodiversity in vegetable crops is composed by the diversity, as species diversity and as diversity of genes within a species referring to the vegetable grown varieties and by the diversity of agro- ecosystem. As a whole 55% of the European varieties entered in the catalogue are hybrids. Puglia, which contributes with about 25% to the Italian vegetable growing area. The region is particularly rich in local vegetable varieties, attained by farmers themselves after reputed simple selection procedures generation after generation. The local varieties for which there is a strong link with the Puglia tradition.

Vegetables are good source of vitamin A & C, niacin, thiamin and riboflavin. Major and minor vegetables species also provide several beneficial products such as medicines, food, raw materials etc. It also supplies minerals like iron and calcium besides of carbohydrates and protein. Biodiversity of vegetable crops in several parts of the planet has been decreases rapidly by urbanization, deforestation, farming population aging & failure to transfer of information to one generation to another generation, etc.

Diversity of vegetable in worldwide is about 400 species and out of which is about 80 species of major vegetables and minor vegetables have originated in India. Biodiversity of vegetable crops is characterized by a number of historical genetic bottlenecks imposed on crop plants during domestication and through modern plant breeding (Tanksley and McCouch, 1997), i.e. critical moments diminishing this diversity, and within some species exerted a selective pressure toward specific phenotypes, thus causing a reduction in the number of species used in their needs and a reduction in allelic diversity of the same. This was followed by a dispersal phase which arose when only a subset of the crop was exported to another region, in which diversity was further reduced through adaptive selection to the new condition (Zeder *et al.*, 2006).

At present the certified age under organic cultivation has spread around 8, 65,323 hectares. The demand for organic products especially for raw materials of organic origin is increasing worldwide. India with its cultural tradition and market structure after enormous potential. The vegetable crops which are suitable for organic cultivation are listed in table- 1.

The main objective of the organic farming in vegetable crops is:

- To maintain genetic diversity of the production system.
- To use renewable resources in locally organized production system.
- To minimize all forms of pollution.
- To create a harmonious balance of crop production and animal husbandry.

Results:

The below table revealed that the significance of Biodiversity in view of medicinal points in vegetable crops.

Table 1: Vegetable crops suitable for organic cultivation in medicinal point of view

S. No.	Vegetables	Botanical name	Uses	Containing vitamin
1	Potato	*Solanum tuberosum* L.	Fresh, Frozen, Dehydration	Vit C, vit B_6
2	Tomato	*Solanum lycopersicum* L.	Cardiovascular disease, Asthma, Cancer, Colon and Rectum	Vit C, Lycopin, Vit B_6
3	Garlic	*Allium cepa* L.	Blood Pressure, Cholesterol, Heart Disease	Vit C, Vit B Complex
4	Methi (Fenugreek)	*Trigonella foenue- graecum*	Balance Cholesterol, reduce fever, Muscle pain, Maintain Liver & Kidney	Vit A, Vit B_6, Vit K
5	Bottle gourd	*Lagenaria siceraria*	Urinary tract infections, keep heart healthy, relieves stress	Vit C, Vit B Complex

6	Brinjal	*Solanum melongena* L.	Heart, Cancer, Brain function, Anaemia	Vit C
7	Coriander	*Coriandrum sativum*	Digestion, upset stomach, Nausea, Diarrhoea	Vit. C, vit. K, Mg, Iron, & Protein
8	Chilli	*Capsicum annum*	Indigestion and heartburn	Vit A, B_6, C, Iron, Copper
9	Musk melon	*Cucumis melo*	Regulates Blood Pressure, Promote Digestion, Skin health	Vit A, C, Beta Keratin or Potassium
10	Peas	*Pisum sativum*	Builds Immunity, Heart, & good for eye health	Iron, Zinc, Mg or Copper

Biodiversity in Different Vegetable Crops:

Some benefits of organic Farming in vegetable crops:

- Reduce cost of production (15-16%) by saving energy.
- Improves water infiltration and thereby reduces runoff of source and ground water.
- Supply all the nutrients required by plants.
- Improve the sustainability of different production systems.
- Enhance biodiversity and improve the value of experimental services.
- Reduction in poverty and enhance food nutritional security due to higher, more stable yields.

Conclusion:

The role of vegetable growers in consuming and using the vegetable biodiversity is still fundamental. Many expressions of vegetable biodiversity are a key source for improvement. In this view it must be underlined that the conservation of biodiversity must be based on institutional and private plant breeders and seed banks, but mainly to the vast number of growers, who continuously select, improve and use vegetable biodiversity at the local scale. An organic farming strategy can be profitable if the production costs are lower and if price premium are available. The organic farming is to achieve acceptable profit, high and sustained production levels, and conserves the environment.

In order to understand the role of biodiversity in vegetable crops in ecosystems and to promote its utility in the development of superior vegetable crop varieties that contribute to better nutritional human health as well as, they are also capable of giving very high yields and very high economic returns to the vegetable growers or farmers i.e. ultimately benefit for the country.

References:

Tanksley, S.D. and McCouch, S.R. (1997). Seed banks and molecular maps: unlocking genetic potential from the wild. Science 277:1063-6.

Zeder, M.A., Emschwiller, E., Smith, B.D. and Bradley, D.G. (2006). Documenting domestication; the intersection of genetics and archeology. Trends Genet, 22:139-55

***

E-04 APPLICATION OF BIOTECHNOLOGICAL TOOLS IN VEGETABLE IMPROVEMENT

Nupur Saini

Department of Plant Molecular Biology and Biotechnology, IGKV, Raipur, India

**Corresponding author e-mail: saininupu@gmail.com*

Abstract

In order to meet the demand of continuously growing population and at the same time protecting horticultural crops from different type of stresses, insects, pests and disease the surge for their improvement is increasing. However, the conventional breeding methodologies are time consuming and labor intensive. Further, they improve genome in an unpredicted manner which results in more number of generations to assemble and fix the desirable traits required. In such circumstances biotechnological tools serves to be good alternative as it holds number of advantages over routinely used methods and reduces the chances undesirable linkage drags. Conventional biotechnological methods such as tissue culture, double haploids, molecular markers as well as new biotechnological tools (NBTs) such as RNA interference (RNAi), cisgenesis/intragenesis, and genome editing tools, like zinc-finger, Transcription activator-like effector nucleases (TALENs) and CRISPR/Cas9 has opened up wide array of precise improvement of plants.

Key words: Stress, biotechnological tools, transgenic

Introduction:

According to the latest reports, vegetables are grown over 10.10 million hectare area of India, with the production of 185.80 million tonnes (Anonymous, 2019). India is the largest producer of okra among vegetables and ranks 2nd in the production of pumpkins, squash and gourds, tomatoes, potatoes, onion, cauliflower, brinjal and cabbage in the world. The yield and quality of vegetables depend on its genotype, environmental conditions, and cultural practices. Abiotic stresses, such as high temperature, cold, drought and biotic stresses such as diseases, insect pest infestation strongly reduce their performance and causes yield losses ranging from 50% to 70% (Sharma *et al.*, 2017). This surges the development of such vegetable varieties which can withstand such adverse conditions and results in minimum damage. The improvement of vegetable crops has until recently, been largely confined to conventional breeding approaches such as inter-specific hybridization, but they are time consuming and doesn’t offers complete guarantee of success even after spending so much time (Sharma *et al.*, 2017). Further, they can’t keep the pace with increasing nation’s as well as global demand. So there is an urgent need to adopt modern biotechnological tools which is a multidisciplinary and coordinated approach of improvement.

Different biotechnological tools available for vegetable improvement:

i. **Tissue culture:**

Tissue culture is one of the oldest and popular biotechnological tools used for vegetable improvement. They provide a wide scope for the rapid multiplication of true to types and virus free propagating material (Pandey *et al*., 2010).

ii. **Doubled haploids:**

Double-haploids generated using either pollen or ovule cultures are homozygous for all their genes. By ssing *in vitro* techniques development of pure line varieties or inbred parental lines are much quicker than conventional breeding. Androgenesis (regeneration from pollen) has been successfully used for crops such as eggplant, pepper and wheat (Limera *et al*., 2017)

iii. **Cisgenesis:**

The term cisgenesis can be explained as the genetic modification of plants using genes that originate only from itself or from a species that can be crossed conventionally with this species. The added gene is an extra copy or natural variant of the existing genome. Generally fruit trees and vegetatively propagated crops such as potatoes are currently the primary target for cisgenic modification (Telem *et al*., 2013).

iv. **RNAinterface (RNAi):**

RNA interference (RNAi) is a sequence-specific gene regulation regulated by the introduction of dsRNA resulting in inhibition of translation or transcriptional. These RNAi are successfully used in enhancing shelf life of vegetables such as tomato, production of seedless vegetables like cucumber (Xiong *et al*., 2005). Further it helps in producing male-sterile plant varieties like tobacco and tomato through RNA interference (Saurabh *et al*., 2014).

Commercial varieties of potato highly resistant to three strains of potato virus Y (PVY) have been developed by using this technique only (Missiou *et al*., 2004). Further, transgenic tomato plants resistant to potato spindle tuber viroid (PSTVd) were obtained by this (Schwind *et al*., 2009).

v. **Gene editing techniques:**

Genome editing is defined as a process in which a specific chromosomal sequence is changed. This change can be due to an insertion, deletion and/or a substitution of at least one nucleotide.

Different type of recent techniques used in editing genome for improvement as per the requirements

- **Zinc-finger nucleases (ZFNs):**

Zinc-finger nucleases (ZFNs) have been widely used for target specific mutagenesis to disrupt the normal functioning of gene and producing several gene knockouts (Bonawitz *et al*., 2018). ZFNs consist of zinc finger protein domains able to bind at sequence-specific, fused with nuclease domain for double strand DNA cleavage. In a study potatoes showed the possibility of overcoming self-incompatibility by S-RNase gene editing with the help of ZFNs (Ye, 2018).

- **Transcription activator-like effector nucleases (TALENs):**

Another widely used tool for genetic engineering is transcription activator-like effector nucleases (TALENs). They work as a eukaryotic transcription factors by binding to the promoter region and activating gene expression (Khan *et al.*, 2016).TALENs, are constructed by modifying transcription activator-like effector (TALE) domain repeats for desirable target recognition and are then fused with the FokI nuclease producing in a TALEN (Stephens and Barakate, 2017).

In potato, disruption of vacuolar invertase gene by TALENs, showed improved storage and processing quality of tubers (Clasen, 2016).

- **CRISPR-Cas9:**

CRISPR-Cas9 emerges out as one of the powerful tool needed for precise genome editing tool which needs a guide RNA (gRNA) of ~20 nucleotides complementary to the gene of interest and a nuclease enzyme Cas9, which cuts 3–4 bases next to the protospacer adjacent motif. This motif is later repaired either by error prone non-homologous end joining or by homology directed repair pathway (Jaganathan *et al.*, 2018). CRISPR/Cas9 system has been successfully used for genome editing in several fruit crops, including apple, banana, cacao, citrus, grape, kiwifruit, and pear and vegetables such as tomato, potato, leuttce, cucumber, carrots, cabbage and chinese kale (Yu *et al.*, 2017; Tian *et al.*, 2018).

Conclusion:

Hence, advanced breeding methods such as tissue culture, double haploids, molecular markers as well as new biotechnological tools (NBTs) such as RNA interference (RNAi), cisgenesis/intragenesis, and genome editing tools, like zinc-finger, Transcription activator-like effector nucleases (TALENs) and CRISPR/Cas9 has opened up wide array of precise improvement of vegetable crops and other agricultural crops.

References:

Bonawitz, N. D., Ainley, W. M., Itaya, A., Chennareddy, S. R., Cicak, T., Effinger, K., &Pareddy, D. R. (2018). Zinc finger nuclease-mediated targeting of multiple transgenes to an endogenous soybean genomic locus via non-homologous end joining. *Plant Biotechnology Journal*, 56- 18

Clasen, B. M. (2016). Improving cold storage and processing traits in potato through targeted gene knockout. Plant Biotechnol. J. 14, 169–176.

Jaganathan, D., Ramasamy, K., Sellamuthu, G., Jayabalan, S., & Venkataraman, G. (2018). CRISPR for crop improvement: an update review. Front. Plant Sci 9:985.

Khan, Z., & Khan, S., Mubarik, Md., Sadia, B., & Ahmad, A. (2016). Use of TALEs and TALEN technology for genetic improvement of plants. *Plant Molecular Biology Reporter*, 016-0997-8.

Limera, C., Sabbadini, S., Sweet, J.B. &Mezzetti, B. (2017). New Biotechnological Tools for the Genetic Improvement of Major Woody Fruit Species. Front Plant Sci. 8:1418.

Missiou, A., Kalantidis, K., Boutla, A., Tzortzakaki, S., Tabler, M. &Tsagris, M. (2004). Generation of transgenic potato plants highly resistant to potato virus Y (PVY) through RNA silencing. Mol. Breed. 14:185–197.

Pandey, S. K., Sarkar, D., Sharma, S. & Chandel, P. (2010). Integration of somatic fusion into potato breeding: problems and perspectives. Potato Journal 37(1-2): 9-20.

Saurabh, S., Vidyarthi, A.S. & Prasad, D. (2014). RNA interference: concept to reality in crop improvement. Planta 239, 543–564.

Schwind, N., Zwiebel, M., Itaya, A., Ding, B., Wang, M. B., Krczal, G. &Wassenegger, M. (2009). RNAi-mediated resistance to Potato spindle tuber viroid in transgenic tomato expressing a viroid hairpin RNA construct. Mol Plant Pathol. 10(4):459-69.

Sharma, A., Aditika, Singh, H., & Kanwar, P. (2017). Vegetable Improvement in India; Recent Past, Present and Future: A Review. Int.J.Curr.Microbiol.App.Sci. 6(8): 3246-3255.

Stephens, J., &Barakate, A. (2017). Gene editing technologies – ZFNs, TALENs, and CRISPR/Cas9," in Encyclopedia of Applied Plant Sciences. (B. Thomas, B. G. Murray, and D. J. Murphyp eds.) (2 ed., pp. 157–161). Cambridge MA: Academic Press.

Telem, R. S., Wani, S. H. & Singh, N. B. (2013). Cisgenics - a sustainable approach for crop improvement. Curr Genomics.14(7):468-476.

Tian, H., Fu, D., Zhu, B., Luo, Y. & Zhu, H. (2018). Lycopene is enriched in tomato fruit by CRISPR/Cas9-mediated multiplex genome editing. Front. Plant Sci. 9, 559.

Xiong, A., Yao, Q., Peng, R., Li, X., Han, P. & Fan, H. (2005). Different effects on ACC oxidase gene silencing triggered by RNA interference in transgenic tomato. Plant Cell Rep 23:639–646.

Ye, M. (2018). Generation of self-compatible diploid potato by knockout of *S-RNase*. *Nat. Plants* **4**, 651–654.

Yu, Q. H., Wang, B., Li, N., Tang, Y., Yang, S., Yang, T., Xu, J., Guo, C., Yan, P. & Wang, Q. (2017). CRISPR/Cas9-induced targeted mutagenesis and gene replacement to generate long-shelf life tomato lines. Sci. Rep. 7, 11874.

***

C-05 RADICLE EMERGENCE TEST AS A QUICK VIGOUR TEST TO PREDICT FIELD EMERGENCE PERFORMANCE IN OKRA (*ABELMOSCHUS ESCULENTUS* L.) SEEDS

G. P. Chinnasamy*, S. Sundareswaran and P. R. Renganayaki

Department of Seed Science and Technology,

Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

**Corresponding author e-mail: chinnasamy1051@gmail.com*

Abstract

Okra (*Abelmoschus esculentus* L.) is one of the important vegetable crop of the tropical countries and most popular in India, Nigeria, Pakistan, Cameroon, Iraq and Ghana. It belongs to the family Malvaceae. India is the largest producer of okra with an area of 514 ha, production of 6126 MT, productivity of 12 t/ha followed by Nigeria. Okra is rich in vitamin A and folic acid, besides phosphorus, magnesium and potassium. It contains carbohydrate (5.4 %), protein (4 %) and total fat (0.5 %). According to Indian minimum seed certification standards (IMSCS) okra seedlings evaluated on 21st day for its germination percentage, which is almost like a month. During this evaluation period the seeds will be kept ideal. Once the seeds meet IMSCS it can be sold in market. Since seed is a living entity keeping it for one month not only reduced the germination percentage but also the vigour. We need advance technology which would give a precise result in short period. In that case radicle emergence test is one of the options for quick prediction of field emergence.

Key words: Okra, seeds, germination, vigour test

Introduction:

Okra (*Abelmoschus esculentus* L.) is one of the important vegetable crop of the tropical countries and most popular in India, Nigeria, Pakistan, Cameroon, Iraq and Ghana. It belongs to the family Malvaceae. India is the largest producer of okra with an area of 514 ha, production of 6126 MT, productivity of 12 t/ha followed by Nigeria. Okra is rich in vitamin A and folic acid, besides phosphorus, magnesium and potassium. It contains carbohydrate (5.4 %), protein (4 %) and total fat (0.5 %) (India Stat, 2019).

According to Indian minimum seed certification standards (IMSCS) okra seedlings evaluated on 21st day for its germination percentage, which is almost like a month. During this evaluation period the seeds will be kept ideal. Once the seeds meet IMSCS it can be sold in market. Since seed is a living entity keeping it for one month not only reduced the germination percentage but also the vigour. We need advance technology which would give a precise result in short period. In that case radicle emergence test is one of the options for quick prediction of field emergence.

With this back drop; the present study was carried outradicle emergence test as a quick vigour test to predict field emergence performance in okra (*Abelmoschus esculentus* L.) vegetable seeds

Materials and Methods:

Genetically pure ten seed lots of okra var. Raja obtained from Dharani seeds, Udumalaipetformed the base material for this study.

Radicle emergence testwas conducted through Top of paper method. Eight replicates of 25 seeds in each lot were placed on germination paper moistened with distilled water in petri - dish. The petri - dishes were kept in germination room maintained at 25±2 °C and relative humidity of 95 ± 2 %. The number of seeds that had produced the radicle of 1mm and 2 mm long were recorded from the initiation of radicle emergence at two hours interval up to 24 hours for each replication (ISTA, 2017).

The first appearance of radicle, which is termed as Mean Just Germination Time (MJGT) and the Mean Germination Time (MGT), which is the mean lag period, to radicleemergence was calculated using the formula proposed by Ellis and Roberts (1980) and expressed in hours.

Results and Discussion:

Radicle emergence test is a good indicator for predicting field emergence potential, determining seed quality and classifying seed lots into different vigour status was also confirmed in pepper, cabbage, soybean and radish seeds (Demeir*et al.*, 2008; Matthews *et al.*, 2012).

The results of present study clearly revealed that the seed vigour could be classified in to three group's *viz.*, high, medium and low vigour based on the relationship between mean germination time and field emergence percentage. When the MGT was < 23 hours, the field emergence exceeded 80 per cent which could be considered as high vigour; when the MGT was 23 to 24 hours, the field emergence was 60 to 80 per cent which could be considered as medium vigour; and when the MGT was > 24 hours, the field emergence was below 60 per cent which could be considered as low vigour (Fig. 1, 2 & 3 and Table 1 & 2). Joosen*et al.* (2010) reported that periodic counting of radicle emergence at different length to produce germination progress curves and calculation of mean germination time is a noval approach to evaluate the seed vigour and field emergence.

Fig. 1&2: Standardization of radicle emergence with 2mm length of MGT in okra seeds

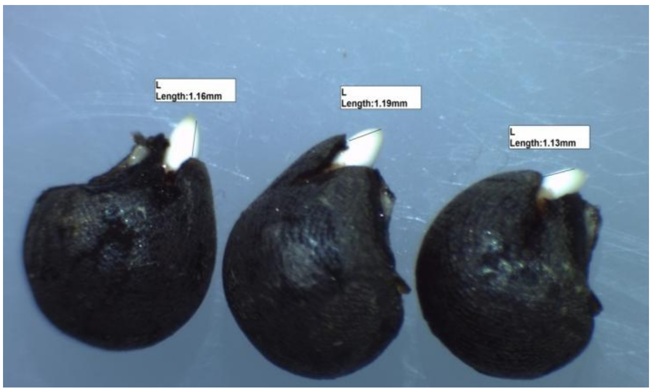


Fig. 1: MGT at 22 hr

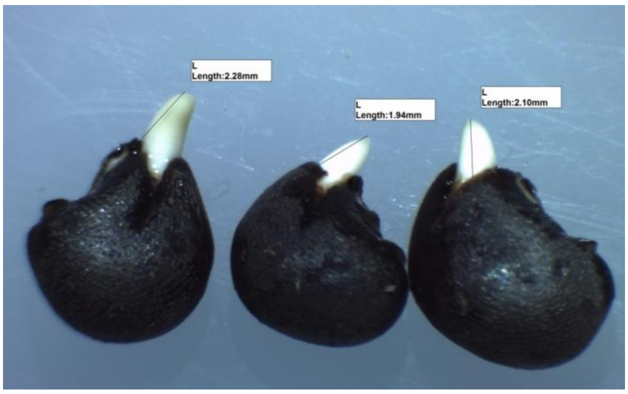


Fig. 2: MGT at 24hr

Table 1. Evaluation of physiological seed quality parameters in different seed lots of okra seeds

Parameters / Seed lots	MJGT (hours)	MGT (hours)	Radicle emergence with 1mm length (%)	Radicle emergence with 2mm length (%)	Field emergence (%)
L_1	18.24	22.08	88 (69.73)	90 (71.56)	84 (66.42)
L_2	18.96	22.56	84 (66.42)	84 (66.42)	80 (63.43)
L_3	18.24	22.08	88 (69.73)	89 (70.63)	84 (66.42)
L_4	18.72	22.32	85 (67.21)	87 (68.86)	81 (64.15)
L_5	19.44	23.04	83 (65.65)	79 (62.72)	77 (61.34)
L_6	20.16	24.00	79 (62.72)	78 (62.02)	70 (56.79)
L_7	19.92	23.76	81 (64.15)	81 (64.15)	72 (58.05)
L_8	20.88	24.96	68 (55.55)	62 (51.94)	53 (46.72)
L_9	20.40	24.48	70 (56.79)	67 (54.94)	57 (49.02)
L_{10}	20.40	24.24	73 (58.69)	69 (56.16)	59 (50.18)
Mean	19.54	23.35	80 (63.43)	79 (62.72)	72 (58.05)
SEd	0.220	0.338	0.94	1.05	0.86
CD (P=0.05)	0.450	0.690	1.92	2.16	1.76

(Figure in parenthesis indicate arcsine values)

Fig. 3. Relationship between germination (%), field emergence (%) and radical emergence (%) in different seed lots of okra seeds

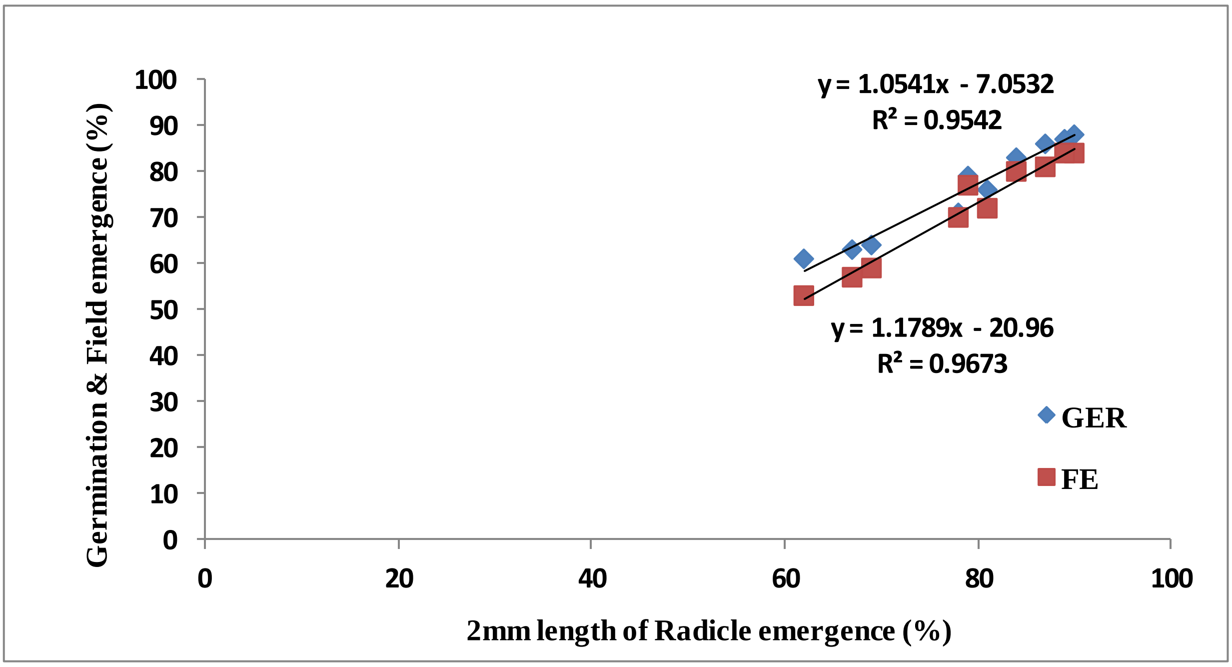


Table 2. Classification of seed lots based on mean germination time and field emergence in okra seeds

Crop	Seed quality classification	Mean germination time (h)	Field emergence (%)
Okra	High vigour	< 23	> 80
	Medium vigour	23 - 24	60 – 80
	Low vigour	> 24	< 60

The current results similar to the findings of Suganthi and Selvaraju(2017) who suggested that when field emergence exceeding 85 per cent, the electrical conductivity was < 13 µS cm^{-1} g^{-1} and the seeds are considered as high vigour; when field emergence between 70 - 85 per cent, the electrical conductivity was between 13 - 26 µS cm^{-1} g^{-1} and it would be considered as medium vigour; and when field emergence fell below 70 per cent the seeds are considered as low vigour with electrical conductivity values of > 26 µS cm^{-1} g^{-1} in groundnut seeds. Demilly*et al*. (2014) observed that the mean germination time determination involves several counts of radicle emergence as the germination progresses. Frequent counts throughout the germination test may not be easy for a large number of seed lots, however, practical automated methods can be used for routine counts in maize seed lots.

Conclusion:

The study concluded that mean germination time with 2mm radicle emergence at 24th hour count could be used for quick indicator of seed vigour in terms of field emergence in okra vegetable seeds.

References:

Demilly, D, Wagner, S. and Carolyne, D. 2014. "Digital imaging of seed germination." *Plant Image Analysis. CRC Press, Boca Raton,*

Demir, I, Ermis, S, Mavi, K. and Matthews, S. 2008. Mean germination time of pepper seed lots (*Capsicum annuum* L.) predicts size and uniformity of seedlings in germination tests and transplant modules. *Seed Science and Technology*, **36(1):** 21-30.

Ellis, R.H. and Roberts, E.H. 1980. The influence of temperature and moisture on seed viability period in barley (*Hordeum distichum* L.). *Annals of Botany*, **45(1):** 31-37.

https://www.indiastat.com

ISTA. 2017. "International Rules for Seed Testing,." *International Seed Testing Association, Bassersdorf, Switzerland.*

Joosen, J, Willems, M. and Henk, W.M. 2010. "Germinator: a software package for high-throughput scoring and curve fitting of Arabidopsis seed germination." *The Plant Journal***62 (1):**148-159.

Matthews, S. and Powell, A. 2012. Towards automated single counts of radicle emergence to predict seed and seedling vigour. *Seed Testing International (ISTA Bulletin)*, **142:** 44-48.

Suganthi, A. and Selvaraju, P. 2017. Fixing accelerated ageing test period and evaluation of physical, physiological and biochemical changes during accelerated ageing in groundnut CO 7 pods. *International Journal of chemical studies,* **5:** 174-179.

***

E-06 COMBATING MICRONUTRIENT MALNUTRITION THROUGH AGRONOMIC BIOFORTIFICATION OF HORTICULTURAL CROPS – A WAY FORWARD

Bholanath Saha[1,*], Shashank Sekhar Solankey[1], Jitendra Kumar[1], Sushanta Saha[2] and V.B. Jha[1]

[1]Dr. Kalam Agricultural College, Bihar Agricultural University, Arrabari, Kishanganj, Bihar - 855 107, India

[2]Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal, India

**Corresponding author e-mail: bnsaha1@gmail.com*

Abstract

Micronutrient malnutrition also known as hidden hunger is a major threat to human health resulting from fast population growth as compared to the crop yield. Amongst micronutrients, good responses to zinc and iron fertilization have been reported for a number of cereal crops including vegetables and fruits. Vegetables and fruits are also one of such links providing many health benefits to human. Antioxidants and antinutritional compounds in vegetables also vary with cultural practices. Phytoene phytase, a key enzyme of carotenoid biosynthesis is activated by manganese. Application of manganese may thus trigger the biosynthesis of carotene. A relationship also exists between ascorbic acid content and boron treatment in different vegetables like summer squash, beet, tomato and potato.

Key words: Micronutrient, vegetables, antioxidants, health

Role of micronutrient in nutritional improvement of vegetable crops:

Malnutrition, often caused by the lack of micronutrients and also accumulation of antinutritional compounds like nitrate may be curbed through inclusion of vegetables in our diet (Shukla *et al*., 2018). For example, increasing the supply of Zn to pea (*Pisum sativum* L.) plants at levels in excess of that required for maximum yield has been shown to increase the concentration of bioavailable Zn in seeds. Increasing Zn levels via Zn fertilization has also been shown for navy beans (*Phaseolus vulgaris* L.), as well as other crops. Some antinutritional compounds like phytic acid, tannins and polyphenols can bind Zn and Fe and reduce their bioavailability to human (Table 1), while these antinutritional compounds may act as anti-carcinogen in some particular cases (Welch and Graham, 1999).

Table 1. Important antinutrient substances to reduce bioavailability of Zn and/or Fe to humans

Antinutrient	Examples of major dietary source
Phytic acid or phytin	Whole legume seeds and cereal grains
Fiber (cellulose, hemicellulose and lignin)	Whole cereal grain products
Tannins and polyphenolics	Tea, coffee, beans, sorghum etc.
Hemagglutinins (e.g. lectins)	Most legumes and wheat
Heavy metals	Plant foods obtained from crops grown on metal polluted soils

Improvement in Ca nutrition in vegetables has been shown to cause a decrease on soluble oxalate content in tissues because of the formation of insoluble Ca-oxalate. Better phosphorus nutrition has also indicated to have similar effect. Nitrate accumulation in vegetables is less when it is applied with NH_4^+, rather than as NO_3^-. Mo is known to be a component of nitrate reductase enzyme that reduces NO_3^- into NH_4^+ in cell. Its application to soil or plants may, therefore, helps in increasing the activity of nitrate reductase enzyme and thus reducing the NO_3- content in vegetables. Recent efforts to increase the levels of Ca in the edible portions of plants have used a modified calcium/proton antiporter to increase Ca transport into vacuoles. Application of B helps in N uptake in some vegetables and thus increases protein synthesis.

Additional information is needed to improve micronutrient recommendations, especially for determining long-term availability, and to evaluate macronutrient fertilizer effects on micronutrient availability. Considerable information about critical deficiency levels of micronutrients is available, but information about critical toxic levels is limited. Information about the interactions of micronutrients with other minerals is also needed.

References:

Shukla AK, Behera SK, Pakhre A, Chaudhari SK (2018) Micronutrients in soils, plants, animals and humans. Indian J Fertil 14(3):30-54

Welch RM, Graham RD (1999) A new paradigm for world agriculture: meeting human needs. Productive, sustainable, nutritious. Field Crops Res 60:1-10.

***

C-07 BIOCHEMICAL CHARACTERISTICS OF BITTER GOURD (*MOMORDICA CHARANTIA* L.) IN SOUTHERN INDIA

Sathish.M*, Lakshmanan.V, Juliet Hepziba.S and Balakumbahan.R

Horticultural College and Research Institute, TNAU, Periyakulam-625604, Theni, Tamil Nadu, India

**Corresponding author e-mail*: *sathishhort@gmail.com*

Abstract

In this present investigation, F_4 progenies of three cross combinations of bitter gourd namely, $P_1 \times P_4$ (MC105× Pant Karela-2), $P_2 \times P_4$ (TCR471× Pant Karela-2), $P_3 \times P_6$ (BBGS-09-1× Arka Harit) and their respective parents P_1 (MC105), P_2 (TCR471), P_3 (BBGS-09-1), P_4 (Pant Karela-2), and P_5 (Arka Harit) were used to analyze the biochemical properties such as total soluble solids, protein content, ascorbic acid content, iron content, momordicine content and total chlorophyll content. The experiment with three cross combination was laid out in a randomized block design. The experiment revealed that the TSS was maximum in progeny $P_2 \times P_4$ (2.52 ºbrix) while it was minimum in $P_1 \times P_4$ (2.38 ºbrix). The maximum protein content (1.78 %) was recorded in P_2XP_4 while it was minimum (1.70 %) in P_1XP_4. The maximum ascorbic acid content (103.50 mg/100g), iron content (2 mg/Kg), momordicine content (1.98 mg/g) and total chlorophyll content (0.43 mg/100g) was recorded in progeny P_1XP_4.

Key words: Bitter gourd, biochemical characters, progenies, parents.

Introduction:

Bitter gourd (*Momordica charantia* L.) is an economically important member of the Cucurbitaceous family that is widely cultivated in India, China, Malaysia, Africa, and South America (Raj *et al.* (1993); Singh (1990). Bitter gourd is known by various names, as balsam pear, bitter melon, bitter cucumber, and African cucumber (Heiser, 1979). In India, the major growing states are Karnataka, Maharashtra, Tamil Nadu and Kerala (Laxuman *et al.* (2012). Bitter gourd originated in Indo-Malayan region but has acclimatized widely in the Old and New World (Bates *et al.* (1995). In India the area under bitter gourd is 76,000 hectares with a production of 77,000 MT NHB (2014 - 2015). It is grown up to an elevation of 1600-1700 meter above mean sea level. Optimum temperature requirement for the crop is 24-27^{0}C (Salunkhe and Kadam (2005).

It is a fast growing warm seasonal climbing annual. The herbaceous tendril bearing vine grows up to 5 m height. It bears simple, alternate leaves, 4-12 cm across, with 3-7 deeply separated lobes and each plant bears separate male and female flowers (Islam *et al.* (2009).Bitter gourd contains a reasonable amount of different nutrients such as proteins, carbohydrates, fats, minerals and vitamins A, B_2, and C etc. Raja *et al.* (2007) reported very high amount of vitamin C (95 mg/100g) and protein (930 mg/100g) in some Indian bitter gourd varieties. Fruits of bitter gourd are widely consumed as a vegetable and are well known for its antidiabetic and other medicinal properties (Robinson and Decker-Walters (1997). The fruit being rich in vitamin A, vitamin C, iron, phosphorous and carbohydrates (Miniraj *et al.* (1993); Desai *et al.* (1998). It increases body's resistance against pathogenic infection (Beloin *et al.* (2005).

Fruit also contains two alkaloids viz., momordicin and cucurbitacin, momordicin is the momordicosides glycosides of tetracyclic triterpinoides with cucurbitane (Chandravadana and Chander (1990).Bitter gourd is usually grown in kitchen garden as a summer vegetable. But at present it is also being grown as commercial crop near the urban areas. Although the bitterness of bitter gourd might turn some people away, it really sweetens the diet because of its disease preventing and health promoting phyto-chemical compounds.

Materials and Methods:

The experimental materials comprised of three F_4 progenies & parents were raised with an inter row spacing of 2 m and intra row spacing of 1.5 m. The study was conducted Western block, Department of Vegetable crops, Horticultural College and Research Institute, Periyakulam, TamilNadu Agricultural University (TNAU), during August 2017- June 2018. The experiment was laid out in the RBD with three replications. Data were recorded on TSS, Ascorbic acid content, Protein content, Iron content, Momordicine content and Total chlorophyll content. Protein content in fruit was estimated following the method of Lowry *et al.* (1951). Ascorbic acid content of tender bitter gourd pulp was estimated as per the procedure described in A.O.A.C. (1975) and expressed in mg/100g of fresh sample. The iron content was estimated following the method suggested by Lindsay andNorvell (1988). The bitter principle (momordicine) of fruit was estimated by analysing the total triterpene content on dry weight basis as suggested by Chandravadana and Chander (1990). The data were analyzed by using GENRES statistical software programme.

Result and Discussion:

In F_4 generation, total soluble solids ranged from 2.38 ºbrix ($P_1 \times P_4$) to 2.52 ºbrix ($P_2 \times P_4$) with the general mean of 2.44 ºbrix. The progeny $P_2 \times P_4$ was recorded maximum TSS (2.52 ºbrix) compared to the mean value 2.44 ºbrix. Similar result was observed by Bahari *et al.* (2012) in watermelon. The protein content ranged from 1.70 per cent ($P_1 \times P_4$) to 1.78 per cent ($P_2 \times P_4$) with mean of 1.73 per cent. The progeny $P_2 \times P_4$ recorded the maximum protein content (1.78 per cent) compared to the mean value of 1.73 per cent. These results are in accordance with Kshirsagar (2009) and Choudhary *et al.* (2014). Ascorbic acid content ranged from 82.60 mg per 100g ($P_3 \times P_5$) to 103.50 mg per 100g ($P_1 \times P_4$) with mean of 94.33 mg per 100g. The progeny $P_1 \times P_4$ was recorded the maximum Ascorbic acid content (103.50 mg per 100g) while it was minimum (82.60 mg/100g) in $P_3 \times P_5$. Similar result was recorded by Thangamani *et al.* (2011) in bitter gourd.

The iron content ranged from 1.37 mg per kg ($P_3 \times P_5$) to 2.00 mg per kg ($P_1 \times P_4$) with mean of 1.72 mg per kg. The maximum iron content (2.00 mg per kg) was noticed in progeny $P_1 \times P_4$ while it was minimum (1.37 mg per kg) in $P_3 \times P_5$. Arunkumar *et al.* (2011) also reported the wide range of variability in iron content of cucumber which is in line with the results of present study. The momordicine content ranged from 1.48 mg per gram ($P_3 \times P_5$) to 1.98 mg per gram ($P_1 \times P_4$) with mean of 1.78 mg per gram. The maximum momordicine content (1.98 mg per gram) was recorded in progeny $P_1 \times P_4$ while it was minimum (1.87mg per gram) in $P_2 \times P_4$. These results are agreement with the results of Bahari *et al.* (2012) in water melon. Total chlorophyll content ranged from 0.32 mg per 100g ($P_3 \times P_5$) to 0.43 mg per 100g ($P_1 \times P_4$) with mean of 0.36 mg per 100g. The maximum total chlorophyll content (0.43mg per 100g) was recorded in progeny $P_1 \times P_4$ while it was minimum (0.32mg per 100g) in $P_3 \times P_5$ which is represented in table 1.Reddy *et al.* (2013) also reported the variability pattern in total chlorophyll content of ridge gourd which is in accordance with the results of present study.

Table 1. *Per se* performance of progenies for different biochemical traits of bitter gourd in F_4 generation

Progenies	TSS (ºBrix)	Protein content (%)	Ascorbic acid (mg/100g)	Iron content (mg/kg)	Total chlorophyll content (mg/100g)	Momordicine (mg/g)
P1XP4	2.38	1.70	103.50*	2.00*	0.43*	1.98*
P2XP4	2.52	1.78	96.90	1.78	0.33	1.87*
P3XP5	2.43	1.72	82.60*	1.37*	0.32*	1.48*
MEAN	2.44	1.73	94.33	1.72	0.36	1.78
SE.d	0.054	0.027	2.452	0.043	0.005	0.027
CD (0.05)	0.122	0.054	5.906	0.093	0.03	0.068

**Significant at 5 percent level*

Conclusion:

Based on the above experimental data the progeny $P_1 \times P_4$ was considered as best one because, it exhibits the superior performance in protein content, iron content, ascorbic acid content, momordicine content and total chlorophyll content. It is thus concluded that thecross combination $P_1 \times P_4$ (MC105× Pant karela-2) were the best one among the studied progeny based on their quality attributes.

Acknowledgement:

The authors thank the Department of Vegetable Crops, Horticultural College and Research Institute for providing the technical and Management support.

References:

Singh. (1990). Gytogenetics and evolution in the cucurbitaceae. Cornell Univ. Press, Ithaca, New York., 11-28.

Raj, Prasanna, & Peter. (1993). Bitter gourd Momordica ssp. In: Kalloo, G., Berg, B.O. (Eds.), Genetic Improvement of Vegetable Crops. Pergmon Press,Oxford, UK, 239- 246.

Heiser, C. B. (1979). The gourd book: University of Oklahoma Press, Norman, UK.

Bates, Merrick, & Robinson. (1995). Evolution of crop plants (Smartt J and Simmonds NW, eds). Minor cucurbits. In, 110.

Laxuman, L., Patil, S., Salimath, P., Dharmatti, P., Byadgi, A., & Nirmalayenagi, N. (2012). Heterosis and combining ability analysis for productivity traits in bitter gourd (*Momordica charantia* L.). Karnataka Journal of Agricultural Sciences, 25 (1).

NHB (2014-15), National Horticultural Board, Ministry of Agriculture and Farmers Welfare, Govt of India.

Salunkhe, & Kadam. (2005). Handbook of Vegetable Science and Technology. Brijbasi Art Press., 282-284.

Islam, Hossain, Bhuiyan, Husna, & Syed. (2009). Genetic variability and path-coefficient analysis of bitter gourd (Momordica charantia L.). International Journal of Sustainable Agriculture, 1(3), 53-57.

Robinson, R., & Decker-Walters, D. (1997). Cucurbits. New York Cab. International Crop Production Science in Horticulture (6): 226p.

Miniraj, Prasanna, & Peter. (1993). Genetic improvement of vegetable plants. Pergamon Press, Oxford, UK., 239-246.

Desai, Musmade, Salunkhe, & Kadam. (1998). Handbook of vegetable science and technology: Production, composition. storage and processing. Marcel Dekker, New York., 273-298.

Chandravadana, M., & Chander, M. (1990). Subcellular distribution of momordicine-II in Momordica charantia leaves. Indian Journal of Experimental Biology, 28(2), 185-186.

Beloin, N., Gbeassor, M., Akpagana, K., Hudson, J., De Soussa, K., Koumaglo, K., & Arnason, J. T. (2005). Ethnomedicinal uses of Momordica charantia (Cucurbitaceae) in Togo and relation to its phytochemistry and biological activity. Journal of Ethnopharmacology, 96(1-2), 49-55.

Raja, S., Bagle, B., & Dhandar, D. (2007). Genetic variability studies in bitter gourd for zero irrigated condition of semi-arid ecosystem. Indian Journal of Horticulture, 64(4), 425-429.

Lowry, O. H., Rosebrough, N. J., Farr, A. L., & Randall, R. J. (1951). Protein measurement with the Folin phenol reagent. Journal of biological chemistry, 193(1), 265-275.

A.O.A.C. 1975. Official methods of analysis. Association of agricultural chemists. Nineth editior, Washington, D.C.

Lindasy, W.L. and W.A. Norvell. 1988. Development of a DTPA soil test for zinc, iron, managanes and copper. Soil Sci. Soc. Amer. J., 42: 421-428.

Bahari, M., M.Y. Rafil, G.B. Saleh and M.A. Latif. 2012. Combining ability analysis in complete diallel cross of watermelon (*Citrullus lanatus*). Sci. World J. Article ID 543158.

Kshirsagar, D.B. 2009 .Studies on transgressive segregation of F3 and F4 generation in tomato (*Lycopersicon esculentum* Mill.) with special reference to resistance against leaf curl virus (TLCV). Ph.D thesis (unpub.), M.P.K.V., Rahuri, M.S. India.

Choudhury, B.R., Pandey, S., Singh, P.K. and Pandey, V. 2014. Genetic diversity analysis for quantitative traits in hermaphrodite ridge gourd [*Luffa acutangula*(Roxb.) L.]. Indian Journal of Horticulture 71(2): 284-28.

Thangamani, C., L.Pugalendhi, T.Sumathi, C. Kavitha and V. Rajashree. 2011. Estimation of combining ability and heterosis for yield and quality characters in bitter gourd (*Momordica charantia*L.) Electron. J. Pl. Breed., 2(1): 62-66.

Arunkumar, K. H., Ramanjinappa, V. and Patil, M.G. 2011. Genetic variability studies in F2 population of cucumber (*Cucumis sativus* L.), Plant Archives, 11 (1): 347-350.

Reddy, B. P., Begum, H. and Reddy, M. T. 2013. Variance component analysis of quantitative traits in muskmelon (*Cucumis melo* L.) Trakia J. Sci., 2:118- 124.

***

E-08 RECENT TECHNIQUES FOR IMPROVEMENT OF PRODUCTIVITY AND QUALITY OF VEGETABLE CROPS

Saurabh Tomar[1,*], Meenakshi Kumari[1], Rajiv[1] and H. G. Prakash[2]

[1]Department of Vegetable Science, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P.) India

[2]Directorate of Research, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P.) India

**Corresponding author e-mail: chaudhary.csa@gmail.com*

Abstract

Vegetables are known as protective foods as they are rich in micronutrients, vitamins and health benefiting compounds. Many of vegetables are rich in protein which are essential for body building, mainly tissue, muscles and blood and also contain good amount of potassium which help in maintaining blood pressure and reducing development of kidney stone etc. The productivity and quality of vegetables are affected by various biotic and abiotic stresses. Now a days, besides yield and stress related traits, the quality traits are also getting adequate attention in vegetable breeding programmes because of increasing awareness among the consumer for nutritional and health concerns.

Key words: Vegetables, protective foods, micronutrients, vitamins, productivity, quality.

Introduction:

Vegetables are known as protective foods because of higher content of vitamins, mineral and fibres. Nutritional content of potato *i.e.*, protein and essential amino acids is increased by a seed-specific protein, AmA1 (amaranth seed albumin) of Grain Amaranthus (*A. hypochondriacus*) (Chakraborty *et al.*, 2000). Recent techniques like organic farming, management of irrigation, grafting, cultivation of vegetable crops under protected structure, conservation tillage, cropping system, mulching, post harvest technology, genetic improvement, biotechnology etc play major role in improvement of vegetable crops under adverse climatic condition. Major pre-breeding applications like broadening the genetic base, moving genes from wild species into breeding population and identification and transfer of novel genes from unrelated species using genetic transformation techniques are also useful in improvement of vegetables crop. Development of such varieties which are resistant to both biotic, abiotic stresses and also have improved quality traits can be possible by next generation genome sequencing. A technique known as marker assisted selection is widely used in breeding programmes to improve the efficiency and speed up the selection procedures (Holland, 2015). In tomato, for introgression of two genes *i.e,* Ty2 and Ty3 marker assisted selection has been employed for development of tomato leaf curl resistant hybrid (Prasanna *et al.*, 2015). Different biotechnology based approaches for next generation agriculture like tissue culture, genomics, molecular breeding, genetic engineering, crops with novel traits. Development of multi-resistant varieties by the help of gene pyramiding has been made possible with the development of different molecular markers (Melchinger, 1990). Gene pyramiding enhances the performance of traits by combining two or more complementary genes. Embryo rescue technique is widely used in several vegetables like in capsicum, tomato and muskmelon to overcome the post-zygotic barriers such as endosperm abortion and embryo degeneration (Kumari *et al.*, 2018). In lettuce, haploid plants were developed through embryo culture techniques (Zenkteler and Zenkteler, 2016).

Table 1: Gene pyramiding in vegetables.

S. No.	Crop	Trait	Pyramided genes	Refrences
1.	Tomato	Tomato Leaf Curl Virus	Ty-2 and Ty-3	Prasanna *et al.*, 2014
2.	Tomato	Bacterial Spot and B. Speck	Pto, Rx3	Yang *et al.*, 2005
3.	Potato	Late Blight	Rpi-mcd1, Rpi-ber	Tan *et al.*, 2010
4.	Soya bean	Soya Bean Mosaic Virus	Rsv1, Rsv3 and Rsv4	Shi *et al.*, 2008
5.	Pea	Nodulation ability	sym9,sym10	Schneider *et al.*, 2002
6.	Common bean	Anthracnose and Poty virus	C0-2c, Co2a252	Ferreira *et al.*, 2012

Table 2: Disease management in various vegetable crops by meristem culture techniques.

S. No.	Crop	Disease management	References:
1.	Onion/ Shallot	Onion yellow dwarf virus	Walke*yet al.*, 1987
2.	Pea	Pea seed borne mosaic virus	Kartha and Gamborg 1978
3.	Brinjal	Mosaic virus	Raj *et al.*, 1991

Table 3: Role of Genetic engineering in maintaining the postharvest traits of various vegetable crops.

Transformed plant	Transgenic product	Transformed plant Achievement	References:
Tomato	Antisense polygalacturonase	Shelf life improved	Sheehy *et al.*, 1988
Tomato	Antisense ACC synthase	Inhibit ripening of fruits	Oeller *et al.*, 1991
Tomato	Antisense ACC oxidase	Inhibit ripening of fruits	Hamilton *et al.*, 1990
Tomato	Phtoene synthase gene	Fruit pigmentation	Bird *et al.*, 1991

References:

Bird CR, Ray JA, Fletcher JD, Boniwell JM, Bird AS, Teulieres C, Blain 1, Bramley PM, Schuch W. 1991. Using antisense RNA to study gene function: inhibition of carotenoid biosynthesis in transgenic tomatoes. Bio/Technology. **(9)**:635-39

Chakraborty S, Chakraborty N and Datta A. 2000. Increased nutritive value of transgenic potato by expressing a nonallergenic seed albumin gene from Amaranthus hypochondriacus. Proc Natl Acad Sci USA. 28: 97(7).

Ferreira, J. J., Campa, A., Pérez-Vega, E., Rodríguez-Suárez, C., &Giraldez, R. 2012. Introgression and pyramiding into common bean market class fabada of genes conferring resistance to anthracnose and pottyvirus. Theoretical and Applied Genetics, 124(4), 777-788.

Hamilton AJ, Lycett GW, Grierson D. 1990. Antisense gene that inhibits synthesis of the hormone ethylene in transgenic plants. Nature 346: 284-287

Holland J. B., 2014. Implementation of Molecular Markers for Quantitative Traits in International Service for the Acquisition of Agri-Biotech Application, 2015. Global Status of Commercialized Biotech/GM Crops: 2014.

Kartha KK, and Gamborg OL. 1978. In diseases of tropical food crops. (H. Maraite and J.S. Meyer, eds.) Proc. Int. Symp. U. C. L. Louvain-la-Neuve, Belgium. p. 267

Kumari P, Thaneshwari, and Rahul. 2018. Embryo rescue in horticultural crops. International journal of current microbiology and applied sciences. 7(6): 3350-3358.

Melchinger A. E., 1990. Use of molecular markers in breeding for oligogenic disease resistance. Plant Breeding 104: 1-19.

Oeller P, Lu M W, Taylor L P, Pike D A and Theologis A. 1991. Reversible inhibition of Tomato fruit senescence by antisense RNA. Science 254(5030):437-9.

Prasanna H. C., Kashyap S. P., Krishna R., Sinha D. P., Reddy S., Malathi V. G., 2015. Marker assisted selection of Ty-2 and Ty-3 carrying tomato lines and their implications in breeding tomato leaf curl disease resistant hybrids. Euphytica 204: 407–418.

Raj SK, Aminuddin, Aslam M, and Singh BP. 1991. Elimination of eggplant mottled crinkle virus using virazole in explant cultures of Solanum melongena L. Indian journal of experimental biology. 29(6): 594-5.

Schneider, A., Walker, S., Sagan, M., Duc, G., Ellis, T., &Downie, J. (2002). Mapping of the nodulation loci sym9 and sym10 of pea (Pisum sativum L.). Theoretical and Applied Genetics, 104(8), 1312-16.

Sheehy R. E, Kramer M and Hiatt W R. 1988. Reduction of polygalacturonase activity in tomato fruit by antisense RNA. Proc Natl Acad Sci U S A. 85(23):8805-09.

Shi, A., Chen, P., Li, D., Zheng, C., Zhang, B., & Hou, A. 2009. Pyramiding multiple genes for resistance to soybean mosaic virus in soybean using molecular markers. Molecular Breeding, 23(1), 113.

Tan A. Y. A, Hutten R C B, Visser R G F and Eck H J V. 2010. The effect of pyramiding Phytophthora infestans resistance genes RPi-mcd1 and RPi-ber in Potato. Theoretical and applied genetics. 121(1):117-25.

Walkey DGA, Webb MJW, Bolland CJ and Miller A. 1987. Production of virus-free garlic (Allium sativum L.) and shallot (A. ascalonicum L.) by meristem tip culture. Journal of horticultural science. 62: 211-220.

Yang, W., Sacks, E. J., Lewis Ivey, M. L., Miller, S. A., & Francis, D. M. 2005. Resistance in Lycopersicon esculentum intraspecific crosses to race T1 strains of Xanthomonas campestris pv. vesicatoria causing bacterial spot of tomato. Phytopathology, 95(5), 519-527.

Zenkteler E and Zenkteler M. 2016. Development of haploid embryos and plants of Lactuca sativa induced by distant pollination with Helianthus annuus and H. Tuberosus. Euphytica. 208(3): 439-451.

***

C-09 ADAPTATION AND MITIGATION STRATEGIES FOR CLIMATE CHANGE TOWARDS THE VEGETABLE PRODUCTION

P. Arun Kumar[1,*], B. Venudevan[1], J. Ramkumar[1] and R. Mangaiyarkarasi[2]

[1]ICAR-Krishi Vigyan Kendra, TNAU, Aruppukottai, Tamil Nadu

[2]Department of Floriculture and Landscape Architecture, HC & RI, TNAU Coimbatore[2]

**Corresponding author e-mail: arunkumarpmeteo@gmail.com*

Abstract

Vegetable production are going to be adversely suffering from the rise or decrease in temperature and also by an overall increase or decrease in rainfall at different growth stages of crops. Several initiatives are undertaken to mitigate the possible impact of climatic change on vegetable production. These include selection of higher adaptable genotypes, genetic manipulation to beat extreme climatic stresses, measures to enhance water and nutrient-use efficiency and exploiting the beneficial effects of CO_2 enhancement on crop growth. Adaption and mitigation is required to avoid risk in vegetable farming and to make sure sustainable livelihoods of the farming community. Meteorology models and growth simulation models are often want to predict the possible impact of global climate change on vegetable crop production and that they also help in framing necessary adaptation measures. Over the years, increasing concentrations of CO_2 and greenhouse gasses *viz*., CFCs, CH_4, and N_2O have headed to heating. The report of Intergovernmental Panel on global climate change as showed a robust evidence of worldwide climate change and projected that the typical global temperature of the earth's atmosphere would rise by 1.4-4.8ºC by the top of this century. The temperature increase during the winter seasons is probably going to be much above rainy seasons. Rainfall is probably going to extend by 15-40% by the top of the century.

Key words: Vegetables, climate change, green house gasses, adaptation, mitigation

Adaptation strategies:

To affect the impact of global climate change, the potential adaptation strategies are: 1. Crop diversification 2 Developing cultivars tolerant to heat and salinity stress and immune to flood and drought, 3.To change the land-use management practices, 4. Cropping season alternatives, 5. Efficient usage of natural resources, 6. Advance Integrated Pest Management, 7. Better meteorology and Crop Insurance Schemes.

Mitigation strategies:

The strategies for mitigating greenhouse emission (GHGs) emission could be: 1. Water management: promoting mid-season aeration by short-term drainage. 2. Organic matter: improving organic matter management by promoting aerobic degradation through composting, incorporating it into soil during off-season drained period. 3. Cultivar: use of rice cultivars with few unproductive tillers, high harvest index; and application of fermented manures like biogas slurry in situ of unfermented farmyard manure. 4. Methane emission: CH4 from ruminants are often reduced by altering the feed composition, either by reducing the share which is converted into methane or by improving the milk and meat yield. 5. Laughing gas emission: Site-specific nutrient management (SSNM), efficient nutrient management. Application of nitrification inhibitors like, nitrapyrin and dicyandiamide (DCD). There are some plant-derived nitrification inhibitors like neem oil, organic and karanja seed extract. 6. Carbon-di-oxide emission: Soil management practices like reduced tillage, manuring, residue incorporation, improving soil biodiversity, micro aggregation, and mulching can play important roles in sequestering carbon in soil which can ultimately reduce the CO_2 emission from agriculture. 7. Technologies: intermittent drying, site-specific N management, etc. are often easily adopted by the farmers without additional investment, whereas other technologies need economic incentives and policy support.

Mitigation strategies wiped out vegetables:

Genetic improvement in vegetable crops: Genetic improvement of crops mainly forms an adaptation strategy because it may be a preparation for crop plants to adapt to future predicted climate. Genetic improvement of crop plants to form them ready to withstand the adverse effects of global climate change is a crucial means for his or her sustainable production and for food security. The complexity arises thanks to the polygenic nature of abiotic stress tolerance, lack of selection criteria and inadequate knowledge about the genetics of stress tolerance, making breeding for abiotic stress tolerance difficult. Vegetable varieties with various stress tolerance in India for cultivation eg., Tomato (Pusa Sheetal – Fruit found out to 8°C (low) night temperature), Okra (Pusa Sawani - Tolerant to salinity), Cucumber (Pusa Uday – Suitable for throughout the year), Brinjal (Pusa Bindu – Salt tolerance), Carrot (Pusa Kesar – Tolerant to high temperature), Sweet potato (Sree Nandini - Drought tolerant), Potato (Kufri Surya - Heat tolerant upo 25°C night temperature; Kufri Sheetman, Kufri Dewa - Frost tolerant), Cassava (Sree Sahya – Drought tolerant).

Grafting of a susceptible scion cultivar onto a resistant rootstock is differently of utilisation of plant biodiversity to adapt to global climate change (Koundinya *et al.*, 2013). It offers a chance to beat several biotic and abiotic stresses (Koundinya & Kumar, 2014), which are a serious setback to vegetable production and are getting intensified by global climate change. High and coldness tolerance in tomato was achieved by grafting onto eggplant EG203 (Burleigh *et al.*, 2005) and *Solanum habrochaites* LA1777 rootstocks (Venema *et al.*, 2008), respectively. Watermelon plants were made drought tolerant by grafting onto ash gourd plants (Sakata *et al.*, 2007). Rootstocks from Cucurbita species were more tolerant to salt than rootstocks from bottle gourd (Matsubara, 1989). Interspecific rootstocks like *Solanum lycopersicum* x *S. habrochaites* provided low soil temperature (10 to 13°C) tolerance to their grafted tomato scions and *S. integrifolium* x *S. melongena* rootstocks provided low soil temperature (18 to 21°C) tolerance to eggplant scions, respectively (Okimura *et al.*, 1986).

Conclusion:

Even the foremost stringent mitigation efforts cannot nullify a number of the impacts of global climate change over subsequent few decades. This makes adaptation an important to deal with near-term impacts. Therefore, it's essential to develop a multidisciplinary or mixture of strategies that has mitigation, adaptation, technological development (to enhance both adaptation and mitigation) and research (on climate science, impacts, adaptation and mitigation).

References:

Burleigh, J. R., Black, L. L., Mateo, L. G., Cacho, D. & Aganon, C. P. 2005. Performance of grafted tomato in Central Luzon, Philippines: a case study on the introduction of new technology among resource-limited farmers. Crop Management.

Koundinya, A. V. V. & Kumar, V. S. 2014. Vegetable grafting: a step towards production of quality seedlings. In: Innovative Horticulture: Concepts for Sustainable Development, Recent Trends (P. S. Munsi, S. K. Ghosh, N. Bhowmick & P. Deb, eds). New Delhi Publishers, New Delhi, India, pp. 217–222.

Koundinya, A. V. V., Kumar, P. P. & Bairagi, S. 2013.Climate challenges in vegetables and their adaptation through biodiversity. In: Proceedings of the Agricultural Graduate Student Conference on Food Safety and Security (J. S. Kennedy & C. Udayasoorian, eds). Tamil Nadu Agricultural University, Coimbatore, India.

Matsubara, S. 1989. Studies on salt tolerance of vegetables – 3. Salt tolerance of rootstocks. Agriculture Bulletin of Okayama University 73, 17–25.

Okimura, M., Matsou, S., Arai, K. & Okitso, S. 1986. Influence of soil temperature on the growth of fruit vegetable grafted on different stocks. Bulletin of Vegetable and Ornamental Crops Research Station Japan C9, 3–58.

Sakata, Y., Takayoshi, O. & Mitsuhiro, S. 2007. The history and present state of the grafting of cucurbitaceous vegetables in Japan. Acta Horticulturae. 731, 159–170.

Venema, J. H., Dijk, B. E., Bax, J. M., Van, H. P. R. & Elzenga, J. T. M. 2008. Grafting tomato (*Solanum lycopersicum*) onto the rootstock of a high-altitude accession of *Solanum habrochaites* improves suboptimal temperature tolerance. Environmental and Experimental Botany. 63 (1–3), 359–367.

***

C-10 CLIMATE CHANGE, ITS RESPONSE ON VEGETABLE CROPS AND MITIGATION STRATEGIES

Nikunj Joshi*, Chirag Thakar and Dipti Parmar

Department of Fruit Science, College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, Mehsana, Gujarat - 384460

**Corresponding author e-mail: joshinikunj42@gmail.com*

Abstarct

The tremendous growth of population and climate change are major challenges of the 21st century and now it is widely accepted that the change in climate is unusual nature of environment. The results of analysis showed that climate change can adversely affects the food security and agro-ecological sector. Agriculture in developing countries lying at low latitudes is more valuable because many of these countries already have very hot climate. Main factors which responsible for climate change are temperature, wind velocity, rainfall rise in sea level, amount of CO_2 content in atmosphere and incidence of natural calamities affect the agriculture sectors by different ways as deteriorate the agricultural productivity, limitations on water resources, increase drought periods, deteriorate soil health, incidence of pest and disease outbreak etc. Climate change occurs due to change in the weather condition over longer period of time and it occurs due to natural factors and human activities. Since the period of starting modernization (i.e., 1750), humans played vital role to deteriorate climate through the emissions of Green House Gases, aerosols and changes in pattern of land use, resulting in a rise in global temperatures. Enhancement in earth temperatures showed different impacts on agriculture, environment and life cycle of living entities. The solutions to global warming and climate change problems can be reduced by adoption of organic agriculture. It has been observed that the adverse impact of climate change on agricultural production is depend on specific region and is more severely observed in developing countries. Thus, organic agriculture is a good option to reduce emission of green house gases and increase carbon sequestration in soils.

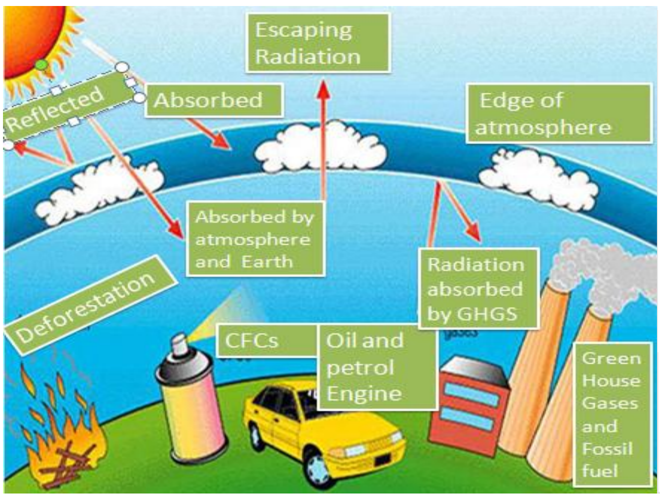
Key words: Vegetables, atmosphere, climate change, adaptation, mitigation

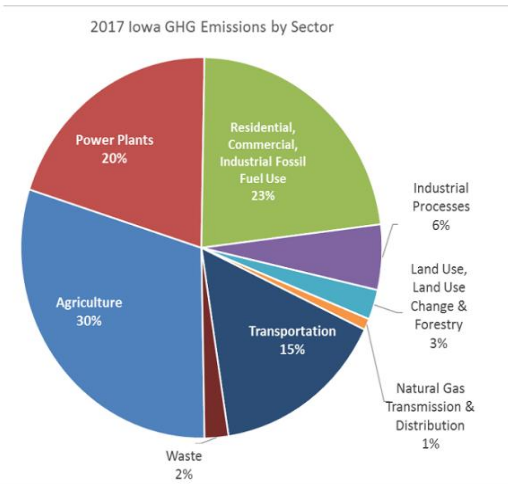
Introduction:

In India, many changes in weather pattern occurs due to climate change in various region of India. Extended summers, unpredicted rainfall, increase in storms, sea level, floods, and droughts while decline of ice sheets, sea ice and glaciers are the adverse impact of climate change. There were several experimental studies were conducted in the country which showed that the rapid increase in surface air temperatures in India has been observed at the rate of 0.4 ^{0}C per hundred years. According to studies, it is predicted that mean winter temperatures will increase by as much as 3.2 ^{0}C up to 2050s and 4.5 ^{0}C up to 2080s while summer temperatures will increase by 2.2 ^{0}C up to 2050s and 3.2 ^{0}C up to 2080s due to various climate change factors. Changes have been noted by scientists at IIT, Delhi for changing in rainfall pattern and have been warned India to decline in summer rainfall up to 70% of the total annual rainfall of the country by the 2050s and is harmful to Indian agriculture. India is heavily dependent rain fall for its water needs for agriculture and also for maintaining its rich biodiversity. Various studies showed that reduction in the duration and yield of crops as temperature rise in different parts of the country. Global warming is responsible to melt snow which will push the dense vegetation upwards.

Impact of climate change: adaptation and mitigation:

This shift will be selective and depends on various species due to the differential response of plants to changing environmental conditions. Changes in rainfall, temperature and wind velocity pattern affect the migratory behavior of the locust. As the temperature increased by 2^0C, yields of both *kharif* and *rabi* crops decreased. The production of fruits also influenced due to significant change in climate in critical period of fruit growth. The nutritional quality of cereals and pulses may also be moderately affected by increase in temperature which is directly related with our nutritional security. As temperature rise of 2-3.5 ^{0}C, farm level net revenue reduces up to 9 per cent to 25 per cent. The organic agriculture provide better results in mitigating climate change which depends on its ability to reduce emissions of atmosphere green house gases content, nitrous oxide and methane by increase soil carbon sequestration and enhance organic farming practices. For decrease in greenhouse gas emissions present experiments results suggested that organic agriculture can reduce significant amount of green house gases emissions. Both traditional and organic agriculture depends on solar and fossil energy for food production. Carbon sequestration in soils and plants is the only way to remove carbon from the atmosphere and decrease CO_2 concentration in atmosphere. This approach make to adopt new and improved farming system to mitigate climate change. In addition, organic agriculture is highly suitable to climate change and is also provides a high degree of diversity in the ecosystem.





Source: IOWA Department of Natural Resources Report (2017)

Conclusion:

The solutions to global warming and recent climate change problems can be reduced by adoption of organic agriculture practices. It has been observed that the harmful effect of climate change on agricultural production depends on different region and more severe observed in developing countries. Thus, organic agriculture has potential to be good option in future to deal with climate change and its harmful impact.

References:

Challinor AJ, *et al.* (2014). A meta-analysis of crop yield under climate change and adaptation. *Nature Climate Change* **4**: 287 – 291.

ICRISAT Annual Report (2017).

IOWA Department of Natural Resources Report (2017).

Lal, R. (2004) "Soil Carbon Sequestration Impacts on Global Climate Change and Food Security", Science, 304: 1623–1627.

Singh, A. K. (2007). Approaches for removal of arsenic from groundwater of northeastern India. *Journal of Indian Society of Soil Science*, 55: 58-61.

***

e-11 ROLE OF CHANGE IN CLIMATE ON PRODUCTION AND QUALITY OF VEGETABLES

Meenakshi Kumari[1*], S.S.Solankey[2], D.P.Singh[3], Neha Sinha[4] and H.G. Prakash[5]

[1,3] Department of Vegetable Science, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh – 208 002, India.

[2]Department of Horticulture (Vegetable & Floriculture), Bihar Agricultural University, Sabour (Bhagalpur), Bihar – 813 210, India

[4]Department of Horticulture (Fruit and Fruit technology), Bihar Agricultural University, Sabour (Bhagalpur), Bihar – 813 210, India

[5]Director Research, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh-208002

**Corresponding author e-mail: meenakshisinghupcs@gmail.com*

Abstract

Climate change affects both quality and production of vegetable crops as vegetable crops contain high amount of water i.e., more than 90% which makes it highly sensitive to theses environmental changes. Changes like rainfall pattern, drought, salinity, heat stress, humidity are some of the climate change which affects the production of modern agriculture. Vegetables boost our immunity system because of presence of high amount of vitamins, minerals, antioxidant etc. One of the other major challenges of today‘s agriculture is emission of green house gases. Among various climatic factors, erratic rainfall patterns and unpredictable high temperature spells highly affected the quality of vegetables. To cope with these challenges adaption of several technologies like biotechnology, molecular marker, genetic engineering and grafting are important which provide protection against various environmental stress. Development of resistant/tolerant varieties against abiotic stresses also provides protection against these changes.

Key words: Climate, Change, Vegetables, Nutrition, Technology

Introduction:

The production and productivity of vegetable crops got highly effected by the extreme event of climate change *i.e*, heat stress, water stress, drought, heavy rainfall, salinity etc. green house gases are also one of the serious challenge of modern agriculture. Vegetables are full of various nutrients which help in lowering the risk of various diseases such as cancer, heart disease, blood pressure, diabetes etc. Most of the vegetables contain more than 90% of water thus highly sensitive to climate change. Sudden change in climatic factors like in temperature affects all stages of plant growth, pollination, flowering and fruiting which directly reduces the yields and quality of major vegetables (Afroza *et al*., 2010). Black spot, postharvest disorder of potato tuber is arises due to water stress during tuber formation stage (Hamouz *et al*., 2011) and water stress in carrot during preharvest stage results in weight loss during sorage (Shibairo *et* *al*., 1998). The knowledge of relation between stages of growth of crop and weather parameter is very essential to maximize the production of any crop (Ray and Mishra, 2017). In a large geographical area, any change in the mean of the various climatic factors over a longer period is known as climate change.

Climate change and vegetables:

Among various climatic factors, vegetables are highly affected by erratic rainfall patterns and unpredictable high temperature spells. Effect of fluctuation of temperature on various vegetables and storage period on the quality has been reported by various researchers (Cotty and Jaime-Garcia, 2007). Higher temperature during growing period of tomato affect pollination process which results in abortion of flower, bud drop and carbohydrate availability along with abnormalities in reproductive process (Hazra *et al*., 2007).

The production of various vegetables got affected by salinity which results in reduction of growth of plant, abscission of leaf, respiration and photosynthesis rate, loss of turgor and cellular integrity which ultimately cause death of plants (Cheeseman, 2008). In case of cabbage, salinity of soil results in poor germination of seed,length of root and shoot and also weight of fresh root and shoot (Jamil and Rha, 2014) wheras, salinity suppressed growth, transpiration and photosynthesis rate in beans (Kaymakanova *et al*., 2008). Genetic improvement of vegetable crops is one of the essential adoption strategy by which vegetables are able to withstand the adverse impact ofclimate change such as stress due to high temperature, moisture, flood, drought (Koundinya *et al*., 2018). Adaption of advanced technologies like biotechnology, molecular marker, genetic engineering, grafting are some of the important tools that provide protection against various environmental stress. On an average for most of the crop, more than 50% loss is reported due to drought condition which is primary cause of crop loss (Sivakumar *et al*., 2016). Sprouting of tubers in potato and germination rate of onion and okra are affected by drought (Arora *et al*., 2010).

Table 1. Abiotic stress tolerance varieties of different vegetable crops.

Crop	Variety/ genotypes	Tolerance to abiotic stress
Solanum lycopersicum L.	Pusa Sheetal	Set fruit at low night temperature *i.e*, 8^{o}C
	Pusa Hybrid 1	Set fruit at high night temperature *i.e*, 28^{o} C
	Pusa Sadabahar	Set fruit at both low and high night temperature
	Sabour Suphala	Tolerant to salt at seed germination stage
	Arka Vikas	Moisture stress tolerance
Capsicum annuum	DLS-10-02, DLS-20-11, DLS—160-1 and DLS-152-1	Heat tolerant
Solanum melongena L.	SM-1, SM-19 and SM-30	Drought tolerance
	Pragati and Pusa Bindu	Salt tolerance

Abelmoschus esculentus L. Moench	Pusa Sawani	Salinity tolerant
Cucumis melo L.	Jobner 96-2	Tolerant to high soil pH
Beta vulgaris L. var. *bengalensis*	Jobner green	Tolerant to high soil pH (upto 10.5)
Cucumis sativus L.	Pusa Barkha	Tolerant to high emperature
	Pusa Uday	Grow throughout year
Lagenaria siceraria	Pusa Santusthi	Hot and cold set variety
Allium cepa L.	Hisar-2	Salinity tolerant
Daucus carota L.	Pusa Kesar	Tolerant to high temperature
Raphanus sativus L.	Pusa Himani	Grow throughout year
Ipomea batatus L.	Sree Nandini	Drought tolerance
Solanum tuberosum L.	Kufri Surya	Heat tolerant upto 25^{o}C night temperature
	Kufri Sheetman, Kufri Dewa	Frost tolerance
Manihot esculenta	H-97, Sree Sahya	Drought tolerance
Phaseolus vulgaris	Arka Garima	Tolerant to heat and low and low moisture stress
Lablab purpureus L.	Arka Jay	Tolerant to low moisture stress
Pisum sativum L. ssp. *Hortense*	Arka Tapas, Arka Uttam, Arka Chaitra	Tolerant to high temperature (upto 35^{O} C)
Daucus carota	Arka Suraj	Flowers and seeds sets under tropical condition.

Source: Koundinya *et al.* (2018)

References:

Afroza B, Wani K. P, Khan S. H, Jabeen N, Hussain K. 2010.Various technological interventions to meet vegetable production challenges in view of climate change. *Asian J. Hort*. 5:523-529.

Arora S. K, Partap P. S, Pandita M. L and Jalal I. 2010. Production problems and their possible remedies in vegetable crops. *Indian Horticulture*. 32: 2-8.

Cheeseman, J. M. 2008. Mechanisms of salinity tolerance in plants. *Plant Physiology*. 87:547-550.

Cotty P.J. and Jamie-Garcia, R. 2007. Influences of climate on aflatoxin producing fungi and aflatoxin contamination. *International Journal of Food Microbiology.* 119(1-2): 109-115.

Hamouz K, Becka D and Morava J. 2011. Effect of environmental conditions on the susceptibility to mechanical damage of Potatoes. In: Agris On-line papers in economics and informatics. Available from http://www.agris.cz/vyhledavac/detail.php?id=116921&iSub=518&sHighlight=agria & PHPSESSID=997764de5509230f23dc06268b7b8344

Hazra P, Samsul H. A, Sikder D and Peter K. V. 2007. Breeding tomato (*Lycopersicon esculentum* Mill) resistant to high temperature stress. *International Journal of Plant Breeding*. 1:31-40.

Jamil M and Rha E. S 2014. The effect of salinity (NaCL) on the germination and seedling of sugar beet (*Beta vulgaris* L.) and cabbage (*Brassica oleraceae capitata* L.). *Korean Journal of Plant Research* 7:226-232

Kaymakanova M, Stoeva N and Mincheva T. 2008. Salinity and its effects on the physiological response of bean (*Phaseolus vulgaris* L.). *Journal of Central European Agriculture*. 9: 749-756.

Koundinya A. V. V, Kumar P. P, Ashadevi R. K, Hegde V, and Kumar P. A. 2018. Adaptation and mitigation of climate change in vegetable cultivation: a review. *Journal of water and climate change*. DOI:10.2166/wcc.2017.045

Koundinya, Ayyagari, Palash Sidhya and Pandit, M. K. 2014. Impact of climate change on vegetable cultivation - a review. Int. J. of Agr., Env. & Biotech., 7(1): 145-155.

Ray M and Mishra, N. 2017. Effect of weather parameters on the growth and yield of Cauliflower. *Environment Conservation Journal* 18 (3) 9-19.

Shibairo S. I, Upadhaya M. K and Toivonen P. M. A. 1998. Influence of preharvest stress on postharvest moisture loss of carrots (*Daucus carota* L.). *Journal of Horticultural Science and biotechnology*. 73(3):347-352.

Sivakumar R, Nandhitha G. K and Boominathan P. 2016. Impact of drought on growth characters and yield of contrasting tomato genotypes. *Madras Agricultural Journal*. 103

***

C-12 INFLUENCE OF CLIMATE CHANGE ON VEGETABLE CROPS

Madhumita

Farm Manager, KVK, Sheohar, RPCAU, Pusa, Samastipur, Bihar

**Corresponding author e-mail-madhumita.300191@gmail.com*

Abstract

Climate change has adversely affected the agricultural crops, vegetable crops not being an exception to it. Unlike any other crop, vegetable crops too are being negatively impacted by changing climatic situations like erratic rainfall, fluctuating temperatures, adverse biotic and abiotic factors etc. Changed climatic conditions have resulted in increased disease incidence and pest infestation. Mainly drought and salinity are among significant side effects of global warming as an outcome of climate change. The germination/ sprouting of seeds vegetable crops is adversely affected due to prevailing drought conditions. Global warming thereby leading to various temperature changes has got remarkable effects on vegetable crops. Climate change is accountable for stresses like drought or moisture stress, salinity and floods and water logging in coastal areas due to melting of polar ice and increased sea levels. Climate change also poses threat to pollination activities due to altered behavior of pollinating agents. Mitigation of this global menace include-agronomic practices such as organic farming, mulching, integrated cropping system, resource conservation technologies etc. which are plausible strategies for addressing the impacts of climate change on vegetable production. Protected cultivation and post-harvest technology can be promising practices in envisaging the challenges of climate change. Weather forecasting models and growth simulation models can be used to predict the possible impact of climate change on vegetable crop production and they also help in designing necessary adaptation measures. It is the need of the hour to follow and adopt measures like those mentioned above, at individual or at group level so as to reduce climate change impacts. This is essential if we want to attain sustainable development in real sense.

***Key words**: Climate change, global warming, stress, mitigation strategies.*

Introduction:

Climate change is posing potential threat to agriculture-both global and Indian. Like any other agricultural crop, vegetable crops are equally vulnerable to these threats. The altered climatic conditions like extreme temperatures, drought, flood, salinity etc. do immensely affect the production of vegetable crops. These effects are briefly described here under following subheads-

1. High temperature:

High temperatures have got significant losses in vegetable crops-like lowered tomato productivity due to reduced fruit set and smaller and lower quality fruits. Sudden development of high temperatures during the growing phase of lettuce and celery cause bolting (premature seed head production), leading to poor quality heads, and reduced yields. Higher temperature is also favourable for pests like DBM (Diamond Back Moth) whose survivalence increases in warm climate.

Pollination is a crucial stage in the reproduction of most flowering plants, including vegetable crops. Change in the climate may be threatening to pollination activities due to altered behaviour of pollinating agents. Among all the climatic factors, an increase in temperature has the highest adverse effect on pollinator interactions.

2. *Low temperature:*

There are severe damages caused to vegetable crops caused as a result of chilling (due to exposure to 0°C-10°C) and freeze injury (exposure to less than 0°C). Exposure to chilling temperature in temperate climate may lead to a serious reduction of yield or complete crop failure either due to direct damage or delayed maturation. Some of the examples of chilling injury are described in the table below-

Table 1: The list of the vegetables, sensitive to chilling temperatures, the lowest safe storage/handling temperature and the symptoms of chilling injury (DeEll, 2004).

Crop	Lowest safe temperature °C	Chilling injury symptoms
Asparagus	0–2	dull, gray-green, limp tips
Bean (snap)	7	pitting and russeting
Cucumber	7	pitting, water-soaked lesions, decay
Eggplant	7	surface scald, *Alternaria* rot, seed blackening
Okra	7	discoloration, water-soaked areas, pitting, decay
Pepper	7	pitting, *Alternaria* rot, seed blackening
Potato	2	mahogany browning, sweetening
Pumpkin	10	decay, especially *Alternaria* rot
Squash	10	decay, especially *Alternaria* rot
Sweet potato	10	decay, pitting, internal discoloration
Tomato (ripe)	7–10	water-soaking, softening, decay
Tomato (mature-green)	13	poor colour when ripe, *Alternaria* rot

3. *Flooding:*

Most of the vegetables, especially those with shallow roots are highly sensitive to flooding. Flooding mainly hinders root respiration seriously, which thereby affects their usual activities of nutrient and water uptake.

4. *Salinity:*

Soil salinity is quite harmful to vegetable production. In hot and dry environments, high evapotranspiration results in considerable water loss from soil, thus interfering in the plant's ability to uptake water. Under the influence of salt stress, growth of many species of vegetables is reduced, such as tomato, pepper, celery and peas.

5. Drought:

Vegetables, being succulent products, generally consist of more than 90% water. Hence, water plays a vital role in affecting the yield and quality of vegetables and so drought conditions drastically reduce vegetable productivity. The drought conditions adversely affect the germination of seeds in vegetable crops like onion and okra and sprouting of tubers in potato. Potato's yield is also seriously affected by drought as it is highly sensitive to water stress. Tomatoes are very sensitive to water deficits. Cucumbers, melons, pumpkins and squashes, lima beans, snap beans, peas, peppers, sweet corn are among other vegetables that are quite sensitive to drought stress whose growth and development largely gets impeded in scarce water situation.

These impacts are detrimental for vegetable production in particular and agricultural production as a whole. But these threats of climate change can be mitigated by agronomic practices like organic farming, mulching, integrated cropping systems, resource conservation technology etc. Moreover, practices like protected cultivation, post-harvest technology and forecasting are significant in adapting as well as mitigating the climate change impacts. These are briefly described below-

Agronomic Practices:

i. Organic Farming:

As compared to conventional farming, in organic farming there is less emission of CO_2 into the environment. Also there is low emission of Green House Gases (GHGs) due to minimal use of farm machines that consume fossil fuels. Organic farming of crops helps in climate change adaptation through preventing and reversing soil erosion, restoring degraded land, improved drought and flooding resilience, increased water use efficiency (WUE), water conservation practices and agro-genetic biodiversity. The addition of organic manures, less tillage and crop rotation improves soil structure, soil organic matter and soil fertility build-up.

ii. Mulching:

Mulching helps to conserve soil moisture, prevents soil degradation and protects vegetables from torrential rains, high temperatures and flooding. Mulching reduces soil moisture evaporation, moderates soil temperature, restricts weed growth and reduces soil runoff and thereby erosion.

iii. Integrated cropping system:

Going for intercropping, mixed cropping, strip cropping or relay cropping can be particularly beneficial as it not only act as buffer to the detrimental effects of climate change by compensating the loss of one crop by yield of another crop, but also ensures optimum use of the available resources, may it be space, moisture, light or so. It also ensures more and stable profit to the vegetable growers.

iv. Resource conservation technology:

Zero tillage prevents the oxidation and escape of soil organic carbon as CO_2 into the atmosphere while cover crops or organic soil cover add carbon to the soil. Moreover, conservation tillage minimizes the use of machinery required for tillage, and hence reduces burning of fossil fuels.

Other mitigation practices/ strategies:

i. Protected Cultivation:

By practicing crop cultivation in protected structures that safeguard the crops from extreme temperatures, drought, flood situations and soil pH stresses, one can alleviate the ill-effects of climate change. The climate inside the greenhouse can be regulated to a large extent by using various devices such as heating and cooling systems, CO_2 emission and absorbing systems, automated need-based irrigation and nutrient supplying systems.

ii. Post- harvest Technology:

The losses incurred due to climate change could be compensated to a large extent by way of processing /preservation of horticultural products like vegetables. The processing not only adds quality to the produce, but also raises its market value. At present there is an enhanced demand for processed goods in the market due to changing lifestyles and taste pReferences: of the consumers.

iii. Weather forecasting:

Technology to improve the quality and accessibility of data on crop production under climate change has been developed. Forecasting is the prediction of future value based on past data. Weather forecasting models (WFM) are advantageous by providing daily forecast of weather information through remote sensing, validation of different land-use products and dissemination of information. The crop growth simulating models (GSM) are helpful as they predict crop growth and yield under future climatic conditions. These can be used to foretell the probable results of climate change on crop production and also help in designing required adaptation measures. Different pest and disease forecasting models have also been developed to predict the appearance of pest and diseases in advance to allow preventive actions to be undertaken.

Conclusion:

In the present scenario it is evident that climate change is causing serious damages to agriculture. This is a grim situation as agriculture not only provides food to mankind but also serves as base for economy. Thus, food and nutritional security as well as livelihood security is at stake. Hence concerted and holistic efforts need to be put in order to combat the climate change's threats. The adaptation and mitigation strategies discussed above needs to be followed/ implemented sincerely. Only then the goals like "Sustainable Development" or "Doubling Farmers' Income by 2022" can be realized in its true sense.

References:

Ayyogari, K., Sidhya, P. and Pandit, M.K. 2014. Impact of Climate Change on Vegetable Cultivation - A Review. *International Journal of Agriculture, Environment & Biotechnology*, 145-155.

Ayyogari, K.V.V, Kumar, P.P., Ashadevi, R. K., Hegde, V. and Kumar, A.P. 2018. Adaptation and mitigation of climate change in vegetable cultivation: a review. *Journal of Water and Climate Change*, 17-36.l,1.

DeEll, J. 2011. Symptoms of chilling injury in vegetables. Ontario Ministry of Agriculture Rural
Affairs 2004. http://www.omafra.gov.on.ca/ english/crops/hort/news/hortmatt/2004/18 hrt04a5.htm.

Prasad, B. V. G and Chakravorty, S. 2015. Effects of Climate Change on Vegetable Cultivation - A Review. *Nature Environment and Pollution Technology* 14(4), 923-929. 14(14(4)6. 145of Water and Climate Change.

***

C-13 CLIMATE RESILIENT TECHIQUES TO OVERCOME HEAT STRESS IN VEGETABLES

Rehan[*] and Ankita Sharma

Ph.D. Research Scholar, Horticulture (Vegetable Science), COA, JNKVV, Jabalpur (M.P.)

[*]*Corresponding author e-mail: rehanazmi477@gmail.com*

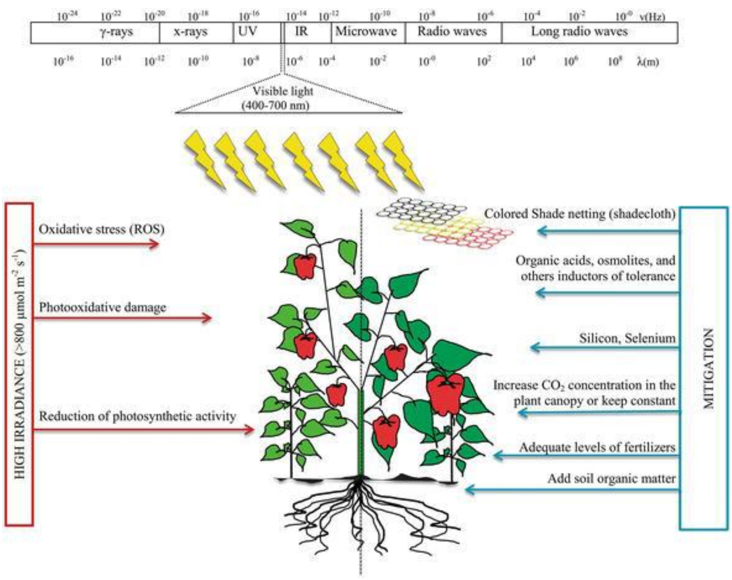
Abstract

Global warming and climate variations have been a matter of great concern. Environmental stresses are the principal cause of loss of vegetable production worldwide. Vegetables play a vital role in assuring proper nutritional supply but are sensitive to varied climatic vagaries which have a detrimental effect on their productivity pose major limitations towards sustainability and survival. These abiotic stresses disrupt the normal growth and development of the crops. A sudden increase in temperature and unpredictable precipitation hampers flowering, pollination, fruiting and overall growth of vegetables thus reduces yield. Climate change is an inescapable event, therefore climate resilient mitigation and adaptive measures need to be adopted to reduce the vulnerability of plants and to ensure a better means of living for farmers. The study of genomics and phenomics can be combined to develop resistance and tolerance, grafting techniques, agronomical practices, cultivation under protected structures and proper post-harvest management technologies would be helpful to address the problems and impact of the adversities on vegetables. The installation of weather forecasting models to obtain information through sensors about the changing weather phenomenon would be effective. Genotypes tolerant to high temperature can be developed to conquer these challenges. Biotechnological approaches can be adopted for introgression of genes tolerant towards heat stresses isolation, proper characterization, identification and using genetic engineering techniques.

Key words: Climate resilient, high temperature, vegetable, yield, abiotic stress.

Introduction:

Climate change is an unavoidable periodic modification occurring in the Earth's climate owing to the anthropogenic activities of the human population having a vulnerable impact on the perishable greens. Due to the changing scenario, the crops are constantly exposed to a detrimental heat stress causing an arrangement of morphology and plant anatomy.



These extreme events persistently reduce the choice of crops and its yield measures to a great extent leading to crop failure. This has an adverse effect upon the livelihoods of the marginal and small farmers and leads to food crisis, thus hampers the national economy. Vegetables are sessile so to avoid such detrimental conditions, they have evolved well-developed mechanisms to perceive the signal stress to enable optimal growth. With the advancements molecular biology and genetics, the magnitude of the impact and vulnerability of environmental stresses can be greatly reduced and sustainable livelihoods of the agricultural communities can be ensured. Mitigation and adaptation strategies should be chalked out to reduce the uncertainties posed by changing climate on rural farming community through risk-management and reduction strategies and economic diversification to build resilience in crops.

High temperature stress:

Transitory or a constant high temperature stress hampers plant maturation, development and progressive growth by affecting the arrangement of the morpho-anatomical, enzyme activity, respiration, nutritional content and other reactions which affects seed germination, flower shedding, pollen viability, fruit setting, fruit quality etc., and lead to a drastic reduction in productivity. Sensing of the stresses will initiate some complex mechanisms in plants such as scavenging superoxide anions, hydroxyl peroxides a free radical reactive oxygen species ROS, accumulation of compatible osmolytes, maintaining membrane stability, producing antioxidative mechanism, production of secondary signaling molecules such as inositol phosphate, activation of protein-kinase cascades and transcriptional activation to prosper under heat stress. High temperature shortens the lifecycle by changing the membrane properties and activating the calcium signalling which causes protein degradation and membrane instability thus, alters plant metabolism. Cellular homeostasis of the plants is affected when the ROS reacts with DNA and plant protein causing oxidative stress which leads to a signal induces programmed cell death causing the termination of plant cell processes.

Table1. Physiological disorders of vegetable crops caused by high temperatures

S. No	Crop	Disorder	Aggravating factor
1.	Asparagus	High fiber in stalks and spheres	Extreme hot Temperature
2.	Asparagus	Feathering and lateral branch growth	Temperature more than 32ºC, if picking frequency is not increased
3.	Beans	High fiber in pods	Heat and temperature
4.	Carrot	Low carotene content	Temperatures < 10 ºC or > 20 ºC
5.	Cauliflower	Blindness, buttoning, riceyness	Extreme Temperature fluctuations
6.	Cauliflower, Broccoli	Hollow strem , leafy heads, no heads, bracting	High temperature
7.	Cole crops and lettuce	Tip burn	Drought, combined with high temperatures; high respiration
8.	Tomato, pepper, watermelon	Blossom end rot	High temperature, especially if combined with drought and high transpiration.

Source: Yadav *et al.* (2012)

Thermo-tolerance can be augmented in vegetables by the preconditioning of the plants under adverse events or by the exogenous application of protectants in the form of phytohormones ABA, GA, Jasmonic acid; brassinosteroids, osmoprotectants (proline, glycine); salicylic acid and polyamines. The plants have varied cardinal points so the temperature requirement differs, but heat stress affects the ontogeny due to varied heat threshold level at diverse developmental stages. Avoidance of HTS is done by altering the leaf orientation to enhance photosynthetic activity and the remodelling of the membrane lipid composition. Heat stress transcriptional factors are produced such as the heat shock proteins and heat induced transcripts which are the molecular chaperons to facilitate protein folding and prevent the aggregation. Heat shock response is accompanied by reprogramming of gene expression by mRNA encoding non-heat stressed induced proteins. A HSP gene (HSP17.7) driven by a promorter CaMV 35S was isolated from carrot as a heat shock response and transferred to other vegetables against heat stress. Antioxidants are produced to counteract the damaging effect of ROS to detoxify the plant system. Under field conditions, high temperature stress usually coincides with drought. Phytohormones such as Abscisic acid (ABA) play a significant role in theromo-tolerance as it mediates by modulating the up-and down- regulationof genes for acclimatization of the vegetables.

Agronomic practices is a vital part includes resource conservation technology, mulching and carbon sequestration to reduce the green house gases responsible for temperature fluctuation and increase the intake and sequester the carbon in biomass.

Grafting technique to grown a plant successfully under stress is another form of utilizing plant biodiversity by joining susceptible scion on tolerant rootstock. High and low temperature tolerance in tomato was achieved by grafting onto *Solanum melongena* EG203 and *Solanum habrochaites* LA1777 rootstocks.

Plants adapt escape mechanism by reducing life cycle through early maturation. Heat tolerant hybrids and breeding lines in tomato (CL5915) and in Chinese cabbage (*Brassica rapa subsp. Pekinensis*) have been developed by AVRDC, Taiwan. The heat tolerant tomato lines were developed using heat-tolerant breeding lines and landraces from the Philippines (viz., VC11-3-1-8, VC 11-2-5, Divisoria-2) and the United States (viz., Tamu Chico III, PI289309. (Opera *et al.*, 1992) Desirable genes can be easily transferred from the heat tolerant species and wild relatives to the cultivated species. *Solanum pimpinellifolium*, wild relative of tomato, is tolerant to high temperature.

Table 2. Varieties to mitigate harmful effect of heat stress

Crop	Varieties	Tolerance
Tomato	Pusa Sadabahar, Pusa Hybrid-1	Tolerant to high temperature
Radish	Pusa Chetki	Better for root formation, tolerate heat stress , grown in mid-march to August
Carrot	Pusa Vrishti	Root formation at high heat and high humidity tolerant Tropical carrot
Early cauliflower	Pusa Meghana	Curd formation at high temperature
Potato	Kufri Surya	Heat tolerant upto 25°C night temperature

Cucumber	Pusa Barkha	Extra early variety can tolerate extreme high temperature
Bottle gourd	Pusa Santushti	Hot set and cold set high yielding variety

Source: Yadav *et al*. (2012)

To access the possible impact on vegetable production, a holistic approach is required to reduce malnutrition and alleviate poverty by comprehensive adaptation of measures to overcome impact of climate change. Long and short term mitigation plans need to be scaled out to enhance the adaptive capacity of the vegetable crops towards the climate changing scenario. Capacity building and imparting education are the vital components for a sustainable adaptation of the climate change strategy. To mitigate the adverse effect on quality and productivity of vegetables, development of production system with improved agronomic practices, effective crop management practices and better cultivars with tolerance need to be developed.

References:

Abewoy D (2018) Review on Impacts of Climate Change on Vegetable Production and its Management Practices. Adv Crop Sci Tech 6: 330.

Opena, R.T., Chen, J.T., Kuo, C.G., Chen, H.M. 1992. Genetic and physiological aspects of tropical adaptation in tomato. In: Adaptation of food crops to temperature and water stress. Kuo, C.G. (Eds), AVRDC, Shanhua, Taiwan Pp. 321 334.

Spaldon S., Samnotra. R.K., Chopra S.(2015) Climate resilient technologies to meet the challenges in vegetable production. Int.J.Curr.Res.Aca.Rev.;3(2):28-47

Yadav, R.K., Kalia, P., Singh, S.D., Varshney, R. 2012. Selection of genotypes of vegetables for climate change adaptation. In: Climate change impact, adaptation and mitigation in agriculture: methodology for assessment and application. Division of Environmental Sciences Indian Agricultural Research Institute, New Delhi 110 012.

***

C-14 IMPACT OF CLIMATE CHANGE AND MITIGATION STRATEGIES IN VEGETABLE PRODUCTION

Mehak Nagora[1,*], Shweta[1], Lalit Kumar[2] and Sharad[3]

[1]Department of Agronomy, [2]Department of Genetics & Plant Breeding, College of Agriculture[3], CCS Haryana Agricultural University, Hisar, Haryana

**Corresponding author e-mail: mehaknagora4@gmail.com*

Abstract

Vegetables are significant component of human diet and are known as protective food as they supply essential nutrients, vitamins and minerals to the human body as well as the best asset for defeating micronutrient deficiencies. They are also good remunerative to the farmer as they fetch higher price in the market. It has been reported that more than one billion people are undernourished (FAO 2009), and over one third of the burden of disease in children below 5 years of age is mainly due to undernutrition (Black *et al.* 2008).The leading vegetable-producing nations in the world are developing nations which are highly prone to climate change. This issue becomes more pertinent when it relates to the fight against poverty, hidden hunger, and livelihoods of billions of people in developing countries. For giving food and nutritional security to the expanding population, worldwide vegetable production needs a sustainable growth. However, climate change is becoming one of the most genuine environmental threats to impact agriculture in a long way. Agriculture is profoundly climate dependent and worldwide climate change will surelyaffect agriculture which subsequentlyinfluence the world's food supply.Climate change is a complex phenomenon which is not necessarily harmful but the nuisance arises from extreme weather situation that are difficult to predict are the main concern (FAO 2001). Climate change is fundamentally associated with extremities of four elements, viz., temperature, drought, salinity, and CO2 concentration.

Key words: Vegetables, climate change, nutritional security

Variation in day by day mean temperature is the foremost effect of climate change that adversely influences the production of vegetables as many plant physiological, bio-chemical and metabolic activities are temperature dependent which ultimately leads to implication in domestic and international trade, e.g.potato is the fourth most important and non-cereal staple food of the mankind. Potato is well known for its definite temperature and day length prerequisite for tuber formation as well as flowering, so it becomes the most vulnerable crop for climate change. The effect of climate change on potato production in India has previously been studied by Singh *et al.*, (2009). Additionally, a high temperature stimulates the outbreak of new and aggressive pests and diseases along with the weeds which altogether invade our standing crop obstructing its performance and yield.

Drought and salinity and are the most significant side effects of global warming. But change in climatic scenario and distribution of amount of rainfall prompts a serious outcome of water stress. Water stress includes two types of events relying upon the amount of rainfall, viz., the water-deficit stress/drought stress and flooding stress. Vegetables, being succulent products, generally consist of more than 90% water. Thus, water act as a very significant factor for determining yield and quality of vegetables. In hot and dry environments, high evapotranspiration results into substantial water loss, thus leaving salt around the plant roots which interferes with the plant's ability to uptake water and as a result reduces crop productivity.

Carbon dioxide concentration in the atmosphere is a key factor for plant growth and physiological processes. By 2100, increase in atmospheric CO2 will be recorded from 360 ppm to 400–750 ppm and elevation in sea level from 15 to 95 cm as per Intergovernmental Panel on Climate Change (IPCC 2007a, b). This rise in CO2 level will subsequently increase the global average temperature from 0.8 °C in 2001 to 1.4–5.8 °C by 2100. Increased atmospheric CO2 is reported as a modifier for net photosynthesis, biomass production, sugar and organic acid contents, stomatal conductance, fruit firmness, seed yield, light, water, nutrient use efficiency, and plant water potential in vegetables (Bazzaz 1990; Cure and Acock 1986; Idso and Idso 1994).

Because of expanded anthropogenic activities, concentration of greenhouse gases like CO2 and CH4 is increasing in the atmosphere day by day. They are not only responsible for dangerous atmospheric deviation but also cause their own immediate effect on growth and development of plants. Potato plants grown under elevated CO2 may have larger photosynthetic rates up to some extent, later on with increase in CO2 concentration the photosynthetic rates will come down (Burke *et al*., 2001). The high atmospheric CO2 content supress tomato fruit ripening. However, handling this immense challenge must involve both adaptation as well as mitigation to avoid the losses while keeping up an emphasis on its social dimensions.

Potential impacts of climate change on agricultural production will depend not only on climate per se, but also on the internal dynamics of agricultural systems, including their ability to adapt to the changes (FAO 2001). Farmers in developing countries of the tropics need tools to adapt and mitigate the negative effects of climate change on agricultural productivity, and especially on vegetable production, quality and yield. Current, and new, advances being created through plant stress physiology research can potentially help in mitigatingdanger from climate change on vegetable production. However, farmers in developing countries are typically small-holders, have fewer choices and must dependvigorously on resources accessible in their farms or within their networks. Hence, technologies that are simple, affordable, and accessible must be utilized to increase the resilience of farms in less developed countries. It is impossible that a single technique to conquer the effects of environmental stresses on vegetables will be found.

A systems approach, where all available options are considered in an integrated manner, will be the best and ultimately the most sustainable, especially for developing countries in the tropics under a variable climate. This comprehensive methodology will require worldwide coordination of efforts. For this to succeed, sufficient and long-term funding is necessary, scientific results have to be delivered, best methodologies should be utilized.AVRDC - The World Vegetable Center, as the world's leading international center focused on identifying vegetable germplasm with resistance to drought, high temperatures and other environmental stresses, and ability to maintain yield in marginal soils. Moreover, agronomic practices that conserve water and protect vegetable crops from problematic environmental conditions must be easily accessible to farmers in the developing world. AVRDC-The World Vegetable Center has createdmethodologies on integrated crop management and significant number of these methodologies directly provides solutions to mitigate the impact of climate change. Finally, capacity building and education are key segment of sustainable adaptation strategy to climate change. Improving adaptation of tropical production systems to changing climatic conditions is a tremendous endeavour. It requires the joint efforts of numerous national and international institutions this can only be accomplished through collaboration, complementarity, and coordinated objectives to address the consequences of climate change on the world's crop production.

References:

Bazzaz, F. A. (1990). The response of natural ecosystems to the rising global CO2 levels. *Annual review of ecology and systematics*, *21*(1): 167-196.

Black, R.E., Allen, L.H., Bhutta, Z.A., Caulfield, L.E., De Onis, M., Ezzati, M., Mathers, C., Rivera, J. and Maternal and Child Undernutrition Study Group (2008). *Maternal and child undernutrition: global and regional exposures and health consequences. The lancet*, 371(9608): 243-260.

Burke, J.I., J.M. Finnan, A. Donnelly, and M.B. Jones. (2001). The effects of elevated concentrations of carbon dioxide and ozone on potato (Solanum tuberosum L.) yield. *Agriculture and Food Development authority, Carlow, Ireland*.1-19.

Cure, J. D., & Acock, B. (1986). Crop responses to carbon dioxide doubling: a literature survey. *Agricultural and forest meteorology*, 38(1-3): 127-145.

FAO (2001) Climate variability and change: A challenge for sustainable agricultural production. Committee on Agriculture, Sixteenth Session Report, 26-30 March, 2001. Rome, Italy

FAO (Food and Agricultural Organization of the United Nations) (2009) State of food insecurity in the world: economic crises—impacts and lessons learned. FAO, Rome.

Idso, K. E., & Idso, S. B. (1994). Plant responses to atmospheric CO2 enrichment in the face of environmental constraints: a review of the past 10 years' research. *Agricultural and Forest Meteorology*, 69(3-4): 153-203.

IPCC (2007a) Climate change, Fourth assessment report. Cambridge University Press, Cambridge P.S. Naik *et al*. 427 IPCC (2007b) Appendix I: glossary. In: Parry ML, Canziani OF, Palutik of JP *et al* (eds) Climate change: impacts, adaptation and vulnerability. Contribution of working group II to the fourth assessment report of the intergovernmental panel on climate change. Cambridge University Press, Cambridge, pp 79–131

Singh, J. P., Lal, S. S., & Pandey, S. K. (2009). Effect of climate change on potato production in India. *Central Potato Research Institute, Shimla, Newsletter*, 40: 17-18.

***

C-15 NEW RECORD OF BACTERIAL PATHOGEN IN BUTTON MUSHROOM *ASPSEUDOMONAS AERUGINOSA* (MUMMY DISEASE) IN INDIA

Anil Kumar*, Satish Kumar and V.P. Sharma

ICAR- Directorate of Mushroom Research, Chambaghat, Solan, Himachal Pradesh

**Corresponding author e-mail: anilrao_mpp@yahoo.co.in*

Abstract

Mushrooms are edible macro-fungi and are important vegetable crop in India and other parts of the world. Like all other horticultural crops these are also ravaged by number of biotic and abiotic stresses, which affect the growth and yield of mushrooms adversely. Among biotic factors fungi and bacteria are the major impediments in the successful cultivation of different mushrooms. Recently in 2019, a new bacterial disease which is known as Mummy disease was identified in India. The disease is caused by *Pseudomonas aeruginosa.* The disease manifested in the mushroom house as sunken water soaked/brown spots, red/brown tissue layer at the base of the stipe and cracks on the infected surface. Pathogen was isolated on selective media of *P. aeruginosa* (Hi media, MP406-50PT), it produced red – brown, yellowish and watery pigments in the media after one week of inoculation. Low temperature conditions (<15^{0}C) during fruit body development were identified as the key factors for the development of Mummy disease. About 55-80 per cent incidence of bacterial infection was recorded during first flush and onwards. Infected fruit bodies are not suitable for culinary and sale purposes. Substantial production losses may be the avoided and mushroom quality may be improved by keeping the temperature between 16-18^{0}C during fruiting and spraying calcium chloride (0.1%) on the infected beds.

Key words: Bacteria, Button Mushrooms, Mummy, *Pseudomonas aeruginosa*

Introduction:

In India, presently three mushrooms namely white button mushroom (*Agaricus bisporus*), dhingri or oyster mushroom (*Pleurotus species*) and paddy straw mushroom (*Volvariella volvacea*) are contributes maximum share in total mushroom production i.e. 2.01 lakh MT. Market price of mushroom depends on its quality and nutritive values (Chang and Miles., 2004). Which is often spoiled by diseases and competitor moulds during different stages of growth (Fletcher and Gaze, 2008).In 2019, a new threat of bacterial pathogen was recorded on white button mushroom in India and identified as *Pseudomonas aeruginosa*. It was generally manifested in the mushroom house during winter months.So far in mushrooms it was only reported from UK (Wuest and Zarkower, 1991). In the sick beds/bags, pinhead formation was delayed after case run for at least one weak and fruit bodies remained under sized. Sunken water soaked/brown spots, red/brown tissue layer at the base of the stipe and cracks on the infected surface were identified as the characteristic symptoms of the *P. aeruginosa* in button mushroom. These blemishes rendered the fruit bodies unmarketable completely.

On isolation on selective media of *P. aeruginosa* (Hi media, MP406-50PT), it produced red – brown, yellowish and watery pigments in the media after 6-7 days of inoculation. Based on the symptoms produced on the host *P. aeruginosa* infected fruit bodies were grouped into four isolates; PA-1, PA-2, PA-3 and PA-4. PA-1 produced large water soaked lesions on pileus and produced yellow-green and fluorescent pigments on MP406-50PT-Hi media (Table 1). On the infected areas, it was felt like plain water has been injected. PA-2 light brown lesions on pileus and produced yellow-green and fluorescent pigments (pyoverdine) ingrowing medium. Growth rate of PA-2 on artificial medium was recorded highest as compared to PA-1. However under filed conditions, incidence of PA-1 was recorded highest (80%). PA-3 isolate produced dark brown lesions on the stipe of the sporocarp and produced bluish pigmentation (may be pyocyanin) in growth medium. PA-4 isolate produced localized dark brown sunken lesions (5-8mm dia) on the sporocarp andproducedblue-green (pyocyanin) pigmentation in MP406-50PT-Hi medium (Wuest and Zarkower, 1991). It is an indication that more than one strain of *P. Aeruginosa* are present in the mycosphere and phyllosphere of button mushroom. About 56-80 per cent incidence of bacterial infection was recorded during first flush and onwards. Crop losses are more severe under low temperature conditions (<15^0C) and winter season of mushroom cultivation under low cost huts. Under field conditions, *P. aeruginosa* infection aggravates the situation by inviting the subsequent infection of bacterial blotch (*P. tolaasii*) under comparatively high temperature conditions i.e. 18-20^0C. *P. tolaasii* produced circular or irregular yellowish spots on or near the margins of the cap which enlarge rapidly under favourable conditions and coalesce to form rich chocolate brown blotches that are slightly depressed. *P. tolaasii* produces the toxin tolaasin that causes brown spots to cover the surface of the mushroom. Good Agricultural Practices (GAP) especially the specific growing temperature and relative humidity are needed to be maintained in the mushroom house to avoid substantial losses due to Mummy disease of button mushroom.

Table 1. Incidence (%) and pigmentation in different isolates of *Pseudomonas aeruginosa* (PA)

Isolates	Disease incidence (%)	Pigmentation in MP406-50PT-Hi medium
PA-1	80.00	Yellow-green and fluorescent pigments (pyoverdine)
PA-2	75.00	-do--
PA-3	72.00	Bluish pigmentation (pyocyanin)
PA-4	56.00	Blue-green (pyocyanin)
Mean	70.75	-
$CD_{0.05}$	13.44	-

References:

Chang, ST., and Miles PG. 2004. Mushrooms: cultivation, nutritive value, medicinal effect and environmental impact. CRC Press, Boca Raton, Fl.

Fletcher JT, Gaze RH, 2008. Mushroom pest and disease control: a color handbook. Ed. Manson Publishing Ltd. Academic Press, San Diego. 192 pp.

Wuest PJ. and Zarkower EA. 1991. Mummy disease of button mushrooms: Causation, crop loss, mycosphere implications. In: Science and cultivation of edible fungi (Mather MJ Ed.). Balakema Pub. Old post road, Brookfield, USA

***

E-16 VEGETABLES AS IMMUNITY BOOSTER AND NUTRITIONAL SECURITY

Mohini Singh[1] and Anshuman Semwal[2,*]

College of Agriculture, College of Forestry, VCSG UUHF Bharsar, Pauri Garhwal, Uttarakhand

Department of Entomology, College of Forestry, VCSG UUHF Bharsar, pauri Garhwal Uttarakhand

**Corresponding author e-mail*: *anshumansemwal123@gmail.com*

Abstract

Vegetable plays a vital role in human diet, they are ready to harvest within 3 to 4 month thus the all essential nutrient found in abundant amount in all horticultural crop. Vegetables are good sourse of nutrition they are important sourse of energy for our daily life and prevent the body from harmful virsus and bacteria. Some horticultural crops helps in increasing or boost up the immunity such as Carotenoids found in carroct , kale and mango and the beauty vitamin (Vitamin E) found in plenty amount in Hazelnut ,Peanut. Broccoli is the good source of vitamin C and Flaxseed and walnut are rich source of omega-3 fatty acid.

Key words: Vegetables, immunity, vitamins, nutrition

Introduction:

Wholesome status of individual is influenced by a few factors, for example, age, sex, wellbeing status, way of life and prescription. Studies have demonstrated that leafy foods give supplements—like beta-carotene, Vitamin C, and Vitamin E that increase the immune system and Antibody. Since numerous vegetables, natural products, and other plant-based nourishments are likewise wealthy in cell reinforcements, they help diminish oxidative pressure. Vegetables, just as natural products, nuts, and seeds, are stacked with supplements that we have to keep our safe frameworks in top wellbeing. Products of the soil where you're well on the way to get to them.Slow down supplement misfortune Where Heat, light, and oxygen corrupt supplements. Examination shows that lycopene increments by 25 percent when tomatoes are bubbled for 30 minutes. Maybe more than 20,000-odd long periods of experimentation, cooks made sense of naturally that an "adjusted" diet with a wide assortment of nourishments is the best kind. Assembling the correct nourishments doesn't simply taste amazing, it additionally causes you ingest all supplements in the food sources you do eat.

Nutritional security and immunity boosting through vegetables:

In specific, cruciferous vegetables like cabbage, kale, and broccoli help bolster liver capacity, a key piece of our bodies' normal detoxification process. Beta-carotene is an amazing cancer prevention agent that can lessen irritation and lift resistant capacity by expanding infection battling cells in the body. Fantastic sources incorporate yams, carrots, and green verdant vegetables. Tomatoes are an extraordinary food to eat when you're wiped out because of their high grouping of nutrient C. Only one medium tomato contains in excess of 16 milligrams of nutrient C, which is a demonstrated fuel to your body's invulnerable framework.

Broccoli and different cruciferous vegetables were demonstrated to help support resistance, as per the investigation. Scientists guarantee that sulforaphane, a substance in the vegetable, turns on cancer prevention agent qualities and catalysts in explicit resistant cells, which battle free radicals in your body and keep you from becoming ill. Spinach is a significant superfood that is incredible for your general wellbeing. In addition to the fact that it is stuffed with assimilation managing fiber, yet it likewise contains nutrient C. A ground-breaking supplement, nutrient C can help with forestalling the basic cold and help decrease manifestations of infection. Diets wealthy in potassium may assist with keeping up sound pulse. Vegetable wellsprings of potassium incorporate yams, white potatoes, white beans, tomato items (glue, sauce, and squeeze), beet greens, soybeans, lima beans, spinach, lentils, and kidney beans.

Dietary fiber from vegetables, as a feature of a general sound eating regimen, diminishes blood cholesterol levels and may bring down danger of coronary illness. Fiber is significant for appropriate gut work. It lessens blockage and diverticulosis. Fiber-containing nourishments, for example, vegetables help furnish a sentiment of completion with less calories.

Folate (folic corrosive) enables the body to shape red platelets. Ladies of childbearing age who may become pregnant ought to expend sufficient folate from nourishments, and furthermore 400 mcg of engineered folic corrosive from braced food sources or enhancements. This decreases the danger of neural cylinder absconds, spina bifida, and anencephaly during fetal turn of events. Vitamin A keeps eyes and skin sound and assists with securing against contaminations. Vitamin C recuperates cuts and wounds and keeps teeth and gums solid. Nutrient C helps in iron assimilation.

Predominance of nourishments containing omega-6 unsaturated fats (e.g., handled bites, vegetable oils, red meat, and so on.) the vast majority have a far higher proportion of omega-6 unsaturated fats than omega-3 unsaturated fats in their cell films. Luckily, enhancing with dietary wellsprings of omega-3s (e.g., greasy fish, green growth oil, or fish oil) can help balance this proportion and the body's reaction to cell stress (Hayk S. Arakelyan, 2020).

Exploration in the course of recent decades recommends that curcumin can bolster cardiovascular wellbeing, mind work, psychological wellness, and you got it, invulnerable framework work. The brilliant flavor turmeric is known for its enemy of oxidant and mitigating properties. Curcumin the compound present in turmeric is a powerful operator and helps in recuperating of wounds and contaminations. This is the explanation, it is frequently recommended to have turmeric milk. 'A great many people have it (turmeric) in the incorrect way. In the event that you are having haldi (turmeric), don't have it in water, rather, bubble it in the milk and have the well known turmeric milk. Tulsi leaves, star anise (a flavor), garlic, and ginger are a portion of the normal enemy of infection food things which gives assurance from occasional influenza also. For boosting resistance and flushing out poisons. "Nutrients B6, C and E have been appeared to help support your insusceptible framework," Hansen says. "On the off chance that you are deficient with regards to a portion of these nutrients, an enhancement could help bolster your safe framework. In any case, your body can indeed ingest a limited amount of quite a bit of any nutrient in a given day. Spices like AHCC, Echinacea, Elderberry, Andrographis and Astragalus can help diminish the length and seriousness of ailment. On head of that, utilizing nutrient and mineral enhancements give the essential supplements to a solid insusceptible framework. Mushroom is nature's method of separating the natural issues to change over it into rich soil. One of the most beneficial foods on earth, mushrooms are plentiful in fundamental supplements and minerals. A portion of the mushrooms that is great for invulnerable frameworks are — A Turkey tail mushroom, Maitake and Shiitake Mushrooms, Tremella Mushrooms.

Be that as it may, great food rehearses are constantly prescribed by tailing them to limit the danger of pollution which are as per the following:

- Wash vegetables and natural products before eating.
- Wash, wash, and sterilize articles and surfaces each time when use.
- Keep cooked and crude nourishments isolated, as it would keep the unsafe microorganisms from crude nourishments spreading to cooked food sources.
- Use diverse hacking sheets and utensils for cooked and crude nourishments to forestall cross-pollution.
- Food administration laborers should utilize gloves while setting up a supper.
- Try not to show or sell opened up food from oneself assistance counter.
- Frequently sterilize surfaces which interacted with clients or laborers, for example, door handles, counters, staple trucks.

Reference:

Hayk S. Arakelyan (2020). Food for Support Immunity, https://www.researchgate.net/publication/342876866_Diary_Foods_Immunity_and_COVID19.

***

C-17 UNDERUTILIZED LEAFY VEGETABLES: A REQUISITE TO EXPLORE AND CONSERVE NUTRITIONAL SECURITY FOR RURAL LIVELIHOOD

Ankita Sharma[1,*], Reena Nair[2] and Rehan[2]

[1]Research Scholar, [2]Assistant Professor

Department of Horticulture, College of Agriculture,

Jawaharlal Nehru Krishi Vishwa Vidhyalaya, Jabalpur, Madhya Pradesh.

**Corresponding author e-mail: ankitasharma199511.as@gmail.com*

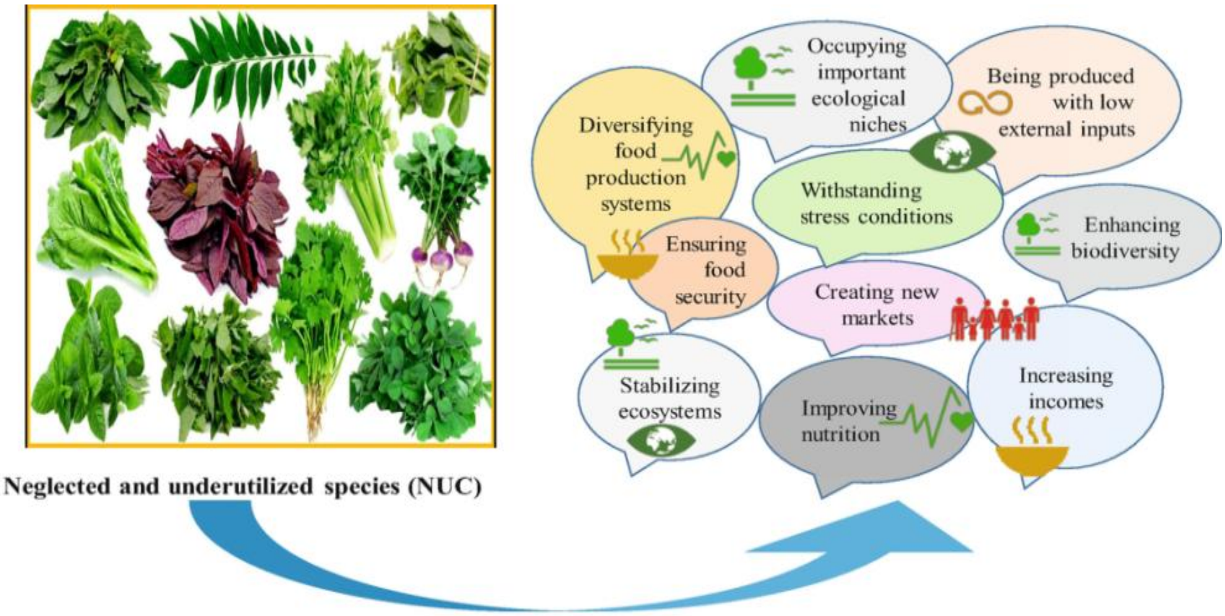
Abstract

India is blessed with a diverse resource of greeneries and green leafy vegetables. The biodiversity of greens is a precious heritage both from genetic and cultural perspectives as out of 3900 plant species used by the tribal belt of the country contributes to 521 species of leafy vegetables. Indigenous and underexploited leafy vegetables have many ethno-botanically important species with rich nutritional value. The ecological diversity which is superimposed with tribal and ethnic heterogeneity is helpful in conservation of traditional *cultural* expressions and biodiversity besides community healthcare and drug development now and in the future is a requisite. The leafy greens are naturally available predominant constituent of nutraceautical, pharmaceutical components and natural antioxidants such as tocopherols, polyphenols which are essential for human well-being by neutralizing free radicals. Leafy vegetables when adapted to a fragile environment contribute a broad spectrum to boost the production capacity of crop and strengthen the global security to meet the market demands as per the needs of consumers. To frame a temporal and spatial heterogeneity in the cropping system, these undervalued leafy crops can be grown as intercrops for a more sustainable supply nutritious food. Pot herbs have minor calories and fats but a considerably high phytonutrients with anti-oxidant and anti-inflammatory benefits such as calcium, magnesium, phosphorus; phyto-chemicals to enhance metabolism such as vitamins, lutein, folate and dietary fibres which play a major role in strengthening the immune system of humans.

Key words: Vegetables biodiversity, underexploited, antioxidants, nutrition, vitamins.

Introduction:

Leafy vegetables are describes as 'Poor Man's Vegetable' are resilient, adaptive and can be raised with minimal external inputs on poor marginal lands. These are nutrient-dense crops used to generate additional income, employment opportunities and constitute essential biological asset of rural poor by improving the farm efficiency, thus reducing the risk of over-resilience on major vegetables. The salad greens remained underutilized due to lack of awareness, un-assessable areas, geographical isolation and unexplored status. These minor leafy veggies are inexpensive, used to eradicate micronutrient deficiency such as 'Hidden hunger', and repress degenerative diseases are traditionally esteemed for utilization and consumed as raw or cooked since time immemorial.



Potential of underutilized leafy vegetables for livelihood and nutritional security:

Amaranth (*Amaranthus* spp.) is a promising leafy vegetable with a potential source of phenolic compound such as vitamin –C, antioxidant pigments and flavonoids possessing antioxidative properties and macronutrients used to attain nutritional sufficiency. The species used as leafy veggies are *A. blitum*, *A. dubius* and *A. tricolor*. Red Amaranth (*Amaranthus cruentus)* are enriched with minerals such as iron, calcium, niacin, riboflavin, tannins and antioxidants are good for lactating mothers and patients suffering from haemorrhage, anaemia and kidney complaints. *Portulaca oleracea,* a succulent prostrate is rich source of β-carotene, omega-3- fatty acids to curb inflammation in blood vessels, alpha-tocopherols to prevent blood clots, ascorbic acid to fight against bacterial infection and folic acid. Soup and stews are prepared using purslane due to its mucilaginous quality.

Nunia saag is used as diuretic, cardio-tonic, sedative and used to treat rheumatism. Agathi leaves (*Sesbania grandiflora*) have a high nutritious and ornamental value. Leaves and flowers have medicinal properties and used as a remedy for smallpox, sore throats, stomatitis, bruises and dysentery. The Ponnanganni Greens, *Alternanthera sessilis,* are rich in proteins, dietary fibres, oleanolic acids, saponins stigmasterol and campesterols. Its leaves, tender stems and floral part are edible. It is effective against skin disease and is an antiulcer, a memory-enhancer and an anti-hyperglyemic. Indian fenugreek (*Trigonella balansae)* is a perennial herb used as a leafy vegetable when harvested at young leaf stage is a rich in of protein, vitamins, antioxidant and Ca and is used as a body coolant. Creeping wood sorrel (*Oxalis corniculata*), is a reservoir of nutrients and therapeutic benefits. It is a good source of phytosterols, galactoglycerolipid, volatile oils, flavonoids and polyunsaturated fatty acids essential for bosy such as ALA α- linolenic acid, palmitic acid and EPA oleic acid. The leaves possess antimicrobial, antifungal, anticancer, anti-inflammator, antimicrobial and diuretic properties.

Water leaf (*Talinum triangulare*) eaten as cooked or as a condiment is a soft mucilaginous pot herb enriched in caroteniods such as Zeaxanthin and lutein which act as stimulants. Its medicinal preparations are used to treat heat diseases, cancer, cataract, diverticulosis and control blood pressure and cholesterol level. *Sauropus androgynus* (Madhurakheera) is a multi-mineral packed leafy vegetable is planted as a live fencing is enriched with carbohydrates, Vitamin B, Retinol, Ascorbic acid, proteins and minerals. The juice extracted from the leaves of chekurmanis is blended with the roots of pomegranate and leaves of *Jasminum* shrub are effective treatment to cure eye trouble. Chinese mallow, a good source of polysaccharides, bioflavonoids, minerals and vitamins, is used to treat renal disorders, diarrhoea, whooping cough and constipation problems. Leaves and stem possess anti-inflammatory properties.

Underutilized leafy vegetables are embedded with potential nutrients and are the cheapest source available round the year in rural areas. Domestication and cultivation of such wild species should be encouraged to avoid genetic erosion, utilization and management of undervalued crops to ensure nutritional security. Crop improvement strategies should be deployed for identification of traits, documentation, utilization, conservation of genetic resource and their exploitation by simply targeting the number of species. Research work should be conducted to explore edible leaves of indigenous endangered plants and understand the nutritive, medicinal and therapeutic value of the greens, for high productivity, meeting market demand and easy post harvest management. Strategies should be adopted at state and national level to produce promising cultivars, good seed and planting material to generate employment, raise incomes and address poverty to strengthen the economic stature of the country.

References:

Deb P, Prasad BVG, Munsi P, Chakravorty S. Underutilized leafy vegetables: diversity, nutritional security and medicinal benefit in context of eastern India. In Joginder Singh, Rashmi Nigam and Wajid Hasan (eds). Advances in biodiversity conservation for sustainable development, 2018, 95-104.

Ebert, A.W. Potential of Underutilized Traditional Vegetables and Legume Crops to Contribute to Food and Nutritional Security, Income and More Sustainable Production Systems. *Sustainability* **2014**, *6*, 319-335

Jena. A, Deuri. R, Sharma P. and Singh S.P. (2018). Underutilized vegetable crops and their importance. Journal of Pharmacognosy and Phytochemistry 2018; 7(5): 402-407

Palanisamy, A., Kannan, D., Kavitha, M., Ravindran, C. and Rajangam, J. (2019). Potential vegetable crops - need for exploration and conservation for nutritional security for rural livelihoods. ActaHortic.1241,69-74

Fasuyi AO. Nutritional potentials of some tropical leafy vegetables meals: Chemical characterization and functional properties of fresh and frozen vegetables. Food Chemistry. 2005; 62(1):59-64.

***

C-18 VEGETABLE KITCHEN GARDENING FOR FOOD, NUTRITIONAL AND ECONOMIC SECURITY DURING PANDEMIC SITUATIONS SUCH AS COVID-19

Munish Sharma[1,*] and P. Suryavanshi[2]
[1]Krishi Vigyan Kendra, S.A.S. Nagar (Mohali),
Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab
[2]CSIR-Cental Institute of Medicinal & Aromatic Plants, Lucknow, Uttar Pradesh

**Corresponding author e-mail: munish_uhf@yahoo.co.in*

Abstract

Mohali district of Punjab is peri-urban area which falls under sub-mountainous agro-climatic zone. This zone has vast potential for the cultivation of seasonal vegetables for the rural as well as urban household. Indigenous or locally grown vegetables which are organic are the cheapest source of vitamins and minerals, and are high value food source for poor and marginal families can be well incorporated in the kitchen gardens. Kitchen gardening not only provides adequate food but also ensures proper nutrition, and provides additional income to the people. Recent Covid-19 pandemic and lockdown has posed challenge to vegetable growers as the vegetables are perishable in nature and due to shortage of labour, availability, transportation and delivery to terminal or consumer market was halted. In such situations kitchen gardening can be a better alternative to cater all these needs. Krishi Vigyan Kendra is working as resource centre for the whole district to provide latest scientific developments in agriculture and allied disciplines to farmers along with training and other extension activities. Krishi Vigyan Kendra, Mohali is promoting kitchen gardening through demonstrations and training of new technology to all farmers especially farm women of district and also developing skill in them which in turn can lead to adoption of crop diversification and self entrepreneurship in them especially in pandemic situations like Covid-19.

Key words: Kitchen gardening, Nutritional security, Covid-19, Women empowerment

Introduction:

The covid-19 lockdown has impacted different sectors of the Indian economy. Even when the industrial production stops the agriculture production has to continue as humans need food for livelihood, hence production and supply of sufficient nutritious food to people needs to be ensured. Kitchen gardening is the revolutionary step to increase vegetable production as well as ensuring availability of low cost and comparatively safer vegetables to the consumers. Mohali district of Punjab is peri-urban area which falls under sub-mountainous agro-climatic zone. This zone has vast potential for the cultivation of seasonal vegetables for the rural as well as urban household.

Keeping in mind the importance of kitchen gardening for this area, Krishi Vigyan Kendra Mohali is working to know the potential, scope and impact of kitchen gardening in enhancing the socio-economic upliftment of people and their training needs in this subject. Kitchen gardening not only provides nutritional security but also provides additional income, aesthetic beauty and also serves as hobby. In the time of fear of pandemic situations like Covid-19, use of poor quality irrigation water containing harmful chemicals along with pesticides residue in horticultural crops, people prefer to grow essential crops in their household. It was recommended that long-term interventions require supporting livelihoods with linkages to the market. Organic cultivation of vegetables is the need of hour, which ensures balance diet to the masses at an economical rate.

Kitchen gardening is easiest way of ensuring access to a healthy food that contains adequate major- and micronutrients and to produce varied kinds of foods in the vicinity of home. Kitchen gardens, also popularly known as home gardens, nutri-gardens or backyard garden are the areas either adjacent to the homes or slightly further away which are planted with diverse vegetable crops of multiple utility and cultural significance providing each household with direct access to fresh vegetables that are not easily available. Indigenous or locally grown organic vegetables are the cheapest source of vitamins and minerals, and are high value food source for poorest families can be well incorporated in the kitchen gardens. In India, all women are working or cooking in kitchen of her home but to run kitchen, most of women are mostly dependant on their male counterpart, so women empowerment seems to be highly challenging. The concept of women empowerment is process of building a women's capacity to be self- independent and to develop her sense of inner strength. Apart from routine house activities, women can spent most of time in kitchen gardening activities.

Krishi Vigyan Kendra is working as resource centre for the whole district to provide latest scientific developments in agriculture and allied disciplines to farmers along with training and other extension activities. Krishi Vigyan Kendra, Mohali is promoting kitchen gardening through demonstrations and training of new technology to all farmers especially farm women of district and also developing skill in them which in turn can lead to adoption of crop diversification and self entrepreneurship in them especially in pandemic situations like Covid-19.

Brief background:

Rybak *et al.* (2018) in their study on kitchen gardening in Tanzania noticed that majority of household depend upon basic farming practices to meet household food demand. Through observations, focus group discussions and face to face interviews of 383 families they observed that women contributed 80% and 75% of the total labour for managing kitchen gardens in Dodoma and Morogoro regions, respectively. Arya *et al.* (2018) conducted study in rural areas of four districts of Uttar Pradesh involving 160 farm families to study the household food security through kitchen gardens. As per study average production of vegetables in kitchen gardens was found to be 403.4 kg in years 2011-12 and 2012-13 with saving of Rs. 9870.25 per annuum. It was mentioned that through kitchen gardens, farm families get fresh and organic vegetables year round and their nutritional needs were fulfilled. Besides this, it empowers women, addresses the poverty alleviation issues, provides socio economic returns and lowers maternal and infant mortality rates. Birdi and Shah (2016) revealed through their study in Melghat India concluded that a well planned kitchen garden along with imparting adequate knowledge can be a sustainable practice to increase diet diversity and green leafy vegetable intake would help address micronutrient deficiencies in the community. Awasthi *et al.* (2016) emphasized that in rural areas of U.P. where people have limited access to market and limited income earning opportunities kitchen gardening can contribute to household food security by direct access to food harvest on daily basis. There are many benefits that have emerged from kitchen gardening practices: better health and nutrition, enhanced income, creation of employment, ensuring food security within the household. Singh and Singh (2017) also conducted study on economic analysis of kitchen gardening amongst 100 families of two villages in district Faridkot of Punjab. The results revealed that there was total income of Rs. 2316.20 from *rabi* vegetables and Rs. 2003.9 from *kharif* vegetables. Some constraints were also observed are brackish irrigation water, high soil pH and EC, limited availability of seed as kits, lack of awareness regarding varieties and management practices and plant protection (management of insect, diseases and weeds).

Conclusion:

Adopting kitchen gardening will provide households with direct access to fresh organic vegetables. It also provides nutritional security and ensures better health of people along with employment generation. It not only drastically reduces expenditure on purchase of vegetables but provides additional income also. Recycling of domestic waste by adopting vermi-composting will clean the surroundings and gives it an aesthetic look. Sale of organic vegetables and their value added products from kitchen gardening will ultimately leads to uplift their health and socio-economic status of farmers. In the time of fear of pandemic situations like Covid-19, organic cultivation of vegetables is the need of hour, which ensures balance diet to the masses at an economical rate in rural as well as urban areas.

References:

Arya S, Prakash S, Joshi S, Tripathi KM, and Singh V. 2018. Household food security through kitchen gardening in rural areas of western Uttar Pradesh, India. *International J. Curr. Microbiol. App. Sci.* **7**(2): 468-474.

Awasthi N, Sahu A, Chandrakala and Singh AK. 2016. Household food security through kitchen garden: A practically workable step by KVK's in U.P. State. *Advances in Social Research.* **2**(1):49-51.

Birdi TJ and Shah SU. 2016. Implementing perennial kitchen garden model to improve diet diversity in Melghat, India. *Global Journal of Health Sciences.* **8**(4): 10-21.

Rybak C, Mbwana HA, Bonatti M, Sieber S, Muller K. 2018. Status and scope of kitchen gardening of green leafy vegetables in rural Tanzania: implications for nutrition interventions. *Food* Security. DOI: http://doi.org/10.1007/s12571-018-0869-1.

Singh, Gurdarshan and Singh, RK. 2017. Economic analysis of kitchen gardens at farmers' doorsteps. *International Research Journal of Agricultural Economics and Statistics.* **8**(2):299-304.

***

e-19 BRINJAL FOR NUTRITIONAL SECURITY

Rashmi Kumari* and Shirin Akhtar

Department of Horticulture (Vegetable & Floriculture), Bihar Agricultural College, Bihar Agricultural University, Sabour, Bhagalpur, Bihar

**Corresponding author e-mail: rashmikumariag@gmail.com*

Abstract

Eggplant fruit contains ascorbic acid and phenolics, both of which are powerful antioxidants. Antioxidants in food have received considerable attention in recent years for their role in human health. Eggplant has a high antioxidant capacity and this is attributed to its high content in phenolic compound. The multiple health benefits of eggplant, which include anti-oxidant, anti-diabetic, hypotensive, cardio-protective and hepatoprotective effects are largely attributed to its phenolic content, particularly, chlorogenic acid.

Key words: Brinjal, antioxidant properties, health, nutritional security

Introduction:

The requirement of vegetables in the country has increased a lot, but to meet the nutritional requirement of an estimated 1200 million population expected by 2020-21 is a difficult task (IIVR VISION, 2020). Vegetables retain remarkable pharmaceutical and nutritive values, there exists a huge potentiality in vegetable technologies in India to address the micronutrient undernourishment, often called "hidden hunger". Brinjal occupies a high-status position among differentiated group of consumers who normally keep it in their diet and traditional purposes. It is a rich source of nutrients, predominantly, carbohydrates, proteins, dietary fibre and vitamins like thiamin, niacin, pantothenic acid and folic acid as well as minerals like calcium, iron, potassium, zinc, copper and manganese (Persid and Verma, 2014). Therefore, it can play a dynamic role in achieving the nutritional security.

Effect of colour, shape and maturity on nutritional value:

Maximum phenolic content in purple round varieties (Tripathi *et al.*, 2014). Purple round varieties are superior over purple long in terms of physical parameters, non-structural carbohydrates and total pigments. Purple genotypes contain much more cane sugar and reducing sugar than the green ones (Wang *et al.*, 2010).

Anthocyanin content

Anthocyanin the phytonutrient found in purple coloured eggplant skin is called nasunin. It is an anthocyanin first isolated from eggplants in 1933. In eggplants it functions to protect the plant from environmental damage, especially from the sun. Nasunin is not only a potent free-radical scavenger, but is also an iron chelator (Noda *et al.*, 2000). Protecting blood cholesterol from peroxidation; preventing cellular damage that can promote cancer; and lessening free radical damage in joints, which is a primary factor in rheumatoid arthritis (Jorge *et al.*, 1998).

Antioxidant properties

The predominant phenolic compound found in all varieties tested is chlorogenic acid (CGA), which is one of the most potent free radical scavengers found in plant tissues. Benefits attributed to CGA include antimutagenic (anti-cancer), antimicrobial and antiviral activities. From the 120 vegetable species evaluated for antioxidant activity, eggplant ranked among the top10 species for superoxide scavenging (SOS) activity (Yang, 2006). Due to its low calorific value (24kcal/ 100 g) and high potassium content (200 mg/ 100 g), it is suitable for diabetes, hypertensive and obese patients (Prabhu *et al*., 2009).

Table-1: Eggplant, cubed, cooked 1.00 cup (99.00grams), Calories: 35

Nutrient	Amount	DRI/DV (%)	Nutrient Density	World's Healthiest Foods Rating
Fiber	2.47 g	9.9	5.1	Very good
Vitamin B_6	0.08 mg	6.5	3.5	Very good
Copper	0.06 mg	6.7	3.5	Very good
Manganese	0.11 mg	5.5	2.9	Good
Vitamin B_3	0.59 mg	3.7	1.9	Good
Potassium	121.77 mg	3.5	1.8	Good
Folate	13.86 µg	3.5	1.8	Good
Vitamin K	2.87 µg	3.2	1.7	Good

World's Healthiest Foods Rating Rule

Excellent	Very good	Good
Density>=7.6	Density>=3.4	Density>=1.5

Dietary Reference Intakes (DRI) and Daily Value (DV)
Source: USDA, National Nutrient Data Base (2005)

Conclusion:

Classification of phenolics composition and content in eggplant fruit and information of their probable health aids is desirable to establish forthcoming dietary rules and encourage consumption of phenolics rich fruit as modulators of disease.

References:

Noda, Y., Kneyuki, T., Igarashi, K., Mori, A., and Packer, L. (2000). Antioxidant activity of nasunin, an anthocyanin in eggplant peels. *Toxicology*, **148** (2): 119-123.

Persid, R. and Verma, V. N. (2014) .Photochemical Studies of *Solanum melongena* (Eggplant) Fruit by Flame Atomic Absorption Spectrometry. *International Letters of Chemistry, Physics and Astronomy*, 20 (2): 211-218.

Prabhu, M., Natarajan, S., Veeraragavathatham, D. and Pugalendhi, L. (2009). Eur Asian Journal of Bio Sciences, 3.

Tripathi, M., Singh, P., Pandey, P., Pandey, V. R. and Singh, H. (2014). Antioxidant activities and biochemical changes in different cultivars of brinjal (*Solanum melongena* L.). *American Journal of Plant Physiology*, **9** (1): 24-31.

***

C-20 EXPLORING JUTE LEAFY VEGETABLES AS AN UNCONVENTIONAL SOURCE OF VITAMIN A

Anita Roy*, Debjani Mondal, Sourav Hazari

Associate Professor, Department of Genetics and Plant Breeding, BCKV, Mohanpur, WB

**Corresponding author e-mail: royanita1925@gmail.com*

Abstract

The present study was conducted with fuve varieties each of oilitorius and capsularis grown in teaching Farm Mondouri, BCKV in RBD with four replications during 2019 (4 rows of 4 m each) following recommended agronomic practices. Planting in 15th Apri, 2019 and were harvested at 30 days. Biomass traits like Leaf length (cm), no of leaves per plant, leaf width (cm), Petiole length (cm), plant height (cm), Weight per plant (gm) were recorded alongwith estimation of Vitamin A, Vitamin C and protein content in the leaves. In olitorius heritability was moderately high in all the traits except no of leaves alongwith moderate GAM for Leaf length and fresh weight indicates that this may be governed by additive gene and selection for these traits may be rewarding. In capsularis heritability was moderately high for all traits except the leaf length alongwith moderate GAM for petiole length and fresh weight indicates that these are governed by additive gene and selection for these traits may be rewarding. JRO 524 recorded high biomass yield alongwith high the content of vItamin A (6950 IU (approximately 40 % of carrot)can serve as a cheap source of Vitamin A in the northe east provinces where it can be successfully taken as a vegetable as it happens to be one amoongst the 25 cultivated leafy vegetables (shaks) in West Bengal . Beside the fibre the sticks and the leaves in Asia and some parts of the world giving wholesome utilzation scope of this crop. However these should be harrvested young for consumption as rich source of betacarotene, iron, calcium and Vitamin C.

Key words: Jute, varieties, phytochemicals, vitamins

Introduction:

Jute is mainly grown for fiber purpose but sometimes for culinary purposes, where it is popular in Middle Eastern and African countries , the leaves are used as an ingredient in a mucilaginous potherb referred as "molokhiya") amongst the sps under cultivation both White Jute (*Corchours capsularis* L.) and Tossa Jute (*Corchorus olitorius* L are considered to have medicinal values. An injection of olitoriside is found to improve cardiac insufficiencies and have no cumulative attributes; and can serve as a substitute for strophanthin. Phytochemical screening of the leaves of capsularis gave evidences of the presence of many biochemical active ingradients like flavonoids, saponins, tannins, steroids and triterpenes. It is also rich in vitamin, carotenoid, calcium, potassium and dietary fiber. Demand for unconventional medicinal plants is nowerdays increasing in developed and developing countries as a result of growing acceptance of natural products being equally effective, safe, non-narcotic, affordable with no side effects.

Demand for food with medicinal values is increasing in both developed and developing countries with considerable recognition of natural products being equally effective, safe, non-narcotic, affordable and having no side effects. Jute dicotyledenous fibre-yielding plant of the genus Corchorus is one of the most important cash crop for the country. When harvested young, jute leaves are flavorful and tender are rich in betacarotene, iron, calcium, and Vitamin C.

Beside the fibre the sticks and the leaves for nutritive and medicinal qualities gives wholesome utilzation scope of this crop.

Jute leaf is a unique plant part with rich source of many chemical compounds and if proper attention is given may play an important role in the national and international market. Prof. Tom D. Rowe (1941) had probably taken the vital steps in the chemical analysis of the plant, (Calleja 2010). Phytochemical screening of the leaves of *capsularis* gave enough evidences about the presence of flavonoids, saponins, tannins, steroids and triterpenes. Alongwith vitamin, carotenoid, calcium, potassium and dietary fiber. *C. capsularis* L. leaves it also contains two functional compounds; phytol and monogalactosyldiacylglycerol as well as capsin, a glycoside, which is responsible for the major bitter taste of the leaves of *C. Capsularis* L. The leaves of *C. capsularis* L. have been found to be effective as it possess stimulant, demulcent, laxative, appetizer and stomachic effects. The infusion or decoction of these leaves is traditionally used to treat fever, constipation, dysentery, liver disorders and dyspepsia. In Japan, the young leaves were used as a substitute for coffee or tea and were regard as a health food

C. olitorius: is known for the richness in potassium, vitamin B6, iron, vitamin A and vitamin C making this crop particularly important for the people covering a high share of their energy requirement by micronutrient-poor staple crops. Consumption of the leaves may be valuable as demulcent, deobstruent, diuretic, lactagogue, purgative, and tonic finding uses as folk remedy for aches and pains, dysentery, enteritis, fever, pectoral pains, and tumors. Leaves of *Corchorus olitorius* are mainly known to have rich sources of many chemical compounds. Including protein, fat, carbohydrate, fiber, ash beta-carotene, thiamine, riboflavin, niacin and ascorbic acid alongwith elements like calcium, potassium, iron, sodium and phosphorus.

Keeping in view a study was undertaken for biomass traits and biochemical composition in the two cultivated species of jute for the people where proportionable amounts of their energy requirement are often supplied by micronutrient-poor staple crops.

Materials and Method:

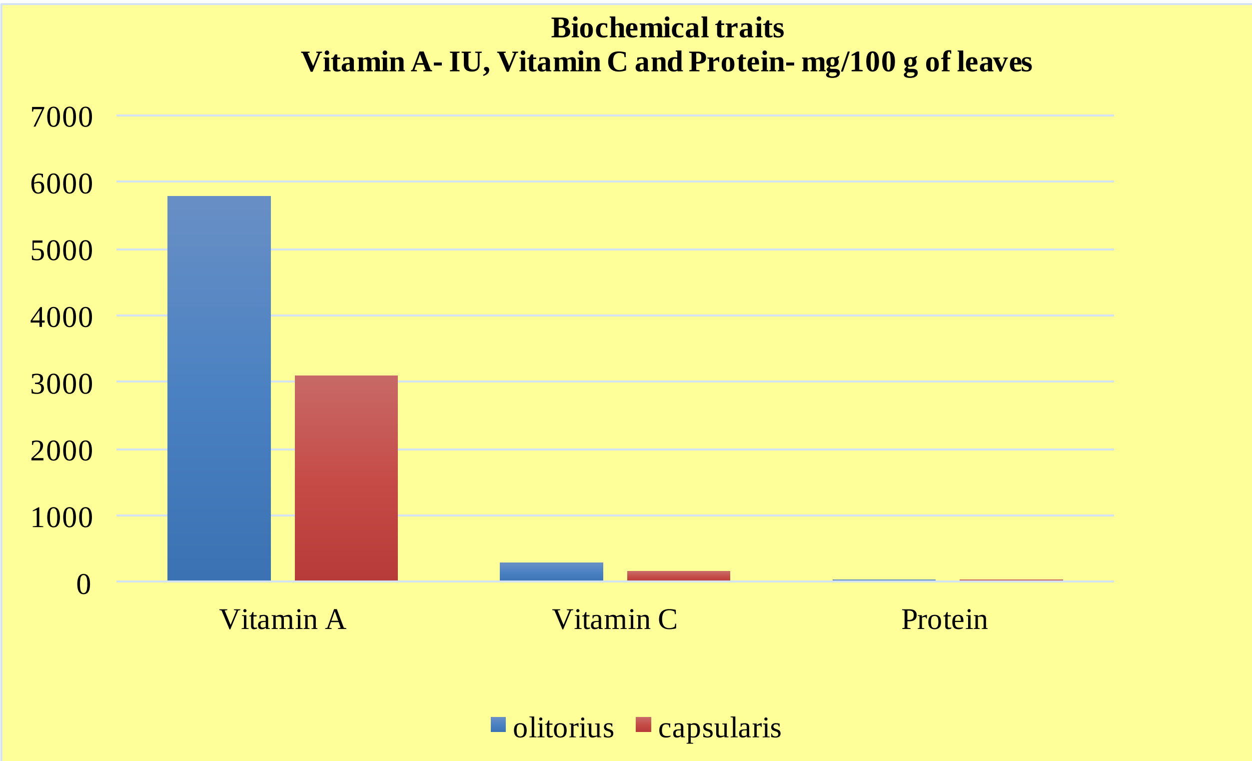
The experiment was conducted in the Teaching Farm located at Mondouri, BCKV, Mohanpur, Nadia. The soils are well drained sandy loam. The center experiences annual average rainfall of approximately 1443.8mm and average daily temperature range of 27 C grown. In the present study five genotypes of *C. olitorious* L. (JRO 8432, JRO 204, JRO 524, BCCO 6 and BCCO 13) and five genotype of *C.capsularis* (JRC 698, JRC 321, JRC 517, BCCC 1 and BCCC 2), collected from AINP JAF, Kalyani centre.

For Field: The freshly harvested seeds of the selected genotypes were taken. Plants were grown in RBD with four replications during 2019 (4 rows of 4 m each). Planting in 15th April, 2019, harvest at 30 days, Spacing was 20 cm between rows and 2-3 cm within plants. Fertilizer application was as per recommendation. (N: P_2O_5 = 40: 20, half as basal and half after 21 days). Five competitive plants were selected randomly per row from each genotype for morphological as well as Biochemical studies (Vitamin A, Vitamin C and protein) from the from the same plants. Recordings were taken for Leaf length (cm), leaf width (cm), Petiole length (cm), plant height (cm), Weight per plant (gm), no of leaves per plant, for leaf characters it was taken for the fifth leaf from the top.

For biochemical studies done in Laboratory: This was done with freshly harvested leaves of the selected genotypes after 30 days from those grown in field for biomass study, since these traits may provide useful information pertaining consumption as leafy vegetables. Biochemical contents were done in laboratory and analysis was carried out in Excel Stat. Biochemical estimation was done following standard prtocols. For Vitamin A - A rapid and colorimetric method to measure vitamin A was used here, Vitamine C- The volumetric method which is a relatively easy and rapid method was used here, Protein - Protein can be estimated by method developed by Lowry *et al.* was followed.

Result and Discussion:

Here it was found that in case of olitorius all the characters under study except number of leaves showed significance and in case of capsularis except leaf length all the characters were significant.In olitorius heritability was moderately high in all the traits except no of leaves alongwith moderate GAM for Leaf length and fresh weight indicates that this may be governed by additive gene and selection for these traits may be rewarding. In capsularis heritability was moderately high for all traits except the leaf length alongwith moderate GAM for petiole length and fresh weight indicates that this may be due to additive gene effects and selection for thes traits may be rewarding.



In case of olitorius the varieties differed significantly for Vitamin A and C content whereas for capsularis it varied for Vitamin C content. According to Ghandi et al. (1964) and Ibrahim and Hussein (2006), prediction of the response to selection are more reliable when GCV, estimates of broad-sense heritability and genetic advance is combined instead of make analysis based only on the estimates of broad-sense heritability estimates Also it was suggested that when the GA is high the heritability is mainly due to additive gene effect (Percy and Turcotte, 1991). Hence selection based on characters such as Vitamin A(80.60, 27.54, 14.89), and Vitamin C (96.50, 22.21, 10.98), and in case of capsularis it can be said for Vitamin C(96.70, 25.47, 12.58) and protein (90.20, 45.96, 23.54) combining high heritability coupled with GAM and moderate to high, GCV respectively are governed by additive gene and will be effective in accurate prediction. It was found that Mitha pat or dark jute had high Vitamin A content 5780 IU, Vitamin C 280 mg/gm and 4.11 gm/100 gm leaves, whereas the nutritive content was less in white or bitter jute high Vitamin A content 3087 IU, Vitamin C 156 mg/gm and 3.76 gm/100 gm leaves, highest Vitamin A and Vitamin C was found in JRO 524 and protein in JRO 204.

Conclusion:

This study will be useful for production of leafy biomass which can be source of several medicinal or biochemical compounds. Considering the low cost of cultivation along with fast growth this should be very well promoted as a leafy vegetable with 30 days span during the kharif and the leaves can be utilised for production of some processed products like herbal tea, tablets etc. Selection for Vitamin A and VitaminC in case of *C. Olitorius* and Vitamin C and protein in *C. capsularis* can be practised for further improvement. JRO 524 recorded high biomass yield alongwith high the content of vItamin A (6950 IU (approximately 40 % of carrot) can serve as a cheap source of Vitamin A in the north- east provinces where it can be successfully taken as a vegetable.

References:

Calleja, Danny O. (2010). "Saluyot now a popular vegetable worldwide". Inquirer. Retrieved August 7, 2011.

Ghandi, S.M., Sanghai, A.K., Nathawat, K.S. and Bhatnagar, M.P. (1964). Genotypic variability and correlation coefficient to grain yield and a few other quantitative characters in Indian wheat. Indian J. Genet. Plant. Breed, 24:1-8.

Ibrahim, M.M. and Hussein, R.M. (2006). Variability, heritability and genetic advance in some genotypes of roselle (Hibiscus sabdariffa L.) World J. Agric. Sci., 2: 340-245.

Percy, R.G. and Turcotte, E.L. (1991). Inheritance of male-sterile mutant ms13 in American Pima cotton. Crop Sci., 31: 1520-1521.

***

C-21 NUTRACEUTICALS ROLE OF VEGETABLES IN HUMAN DIET AS IMMUNITY BOOSTER

Meenakshi Kumari[1], S.S. Solankey[2], D.P. Singh[3], Saurabh Tomar[4] and Neha Sinha[5]

[1,3,5] Department of Vegetable Science, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh – 208 002, India.

[2]Department of Horticulture (Vegetable & Floriculture), Bihar Agricultural University, Sabour (Bhagalpur), Bihar – 813 210, India

[5]Department of Horticulture (Fruit), Bihar Agricultural University, Sabour (Bhagalpur), Bihar – 813 210, India

**Corresponding author e-mail: meenakshisinghupcs@gmail.com*

Abstract

The improper diet and unbalanced nutrition are the major reasons of malnutrition of about 3 billion people in our world. Occurrence of good amount of nutraceuticals and phytonutrients compound in vegetables placed it at prime position in human nutrition and health, therefore also known as protective foods. Several important nutrients like vitamins, minerals, dietary fibre, antioxidant, proteins and flavonoids are present in vegetable which are biologically active against many chronic diseases. Healthy diet contains all the nutritional compounds required for proper growth and development of human body. Hence, fresh vegetable could be a major part of healthy diet due to cheap availability of large number nutritional compounds. Each vegetable contains a unique combination of phytonutriceuticals. Coloured vegetables are good source of antioxidants like Vitamin C, E and K along with these other nutrient and minerals like calcium, magnesium, potassium, iron, beta-carotene, vitamin B- complex. Phytonutriceuticals are chemical compounds which derived from plants and having health-promising properties. Nutraceuticals are the food components or additives which are having nutritional property along with good health benefits like prevention or treatment of disease. It plays key role in future therapeutic developments.

Key words: Vegetables, nutraceuticals, phytochemicals, human nutrition, benifits

Introduction:

Vegetables are rich in various vitamins, minerals, or other nutrients such as carbohydrates, proteins, fats which posses various medicinal properties. Now a days due to pandemic nature of various diseases, people concern more about their health which increase the demand of food that are rich in antioxidants, proteins and vitamins. Consumption of fresh vegetables could be a major part of healthy diet due to cheap availability of larger number of nutritional compounds. Many vegetables contain high amount of various immune-stimulating amino acids which have ability to fight against infection, illness and diseases. They also contain high amount of carotenoids, flavonoids, and vitamin C which improve immune function (Webb and Villamor, 2007).

Nutraceutical role of vegetables:

Different vegetables contain various combinations of nutraceuticals compounds. Different coloured vegetables are also a good source of antioxidants like Vitamin C, E and K along with these, other nutrient and minerals like calcium, magnesium, potassium, iron, beta-carotene, vitamin B complex are also found in abundant quantity. Those chemical compounds which are having health-promising activities and derived from plants are known as 'Phytonutriceuticals'. Nutraceuticals are the food components or additives which are having nutritional property along with good health benefits like prevention or treatment of diseases. In India, as many as more than 60 types of vegetables are grown in different tropical, subtropical and temperate climatic region of the country and occupy second position in the world, next to China by accounting 15% of global vegetable production. Increasing consumption of vegetable is one of the cornerstones of a healthy diet.

For prevention of cardiovascular diseases and cancer, consumption of fruit and vegetables are benificial (Aune *et al.*, 2017). Thus, natural antioxidants like phenolics, flavonoids, ascorbic acid, carotenoids available in fruits and vegetables can help in minimizing the harmful effects of ROS (Reactive oxygen species) on human health (Macedo *et al.*, 2013). Different horticultural crops contain varying amount of biochemical, morphological, and quality parameters in accordance of their varietal wealth, climatic conditions and diversity (Prasad *et al.*, 2016).

Among horticultural crops, vegetables hold a special place in dietary guidance because of their high concentration of various phytochemicals like vitamins (Vitamins C, E and A), minerals, fibre and antioxidants that function as phytoestrogens, and anti inflammatory agents and in other protective mechanisms (Joanne *et al.*, 2012). Different vegetables contain varying quantity of nutraceuticals e.g. cruciferae vegetables like broccoli, cauliflower, brussel sprouts and alliaceae vegetables like onion and garlic contain high amount of organosulfur compounds (Bianchini *et al.*, 2001) which have beneficial effect on chemoprevention of cancer whereas, high carbohydrate, protein, vitamins and minerals are found in leafy vegetables. Vegetables come under salad crops play major role against chronic and cardiovascular disease (Azadbakht *et al.*, 2012).

Vegetables which belongs to Crucifer (broccoli, cauliflower, brussel sprouts) and Alliaceae (Onion and garlic) family contains high amount of these compounds (Bianchini *et al.*, 2001) therefore, natural products *i.e*, organosulfur compounds derived from these family has beneficial effect in chemoprevention of cancer. Phenolic acids and flavonoids work as reducing agents and free radical scavengers because of their antioxidative activities. Antioxidants present in vegetables provide protection against damage caused by reactive oxygen species (ROS) responsible for causing a wide number of health problems.

Carotenoids are the second most abundantly occurring pigments in nature which is responsible for orange and yellow color of vegetables (carrots, pumpkin, sweet potatoes, winter squash, cantaloupes and red peppers). Cruciferous vegetables are rich in glucosinolates content, an activator of liver detoxification and consumption of these vegetables is beneficial against toxicity of electrophiles, reactive form of oxygen, carcinogenesis and mutagenesis (Fahey *et al.*, 1997).

Table 1. List of nutraceutical compound isolated from vegetables

S. No.	Nutraceuticals	Vegetables	Properties
1.	Glucosinolates, Sulforaphane	Cruciferous crops	Having antioxidant properties thus provide protection against free radicals and also against breast cancer
2.	Lycopene	Tomato and other Solanaceous vegetables, Watermelon	Reduce the risk of cancer and scavenge harmful free-radicals, enhance resistance against total body x-rays irradiation.
3.	Silymarin	Artichoke	Reduce the risk of chronic liver diseases caused by oxidative stress.
4.	Vitamin C	Cabbage, Broccoli, Green Leafy vegetables(GLV)	Most important source of antioxidant thus provide protection to body tissue from oxidative damage and also from free radicals.
5.	Vitamin E (Tocopherol)	Green Leafy vegetables (GLV)	Provide protection against oxidative damage.
6.	Allyl Sulphides	Onion and garlic	Prevention/treatment of cancer, inhibit toxicities caused by alcohol and drug and regulate HIV protein and diabetes-mediated toxicities (Rao *et al.*, 2015).
7.	Vit A (Retinol)	Carrot, Pumpkin, Cantaloupe, Spinach, Amaranth, Broccoli	It helps in cell reproduction, improve immunity, vision, bone growth and development of tooth and also maintain skin and hair.
8.	Alliin, Methiin	Alliums	Antiviral,antibacterial,antihypertensive
9.	Quercetin	Onion and Garlic	Treatment of Alzheimer's disease; used in cancer and heart disease
10.	Kaempferol, Myricetin, Fisetin	Onion, lettuce, Endive, Horse Radish	Reducing the risk of chronic diseases, especially cancer (Chen and Chen, 2012). Fisetin- Neurotrophic, anticarcinogenic, anti-inflammatory (Khan *et al.*, 2013).
11.	Luteolin	Celery, Broccoli, sweet pepper	A carotenoid which shows eye benefits.
12.	Apigenin	Celery, Cabbage and Lettuce	4,5,7-trihydroxyflavone is a flavones that is aglycone of several glycosides.
13.	Isoflavonoids	Legume vegetables, Broccoli, Okra	Act against cancer, skin diseases, obesity, osteoporosis.
14.	Glucoraphanin	Red cabbage,	Provide protection against cancer and other

		Broccoli and Brussels sprout	oxidative and degenerative diseases.
15.	Glucobrassicin, Progoitrin, Gluconasturtiin	Broccoli	Anticancer, reduce the risk of cardiovascular disease and also have antithyroid effects.
16.	Glucoerucin, Glucoraphanin	Turnip and Rutabaga	Have tumor prevention properties
17.	Lysine, Chlorgenic Acid	Potato	Inhibit formation of DMBA-initiated/TPA-promoted, skin tumors also reduced serum complement activity in normal human serum.
18.	Caffeic acid, Chlorgenic Acid	Egg plant, Carrot	Inhibitor of the lipoxygenase enzyme that forms leukotrienes from arachidonic acid
19.	Nasunin	Egg plant	Important antioxidant provide protection to brain cell membranes from free radical damage and facilitate flow of blood in the brain.
20.	Angelicin, Xanthotoxin	Parsnip	Used to treat psoriasis and cancer and also used in skin disorders.
21.	Ferulic Acid	Turnip	Having properties of anti-oxidizing that moisturize our skin and provide protection against light and weather damage.
22.	Anthocyanin and Chlorgenic Acid	Sweet potato	Prevent cancer, cardiovascular problems and also have microbial activities.
23.	Rutin	Asparagus, Green chilli	Cytoprotective, vasoprotective, anticarcinogenic, neuroprotective and cardioprotective activities (Ganeshpurkar and Saluja, 2017).
24.	Patuletin, Spinacetin	Spinach	Scavenge reactive oxygen species and prevent macromolecular oxidative damage (Roberts and Moreau, 2016).
25.	Zeaxanthin	Carrot , celery, kale, lettuce	Used for eye health and in agerelated macular degeneration.
26.	Betanin	Beet root, chard	Natural colourant used in ice creams.
27.	Capsaicin or trans-8-methyl-N-vanillyl-5 nonenamide	Red chilli	Act as a pain killer, antioxidant and antiallergic.
28.	Hesperitin	Green vegetables	Anti-inflammtory property.
29.	Lignan	Soybean and Broccoli	Reduce cellular destructions and aging etc.
30.	Allicin (organosulphur	Garlic, Onion, parsnip	Antifungal; antibacterial, antioxidant; used to treat arteriosclerosis.

	compound)		
31.	Beta carotene	Carrots, pumpkin, sweet potatoes, winter squash	Anti aging, anti cancerous, improve lung function, reduce complications associated with diabetes.
32.	Glutathione (GSH)	Cruciferous vegetables	Provide protection against oxidative damage which is caused by free radicals.
33.	Saponin	Soybeans, beans, other legumes	Reduces blood cholesterol levels and the risk of cancer.
34.	Proanthocyanin	Red cabbage, egg plant	Help in urinary tract infections by inhibiting adhesion of microorganisms like *E. coli* to the urinary tract wall.
35.	Butylphthalide	Celery	Used to control high blood pressure.

Source: Singh and Devi (2015); Rai *et al.* (2012).

Refrences:

Aune D, Giovannucci E, Boffetta P, Fadnes L.T, Keum N, Norat T and Tonstad S. 2017. Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality- A systematic review and dose-response meta-analysis of prospective studies. *International Journal of Epidemiology*. 46(3):1029–1056.

Azadbakht L, Haghighatdoost F, Karimi G and Esmaillzadeh A. 2012. Effect of consuming salad and yogurt as preload on body weight management and cardiovascular risk factors: A randomized clinical trial. International Journal of Food Science and Nutrition. 64: 392-399.

Bianchini F and Vainio H. 2001. Allium vegetables and organosulfur compounds: do they help prevent cancer? Environmental health perspectives. 109(9):893-902.

Chen A.Y and Chen Y. C. 2012. A review of the dietary flavonoid, kaempferol on human health and cancer chemoprevention. Food Chemistry.138(4): 2099-2107.

Fahey J.W, Zhang Y and Talalay P. 1997. Broccoli sprouts: an exceptionally rich source of inducers of enzymes that protect against chemical carcinogens. Proceeding of the national academy of sciences. 16:10367-10372.

Ganeshpurkar A and Saluja A. K. 2017. The Pharmacological Potential of Rutin. Saudi Pharmaceutical journal. 25(2): 149-164.

Joanne L. S and Lloyd B. 2012. Health Benefits of Fruits and Vegetables. Advances in nutrition. 3(4): 506–516.

Khan N, Deeba N, Syed, Ahmad N and Mukhtar H. F. 2013. A Dietary Antioxidant for Health Promotion. Antioxidants and Redox Signaling. 19(2):151-162.

Macedo L.F.L, Rogero M.M, Guimaraes J. P, Granato D, Lobato L. P and Castro I. A. 2013. Effect of red wines with different in vitro antioxidant activity on oxidative stress of high-fat diet rats. Food Chemistry. 137: 122–129.

Prasad K, Sharma R. R and Srivastava M. 2016. Postharvest treatment of antioxidant reduces lenticel browning and improves cosmetic appeal of Mango (Mangifera indica L.) fruits without impairing quality. Journal of food Science and technology. 53(7): 2995–3001.

Rai S. K, Arora N, Pandey N, Meena R. P, Shah K and Rai S. P. 2012. Nutraceutical enriched vegetables: Molecular approaches for crop improvement. International Journal of Pharma and Bio Sciences. 3(2): 363-379.

Rao P.S.S, Midde N.M, Miller D.D, Chauhan S, Kumar A and Kumar S. 2015. Diallyl Sulfide: Potential use in novel therapeutic interventions in alcohol, drugs, and disease mediated cellular toxicity by targeting cytochrome. Current drug metabolism. 16(6): 486-503.

Roberts J. L and Moreau R. 2016. Functional properties of spinach (*Spinacia oleracea* L.) phytochemicals and bioactives. Food and function. 8:3337-3353.

Singh S and Devi M. B. 2015. Vegetables as a potential source of nutraceuticals and phytochemicals: A Review. Journal of Medicine and Pharmaceutical Sciences. 5(2):1-14.

Webb A.L and Villamor E. 2007. Update effects of antioxidant and non-antioxidant vitamin supplementation on immune function. Nutr Rev. 65:181-217.

***

C-22 ROLE OF VEGETABLES TO BOOST HUMAN HEALTH AND NUTRITION

Priyanka Sahu[1] and Barsha Tripathy[2]

[1]Ph.D Scholar Department of Vegetable Science, O.U.A.T, Bhubaneswar, India

[2]Deparment of Horticulture, M.S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Paralakhemundi, Odisha, India

**Corresponding author e-mail: priyanka.ouat6565@gmail.com*

Abstract

Excellent nutrition is considered as the backbone to a good health and strong immune response to combat diseases. Vitamins like A, B, C, D, E deficiency in individuals are more susceptible to develop many nutritional disorders as vitamins in particular A, B_2, B_6, C, D and E plays a critical role in cellular homeostasis and maintaining strong immune response in body. So adding immune boosting foods to the daily routine diet is an ideal decision to build up a healthy body and mind. Combination of vitamins, minerals, protein, antioxidant and plant compounds in vegetables make it an absolute immunity booster food. Many vegetables are enriched with vitamins and mineral, so taking it in daily recommended quantity in diet keep an individual away from vitamin supplements and medicines. Body rapidly absorb and assimilates major proportion of vitamins and minerals when it comes preferably from a plant dietary source. At present scenario as a developing nation India faces two major challenges the most like hunger and malnutrition. So vegetables as a diversified and nutritionally rich crop can play a significant role in solving global issues regarding malnutrition and hidden hunger of developing countries in the current scenario.

Key words: Antioxidants, Immunity, Nutrition, Phyto-nutraceutical, Probiotic, Vegetables

Introduction:

Vegetables constitute a bulk proportion of routine human diet as they are low in saturated fat, high in fiber, low in calories, rich in antioxidants with flavonoids, micro/macro nutrients, vitamins and minerals hence called as "Protective Food". Vegetables are harvested usually as an annual or perennial horticultural crops, consumed either in raw or cooked form. Minimal intake of vegetables in diet for prolong duration contributed 31% of ischemic heart disease and 11% of stroke globally (Sedani *et al.*, 2019). ICMR recommended a person should consume not less than 300g of vegetable per day in a serving plate that includes 75 g-green leafy vegetables, 100g-root and tuber vegetables and 125g-leafy vegetables for optimal function of vital organs. Annual availability and enhanced awareness among consumers regarding health benefits of Phyto-nutraceuticals can promote adding more of vegetables in their daily diet. Some phytochemicals of vegetable have strong antioxidant property and are thought to reduce the probability of chronic lifestyle disease by safeguarding vital organs against the deleterious effect of free radical either by modifying metabolic activation, detoxification of carcinogens or alter the pathways that modify the course of activation in tumor cells (Dias, 2012). There is an increasing evidence that consumption of whole food is better acts as a health safeguard than isolated food component *i.e.*, dietary supplement and nutraceuticals (Southon, 2000).

Vegetables are Potential Source of Antioxidant:

These are the substances that protect cells from free radical damage and have a vital role to play in heart disease, cancer, metabolic syndrome and other life style modification diseases. Free radicals are molecules that are produced during cellular catabolism or on prolonged exposure to tobacco smoking and substance abuse. Vitamin A, C and E with other plant based compound like flavonoids, tannins, phenols and lignans are rich in antioxidant, that protect cells from adverse effect of free radicals. Vegetables are best sources of antioxidant, high fiber, low in saturated fat and low in calories. Vegetables like cabbage, cauliflower, turnip, broccoli *etc.* are contain compounds called as sulforaphane (SFN) which helps to fight against cancer. Many researcher concluded, per week consumption of 3-5 servings of vegetables from Brassicaceae family lowers down he risk of cancer (Mukhtari *et al.*, 2018).

Vitamins and Minerals:

These are naturally occurred compounds accumulate in an extensive range of food and highly crucial to keep up a good health condition. These are required in trace amount for our body. Solely vitamins don't provide energy or act as tissue repair and regeneration material but potentially act as catalyst in most of biochemical process and essential component for usual metabolic functions and growth. It groups under two category *i.e.*, Fat Soluble vitamins (*i,e.*, vit. A, D, E and K) and hydrophilic vitamins (*i,e.*, vit. B complexes and vit. C). Mineral also need in trace amount for basic growth and development of human body.

Vitamin A: Stimulates new cell growth, keeps cell healthy and deficiency leads to night blindness. Foods rich in carotenoids like Pumpkin, carrot are rich source of vit. A.

Vitamin B: Helps in releasing energy from food, also well for nervous system. Green vegetables are richest source of vit B complexes.

Vitamin C: Promote collagen synthesis, absorption of dietary iron, build resistance to infection, adds prevention and treatment of common cold, and gives strength to blood vessels. Deficiency leads to scurvy (soft and bleeding gums).

Vitamin D: Helps in Ca absorption, essential for maintaining kidney and bone health. Deficiency leads to rickets in children, osteomalacia in adults (degeneration of bones).

Vitamin E: Possesses antioxidant property, reduce risk of degenerative disease, prevents oxidation of lipid and helps in maintaining cell integrity. Deficiency leads to fragility of red blood cell and increased urinary excretion of creatine indicating muscle damage.

Vitamin K: Helps in maintaining blood pressure, controlling bleeding diathesis, neuro-muscular transmission, cellular signalling pathways. Lima bean, kidney bean, spinach are rich source of vitamin K.

Fiber:

Fiber helps in digestion and contributes to regular laxation. It also helps to maintain an ideal weight of the body and lowers risk for cardiovascular disease, relieves constipation, lowers inflammatory bowel disease, lowers intestinal absorption of saturated fat and helps in maintaining normal body weight. Fibers which are rich in complex form of cellulose and pectin minimises the reabsorption of dietary lipids, hence play a major role in hypertriglyceridemia and its associated complications on human body (Otles and Ozgoz, 2014).

Water:

Water is the key component of our daily diet and also reported as forgotten nutrient. It required to replace body fluid permanently loss through urine and sweat. Maintains cell and tissue turgidity, control body temperature, regulate pH, facilitate digestion and absorption and acts as a transport media in many metabolic processes.

Probiotic:

Fermentation of vegetable is an age old practice of preservation. Fermented vegetables offer a suitable media to deliver probiotics. Kimchi, sauerkraut and other fermented products of carrot, onion, cucumber product of lactic fermentation by *L. plantarum* which is a potential source of probiotic (Lee *et al.*, 1999 and Yoon *et al.*, 2006). Probiotics are notified to facilitate intestinal microflora. Several probiotics reported to prevent diarrhoea caused by antibiotic-related superinfection. Potential functions are antigenotoxicity, antimutagenicity and anticarcinogenicity (Vasilijevic and Shah, 2008).

Table 1: Constituent of vegetables that have positive impact on human health

Constituents	Sources	Impacted human disease
Antioxidants	Green leafy vegetables, cucumber, tomato, Lycopene rich vegetables	Cancer, cardiovascular disease, stroke, cataracts, dementia, liver disorders
Vitamin C (Ascorbic acid)	Broccoli, cabbage, tomato	Promote immune system, wound repair, gum bleeding
Vitamin A (Carotenoids)	Dark green vegetables (spinach, turnip green), orange vegetables (carrot, pumpkin, sweet potato),	Psoriasis, prevent night blindness, skin disorders, embryonic development
Vitamin E (Tocopherols)	Curry leaf,cabbage,broccoli	skin disorders, peripheral neuropathy,
Vitamin K	Cabbage	Clotting disorders
Flavonoids	Red, blue and purple vegetables	Heart disease, cancer, cataracts, allergies,bleeding disorders,dementia
Fiber	Okra, pointed gourd, ivy gourd, beans and peas, most of fresh vegetables	Diabetes, ischaemic heart disease, inflammatory bowel disease,
Folate (folicin/ folic acid)	Leafy vegetables and Legumes	Neural tube defects, cancer, heart disease
Potassium	Cucumber, beans, leafy vegetables,	Hypertension, stroke,

	Baked potato and sweetpotato	arteriosclerosis
Calcium	Cooked vegetables (beans, greens, okra, tomato), peas, pumpkin, rutabaga, cauliflower, papaya, snap bean	Osteoporosis, hyperparathyroidism, hemodynamic regulation
Magnesium	Spinach, okra, potato, banana	Osteoporosis, nervous system, strengthening of enamel, immune system

Source: Kader *et al.* (2001).

Table 2: Weekly vegetable recommendation to different category and age group

Category	Age group (year old)	Vegetable quantity per week for consumption (cup)				
		Dark Green	Red and Orange	Beans and Peas	Starchy	Other
Children	2-3	½	2 ½	½	2	1 ½
	4-8	1	3	½	3 ½	2 ½
Girls	9-13	1 ½	4	1	4	3 ½
	14-18	1 ½	5 ½	1 ½	5	4
Boys	9-13	1 ½	5 ½	1 ½	5	4
	14-18	2	6	2	6	5
Women	19-30	1 ½	5 ½	1 ½	5	4
	31-50	1 ½	5 ½	1 ½	5	4
	51 above	1 ½	4	1	4	3 ½
Men	19-30	2	6	2	6	5
	31-50	2	6	2	6	5
	51 above	1 ½	5 ½	1 ½	5	4

Source: USDA (2015).

Precaution to holding on more nutrients:

- Cutting vegetables with a blunt knife can cause more loss of B complexes and vitamin C due to larger surface area so use instead a sharp knife to minimise loss by reducing surface area during cooking.
- Skin of vegetables should remain intact as they contain more fiber and B complex vitamins.
- Soaking time of vegetables in fresh water need to keep minimum time so as to prevent loss of water soluble vitamin *viz.*, Vit. B complexes and Vit. C.
- Use minimum amount of liquid (water) while cooking and steaming of vegetables is preferred over boiling to increase more bioavailability of water soluble vitamins.
- Avoid using of backing soda to retain colour.
- Salad vegetables need to be prepared freshly to reduce the more oxidation of B complex compounds.

Conclusion:

Nutrition is a subject of both quantity as well as quality, so adding vegetables to regular diet helps in addressing many aspects of nutritional disorders and hunger in underdeveloped countries. The mechanism by which vegetables lower morbidity and mortality of a disease is very complex and largely unknown which preferentially adding to their health benefits. Vegetables contain various phyto-nutraceuticals *i.e.,* phytochemicals, dietary fibers, vitamin and minerals hence a good amount of diversified vegetables had better be served in plate to make sure more health benefits of an individual. So vegetables can be used as a low cost medicine to prevent almost all type of heath disorders. By creating educational awareness about nutritional and medicinal aspect of vegetables among people kitchen gardening /backyard vegetable cultivation can be promoted.

References:

Dias JS. 2012. Nutritional quality and health benefits of vegetables: a review. *Foof and Nutrition Science*, 3:1354-1374.

Kader A. 2001. Importance of fruits, nuts and vegetables in human nutrition and health. *Perishables Handling Quarterly,* 106: 4-6.

Lee SK, Ji GE and Park YH. 1999. The viability of bifidobacterial introduced into kimchi. *Letters in Applied Microbiology*, 28(2): 153-156.

Mokhtari RB, Baluch N, Homayouni TS, Morgatskaya E, Kumar S, Kazemi P and Yeger H.2018. The role of sulforaphane in cancer chemoprevention and health benefits: a mini review. *Journal of Cell Communication and Signalling*, 12(1): 91-101.

Otles S and Ozgoz S. 2014. Health effects of diatary fiber. *Acta Scientiarum Polonorum Technologia Alimentaria*, 13(2):191-202.

Sedani SR, Pardeshi IL, Bhad RG and Nimkarde PG.2018. Vegetables: a boon to human healthy life. *Journal of Ready to Eat Food*, 5(3): 22-30.

Southon S.2000. increased fruit and vegetable consumption within the EU: potential health benefits, *Food* ResIntl, 33:211-217.

USDA. 2015. Department of Agriculture. ChooseMyPlate.gov Website. Washington, DC. Why it is important to eat vegetables? http://www.choosemyplate.gov/food-groups/vegetables-why.html.

Vasilijevic T and Shah NP.2008. Probiotics-from Metchikoff to bioactives. *International Diary Journal*, 18:714-728.

Yoon KY, Woodams EE and Hang YD.2006. Production of probiotic cabbage juice by lactic acid bacteria. *Bioresource Technology*, 97:1427-1430.

***

C-23 CAROTENOID ENHANCEMENT IN PLANTAIN CROP UNDER CHANGING CLIMATE SCENARIO

Neha Sinha* and Meenakshi Kumari

Department of Fruit and Fruit Technology, Bihar Agricultural University, Sabour, Bhagalpur (Bihar), India

Department of vegetable science, Chandra shekhar azad university of agriculture and technology, Kanpur (U.P), India

**Corresponding author e-mail: sinhanehans37@gmail.com*

Abstract

Humans cannot synthesize vitamin A, and therefore, depends on their diet for its supply; on animal or plants origins in the form of preformed vitamin A. Commonly known plant sources that are rich in pVACs include yellow and orange fruits and vegetables like carrot, mango and banana. Plantains, in most of these countries, are a major staple crop, often grown in backyard of the house, with other food crops, like cassava, sweet potato and other green vegetables. Generally local and regional species are rich in micronutrients and has potential sources of pro-vitamin A in banana-dependent communities. High incidence of the sun's UV-B shown positive effect on carotenoid content in plantains.

Key words: Fruits, vegetables, vitamins, health

Introduction:

Vitamin and micronutrient deficiencies are known to affects millions of the people in the developing world. Of these, Pro-Vitamin A is of great importance. Vitamin A deficiency is a major health problem in many countries due to an over-dependency on starchy staples and processed foods that are typically deficient in vitamin A. Vitamin A deficiency causes serious chronic diseases such as night blindness, keratomalacia loss of vision, bronchopulmonary dysplasia, thickening of bones, growth retardation, shortening and atrophy of the testes, immunodeficiency, and increased morbidity and mortality from infectious diseases (Strobel, *et al.*, 2007). In most of the countries, plantains are a major staple crop, often grown in backyard of the house, with other food crops, like cassava, sweet potato and other green vegetables. It is reported that certain vitamin concentrations in some fruits and vegetables may be affected by irradiation.

Result and discussion:

Plantains are among the most popular starchy crop grown in the humid tropical regions where, micronutrient deficiency is prevalent. Nutritional analysis of plantains from West and Central Africa showed significant variations in both provitamins A carotenoids (pVACs) and mineral micronutrient (Fe, Zn) contents. Orange-fleshed Musa cultivars show exceptionally high provit. A carotenoids (pVACs) contents (Englberger, *et al.*, 2003; Davey, *et al.*, 2008) and a high degree of genetic variability in the fruit pVACs contents of Musa genotypes, with values ranging from 0 to as high as 11,337 µg/gdw (Davey, *et al.*, 2009) have been noticed. Ekesa *et al*. (2015) also reported a larger proportion of t-BC (61 to 69%) compared to t-AC (30–38%) in some plantain cultivars; t-AC has only 50% of the retinol activity equivalent (RAE) of t-BC and thus the relative proportions of t-AC and t-BC affect the overall vitamin A value in foods (Fraser, *et al.*, 2004). The proportion of t-BC relative to other pVACs is therefore a good indicator of the quality of vitamin A supplied by a given food. Studies on other crops such as maize and wheat have reported a much lower t-BC proportion of 10% to 20% of the total carotenoid content (Davey, *et al.*, 2009c). Similarly, Guy *et al.*, (2020) reported in his study that the quality of the pVACs in the 48 plantains is good compared to some other plant pVACs sources. Studies also revealed that diet rich in carotenoids is associated with reduced risk of heart disease and cancer (Melendez, *et al.*, 2004; Shetty, 2011).

Conclusion:

The current high incidence of the sun's UV-B shown positive effect on carotenoid content in plantains. Studies showed that increase in the sun's UV-B can cause photomorphogenic as well as genetic and physiological changes in plants. Hence, plantain cultivars could potentially be introduced / promoted as alternative sources of pro-vitamin A in banana-dependent communities. Therefore climate change could have positive effect plants secondary metabolites and improve nutritional content of some crops.

References:

Davey MW, Van den Bergh I, Markham R, Swennen R and Keulemans J, Genetic variability in Musa fruit provitamin A carotenoids, lutein and mineral micronutrient contents. Food Chem 115:806–813 (2009c).

Davey, M.W.; Garming, H.; Ekesa, B.; Roux, N.; Van den Bergh, I. Exploiting banana biodiversity to reduce vitamin A deficiency-related illness: A fast and cost-effective strategy. In Proceedings of the Tropical Fruits in Human Health and Nutrition Conference, Brisbane, Australia, 5–8 November 2008. In press.

Davey, M.W.; Van den Bergh, I.; Markham, R.; Swennen, R.; Keulemans, J. Genetic variability in Musa fruit provitamin A carotenoids and mineral micronutrient contents. Food Chem. 2009, in press.

Ekesa B, Nabuuma D, Blomme G and Van den Bergh I, Provitamin A carotenoids content of unripe and ripe banana cultivars for potential adoption in eastern Africa. J Food Compos Anal 43:1–6 (2015).

Englberger, L.; Aalbersberg, W.; Ravi, P.; Bonnin, E.; Marks, G.C.; Fitzgerald, M.H.; Elymore, J. Further analyses on Micronesian banana, taro, breadfruit and other foods for provitamin A carotenoids and minerals. J. Food Compos. Anal. **2003**, 16, 219–236.

Fraser, P.D. and Bramley PM, The biosynthesis and nutritional uses of carotenoids. Prog Lipid Res 43:228–265 (2004)

Guy Blomme, Walter Ocimati, Deborah Nabuuma, *et al.*, 2020. Pro-vitamin A carotenoid content of 48 plantain (*Musa* AAB genome) cultivars sourced from eastern Democratic Republic of Congo.J Sci Food Agric. Jan 30; 100(2): 634–647.

Melendez-Martinez, A.J.; Vicario, I.M.; Heredia, F.J. Nutritional importance of carotenoid pigments. Arch. Latinoam. Nutr. **2004**, 54, 149–154

Shetty, P. Addressing Micronutrient Malnutrition to Achieve Nutrition Security. In Combating Micronutrient Deficiencies: Food-based Approaches; Thompson, B., Amoroso, L., Eds.; CAB International: Wallingford, UK; FAO: Rome, Italy, 2011; pp. 28–40.

Strobel M, Tinz J and Biesalski HK, The importance of β-carotene as a source of vitamin A with special regard to pregnant and breastfeeding women. Eur J Nutr 46:1–20 (2007).

***

C-24 VEGETABLE CROPS: BOOSTER OF HEALTH AND LIVELIHOOD

Archana. P.V

M. Sc.Fruit Science Scholar, Department of Fruit Science,

College of Agriculture Padannakkad, Kerala Agricultural University, Trissur

**Corresponding author e-mail:achuvikram1@gmail.com*

Abstract

Vegetables are parts of plants that are consumed by humans or other animals as food. The original meaning is still commonly used and is applied to plants collectively to refer to all edible plant parts including flowers, fruits, stems, leaves, roots, and seeds. The alternate definition of the term is applied somewhat arbitrarily, often by culinary and cultural tradition. It may exclude foods derived from some plants are fruits, flowers, nuts, and cereal grains, but include savoury fruits such as tomatoes and courgettes, flowers such as broccoli, and seeds such as pulses. Originally, vegetables were collected from the wild by hunter-gatherers and entered cultivation in several parts of the world, probably during the period 10,000 BC to 7,000 BC, when a new agricultural way of life developed. At first, plants which grew locally would have been cultivated, but as time went on, trade brought exotic crops from elsewhere to add to domestic types. Now-a-days, most vegetables are grown all over the world as climate permits, and crops may be cultivated in protected environments in less suitable locations. China is the largest producer of vegetables, and global trade in agricultural products allows consumers to purchase vegetables grown in faraway countries. Vegetables are generally sensitive to environmental extremes, and thus high temperatures and limited soil moisture are the major causes of low yields in the tropics and will be further magnified by climate change.

Key words: Vegetables, climate, temperature, production

Introduction:

Vegetables are the best resource for overcoming micronutrient deficiencies and provide smallholder farmers with much higher income and more jobs per hectare than staple crops (AVRDC, 2006). The worldwide production of vegetables has doubled over the past quarter century and the value of global trade in vegetables now exceeds that of cereals. In Asia, vegetable production grew at an annual average rate of 3.4% in the 1980s and early 1990s, from 144 million MT in 1980 to 218 million MT in1993 (Ali, 2000). In addition, the area under vegetable cultivation increased at an annual rate of 2.1%, from 12 million hectares in 1980 to 16.3 million hectares in 1993 with most of the increase coming from increased production in China. Amongst vegetable crops, tomatoes are the most important horticultural crop worldwide and grown on over 4 million hectares of land area (FAO 2006, Brown *et al.*, 2005). Tomato, cabbage, onion, hot pepper and eggplant are particularly important in Asia and Sub-Saharan Africa (Brown *et al.*, 2005). Yields in Asia are highest in the east where the climate is mainly temperate and sub-temperate. Most vegetables prefer cooler temperatures, thus productivity is lowest in the hot and humid lowlands of Southeast Asia (Ali, 2000). In Sub-Saharan Africa (excluding South Africa) and tropical Asia, average tomato yields are only about 10 – 12 MT/hectare, well below the yields in temperate regions (FAO, 2006).

Varied agro-climatic conditions round the year in India make it possible to grow a wide variety of vegetable crops all the year round in the entire length and breadth of the country. Singh (1986) listed over 60 vegetables grown in India. Dependable statistics on area and production of vegetables in India are not available. Chadha (1988) reported an area of 4.50 million hectares under vegetable crops with a total production of 41.20 million tons in 1984-85, while FAO estimates estimated the production at 18.9 million tons in 1979-80, 41.70 million tons in 1984-85 and 48.27 million tons in 1987-88. India sharing only about 12% of the world output is the second largest producer of vegetables in the world, next only to China (Singh, 1986 and Chadha, 1988).

However, productivity per unit area is one of the lowest in the world. Singh (1986) has projected India's present requirement of vegetables to be about 70 million tons. However, at the present level of population of about 800 million our annual requirement of vegetables at the rate of 250 g per capita per day should amount to the order of 7 million tons. From our present production availability of vegetables is only 125g per capita per day. According to the project document of Technology the major constraint on vegetable production in the country is the low priority given to vegetable crops in the national planning. Non-availability of reliable statistics on area and production makes their economic appreciation inadequate and consequently impairs the prospective planning for research and development. Inadequate availability of quality seed of improved varieties leads to low productivity per unit area. Inadequate extension support and lack of efficient post-harvest and marketing infrastructure and absence of price support, in addition to lack of high-yielding. Widely adaptable varieties and hybrids resistant to some specific diseases, insect pests and abiotic factors in some vegetable crops are other serious problems. Hardly 25% of the new technology developed has reached the grower.

Integrated disease and pest management systems and vegetable-based cropping systems have not been developed to the desired extent which has also kept the productivity of these crops at a very low level. Intermittent situations of glut and scarcity due to inadequate post-harvest technology support have resulted in very Thereby discouraging them from producing vegetables consistently as a major venture The National Commission on Agriculture 0976) projected the total production of vegetables at 84.00 million tons from an area of about 5.00 million hectares at an average yield of 20 tons per hectare. However, all the present rate of population growth in India we are expected to feed about 1000 million mouths by 2000 A.D. The minimum requirement of vegetables to feed this large population at the rate of 250 g/capita/day will be over 91 million tons. As such we have to practically double the present day production of vegetables during the next decade. Breeding is probably as old as agriculture itself. Early vegetable breeders developed landrace cultivars by selection of favourable variations in horticultural traits, yield and resistance to diseases and other problems. Later new breeding methods were developed, including hybridization techniques, culminating with the use of recently developed molecular tools, all leading to our modern improved vegetable cultivars. Great emphasis on protection of cultivars by seed companies, including development of F1 hybrids, plant cultivar protection and patenting have been done. There were 392 vegetable crops cultivated worldwide but only slightly over one half of the total numbers of them have attracted commercial breeding attention. In recent times, there have been challenges and new trends in the breeding domain. These include an unrelenting movement away from well supported public breeding institutions to a breeding world dominated by private entities, and an increase in size of the companies in the private sector, with emphasis on the major vegetable crops. Almost half of the world vegetable farmers are poor and cannot afford to buy hybrid seed every growing season. Their economics and logistics make them difficult to buy expensive improved or hybrid cultivars since the lack of capital by subsistence farmers denies them the opportunity to invest in vegetable production inputs. If credit facilities and other input facilities are offered, improved or hybrid cultivars can have also a great impact on subsistence vegetable farmers overcoming their poverty and food insecurity. In last 50 years vegetable genetic resources are being lost, on a global scale at the rate of 1–2% per year.

The multinational seed company's concentration in huge corporations have merged or cancelled some vegetable breeding programs to reduce costs. Then there will be fewer vegetable breeders in the future and the growers will be dependent on a narrower genetic background that could contribute in a near future, for food insecurity. Smaller seed companies, which are usually specialize in few vegetable crops, must be supported, possibly through autonomous affiliation with the larger companies. There is a need of investment in research breeding and cultivar development in traditionally open-pollinated cultivars and in the minor and so-called "forgotten" vegetables. More investments in this area will mean cheaper cultivars for growers to choose from and more preservation of vegetable biodiversity. In recent years, private plant breeding programs have increased in size and number. Financial investment also increased, as well as interest in intellectual property protection. Protective measures, especially patenting, must be moderated to eliminate coverage so broad that it stifles innovation. The intellectual property protection laws for plants must be made less restrictive to encourage research and free flow of materials and information. Public sector breeding must remain vigorous, especially in areas where the private sector does not function. This will often require benevolent public/private partnerships as well as government support. Intellectual property rights laws for plants must be made less restrictive to encourage freer flow of materials. Active and positive connections between the private and public breeding sectors and large-scale gene banks are required to avoid a possible conflict involving breeders' rights, gene preservation and erosion. Improved and hybrid vegetable cultivars are, and will continue to be, the most effective, environmentally safe, and sustainable way to ensure global food security in the future. The combination of cultivar variation and responsiveness to specific environmental conditions can create opportunities for the production and processing of fruits and vegetables with improved antioxidant properties.

Climate change is the primary cause of low production of most of the vegetables worldwide; reducing average yields for most of the major vegetables. Moreover, increasing temperatures, reduced irrigation-water availability, flooding, and salinity will be the major limiting factors in sustaining and increasing vegetable productivity. Under changing climatic situations crop failures, shortage of yields, reduction in quality and increasing pest and disease problems are common and they render the vegetable production unprofitable. As many physiological processes and enzymatic activities are temperature dependent, they are going to be largely affected. Drought and salinity are the two important consequences of increase in temperature worsening vegetable production. These effects of climate change also influence the pest and disease occurrences, host-pathogen interactions, distribution and ecology of insects, time of appearance, migration to new places and their overwintering capacity, there by becoming major setback to vegetable cultivation. To mitigate the adverse impact of climatic change on productivity and quality of vegetable crops there is need to develop sound adaptation strategies. The emphasis should be on development of production systems for improved water use efficiency adoptable to the hot and dry condition. The crop management practices like mulching with crop residues and plastic mulches help in conserving soil moisture. Excessive soil moisture due to heavy rain becomes major problem that can be overcome by growing crops on raised beds. Development of genotypes tolerant to high temperature, moisture stress, salinity and climate proofing through conventional, non-conventional, breeding techniques, genomics and biotechnology etc. are essentially required to meet these challenges. Developing cultivars tolerant to heat and salinity stress and resistant to flood, change in the sowing date, use of efficient technologies like drip irrigation, soil and moisture conservations measures, fertilizers management through fertigation, use of grafting techniques, use of plant regulators, protected cultivation, improving pest management are the effective adaptations strategies for reducing the impact of climate change. Resource conservation techniques and organic farming are the other mitigation measures which can be followed. Vegetables are the important component of human diet as they are the only source of nutrients, vitamins and minerals. Wild vegetables in particular play significant roles in the livelihood of many communities in the developing countries as food and medicinal. They contain micronutrients that aid in promoting immunity against infections and providing food security for the people. Most vegetables are naturally low in fat and calories. None have cholesterol. (Sauces or seasonings may add fat, calories, and/or cholesterol). Vegetables are important sources of many nutrients, including potassium, dietary fiber, folate (folic acid), vitamin A, and vitamin C. Diets rich in potassium may help to maintain healthy blood pressure. Vegetable sources of potassium include sweet potatoes, white potatoes, white beans, tomato products (paste, sauce, and juice), beet greens, soybeans, lima beans, spinach, lentils, and kidney beans. Dietary fiber from vegetables, as part of an overall healthy diet, helps reduce blood cholesterol levels and may lower risk of heart disease. Fiber is important for proper bowel function. It helps reduce constipation and diverticulosis. Fiber-containing foods such as vegetables help provide a feeling of fullness with fewer calories. Folate (folic acid) helps the body form red blood cells. Women of childbearing age who may become pregnant should consume adequate folate from foods, and in addition 400 mcg of synthetic folic acid from fortified foods or supplements. This reduces the risk of neural tube defects, spina bifida, and anencephaly during fetal development. Vitamin A keeps eyes and skin healthy and helps to protect against infections. Vitamin C helps heal cuts and wounds and keeps teeth and gums healthy. Vitamin C aids in iron absorption. Health benefits are as part of an overall healthy diet, eating foods such as vegetables that are lower in calories per cup instead of some other higher-calorie food may be useful in helping to lower calorie intake. Eating a diet rich in vegetables and fruits as part of an overall healthy diet may reduce risk for heart disease, including heart attack and stroke. Eating a diet rich in some vegetables and fruits as part of an overall healthy diet may protect against certain types of cancers. Adding vegetables can help increase intake of fiber and potassium, which are important nutrients that many Americans do not get enough of in their diet.

Minor vegetables are becoming more widely and effectively deployed to address malnutrition, poverty and economic prosperity. They constitute essential biological assets of the rural poor and can contribute to improving the well-being of millions of tribal population. Those vegetables are rich in vitamins, minerals and other health promoting factors including high antioxidant activity. They play a major role in the diversification of diet leading to more balanced source of micronutrients. Furthermore, those vegetables possess resistance to several biotic and abiotic stresses the underutilized vegetable crops can also provide nutrition to the poor by meeting the nutrient requirements of vulnerable groups too. Many neglected and underutilized vegetables are nutritionally rich and are adapted to low-input agriculture. The erosion of these species, whether wild, managed or cultivated, can have immediate consequences on the food security and well-being of the poor. Their enhanced use can bring about better nutrition. For example, many minor vegetables contain more vitamin C and pro-vitamin A than widely available commercial species and varieties. Focusing attention on neglected and minor vegetables is an effective way to help maintain a diverse and healthy diet and to combat micronutrient deficiencies, the so-called 'hidden hunger', and other dietary deficiencies particularly among the rural poor and the more vulnerable social groups in developing countries. Minor vegetables production will meet the shortage of per capita consumption availability there by solve the nutritional problems and at the same time it generates the employment and also increase the income of rural people and finally it could contribute the national economy.

Conclusion:

Vegetable crops have huge potential in the present situation of climate change. They play a major role in the diversification of diet leading to more balanced source of micronutrients. The scale of production varies from subsistence farmers supplying the needs of their family for food, to agribusinesses with vast acreages of single-product crops. Depending on the type of vegetable concerned, harvesting the crop is followed by grading, storing, processing, and marketing. Vegetables can be eaten either raw or cooked and play an important role in human nutrition, being mostly low in fat and carbohydrates, but high in vitamins, minerals and dietary fiber. Many of the nutritionists encourage people to consume plenty of fruit and vegetables, five or more portions a day often being recommended.

References:

Cameron, P. J. (2007). Factors influencing the development of integrated pest management (IPM) in selected vegetable crops: A review. *New Zealand Journal of Crop and Horticultural Science*, 35(3), 365–384.

O'Hare, T. J. (2015). Biofortification of vegetables for the developed world. *Acta Horticulturae*, (1106), 1–8. doi:10.17660/actahortic.2015.1106.

Roy, P., & Kumar, V. (2018). Functional Food: Probiotic as Health Booster. *Journal of Food, Nutrition and Population Health*, 02(02). doi:10.21767/2577-0586.100042

Sharma, R., & Peshin, R. (2016). Impact of integrated pest management of vegetables on pesticide use in subtropical Jammu, India. *Crop Protection*, 84, 105–112.

Shetty AA, Magadum S, Managanvi K (2013). Vegetables as Sources of Antioxidants. *J Food Nutr Disor,* 2:1.

Slabbert, R., Spreeth, M., Krüger, G. H. J., & Bornman, C. H. (2004). Drought tolerance, traditional crops and biotechnology: breeding towards sustainable development. *South African Journal of Botany*, 70(1), 116–123. doi:10.1016/s0254-6299(15)30271-4

Williamson, G. (1996). Protective effects of fruits and vegetables in the diet. *Nutrition & Food Science,* 96 (1): 6-10.

***

C-25 UNDERUTILIZED VEGETABLES: CROPS FOR FUTURE

Barsha Tripathy[1], Priyanka Sahu[2], Sandeep Rout[3] and Kalyani Pradhan[3]

[1]Department of Horticulture, M.S.Swaminathan School of Agriculture,

Centurion University of Technology and Management, Paralakhemundi, Odisha, India

[2]Department of Vegetable Science, OUAT, Bhubaneswar, Odisha, India

[2]Faculty of Agriculture, Sri Sri University, Cuttack, Odisha, India

**Corresponding author e-mail: barshatripathy185@gmail.com*

Abstract

Agriculture has been placed under pressure by the production of more vegetables on limited land resources. Extreme variations in agro-climatic regions in India are a blessing in this sense. Under-exploited vegetables also play a crucial role in nutritional welfare and livelihoods around the globe, along with over-exploited vegetables. The wider use of today's underutilized crops offers further opportunities to establish standardized cropping systems for temporal and spatial heterogeneity and is resilient, adaptive, and tolerant of adverse climatic conditions and biotic stresses. Many underused vegetable crops are an important source of micronutrients and are also high in antioxidants and phytochemicals that are anti-microbial. Underused crops are frequently referred to as 'new crops' not because they are 'new' but because they have been picked up for a new market by commercial businesses and researchers. While they can be raised at lower management costs even on poor marginal lands, due to lack of knowledge and popularization of technologies for use, they have remained underutilized. Because of insufficient knowledge on their nutritional, anti-nutritional and nutraceutical aspects, etc., these vegetables are also not under-used nor undervalued. Studies presenting scientific evidence will also establish new paradigms for maintaining, gathering, popularizing and carefully utilizing these potential tools for humanity on a large scale.

Key words: Underutilized vegetables, antioxidants, nutritional security and livelihood

Introduction:

India faces severe food security, redundancy and environmental degradation problems as a result of the population explosion. 65.53 percent of the Indian population currently lives in rural areas, according to the World Bank, and 70 percent of these rural families rely for their livelihood on agro-based activities (FAO, 2018-19). About 800 million people still suffer from nutritional and dietary malnutrition in overlooked population groups (Da Silva, 2014). As malnutrition can lead to diseases such as iron deficiency and anaemia, iodine deficiency and mental disability, as well as vitamin A deficiency and blindness, malnutrition and disease are closely related (Ransom and Elder, 2003). For food welfare and livelihoods around the world, vegetables play a crucial role. Although animal foods are often too costly for low-income families, various underexploited vegetables can be a replacement for vitamins, micronutrients, and secondary plant metabolites that promote health. Under-exploited vegetable crops are neither commercially cultivated on a large scale nor extensively traded. Due to the lack of availability of planting material, lack of awareness on medicinal and nutritional significance, and lack of information on the complete package of practises for the development of these crops, the utilisation of these crops is very poor. Therefore, to improveexisting local landraces into competitive varieties with wider adaptability and commercial value, substantial breeding and R&D are required.

Important features of underexploited vegetables:

- Few are planted as commercial crop than other common crops.
- Having indigenous uses in localized area.
- No attention was received from growers, research, extension services, decision-makers and policy makers and suppliers of technology.
- It may be extremely nourishing and/or have medicinal or therapeutic properties or various other applications for therapeutic purposes.
- Described by landraces.
- Illustration of indigenous skills cultivated and used.
- Needs only minimal external production inputs.
- Ideal for organic production.
- Suitable for marginal land agriculture (poor soil fertility, etc.)
- Suitable for small-scale agricultural systems.
- Easy to store and process by resource-poor classes.
- Accessible local business opportunities.

Making it happen: crops for future:

1. Food security and better nutrition:

Nutritionally rich and adapted to low input agriculture, many underexploited species are. They provide the diet with essential minerals and vitamins based on a few staple crops. Further neglect and genetic depletion of these species could have an immediate effect on the world's nutritional status and food security.

2. Medicinal value:

A number of underexploited vegetables possess several desired medicinal properties. Drumstick (*Moringa oleifera*) is known for its therapeutic properties since time immemorial and its leaves are used by physicians as traditional medicine for the treatment of hypertension. Bhalla *et al.* (1983) has reported the hypotensive action of alcoholic extract obtained from the dried drumstick leaves in patients with moderate to severe hypertension.

3. Increased income for rural poor:

There is a great genetic diversity of underexploited species and a huge heritage of indigenous knowledge. The new importance given to indigenous knowledge is creating new favourable conditions, mostly preserved by local communities today, for the improvement of these species.

4. *Ecosystem stability and environmental sustainability:*

Climate change, land loss and water shortages have contributed to greater enjoyment for these animals, better adapted to challenging conditions and stress, where they have a significant role to play in preserving a rich and thus healthier diversity. The use of many of these species is currently confined to niches where they are held in vulnerable habitats by poor agricultural societies, including those areas impacted by salinization and desertification. The potential of underexploited species to develop in marginal areas has been recognized. Therefore, the selection criteria should take into account their comparative advantages in preventing soil erosion, contributing to soil regeneration, the ability to endure challenging soils (salt surplus, lack of water, etc.), contributing to preserving healthy environments and the ability to survive heat, cold and other abiotic stresses.

5. Strengthen biodiversity and genetic germplasm:

The availability of newly developed methods for the assessment, distribution and use of genetic diversity in plant species (s.a. GIS and molecular markers) and creative ways of raising productivity constraints (s.a. techniques for gene transfer) open up new possibilities for better use of agro-biodiversity.

6. Used as rootstock in grafting:

- Imparting disease and pest resistance
- Avoid soil borne diseases *fusarium* wilt in cucumber and melon
- Bacterial wilt in tomato and pepper
- Boon for organic farming
- Avoiding nematode infestation
- Minimizing the auto-toxic effect
- Providing cold hardiness

❖ Cucumber grafted on *Cucurbitaficifolia* survived at 10°C temperature
  - Survival of graftage under excessive moisture
  - Manipulating the harvesting time

7. New market opportunities:

- The availability of new biotechnological resources for renewing useful plant species into a variety of goods, from plastics to surgical tissues or extending the shelf life of perishable crops, symbolizes important factors that improve the commercialization and marketing processes of underexploited plants.
- Globalization creates opportunities to amplify underexploited crop markets in which immigrants understand their own culture and traditions.
- Increasingly, tourism is an important source of funding for the local market for under-exploited animals.
- The demand for more natural food and eco-friendly goods is created by high living standards in developed countries, and this demand can also be fulfilled by under-exploited species.

Advantages of underexploited vegetables

- Potential of the reduction of poverty by income generation and work opportunities.

- The risk of over-reliance on a very small number of major crops is minimised.
- Contribution to sustainable livelihoods by food protection for households as they can broaden food diversity.
- They add nutrients to the diet and are sometimes comfort food for urban people with low incomes.
- Adapted to fragile habitats, they may contribute to the strength of agro-ecosystems, particularly in arid, semi-arid lands, hills, steppes and tropical forests.
- To meet new market demands, they have a wide range of crops.
- They support rural community growth through small-scale projects.
- They are related to traditional ethnicity and values and have a well-built cultural and sacred identity. Therefore, the best way to sustain and celebrate diversity of culture and nutrition.

Limitations:

- Lack of data on the production, quality of nutrition, consumption and use of many of the underexploited plant products that are unpopular compared to the main fruits.
- Lack of awareness about the advantages of the economy and business prospects.
- Lack of value added technology by food processing at the village level.
- Lack of high quality planting materials. Lack of software to reduce the gestation period and increase the quality of fruit.
- Lack of interest among researchers, farmers and extension staff.
- Lack of interest from manufacturers. With poor yield. Losses from post-harvest and shipping.
- Non-existence of an under-exploited fruit marketing network and infrastructure facility. Absence of national strategy.
- Lack of investment and credit.
- Non-availability of scientific tools for various underexploited vegetables for testing, valuation and post-harvest management.

Future strategies for the development of underexploited vegetable crops:

- Focusing on local traditions, aboriginal awareness,
- Promoting stakeholder community collaboration and building state, regional and international synergies
- Progress storeys must be linked and disseminated.
- Analyze and boost demand using market-oriented approaches
- Empower and improve the ability of rural poor to negotiate with the private sector and the government
- Mainstream gender-sensitive management and use approaches
- Interdisciplinary approach to work

Conclusion:

It was concluded that the range of plant species used by humans must be increased. Global knowledge is needed not only among researchers, but also among planners, policy makers, growers and consumers worldwide. The genetic diversity followed by the protection and use of under-exploited species for the production of improved cultivars that are likely to assist in eradicating poverty , hunger and malnutrition must also be explored.

References:

Bhalla IN, Singh SP, Singh N and Bhargava KP. 1983. A clinical trial of an indigenous drug *Moringaoleifera* (Sahjan) on hypertensive patients. World Conference on Clinical Pharmacology and Therapeutics, Washington, Abstract II, 95 pp.

Chadha, M.L.2009. Indigenous Vegetables of India with Potentials for Improving Livelihood.*ISHS ActaHorticulturae*806: pp 579-585.

Da Silva JG. 2014. Don't just produce more food - produce better food, *National Geographical Special Series Future Food*, **5**(2):1–2.

Fanzo J, Hunter D, Borelli T, and Mattei F.2013. Diversifying Food and Diets: Using Agricultural Biodiversity to Improve Nutrition and Health. Routledge.

Jaenicke H and Hoeschle ZI, 2006, Strategic Framework for Underexploited Plant Species Research and Development, with Special Reference to Asia and the Pacific and to Sub-Saharan Africa. GFU, Rome, 33pp.

Kalia P, Sharma A, Singh S and Singh Y. 2007.Locally Adapted Indigenous Vegetables of Himachal Pradesh and Their Role in Alleviating Poverty, Hunger and Malnutrition.*Acta Hort. 752*, *ISHS*: 239-242.

Kunkel, G. 1984. Plants for human consumption.Koeltz Scientific Books, Koenigstein, Germany.

Pandey AK, 2008, Underexploited Vegetable: Concepts and Prospects, Underexploited Vegetable Crops, 1-3pp, Satish Serial Publishing House, Delhi-110033.

Ransom E.I. and Elder L.K. 2003. Nutrition of women and adolescent girls: Why it matters. Population Reference Bureau, Washington, DC.

Thompson J, Hodgkin T, Atta-Krah K, Jarvis D, Hoogendoorn C, and Padulosi S. 2007. Biodiversity in agro-ecosystems Farming with nature: the science and practice of ecoagriculture. In: The Science and Practice of EcoagricultureScherr, S.J. and McNeely, J.A. eds., (pp. 46– 60), Island Press, Washington, DC.

Williams JT and Haq N. 2002. Global research on underexploited crops - an assessment of current activities and proposals for enhanced cooperation. Southampton, UK: International Centre for Underexploited Crops. ISBN 92-9043-545-3.Accessed on 21st August 2013.

Yang RYandKeding GB.2009. Nutritional contributions of important African indigenous vegetables.African indigenous vegetables in urban agriculture (pp. 105–144).Earthscan, London.

***

C-26 SCOPE OF UNDERUTILIZED VEGETABLE CROPS IN INDIA

Pinki Kumari* and Amit Raj

S.M.C, T.M.B.U, Bhagalpur*, P.S.B. Visva-Bharati, Sriniketan, West Bengal

**Corresponding author e-mail:amithortraj@gmail.com*

Abstract

Underutilized vegetable crops are those crops which do not grow commercially on large scale nor traded broadly and are indigenous, tolerant to biotic and abiotic stress, grown mainly wild, suitable for disaster and prone area, having excellent attractive color and flavor, and being used by the local inhabitants as a source of protective food since time immemorial but have not undergone any conscious phase of domestication and human selection due to unavailability of planting or genetic material, unawareness about its nutritional and medicinal properties and partial or very low knowledge of cultivation techniques. Few minor vegetable crops like *Canavalia gladiata, Cyphomandra betacea, Dendrocalamus strictus, Merremia tuberosa, Momordica cochinchinensis, Mucuna pruriens, Parkia roxburghii, Portulaca oleracea, Sechium edule, Sesbania grandiflora, Solanum torvum, Talinum triangulare, Trichosanthes cucumerina, Vigna angularis*, and *Vigna umbellata* have tremendous potential to be commercialized as other major vegetable crops because of its high nutritional and medicinal value. Among these crops, *Canavalia gladiata* is reported highly nutritive; its pods and seeds are consumed for vegetable purposes and are a good source of protein. *Cyphomandra betacea* is liked by people for its unique flavor. *Dendrocalamus strictus* contain higher amino acid than other vegetable crops. The fruits, leaves, and tubers of *Merremia tuberosa* are used for medicinal purposes. The immature tender fruits of *Momordica cochinchinensis* are used as a vegetable and have great economic value. The plant of *Mucuna pruriens* and its extracts is used as a toxin antagonist for snakebite and is a good source of proteins. *Vigna angularis* is famous for its sported beans and an excellent source of vitamin A, vitamin B, and folic acid. *Vigna umbellata* contains high-quality vitamins like niacin, riboflavin, and thiamine, which is essential for good health. Therefore, keeping the importance of these underutilized vegetable crops there is a need to formulate a plan of action on an exploration of genetic resources, its management, adoption, and advancement of these underutilized vegetable crops to insure overall food and nutritional security for common people and to generate employment opportunities to rural folk for self-reliant India.

Key words: underutilized, minor, vegetables, nutrition, employment

Introduction:

Underutilized vegetable crops are those vegetable crops that do not grow commercially on large scale nor traded broadly, but have highly nutritive and protective value (Rai *et al.* 2015). These crops are embedded with rich sources of vitamins, minerals, and other nutrients such as proteins, carbohydrates, and fats which are very cheap and readily available and it is locally grown, sold, and utilized. The demand for these vegetable crops varies from locality to locality and crop to crop, despite it can be raised to larger magnitudes through promotion. These crops can be grown even under adverse soil and climatic condition due to its hardiness nature and wide adaptability. India has the richest reservoir of genetic resources of the vegetable crop of varying morphological and biochemical characters and resistance to diseases and pests but most of them are underutilized. In India, there are vast wastelands of various kinds like saline soils, acidic soils, dunes, marshy, ravines, and marginal lands that are not fit for backing cultivation of high input demanding crops. Such lands can readily be underutilized to grow these vegetable crops to diversify the agricultural system which is so inevitable because of the fast reduction of natural resources due to the rising population. Underutilized vegetable have several health benefits that is also discussed in many traditional literatures like, the fruit peel and leaf of *Parkia roxburghii* are used in the treatment of diarrhea and dysentery from a long time, beans that are tender and matured used in various dishes. *Portulaca oleracea* is a rich source of folic acid, beta carotene, vitamin C, and other essential fatty acids. The seeds of *Sechium edule* are a good source of protein, its young and tender stem tips are consumed as vegetables. Flower, leaves, and tender fruits of *Sesbania grandiflora* are consumed as raw vegetables and regarded as a good remedy for headaches, eyes problem, dysentery, bruises, catarrh, colds, and fevers. The fruits of *Solanum torvum* are consumed as a vegetable and used for the treatment of high fever, wounds, tooth decay, arterial hypertension, and reproductive problems. *Talinum triangulare* is embedded with rich carotenoids such as zeaxanthin and lutein which act as a stimulant. *Trichosanthes cucumerina* is an important vegetable crop eaten as immature. In this article, we have tried to provide brief knowledge of some of the underutilized vegetable crops grown in different parts of the country.

Criteria of underutilized vegetable crops:

Underutilized vegetable crops have to be scientifically and culturally proof of food value and have been broadly or partly cultivated, either in the past or only being grown in a specific geographical region and also have been grown less than other traditional vegetable crops and have an inadequate or informal seed supply chain, and also indigenously used by local inhabitants and little attention from the side of policy & decision-makers, researcher, extension workers, farmers and also it have medicinal or therapeutic value (Rai *et al.* 2015).

Some of the important underutilized vegetable crops:

***Canavalia gladiata* (Sword bean):** It belongs to the legume family Fabaceae and is used as a vegetable crop in the central and southern parts of India. Its fruits are eaten as a vegetable. Tender pods and seeds are used as a green vegetable (Janardhan *et al.* 2003). A lot of research is needed to improvise the quality and promotion of this crop.

***Cyphomandra betacea* (Tree tomato):** It is an annual shrub and cultivates as a terrace crop in the eastern region of India especially in Meghalaya and Sikkim state (Takur *et al.* 1988). It is commonly known as Sohbainon-dieng in the Khasi region. It is a tiny tree having 2-3 m in height, bearing egg-shaped berries with sharp ends in a cluster near the young shoots. The inner flesh of the fruit is light orange and the seeds are black. The fruit is also enjoyed as chutney. It is loved by the people due to its unique flavor.

***Dendrocalamus strictus* (Male Bamboo):** It is a tropical and subtropical clumping species found in abundantly in Southeast Asia and also known as Solid Bamboo or Calcutta Bamboo (Wikipedia), widely used as a raw material in paper mills and has esculent shoots. It belongs to the family Poaceae. Its tender shoots are cooked for vegetables and have high nutritive value containing a high amount of proteins, minerals, carbohydrates, fibers, and lower fats and cholesterol (Devi *et al.* 2013). More than two million tons of tender bamboo shoots are consumed in the world each year (Yang *et al.* 2008). The amino acid is found much higher in its shoot than other vegetable crops such as onion, pumpkin, and carrot (Nirmala *et al.* 2001). It is generally consumed as a vegetable in the north-eastern part of India. It is commonly propagated by rhizome, cuttings, and seed.

***Merremia tuberose* (kasarkaya):** It is grown wild in the southern part of India especially Andhra Pradesh, Tamil Nadu, and parts of Karnataka. It belongs to the vine family Convolvulaceae. It contains greater amounts of protein, carbohydrate, fiber, fat, and ash. Fruits are prepared as a pickle. It is broadly used in the treatment of diabetes and the preparation of tonic for a stomach problem. (Reddy *et al.*, 2007). It is commonly propagated through tuberous roots. The fruit is also beneficial in rheumatism, spleen, and liver problem (Koneri *et al.* 2006).

***Momordica cochinchinensis* (Spine guard):** It is a type of perennial melon crop grown in South East Asia that belongs to the family Cucurbitaceae. It is known for its orange-reddish color due to the high content of beta carotene and lycopene. In India, it is cultivated abundantly in Assam and Meghalaya state (Ram *et al* 2002). Its flower, fruit, young leaves, and seeds are consumed as a vegetable. Fruits are utilized in the treatment of many diseases like piles, sores, liver, and spleen problems. Fruit juice is useful for people suffering from the problem of indigestion and cough.

***Mucuna pruriens* (Velvet bean):** It is a tropical legume that belongs to the family Fabaceae and is preferred as a vegetable by the tribal community of the north-eastern state especially in Nagaland. Young shoots and beans are cooked as a vegetable. It is commonly propagated by seeds. Plant extract is being utilized as a toxin antagonist for snake bites by the tribal people (Pugalenthi *et al.* 2005). Its bean contains a high amount of protein much higher than other pulses crops (Gurumoorthi *et al.* 2003).

***Parkia roxburghii* (Tree Bean):** It is a multipurpose tree species of the family Mimosaceae. In India, It is commonly cultivated in every household of the hilly region of Manipur and Mizoram state. The height of the tree is medium (10-12 m) having bipinnate leaves. The tender pods are cooked as a vegetable crop. It is mainly propagated by seeds. Its flowers and tender shoots are used in salad and curries. The tree is used as local medicine. Its leaf, bark, fruits are used in the treatment of diarrhea. (Roy *et al.* 2016)

***Portulaca oleracea* (Purslane):** It is an annual succulent belongs to the family Portulacaceae, It has a green-purple stem. It is found in India as a weed in the Himalayan region up to above 1500 altitude. It is a big source of carotenoids, vitamins, and other minerals. (Simopoulas *et al.* 1992). It is commonly propagated by seed.

***Sechium edule* (Chayote):** It is a perennial vigorous vine that belongs to the family Cucurbitaceae, bearing heart-shaped leaves and tuberous rootstock. Fruits are irregular singleseeded, fleshy, coloring white to green depending on the cultivar (Moudgul *et al.* 1997). Fruits are used in the treatment of lowering blood pressure, leaves in dissolving kidney stones, tubers in pulmonary and intestinal inflammations. Its young leaves, fruits, beans, stem tips, and tubers are consumed as a vegetable. Plant propagation is mainly done through seeds**.**

***Sesbania grandiflora* (Agathi):** It is a fast-growing small tree in the family Fabaceae. It is commonly known as a vegetable hummingbird. Its leaves flower and tender fruits are valued as vegetables. It is highly nutritious containing vitamin A and minerals. It is mainly propagated through seed. It is used as a windbreak in Tamil Nadu in Banana Orchard. It has also ornamental values. It is used for the treatment of fever, dysentery, bruises, smallpox, headache, etc. (Duke *et al.*1981)

***Solanum torvum* (Pea eggplant)**: It is a bushy, erect, and spiny perennial plants belong to the family Solanaceae, used as a rootstock for eggplant. Its grafted rootstock is vigorous, regular, and disease resistant. Fruits are used as a vegetable and are an essential ingredient of the diet of the southern population of India. It is generally propagated through seeds. It is traditionally used in medicine as an antidote for poison and the treatment of wounds, cold, fever, teeth decay, etc. (Sahoo *et al.* 2002).

***Talinum triangulare* (Waterleaf):** It is a soft mucilaginous leafy vegetable. It belongs to the family Portulacaceae, which contains a higher amount of carotenoids such as zeaxanthin and lutein and it acts as a stimulant that influenced the immune cells of the eyes (Shakuntla *et al.* 1985). It is eaten as salad, soup and is a rich source of mineral and amino acids having anti ascorbic properties. (Disu *et al.*, 2010). It helps in lowering increased blood pressure by minimizing cholesterol. It is also used in the treatment of cancer and vision loss (Fasuyi *et al.* 2005). It is mainly propagated by the Cutting/Division.

***Trichosanthes cucumerina* (snake guard)**: It is an annual tropical and subtropical vine of the family Cucurbitaceae. It is a monoecious annual vine climbing using tendrils. In India or abroad, it is eaten immature. Leaves are palmately lobed. Flowers are white in color; Fruits are large measuring up to 200cm with deep red color at maturity (Wikipedia).

***Vigna angularis* (Adzuki bean):** It belongs to the family Fabaceae. Its beans are cooked as a vegetable. Its sprouted beans are a good source of vitamin A, vitamin B, and folic acid (Duke *et al.* 1981). It is commonly propagated through seeds.

***Vigna umbellata* (Rice bean):** It is a warm-season annual vine legume crop that belongs to the family Fabaceae. Its flowers are yellow in color and pods are slender in shape (Joshi *et al.* 2008). Tender pods, seeds, leaves are consumed as vegetables. In India, it is generally found in the hilly area of the Eastern and Western Ghats and Himalayan region (Arora *et al.* 1980). It contains a high amount of amino acid. It is commonly propagated through seeds. It also contains high-quality vitamins. It also contains a fair amount of calcium and iron (Singh *et al.* 1980).

Strategies for the sustainable development of underutilized vegetable crops:

Special efforts should be made by research scientists to develop some criteria for commercial exploitation of these crops like the development of the location-specific package of practices for underutilized vegetable crops including improvement in the cultivar and germplasm conservation through In -vitro technology. A large number of extension activities like awareness campaigns, exhibitions, etc., should be organized at the mass level highlighting the importance of underutilized vegetable crops and its medicinal value. The use of modern technology of mass communication and conventional printed literature can play a boon in making consciousness among the farming community. A wider promotion program must be started for setting up processing industries and industries for the manufacturing of gums, resins, etc for proper exploitation for better economic returns and to provide employment opportunities to the rural folk should be also be encouraged. To avoid over-exploitation of natural resources domestication of potential and demanding wild species should be encouraged. Documentation of indigenous knowledge is also required to tap the value additions for multipurpose uses. (Jena *et al*. 2018).

Conclusions:

Underutilized vegetable crops are abandoned with a rich source of nutrient potential having the potential to stand against the unfavorable climatic situation and can prove boon to all concerns viz farmers, consumers & environmentalists. The potential bases for the low utilization of underutilized vegetables are discussed above in brief, if it is sorted out properly no doubt we will achieve our millennium goal of sustainable and self-reliant India.

References:

Arora D, Chandel KPS, Joshi BS, Pent KC (1980): Rice bean: Tribal pulse of eastern India. *Economic Botany*. **34**:260-263

Dendrocalamus strictus germplasm resources Information network. *Wikipedia*

Devi YR (2013): Bamboo forest resources and its role in food security. *Agricultural research community center*. **34** (3):236-241

Disu SO (2010): Gbure the waterleaf vegetable .*Agric. Products in Lagos markets*

Duke JA (1981): Handbook of legumes of world economic importance. *Plenum Press*, New York, and London, 288-291

Duke, JA. and Wain, KK (1981): Medicinal plants of the world. Computer index with more than 85,000 entries, 3 vol.

Fasuyi AO (2005): Nutritional potentials of some tropical leafy vegetable meals: Chemical characterization and functional properties of fresh and frozen vegetables. *Food Chemistry*. **62**(1):59-64.

Gurumoorthi P, Pugalenthi M, Janardhanan K (2003): Nutritional potential of five accessions of a south Indian tribal pulse *Mucuna pruriens* var. utilis; II Investigation on total free phenolics, tannins, trypsin and chymotrypsin inhibitors, phytohaemag glutenins, and in vitro protein digestibility. *Trop. Subtrop. Agroecosys*, **1**:153-158.

Janardhanan K, Gurumoorthi P, Pugalenthi M (2003). Nutritional potential of five accessions of a South Indian tribal pulse, *Mucuna pruriens* var. utilis. Part I. The effect of processing methods on the contents of L-Dopa phytic acid, and oligosaccharides. *Journal of Tropical and Subtropical Agro-ecosystems*, **1**:141-152.

Jena AK, Deuri R, Sharma P and Singh SP (2018): Underutilized vegetable crops and their importance, *Journal of Pharmacognosy and Phytochemistry*, 7(5): 402-407

Joshi KD, Bhanduri B, Gautam R, Bajracharya J, Hollington PB (2008). Rice bean: a multi-purpose underutilized legume. In: Smart, J. Haq, N. New crops and uses: their role in a rapidly changing world. *CUC*, UK, 234-248.

Kew garden. Snake Guard *Trichosanthes cucumerina* var. anguina (Wikipedia)

Koneri R, Balaraman R, Saraswati CD (2006): Antiovulatory and abortifacient potential of the ethanolic extract of roots of *Momordica cymbalaria* fenzl. in rats. *Indian Journal Pharmacology*. **38**:111-114.

Moudgil M (1997): Comparative nutritional evaluation of chayote (*Sechium edule*) and bottle gourd (*Lagenaria siceraria*) of Palam valley of HP. *Himachalyan Journal of Agriculture and Research*. **25**:72-75.

Pugalenthi M, Vadivel V, Siddhuraju P (2005): Alternative food/feed perspectives of an underutilized legume Mucuna pruriens Utilis-A Review. *Linn Journal of Plant Foods and Human Nutrition*, **60**:201-218.

Rai N, Asati BS, Patel RK, Patel KK and Yadav DS (2015): Underutilized horticultural crops in the northeastern region, ENVIS Bulletin*: Himalayan Ecology*, **13** (1):1-10

Reddy RVSK, Subbaiah YPV, Reddy MGDM (2007): Exploit kaasara kaya (*Momordica tuberosa*) for diversification of vegetables. *Acta Horticulture*, **752**:577-79

Roy SS, Kumar Sudhir, Sharma SK, Devi AR, Singh NA, Prakash N and Ngachan SV (2016): Tree Bean (Parkia roxburghii): A Potential Multipurpose Tree Legume of North East India, *National Symposium on Vegetable Legumes for Soil and Human Health*, **pp** 201-208

Sahoo J, Panigrahi R, Moharana T. (2002): Winged bean: A promising under-exploited pulse crop for the farmers. *Indian Farming*, 26-28.

Shakuntala MN, Shadaksharaswamy M. (1985) Foods (Facts and Principles). *Wiley Eastern Limited*: New Delhi, India, (3rd ed), 94-100

Simopoulos AP, Norman HA, Gillaspy JE, Duke JA (1992): Common purslane: a source of omega-3 fatty acids and antioxidants," *Journal of the American College of Nutrition*, **11**(4):374-382.

Singh SP, Mishra BK, Chandel KPS, Pant KC (1980): Major food constituents of rice bean (*Vigna* umbellata). *Journal of Food Science and Technology*, **1**7:238-240

Takur NS Azad, Sharma YP and Barwal RN (1988): Tree tomato cultivation in Meghalaya, *Indian Farming*, pp 3.

Yang Q, Duan Z, Wang Z, He K, Sun Q, Peng Z. Bamboo resources, utilization, and ex-situ conservation in Xishuangbanna, South-eastern China. *Journal of Forest Resource*, 2008; **19**(1):79-83.

***

C-27 EFFECT OF SOWING TIME AND FERTILIZER LEVELS ON SEED YIELD OF KASURI METHI (*TRIGONELLA CORNICULATE* L.)

S.M.Ghawade*, S.V. Bhavar and D.S. Phad

Chilli and Vegetable Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India.

**Corresponding author e-mail: smghawade@gmail.com*

Abstract

A field experiment entitled "Effect of sowing time and fertilizer levels on seed yield of kasuri methi (*Trigonella corniculate* L.)" was conducted at Chilli and Vegetable Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during *rabi* season of the years 2016-17 and 2017-18 with the objectives to study the different sowing time and fertilizer levels for seed production of kasuri methi and to find out best treatment combination of sowing time and fertilizer level for seed production of kasuri methi. The results of the present investigation indicated that, the earlier sowing (10^{th} October) of kasuri methi fertilized with maximum fertilizer dose (50:50:25 kg ha^{-1} NPK) expressed better vegetative growth characters i.e. plant height, number of branches per plant and number of leaves per plant. The yield attributing characters like days to flower initiation, days to 50 per cent flowering, number of florets $plant^{-1}$, pods $floret^{-1}$, seeds pod^{-1}, seed yield $plant^{-1}$, yield $plot^{-1}$ and yield ha^{-1} were found maximum in kasuri methi seed sown earliest i.e. 10^{th} October and fertilized with the maximum dose 50:50:25 kg ha^{-1} NPK. The quality parameters like test weigh, germination per cent, chlorophyll content and protein content were found maximum in kasuri methi seed sown on 10^{th} October with higher fertilizer dose 50:50:25 kg ha^{-1} NPK. While, the maximum trigonelline content was found in the seeds of kasuri methi sown on 10^{th} October and fertilized with 40:40:20 kg ha^{-1} NPK. The maximum oleoresin content was observed in the same with early sowing date (10^{th} October) fertilized with 40:50:25 kg ha^{-1} NPK. The maximum total dry matter, nutrient content in plant and nutrient uptake by plant were recorded in kasuri methi crop sown earliest i.e. 10^{th} October with higher fertilizer dose 50:50:25 kg ha^{-1} NPK. While, the maximum available nutrients of soil were recorded in kasuri methi crop which were sown late (20^{th} January) with higher fertilizer dose 50:50:25 kg ha^{-1} NPK.

Key words: Kasuri methi, sowing dates, fertilizer doses, seed yield, soil nutrient status

Introduction:

The present investigation entitled "Effect of sowing time and fertilizer levels on seed yield of kasuri methi (*Trigonella corniculata* L.)" which was carried out at the Chilli and Vegetable Research Unit (CVRU), Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *rabi* seasons of the years 2016-17 and 2017-18 with the objectives to study the different sowing time and fertilizer levels for seed production of kasuri methi and to find out best treatment combination of sowing time and fertilizer level for seed production of kasuri methi. The experiment was laid out in factorial randomized block design with three replications. There were two factors of an experiment, first being the sowing dates consisted of six levels viz. D_1 (10^{th} October), D_2 (30^{th} October), D_3 (20^{th} November), D_4 (10^{th} December), D_5 (30^{th}

December), D_6 (20th January) and four levels of fertilizer doses viz. F_1 (40:40:20 kg ha^{-1}), F_2 (40:50:25 kg ha^{-1}), F_3 (50:40:20 kg ha^{-1}) and F_4 (50:50:25 kg ha^{-1} NPK). The experiment was conducted with 24 (twenty four) treatment combinations, to study the effect of sowing time and fertilizer levels on vegetative growth, flowering, seed yield, seed quality and yield attributing characters, along with the nutrients content in soil and kasuri methi plants.

Yield attributes and seed yield:

The kasuri methi crop sown on 30th October (D_2) and fertilized with 40:40:20 kg ha^{-1} NPK (F_1) were got the maximum days to flower initiation and 50 per cent flowering during both the years of experimentations. While, the crop sown on 10th October (D_1) and fertilized with 50:50:25 kg ha^{-1} NPK (F_4) were recorded the maximum florets per plant during 2016-17 (34.44, and 27.93, respectively); during 2017-18 (36.47 and 27.70, respectively), the maximum pods per florets (23.54 and 19.34, respectively), seeds per pod (5.63 and 4.52, respectively), seed yield per plant (5.32 and 4.26 g, respectively), seed yield per plot (370.77 and 297.71 g, respectively) and seed yield per hectare (8.83 and 7.09 q, respectively) were reported.However, the kasuri methi crop sown on 20th January (D_6) and fertilized with 50:50:25 kg ha^{-1} NPK (F_4) got the minimum days to flower initiation and 50 per cent flowering during both the years of experimentations. While, the crop sown on 20th January (D_6) and fertilized with 40:40:20 kg ha^{-1} NPK (F_1) were recorded the minimum florets per plant during 2016-17 (17.45, and 24.77, respectively); for the year 2017-18 (16.04 and 25.02, respectively), minimum pods per florets (12.98 and 17.60, respectively), seeds per pod (2.92 and 4.03, respectively), seed yield per plant (2.69 and 3.90 g, respectively), seed yield per plot (189.39 and 273.71 g, respectively) and seed yield per hectare (4.51 and 6.51 q, respectively) were reported. Similar results have been recorded by the earlier workers like Anitha *et al.* (2016) and Meena *et al.* (2018) in fenugreek.

Seed quality parameters:

The kasuri methi crop sown on 10th October (D_1) and fertilized with 50:50:25 kg ha^{-1} NPK (F_4) were produced the maximum test weight of seed (1.176 and 1.172 g, respectively), total chlorophyll content (3.07 and 2.89 mg/100 g, respectively), protein content (21.02 and 20.04 %, respectively) and the maximum germination percentage of seed (68.50 and 63.50 %, respectively), during the year 2016-17 and germination per cent (69.67 and 64.11 %, respectively) during the year 2017-18 was observed, similar results have been obtained by earlier workers like Singh *et al.* (2017a) in fenugreek. While, the maximum trigonelline content (0.25 %) was reported by the crop sown on 10th October and fertilized with 40:40:20 kg ha^{-1} NPK (F_1). However, the maximum oleoresin content (20.54 and 20.61 %, respectively) was reported by the crop sown on 10th October and fertilized with 40:50:25 kg ha^{-1} NPK (F_2).

However, the crop sown on 20th January (D_6) and fertilized with 40:40:20 kg ha^{-1} NPK (F_1) were produced the minimum test weight of seed (1.166 and 1.170 g, respectively), total chlorophyll content (2.70 and 2.78 mg/100 g, respectively), protein content (18.31 and 20.29 %, respectively). The minimum germination percentage of seed (54.92 and 60.56 %, respectively in the year 2016-17) and (54.17 and 60.50 %, respectively in the year 2017-18) was observed.While, the minimum trigonelline content (0.23 and 0.24, respectively %) was reported by the crop sown on 20th November (D_3) and fertilized with 50:40:20 kg ha^{-1} NPK

(F_3). However, the minimum oleoresin content (20.02 and 20.04 %, respectively) was reported by the crop sown on 30th October (D_2) and fertilized with 50:50:25 kg ha^{-1} NPK (F_4).

The treatment combination D_6F_4 (crop sown on 20th January and fertilized with 50:50:25 kg ha^{-1} NPK) registered the maximum values for available nitrogen, phosphorus and potassium content in the soil.While, treatment combination D_1F_4 (crop sown on 10th October and fertilized with 50:50:25 kg ha^{-1} NPK) was recorded the maximum numerical values for nitrogen, phosphorus and potassium content of plant and uptake by plant. Whereas, minimum values for content in plant and uptake by plant were noticed in the treatment combination D_6F_1 (crop sown on 20th January and fertilized with 40:40:20 kg ha^{-1} NPK).

Table 1. Interaction effect of dates of sowing and fertilizer doses on germination per cent of seed (%) in kasuri methi

Treatments	Seed yield per hectare (q)	Germination per cent (%)
D_1F_1	8.61	67.50(55.24)
D_1F_2	8.93	69.83(56.68)
D_1F_3	8.77	68.67(55.96)
D_1F_4	9.00	70.33(57.00)
D_2F_1	8.47	66.17(54.43)
D_2F_2	8.69	68.00(55.55)
D_2F_3	8.56	67.50(55.24)
D_2F_4	8.74	70.17(56.89)
D_3F_1	6.88	62.83(52.44)
D_3F_2	7.40	65.17(53.83)
D_3F_3	7.15	64.00(53.13)
D_3F_4	7.64	65.67(54.13)
D_4F_1	6.32	59.50(50.48)
D_4F_2	6.12	61.50(51.65)
D_4F_3	5.62	60.50(51.06)
D_4F_4	6.65	62.00(51.94)
D_5F_1	4.35	51.00(54.57)
D_5F_2	5.45	58.83(50.09)
D_5F_3	5.61	57.50(49.31)
D_5F_4	5.63	59.50(50.48)
D_6F_1	4.46	56.17(48.54)
D_6F_2	4.60	54.33(47.49)
D_6F_3	4.11	52.50(46.43)
D_6F_4	4.87	55.17(47.97)
‘F’ test	Sig.	Sig.
SE(m) ±	0.24	0.41
CD at 5%	0.68	1.17

(Figures in parentheses are arc sin value transformation.)

Table: Effect of dates of sowing and fertilizer doses on qualitative characters in kasuri methi.

Treatments	Trigonelline content (%)	Total chlorophyll content (mg/100 mg of leaves)	Oleoresin content (%)	Test weight of seed (g)
Dates of sowing (D)				
D_1 - 10th October	0.25(2.85)	3.07	20.54(26.95)	1.176

D_2 - 30th October	0.24(2.82)	2.94	20.02(26.58)	1.175
D_3 - 20th November	0.23(2.76)	2.72	20.48(26.90)	1.13
D_4 - 10th December	0.24(2.83)	2.83	20.19(26.69)	1.170
D_5 - 30th December	0.23(2.77)	2.73	20.33(26.80)	1.167
D_6 - 20th January	0.24(2.81)	2.70	20.40(26.84)	1.166
'F' test	NS	Sig.	NS	Sig.
SE(m) ±	0.02	0.03	0.14	0.0004
CD at 5%	-	0.10	-	0.0011
F_1 - 40:40:20 kg ha^{-1} NPK	0.25(2.83)	2.78	20.29(26.77)	1.170
F_2 - 40:50:25 kg ha^{-1} NPK	0.24(2.82)	2.82	20.61(27.00)	1.172
F_3 - 50:40:20 kg ha^{-1} NPK	0.24(2.78)	2.84	20.36(26.82)	1.171
F_4 - 50:50:25 kg ha^{-1} NPK	0.24(2.79)	2.89	20.04(26.59)	1.172
'F' test	NS	NS	NS	Sig.
SE(m) ±	0.02	0.03	0.11	0.0003
CD at 5%	-	-	0.32	0.0009
'F' test	NS	NS	NS	NS
SE(m) ±	0.05	0.12	0.27	0.0008
CD at 5%	-	-	-	-

(Figures in parentheses are arc sin value transformation)

References:

Anitha B., M. Lakshmi Narayana Reddy, A. V. D. Dorajee Rao, T. S. K. K. Kiran Patro and D. R. Salomi Suneetha. 2016. Effect of sowing dates on yield and quality of fenugreek. *Plant Archives*. **16**(1), PP. 479-484.

Meena N.K., S. S. Meena, Suman Gupta and G. Lal. 2018. Influence of different date of sowing, fertilizer level and weedicides on growth and yield of fenugreek (*Trigonella foenum-graecum* L.) under semi-arid condition. *Int. J.Curr. Microbiol. App. Sci*. **7**(8): 1844-1854.

Singh B., Kumar Nanavati, Sirpurkar W. M. and Nanavati V. S. 2017[a]. Standardization of date of sowing and stage of pinching on fenugreek yield and quality parameters. *Int. J. of Agril. Sci*. **7**(4):1309-1313.

***

C-28 STUDIES ON EFFECTIVENESS OF PRE AND POST EMERGENCE APPLICATION OF METRIBUZIN ON YIELD AND ECONOMICS OF POTATO (*SOLANUM TUBEROSUM* L)

R. B. Verma[1,*], A. P. Singh[2], M. D. Ojha[3], Vijay Kumar[3], R.K. Verma[4] and S. S. Solankey[5]

[1]Associate Professor-cum Sr. Scientist, Department of Horticulture (Vegetable and Floriculture), Bihar Agricultural University, Sabour, Bhagalpur, Bihar

[2] Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya

[3]Nalanda College of Horticulture, Noorsarai, Nalanda (BAU, Sabour)

[4]KVK, Madhepura (BAU, Sabour)

[5]Dr. Kalam Agricultural College, Kisanganj (BAU, Sabour)

**Corresponding author e-mail:* rbv1963@gmail.com

Abstract

An experiment was conducted to explore the economic and effective concentration of pre and post emergence application of Metribuzin on yield of potato. It was observed that the use of Metribuzin @ 1.00kg/ha as pre- emergence is the most economical and viable for the higher yield as well as net return to the potato growers.

Key words: Metribuzin, potato, effectiveness, yield

Intrduction:

Weeds pose an awesome challenge in potato cultivation as it competes for different growth resources and harbour various pest organisms. Its management requires special attention as weeds causes losses in potato yields to the extent of 40-65 per cent (Tripathi, 1989). Weeds pose an awesome challenge in potato cultivation. Manual weeding no doubt is quite effective, but is tedious, time consuming, costly and sometimes may cause root injury (Khurana, *et al.,* 1993). Even after use of Pre- and post- emergence herbicides weeds are also emerge during later stages of growth. An introduction of Metribuzin increased the flexibility in the timing of application as it has been found to be very effective in controlling weeds in both pre as well as post emergence weeds, however, it is being strongly realised to find out its effectiveness as pre and post emergence doses suitable for broad spectrum of weed flora for comparatively longer period in potato. Hence this study was undertaken to search for an appropriate time and doses of application which could be most effective against potato weeds and increasing yield of potato.

Material and methods:

The field experiment was conducted at the main experiment station, department of Vegetable Science, ND University of Agriculture & Technology, Kumarganj, Ayodhya which is located at 26.47^{0}C North latitude and 82.12^{0}C East longitude with an elevation of about 113meters above mean sea level in Indo-Gangetic belts of eastern Uttar Pradesh. Eight treatment namely weedy check (T_1), weed free (T_2), Metribuzin @ 0.50kg ha^{-1} pre-emergence

(T_3), Metribuzin @ 0.75kg ha^{-1} pre-emergence (T_4), Metribuzin @ 1.00kg ha^{-1} pre-emergence (T_5), Metribuzin @ 0.50kg ha^{-1} post-emergence (T_6), Metribuzin @ 0.75kg ha^{-1} post-emergence (T_7), Metribuzin @ 1.00kg ha^{-1} post-emergence (T_8) were arranged in randomised block design replicated thrice. As per treatment a spray volume of 600 litres of Metribuzin per hectare was used as pre and post- emergence at 3 and 20 days after planting, respectively during both the years of experimentation through hand operated Knapsack sprayer fitted with flat fan nozzle.Weed free plots were maintained by normal weeding from 20 DAP to crop harvested and weedy check plot were kept untreated though out the growing season. All the recommended package of cultural practices was adopted for a health crop.Data recorded on yield were subjected to statistical analysis and results were evaluated at 5% levels of significance to draw the valid conclusion.

Results and discussion:

Table 1. Effect of various concentration of Metribuzin as Pre and post- emergence application on average yield and economics of potato *cv*. Kufri Arun

Treatment	Yield (q/ha)	Cost of cultivation (Rs./ha)	Gross income (Rs./ha)	Net income (Rs./ha)	Benefit :cost ratio
T_1 (Weedy check)	211.75	43409	84700	41390	0.95
T_2 (Weedy free)	287.70	46309	115080	68770	1.49
T_3 (Metribuzin@0.50kg ha^{-1} pre-em)	283.95	44491	113580	69088	1.55
T_4 (Metribuzin@0.75kg ha^{-1} pre-em)	294.35	44916	117740	72823	1.62
T_5 (Metribuzin@1.00kg ha^{-1} pre-em)	307.75	45341	123100	77758	1.71
T_6 (Metribuzin@0.50kg ha^{-1} post-em)	266.65	44491	106660	62168	1.40
T_7 (Metribuzin@0.75kg ha^{-1} post-em)	271.53	44916	108540	43423	1.42
T_8 (Metribuzin@1.00kg ha^{-1} post-em)	243.65	45341	97460	52118	1.15
C. D. (P=0.05)	24.70				

Data presented in above table obviously indicated that the pre –emergence application of Metribuzin @ 1.0 kg/ha significantly increased the yield of potato tubers, which was equally effective to its lower doses as pre emergence and weed free plots and significantly higher over all the concentration as post emergence. The higher tuber yield in all weed control treatment and Metribuzin @ 1.0 kg/ha pre-emergence may be due to the fact that all the weed control treatments reduced the weed population, white Metribuzin @ 1.0 kg/ha effectively controlled the weeds in comparison to weedy check and might have increased the availability of light, nutrients and moisture to the crop and resulting in higher photosynthesis. The result is in close conformity with the findings of Mircov *et al.* (2006) and Singh *et al.* (2007). So for as the economics is concerned it was observed that the highest benefit: cost was also incurred maximum (1.71) with Metribuzin@1.00kg ha^{-1} pre-emergence, which might be due to higher yield under this treatment.

Conclusion:

On the basis of two years experiment it may be summarised that the use of Metribuzin @ 1.00kg/ha as pre- emergence is the most economical and viable for the higher yield as well as return to the potato growers.

References:

Khurana, S. C., Thakral, K. K. and Bhatia A.K. (1993). Effect of Pendimethalin and Isoproturon on weeds and tuber yield in potato. *J. Indian Potato Assoc*.20: 255-257

Mircov, V. D. Alovic, I and Brosic, Z (2006).Results of weed control in field potatoes. Herbologia, 7(1): 3-7

Singh. P., Mehra, B.K. and Khurana S.C. (2007). Effect of herbicides n weed control in potato. Potato Journal, 34 (1-2): 53-57

Tripathi, B Singh, C.M. and Bhargava (1989).comparative efficacy of herbicides in potato under the condition of north-western Himalayas. Pesticides, 23 (5):37-38

***

C-29 MULTITIER CROPPING SYSTEM FOR SUSTAINABLE MANAGEMENT OF LAND

Anupam Adarsh, Anupma Kumari, Savita Kumari and Kamlesh Kumar Singh

KrishiVigyan Kendra, Saraiya, Muzaffarpur, Bihar

**Corresponding author e-mail: anupamadarsh111@gmail.com*

Abstract

Due to rapid urbanization, highway building and fertile land degradation, crop erosion, soil salinity and water extraction our land for agriculture is diminishing day by day. Multitier vegetable production is one of the advanced technologies that involve multi-species cultivation, both annual and perennial, as a new alternative to sustainable growth in small and marginal horticultural crops that can produce higher economic returns per unit area. It is a multiple cropping schemes of dynamic collaborative activities that enhance the use of basic output such as dirt, air, soil, solar radiation and all the rest. Multi- tier cropping system is also beneficial for providing insurance against market glut of single commodity, growing crop according to market demand; maintaining an ecological balance and generating higher income from per unit area, supply food and nutritional security to the farming family. The experiment was carried out at the kvk Saraiya research farm and different farmers field of Saraiya block. Each experimental plot was 30 m wide and 30 m long. Multitier cropping study comprises of Bottle gourd, sponge gourd, capsicum, bitter gourd and coriander of different height in an area of 0.10 hectare. Among all the cropping systems, treatment T_3(sponge gourd + capsicum + coriander) gave maximum net returns of Rs. 57,270 from an area of 0.10 hectare of land with B: C ratio of 11.26. Being a cucurbitaceous crop it can fetches good market price during cessation of winter season as well as efficiently utilize the nutrient condition of soil.

Key words: Multitier, cropping system, off-season vegetable.

Introduction:

India is a diversified land, having year-round agricultural production with varying agro-climatic conditions. Approximately 70 per cent of the population relies on agriculture for their livelihood or as a source of income. Due to rapid urbanization, highway building and fertile land degradation, crop erosion, soil salinity and water extraction our land for agriculture is diminishing day by day. Because of high flood risk, small area of land was inaccessible to agriculture (Nimbolkar *et al.*, 2016). By using advanced technologies using vertical and horizontal land along with sunlight and other natural resources, we can use any area to optimize unit production. Multitier vegetable production is one of the advanced technologies that involve multi-species cultivation, both annual and perennial, as a new alternative to sustainable growth in small and marginal horticultural crops that can produce higher economic returns per unit area (Sankaranarayanan *et al.*, 2011). It is a multiple cropping schemes of dynamic collaborative activities that enhance the use of basic output such as dirt, air, soil, solar radiation and all the rest. Sustainable goods allowing land to make the most of scarce resources. This is quite well known and true among minor and marginal landowners. This is also helpful in defending against competition from seed weeds. Single product surplus, grow crop according to consumer demand for sustainable environmental services. The basic founding principles for Multi-storey cropping system includes field diversification prospects based on Scientific, ethical & economic principles of maximizing the efficiency of the system, Usage of higher output resources, Heavy use of inputs, and Long term management of farm land & climate. Generally, farmers are seasonally bound and seasonal crops are planted. Earnings are in fact restricted due to aberrant season. Several times, the climate destroys standing crops and exacerbates their poverty. Multi- tier cropping system is also beneficial for providing insurance against market glut of single commodity, growing crop according to market demand; maintaining an ecological balance and generating higher income from per unit area, supply food and nutritional security to the farming family. The new transfer of technology attributes the adoption of the farmers to the neighbouring farmers and puts this into practice and maintenance, and further diffusion. So successful technology necessitates diffusion, which is the mechanism by which the participants of a social network express an idea through other networks overnight. According to the Minister of Agriculture, "Adopting multi-layer farming is more competitive than conventional systems. In the backward districts of Bihar the ICAR began multi-layer farming models on high-value vegetable cultivation under a 3-tiered structure. Cultivators could grow 3 separate vegetables at one time on the same piece of ground. As an intercrop it will grow profitably in different horticultural crops. While offering additional jobs, they will complement the family's food requirement and these vegetables are rich in calcium, phosphorus, vitamins and other minerals (Jakhar *et al.*, 2012). In this study, multitier-cropping vegetable of different families can be grown at different height. This system entails some input to produce farm production soil, water, crops, livestock, labour and other resource within an environmental setting of output like production and net profit. Keeping above point in view, the present study was performed at kvk Saraiya farm and different farmer’s field of Saraiya block to find out most suitable technology.

Results and discussion:

The experiment was carried out at the kvk Saraiya research farm and different farmers field of Saraiya block. Each experimental plot was 30 m wide and 30 m long. Multitier cropping study comprises of Bottle gourd, sponge gourd, capsicum, bitter gourd and coriander of different height in an area of 0.10 hectare. The experiment comprises of three-treatment *i.e.*T_1-Bottle gourd + capsicum + coriander, T_2- Bitter gourd + capsicum + coriander and T_3-Sponge gourd + capsicum + coriander in four replication. Curbitaceous crop trails at height of 3m and rest at height of 1.5 m, and 0.80 m respectively. All the crops were grown in rainy season with recommended organic farming cultivation practices of the region. Combination of Neem leaf and cow urine was used as fungicide and insecticide.

These was introduced as vine crop grown at greater height. Bottle gourd, sponge gourd and bitter gourd are known as cucurbitaceous crop. The cucurbitaceous crop serves as shady plant for capsicum and coriander. As we know capsicum, cultivation has been perform better in low temperature. Due to shady effect of cucurbits, both capsicum and coriander receive low temperature due to partial transmission of sunlight. Among all the crop sponge gourd provides better production in terms of yield this limited piece of land. Treatment T_3 perform better in terms of number of fruit/ plant, average yield /plant. Sponge gourd can compete with other crops for nutrients rather than left over nutrients from intercropped area of capsicum and coriander. The calculation of benefit-cost ration considering all the components of different multitier systems showed relevance to the practical adoptability to the farmers of the region. Among all the cropping systems, treatment T_3(sponge gourd + capsicum + coriander) gave maximum net returns of Rs. 57,270 from an area of 0.10 hectare of land with B: C ratio of 11.26 followed by T_1(10.95) and T_2(8.33). Being a cucurbitaceous crop it can fetches good market price during cessation of winter season as well as efficiently utilize the nutrient condition of soil. Multitier cropping serve as better options for farmers to improve crop production and productivity through intensive cultivation of vegetables, off-season vegetable cultivation which leads to increase in farm income. The above finding is in consonance of (Sultana *et al* 2020) Farmers need to be trained and motivated so that they can fulfil the issue of sustainable management of lands in the current scenario of climate change and provide good profit to farmers.

Table1. Yield estimation of different crop in multitier system

S. No.	Crop	Number of plants/ ha.	Number of fruits/ plant	Average yield / plant (kg)	Total yield / hectare (qt.)
1.	Bottle gourd	140	10	1025	15.35
2.	Bitter gourd	250	20	50	25.6
3.	Sponge gourd	180	13	2500	58.45
4.	Capsicum	350	20	60	42.5
5.	Coriander	-	-	-	120

Table 2. Economcs of different treatment

S.No.	Treatment details	Input	Output	B:C ratio
1.	T_1-Bottle gourd + capsicum + coriander	5025	55050	10.95
2.	T_2- Bitter gourd + capsicum + coriander	6220	51820	8.33
3.	T_3-Sponge gourd + capsicum + coriander	5580	62,850	11.26

Conclusion:

Multitier cropping serve as better options for farmers to improve crop production and productivity through intensive cultivation of vegetables, off-season vegetable cultivation which leads to increase in farm income.

References:

Jakhar P., Barman D., Gowda H.C.M. and Madegowda M. (2012). Multitier cropping system for profitable resource conservation and sustainable management of sloping lands of eastern India. *Indian Journal of Agricultural Research*.46(4):309-316.

Nimbolkar P.K., Awachare C., Subhash C. and Husain F. (2016). Multi Storied Cropping System In Horticulture-A Sustainable Land Use Approach. *International Journal of Agriculture Sciences*.8 (55):3016-3019.

Sankaranarayanan K., Nalayini P., Sabesh M., Rajendran K., Nachane R P. and Gopalakrishnan N. (2011). Multi-tier cropping system for profitability and stability in Bt cotton production.Technical Bulletin 2:4.

Sultana S., Roy R., Das B., Mondal A. and Rahman F.H. (2020). Vegetable-Based Multitier Cropping System: A Model for Higher Income for the Farmers in Old Alluvial Soils of West Bengal. *Advances in Research*.21 (6):30-34.

***

E-30 ROLE OF ZINC IN VEGETABLE CROP PRODUCTION

Kamlesh Kumar Singh[1*], Anupam Adarsh[1], Sunita Kumari[2], A. K. Singh[3] and S.S. Solankey[4]

[1]Krishi Vigyan Kendra, Saraiya, Muzaffarpur -Dr. RPCAU, Pusa, Samastipur, Bihar,

[2]Krishi Vigyan Kendra, Vaishali-Dr. RPCAU, Pusa, Samastipur, Bihar

[3]Krishi Vigyan Kendra, Piparakothi, E. Champaran-Dr. RPCAU, Pusa, Samastipur, Bihar

[4]Dr. Kalam Agricultural College, Kishanganj, Bihar-Bihar Agricultural University, Sabour, Bhagalpur, Bihar

**Corresponding author e-mail: kamleshbhu@rediffmail.com*

Abstract

Zinc always has been a significant mineral element for agriculture. It is necessary for normal growth, development and reproduction of vegetable plants. The application of zinc was found to increase the green pigments of necrotic leaf of vegetable plants. Also application of Zn significantly increased the bulb weight as well as yield. In the lake of zinc many deficiencies induce some physiological disorders in plants afterward, affected the quality and quantity of vegetables crops.

Key words: zinc, vegetable, disorder, quality

Introduction:

Plant nutrients are most important for high-quality vegetable crop production. Integrated micronutrient application along with appropriate proportion of macronutrients is one of the key important practices for plant growth and development. Usually plant requires micronutrients in minute quantities which are vital for plant growth viz. plant metabolism, chlorophyll synthesis, reproductive growth, floral survival, fruit and seed setting. Zinc is one of the most important micronutrient. It is an enzyme activator, which involves in the synthesis of proteins and has a direct effect on plant enzyme regulation. Zinc plays an important role in biological systems such as maintenance of structural integrity of cell membranes and direct contributions to protein synthesis and gene expression.

India is the second largest producer of vegetables (next to China) with 2.1 % of total cropped area under vegetable crops, contributing 14 % of world production. The area under vegetable crop was 10.26 million hectares with a production of 184.40 MT in India (Horticulture statistics at a glance, 2018). Vegetables are non-woody herbaceous plant or part of the plant eaten as food by humans in whole. It is useful in the edible parts such as root, fruits, bulbs and tubers of plants. The nutrient elements, which are required comparatively in small quantities, are called as micronutrients or trace elements. For the better growth in yield and improved quality in plants micronutrients is most important in addition to macronutrients.

According to Food and Agriculture Organization (FAO) zinc is the most common deficient micronutrient in agricultural soils; almost 50% of agricultural soils are Zn deficient. The edible parts of Plants containing very low concentration of zinc that growing on potentially zinc-deficient soils have reduced productivity .There is a playing very important role by zinc in biological systems, like maintenance of structural reliability of biological membranes and direct contributions to protein synthesis and gene expression also. Micronutrients play an important role in plant growth, development and plant metabolism (Huber, 1980).

Role and deficiency of Zinc

Zinc promotes carbohydrate formation, starch formation, seed maturation, production, enhances seed viability and seedling vigor. It helps in reproduction of certain plants and various enzymatic activities. It also plays a vital role in sulphur and nitrogen metabolism. Zinc deficiency causes interveinal chlorosis/ necrotic spot, bronzing, rosetting of older leaves, due to which leaves turn grey-white and fall prematurely or sometime die. Crops like tomato, potato, beans and onion are highly sensitive to Zn deficiency. Zinc being a significant mineral element for agriculture. It is essential for regular growth, development and reproduction of plant. Furthermore, it was found that application of zinc increased the green pigments of necrotic leaf of plants. The application of Zn significantly increased the bulb weight, when applied with 2, 4-D (3 ppm) as foliar spray in onion (Trivedi and Dhumal, 2013). Zinc plays an indispensable role in growth and development of vegetables crops. It also improves nutritional value of vegetable crops and is profound significant to sustain soil health and crop productivity as well as maintaining the quality of vegetable crops.

Source of Zinc fertilizer

Three types of zinc compounds vary considerably in content of Zn and effectiveness for crops on various types of soils. The sources of zinc contain: inorganic compounds, synthetic chelates and natural organic complexes (Table 1).

Table 1. Zinc containing compounds used in zinc fertilizers

Zinc Source	Formula	Zinc Content (%)	Water solubility	Soil type
Inorganic Compounds				
Zinc sulphate monohydrate	$ZnSO_4.H_2O$	36	Highly soluble	All soils
Zinc sulphate heptahydrate	$ZnSO_4.7H_2O$	22	Highly soluble	All soils
Zinc oxysulphate	$Zn_3O(SO_4)_2$	20-50	Variable*	Variable*
Zinc oxide	ZnO	72-80	Very low	Acidic soils
Zinc chloride	$ZnCl_2$	50	Highly soluble	All soils
Zinc nitrate	$Zn(NO_3)_2.3H_2O$	23	Highly soluble	All soils
Zinc phosphate	$Zn_3(PO_4)_2$	50	Highly soluble	All soils
Ammoniated zinc	$Zn(NH_3)4SO_4$	10	Highly soluble	All soils
Organic Compounds				
Zinc EDTA	Na_2Zn EDTA	8-14	Highly soluble	All soils

*Zinc fertilizer used depends upon percentage of Zn So_4 or ZnO

Conclusion:

Zinc plays an indispensible role in growth and development of vegetables crops. The nutritional value of crops is becoming a major issue; therefore, application of micronutrients to sustain soil health and crop productivity as well as maintaining the quality of vegetables is of profound significance. The most common sources are $ZnSO_4$ and ZnO, but other inorganic products and sources such as chelates and natural organic complexes are used.

References:

Horticulture statistics at a glance (2018) Horticulture statistics division, Department of Agriculture Coopration & Farmers' Welfare, Govt. of India. Pp 3-4.

Huber, D. M. (1980). The role of mineral nutrition in defense," in Plant disease: An advanced treatise, Vol. 5, How plants defend themselves, eds. Horsfall, J. G., Cowling, E. B. (New York, Academic Press), 381–406.

Trivedi A.P. and Dhumal K. N. (2013) Effect of soil and foliar applications of zinc and iron on the yield and quality of onion (*Allium cepa* L.) *Bangladesh J. Agril. Res*. 38(1): 41-48.

***

C-31 VEGETABLES AS IMMUNITY BOOSTER AND FOR NUTRITIONAL SECURITY

A. Palanisamy[1,*] and P. Parameshwari[2]

[1]Assistant Professor (Department of Horticulture),

[2]B. Sc., Agriculture Student,

Sethu Bhaskara Agricultural College and Research Foundation, Karaikudi.

**Corresponding author e-mail: anbu645@gmail.com*

Abstract

In response to COVID-19 pandemic, immune power plays a pivotal role for overcoming the corona virus. The immune system helps in various functions within the human body. Due to deficiency of immunity, humans are more susceptible to viral and bacterial infections. For boosting up the immune power, healthy diets and hygienic practices to be carry out by regular consumption of vegetables in our nutritional diet. Vegetables are called as protective foods, rich in Carbohydrates, Vitamins, Minerals, phytochemical compounds, Dietary fiber content and they are low in calories with high nutritive value. Consumption of vegetables in our daily diet keeps our immune system strong.. Vegetables such as onion, Garlic, Ginger, Bhendi, Red bell peppers, Green peas, Carrot, Beetroot, Sweet Potato, Amaranthus, Red Cabbage, Cauliflower, Asparagus, Broccoli, Kohlrabi, Brussel sprout, Spinach, Collard greens are providing essential needed nutrients and acts as a immunity booster. Especially, Onion and Garlic is having heavy concentration of sulphur - containing compounds, such as Allicin is responsible in building and regulating the immune system. Per-capita consumption of vegetables by human being is 300 grams per day (Indian Council of Medical Research). Vegetables are the most important source of nutraceuticals for promoting health. Nowadays, consumption of vegetables less than 300 grams occurs in many countries due to poverty and poor medical services. The scientist community battling with malnutrition and hunger, but the political resolve supports the causes of nutritional security. The highly nutritive vegetables are of greater importance in alleviating the malnutrition. In this chapter, basic information will be given about the classification of vegetables, per-capita consumption of vegetables, vegetables as immunity developer and for nutritional security.

Key words: vegetables, immune system, nutritional security, vitamins, minerals, phytochemical compounds, nutraceuticals, poverty, malnutrition

Introduction:

Vegetables are rich in vitamins and minerals and so they are called as protective foods. Vegetables are naturally low in fats and calories. Also, most important sources of many nutrients, including potassium, dietary fiber, folate (folic acid), vitamin A and vitamin C. Vitamin A keeps eyes and skin healthy and helps to protect against infections. Vitamin C helps heal cuts and wounds and keeps teeth and gums healthy. Vitamin C aids in iron absorption. Onions and Garlics are playing an important role in boosting up the immune power in human beings. Green leafy vegetables are rich in iron and folic acid. All type of nutrients can be available by the consumption of vegetables, hence they are playing role in nutritional security.

Classification of vegetables:

Vegetables are classified according to the parts of plant consumed or colour of vegetable or according to the nutritive values. Nutritionally they are classified into three major groups.

1. Green-leafy vegetables
2. Roots and tubers
3. Other vegetables

Nutritive value of green leafy vegetables:

Leaves are the manufacturing organs of a plant where the life-giving process of photosynthesis takes place. In the cells, photosynthesis transforms elements into carbohydrates which are carried to other parts of the plant. The leaves in consequence are low in carbohydrates and energy but they are good sources of beta carotene, calcium, riboflavin, folic acid, ascorbic acid, iron and vitamin-K. Generally, green leafy vegetables are good source of vitamins and minerals. They are excellent in carotenes which are converted to vitamin A. Among all the greens colocasia leaves contain highest amount of carotene and cabbage has the least. The greener the leaves the higher the carotenes. Beta-carotenes are also good antioxidants. Greens are good sources of B-vitamins particularly riboflavin and folic acid. Drying and withering reduce B-vitamins. Green-leafy vegetables also contain vitamin C and can be used as substitute for fruits if needed. Agathi, drumstick leaves and coriander leaves contribute to vitamin C. the practice of using coriander as garnishing agent is good as heating results in some loss of vitamin C. Green leafy vegetables are also rich in iron. The leaves normally discarded leaves like cauliflower leaves and beetroot leaves are excellent sources of iron. One need to know to incorporate these leaves in the regular diet. Mint, paruppu keerai and mayalu (red bacchali) are good in iron content. Agathi, colocasia leaves, drumstick leaves and fenugreek leaves contribute calcium in our diet. The availability of calcium and iron to the body is limited as greens also contain oxalic acid. Greens generally are high in moisture and easily withered and need to preserve properly. Greens are not good sources of protein, fat and carbohydrate and hence they do not contribute to the energy value of food. Greens are good sources of fibre which help in preventing degenerative diseases. Of all the green leafy vegetables agathi is the most nutritious one.

Nutritive value of roots and tubers:

Roots and tubers give more calories compared to green-leafy vegetables because they contain more starches. Carrots contain high amount of carotene though this amount is lower when compared to the content present in green leafy vegetables. Roots and tubers are fairly good source of vitamin C and poor source of protein, calcium, iron and B-vitamins.

Nutritive value of other vegetables:

They contain high amount of moisture and hence they are highly perishable. They are generally poor in all nutrients but are fairly good source of vitamin C, also contribute to the fiber content of the diet. Plantain green contains high amount of iron. Capsicum contains vitamin C. Small bitter gourd is more nutritious than the ordinary one. Lady's finger, broad beans have good antioxidant activity. Roots and tubers are not good source of antioxidants.

Spinach:

Spinach is rich in antioxidants that may reduce the risk of chronic disease and plays a vital role in protecting the immune system

Carrots:

Carrots are especially high in beta-carotene, which can turn into vitamin-A in the body.

Broccoli:

Broccoli is a cruciferous vegetable that contains sulforaphane, a compound that may prevent cancer growth. Consumption of broccoli may also help to reduce the risk of chronic infections by protecting against oxidative stress.

Onion and Garlic:

The main active compound in garlic is allicin, a plant compound that is largely responsible for garlic's variety of health benefits. Onion and Garlic is having heavy concentration of sulphur - containing compounds, such as Allicin is responsible in building and regulating the immune system.

Brussel Sprouts:

Brussel sprouts contain an antioxidant called Kaempferol, which may protect against oxidative damage to cells and prevent chronic disease. They may also help in enhancing the detoxification in the body.

Kale:

Kale is high in vitamins A, C and K as well as antioxidants.

Garden peas:

They are high in fiber content and peas support digestive health by enhancing the beneficial bacteria in your gut and promoting regular bowel movements.

Swiss chard:

Swiss chard is low in calories but high in many essential vitamins and minerals.

Ginger:

Ginger also contains potent anti-inflammatory properties, which can be helpful in treating inflammation-related disorders. Ginger supplements may also help decrease blood sugar.

Asparagus:

High in folate and prevent neural tube birth defects

Red cabbage:

Red cabbage contains a good amount of fiber, vitamin C and anthocyanins. Red cabbage is brimming with antioxidants and health-promoting properties, also rich in anthocyanins, a group of plant compounds that contribute to its distinct color as well as a whole host of health benefits.

Sweet Potato:

One medium sweet potato contains 4 grams of fiber, 2 grams of protein and a good amount of vitamin C, vitamin B6, potassium and manganese. It's also high in a form of vitamin A called beta-carotene.

Collard greens:

Collard greens are also high in antioxidants and could even reduce your risk of developing certain diseases. They are the best plant sources of calcium.

Kohlrabi:

Also known as the turnip cabbage or German turnip. Kohlrabi, is rich in both fiber and vitamin C.

Conclusion:

The scientist community battling with malnutrition and hunger, but the political resolve supports the causes of nutritional security. The highly nutritive vegetables are of greater importance in alleviating the malnutrition. In this chapter, basic information will be given about the classification of vegetables, per-capita consumption of vegetables, vegetables as immunity developer and for nutritional security.

References:

file:///C:/Users/PARAMESHWARI/Downloads/nutrients-11-01933.pdf

https://www.healthline.com/health/food-nutrition/foods-that-boost-the-immune-system

https://www.pcrm.org/news/blog/foods-boost-immune-system

***

Theme – I

Present status, challenges and future prospects of vegetables at national and global perspective

T-01.1 TALES FROM THE TROPICS: THE SCIENCE AND ART OF VEGETABLE BREEDING

Sanjeet Kumar

Plant Geneticist and Breeder

House # 809, World Vegetable Center (WorldVeg) Campus, Shanhua, Tainan 741, Taiwan

**Corresponding author e-mail: sanjeetk1@gmail.com*

Abstract

My plant breeding career's primary goals have been to improve income generation, create employment opportunities, and balance diets of low and middle-income communities through teamwork and effective partnerships. This presentation includes stories of vegetable breeding research, mostly pepper (*Capsicum annuum*), and okra (*Abelmoschus esculentus*). I shall try to relate new breeding tools and approaches in the post-genomic era, traits of domestication syndrome, and the importance of biodiversity conservation in breeding. In a generic comparison, I will draw attention to similarities and contrasts between vegetable and staple crops breeding research, seed delivery systems at scale, and impact pathways.

In Asia (India, Taiwan), research focused on breeding chili and sweet peppers. At ICAR-Indian Institute of Vegetable Research, Varanasi, India, we investigated the validity of molecular markers associated with cytoplasmic male sterility (CMS) and *restoration-of-fertility* (*Rf*), identified resistant sources for *Begomovirus*, developed mapping population, and improved inbred and hybrid chili cultivars. For example, cultivar "Kashi Anmol" became popular among the Indian farmers and inbred of this cultivar is one of the parents in several commercial hybrids of private seed companies. In Taiwan, the WorldVeg team explored the validity of molecular markers associated with chili anthracnose resistance, *Chili venial mottle virus* resistance, and other traits. We demonstrated case-specific uses of the marker to enhance breeding efficacy, e.g., marker-assisted backcrossing for the transfer of *Rf* locus from hot pepper into sweet pepper. The screening of more than 1000 *Capsicum* germplasm (open-pollinated cultivars, hybrids, improved lines, landraces) about 8% of pepper accessions has CMS(S) cytoplasm. We developed markers tightly linked to two monogenic recessive male sterility genes (*ms3*, *ms1*). More than 70 pepper lines supplied by WorldVeg were put into commercial use (either direct release or parent(s) in hybrids) in 17 African and Asian countries. For example, in India alone, an estimated 220000 smallholder farmers annually plant hybrid seeds (sold by seed industry) containing germplasm originated from the WorldVeg pepper breeding program.

In West Africa (Niger), while working with International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), we selected and disseminated heat-tolerant vegetable cultivars under irrigated and rainfed production systems in the Sudano-Sahel of West Africa.

Okra cultivar "Konni" (VI060872) purified from a local population is still popular among the farmers, including women growers because of its earliness (highly successful under rain-fed conditions), desirable pod traits, and small and spineless plants (harvesting comfortable - no itching). The team also enriched okra germplasm enhancement (for screening against okra yellow vein mosaic and enation leaf curl viruses) and generated first gene sequence information that catalyzed the seed industry to invest and start the okra genome consortium.

The first-hand stories encountered with the farmers tell us that they are intelligent to adapt to the needs. However, during desperate times they may be compelled to take undesirable actions for several reasons, including possible lack of behavior change communications. The seed delivery systems of vegetables such as peppers (absence of subsistence farming) have low volume seed requirements and staples such as legumes, millets, rice, or corn (absence of home gardening) volume seed. Smallholder and land renter farmers in the tropics face multiple socio-political obstacles aggravated by gender inequity, urban migration, un-organized markets, and competition for farmland. They also face challenges posed by climate change such as unpredicted extreme weather, unprecedented current pandemic, and problems inherited by intensive commercial agriculture such as abuse of pesticides and natural resources. Vegetable breeding research led by public and private organizations has already contributed to solving some of these challenges by empowering vegetable producers and actors involved in value chain. Vegetables have immense potential to contribute further to poverty reduction and improve balanced diets in a global society.

Figures: Marker for *ms1* gene in pepper and "Konni"-okra grown in North Benin, West Africa

Key words: Vegetables, breeding, pepper, okra, potential, poverty

***

T-012 VEGETABLE BIODIVERSITY FOR FUTURE SECURITY

S.S. Solankey[1,*], Shyama Kumari[1], Shirin Akhtar[2], D.P. Saha[1], V.B. Jha[1], R.K. Sohane[3] and R.R. Singh[4]

[1]Dr. Kalam Agricultural College, Kishanganj, Bihar,

[2]Bihar Agricultural College, Sabour, Bhagalpur, Bihar,

[3]Director Extension Education, Bihar Agricultural University, Sabour, Bhagalpur, Bihar

[4]Dean Agriculture, Bihar Agricultural University, Sabour, Bhagalpur, Bihar

**Corresponding author e-mail: shashank.hort@gmail.com*

Abstract

The genetic diversity is the backbone of crop improvement programme. Without the genetic biodiversity the resistant or desirable genes employment is major issue. Day-by-day many important germplasm of agricultural crops are lost. Moreover, after green revolution the loss of genetic diversity has been increases in India. Though, our country is known for many traditional and ayurvedic medicines i.e. extracted or prepared from many indigenous crop plants so far due to continuous loss of indigenous germplasm the traditional medicines expertise will also loss. Moreover, traditional knowledge about these indigenous vegetables has also reduced in the youth influenced by urbanisation. It is surprising to know that human activities accelerated species loss by 1,000 times faster as compare to natural circumstances. The vegetable crops which are known for their nutritional values and high yield potential or we can say that vegetable are futuristic crops which have wide genetic diversity, which includes species diversity, cultivated varieties, and also the diversity of natural and agro-ecosystems. However, genetic diversity of vegetable crops in several parts of the country has been unfortunately eroded by human interferences. Across the globe the species diversity of vegetable is around 400, out of which 80 species are indigenous to our country. Indigenous vegetables can also require relatively less men power and inputs compared to exotic vegetables. Moreover, many major, indigenous, underutilised and exotic vegetables species provide several valuable products like, food, medicines and raw materials. Vegetable biodiversity is one of humanity's most potent weapons in the fight against present hunger and poverty. Thus they are powerful tools in the present battle as well as future scuffles for enhancing immunity as well as malnutrition worldwide.

Key words: Vegetables, biodiversity, genetic resource, indigenous, hunger, poverty

***

T-01.3 FUTURE STRATEGY TO INCREASE VEGETABLE PRODUCTION

T. Tejaswini* and T. Thomson

College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, Tadepalligudem, West Godavari, Andhra Pradesh

**Corresponding author e-mail: tejabhaskar61@gmail.com*

Abstract

In view of the insufficient vegetable production, concerted efforts have to be made to increase substantially to ensure nutritional security to everyone in India. Priority should be given to expansion of crop area, both irrigated and rainfed, providing better water resources, increasing crop productivity by using better varieties or hybrids suited to eco-specific regions and advanced production technology with economy in use of water, pesticides and fertilizers and preference to drip irrigation, fertigation, bio pesticides, bio fertilizers, organic farming, integrated pest management and integrated plant nutrient supply. The production technology should be cost effective, efficient, environment friendly, resource sustainable and preferably with wider adaptation to different eco regions. It is absolutely necessary to minimize the high post-harvest losses in handling, storage and transportation by adopting improved cost-effective packaging, cool chain from farm to market outlets and rapid refrigerated transport system. Supply and demand gaps varying with season, year, location and kind of vegetable results in shortage or overproduction and instability in vegetable prices that are often highly fluctuating and unpredictable. Convenient and low-cost processing technology or intermediate preservation technology is required for utilization of surplus production at the farm site or nearby. Development of improved cultivars or hybrids and cultivation methods suited to rainfed and arid conditions will be helpful in increasing the area and production of vegetables. Fast dissemination of information on production technology, varieties/hybrids, forecast on weather, diseases and insect pests, product quality and market prices on internet and website in local language will be useful to farmers. Simultaneously it will be essential to educate people, including children especially in rural areas regarding usefulness of vegetables in human diet for healthy nutrition.

Key words: Vegetable, advanced production technology, economy

***

T-01.4 ABIOTIC STRESS ADAPTATION IN VEGETABLE CROPS FOR PROTEIN FOLDING STABILITY

Sharvan Kumar, V.B. Singh, Manjeet Kumar, Yogesh Kumar and Shalu Yadav

Department of Vegetable Science, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.)

**Corresponding author e-mail: sharvankumar41619@gmail.com*

Abstract

Vegetables tend to be more sensitive to nature, so high temperatures and soil moisture are determined by the major causes of low yields in tropical areas and will also be exacerbated by climate change. Plant response to environmental stress depends on the stage of plant growth and the length and size of the weight. Abiotic stress is best described as any natural factor in the proper functioning of the body. Abiotic pressures such as heat, cold, cold, dry salt, floods or oxidizing agents often cause protein inefficiency. The tightness of protein binding is undoubtedly one of the most challenging problems in living conditions under stress. Effective protein preparation programs and overall protein intake contribute to the survival of sudden changes in the environment. Like organic sessile plants plants need to adapt quickly to overcome various environmental pressures during their lifetime. More recently, much emphasis has been placed on understanding how plants perceive external conditions and initiate protective responses as the means by which protein activity is protected and maintained. Biological macromolecule proteins are involved in almost all biological processes in the living system. The role of proteins is unique and complex. Proteins are used for the storage and transport of small molecules or ions and to regulate the passage of molecules by cell cells that are essential for body function. Hormones, which transmit information and allow for the regulation of complex cellular processes, are important regulators in response to abiotic stress. Enzymes act as stimulants and increase, precisely, the speed of chemical reactions that are essential for the body's survival.

Key words: Abiotic stress, protein, biological traits, environment

***

T-01.5 BIO-EFFICACY OF SOME INSECTICIDES AGAINST FRUIT AND SHOOT BORER (*LEUCINODES ORBONALIS* GUENEE) OF BRINJAL AND THEIR EFFECT ON NATURAL ENEMIES

Shalini Pandey

Agricultural Research Station, Agriculture University, Mandor, Jodhpur, Rajasthan

**Corresponding author e-mail: pandeyshalini80@gmail.com*

Abstract

Field experiment was conducted to evaluate the bio-efficacy of various insecticides against fruit and shoot borer of brinjal, *L. orbonalis* at Agricultural Research Station, Mandor during rabiseason, 2018. The experiment was laid out in randomized block design with 6 treatments included untreated control. Different insecticidal treatments were Emamectin benzoate 5% SG @ 150, 200 and 250 g/ha, lambdacyhalothrin 5% EC @ 300 ml/ha, Chlorpyriphos 20% EC @1000 ml/ha. Observations for *L. orbonalis* incidence was based on fruit damage and it recorded after 10 days of first spray and 10 and 20 days after second spray on 5 plants per

replication. Population of natural enemies was also recorded before spray and after 3 and 7 days of each spray from each plot. Minimum fruit damage (2.33%) was observed in treatment Emamectin benzoate 5% SG @ 250 g/ha with highest yield of 163.12 q/ha. However, it was at par with Emamectin benzoate 5% SG @ 200 g/ha (2.67%) with yield of 159.26 q/ha.Population of natural enemiesviz., coccinellid beetle in the treatment Emamectin benzoate 5% SG, Lambdacyhalothrin 5% EC and Chlorpyriphos 20% EC were statistically at par with control. Considering the results, Emamectin benzoate 5% SG @ 200 g/ha was found to be most effective in protecting the brinjal crop from the incidence of *L. orbonalis*.

Key words: Bio-efficacy, insecticides, leucinodes orbonalis, brinjal, natural enemies.

***

T-01.6 PRESENT STATUS, CHALLENGES AND FUTURE PROSPECTS OF VEGETABLES AT NATIONAL AND GLOBAL LEVELS PRESENT AND FUTURE SITUATION OF VEGETABLES

Sushma Kotha

Department of Vegetable Science, College of Horticulture, SKLTSHU, Rajendranagar, Hyderabad

**Corresponding author e-mail*: *kothasushma20*@gmail.com

Abstract

Vegetables play an integral part in human diet. On average, global production of vegetables is not sufficient. Despite, India being second highest producer in world but is not sufficient due to the low yield per hectare. Presently, vegetable production and storage till consumption, faces a lot of challenges and issues. Lack of technical knowledge of scientific cultivation, Irrigation, transportation, Refrigeration, storage facilities and malpractice in marketing, lack of research and capital. Problems with insects, pests, diseases, weeds, quality and quantity of seed production, post-harvest management. At global level these issues achallenge if overcome, there is a bright future for vegetables. Mainly, protected cultivation and vertical farming are our future prospects. There are only few types of vegetable crops which are more focused on like tomato and potato. Different vegetable crops should be given equal importance and proper knowledge of their nutritive value should be given. Proper varieties and quality if maintained, there is scope for vegetable export industry. Vertical farming of vegetables is to play an important role to feed the large future population.

Key words: Vegetables, production, abiotic, vertical farming

***

T-01.7 DOMINANCE OF *APHIS GOSSYPII* AMONG DIRRERENT APHID SPECIES RECORDED FROM DIFFERENT HORTICULTURAL PLANTS AT RAIPUR, CHHATTISGARH

Rashmi Gauraha, Jayalaxmi Ganguli, Chunni Kumari and Ambika Nag

Department of Entomology, College of Agriculture,

Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh. 492012

**Corresponding author e-mail*: rashuritu@yahoo.co.in

Abstract

Aphids (Hemiptera: Aphididae) are among the most important sucking pests of agricultural crops. The economic importance of aphids has been widely accepted since they suck the sap affect the plant growth transmits several plant viruses. The recent studied were carried out in Raipur (Chhattisgarh) during the year 2018-19 on more than ten host plants and observed that Aphis gossypii was recorded on Bottle gourd, Tecoma plant, Tridax procumbens, Hibiscus, Marigold and from Parthenium was most dominating spp. followed by *Aphis craccivora* on Cow pea & beans, *Aphis nerri* on Callotrophis plant. Other species of aphids recorded were *Schoutedenia emblica* on Aonla, *Myzus persicae* on potato, *Brevicoryne brassicae* and *Lipaphis erysimi* on Cabbage, *Schizaphis graminum* on *Echinocloa* spp., *Uroleucon compositae* on Bellis perennis (daisy), *Aphis spiraecola* on Bruise wort. The samples of aphids were identified by Dr. Sunil Joshi, NBAIR, Bengaluru.

Key words: Aphid, host plants, viruses, transmission

***

T-01.8 EFFICACY OF BIO-AGENTS FOR MANAGEMENT OF POTATO DISEASES

Ram Pal Verma* and Shivam Kumar

Department of Plant Pathology,

C. S. Azad University of Agriculture and Technology, Kanpur, U.P.

**Corresponding author e-mail*: *rampalverma38@gmail.com*

Abstract

Potato is an important food crop in the world as well as in India. It is being affected by different pathogens, *viz.* fungi, bacteria, viruses and nematodes. These pathogens may cause significant yield losses of the crop, if proper protection measures not applied. Potato crop affected by many diseases such as: late blight of potato (*Phytophthora infestans*), early blight of potato (*Alternaria solani*), Black scurf of potato (*Rhizoctonia solani*).Fusarium dry rot (*Fusarium*

spp.), Bacterial wilt (*Ralstonia solanacearum*) common scab of potato (*Streptomyces* spp.) Blackleg and bacterial soft rot (*Erwinia carotovora* sub sp. *Atroseptica*) and potato viruses are the major disease of potato. For management of these pathogens, various methods are applied that is, cultural control, physical control, biological control and chemical control. Out of these methods, biocontrol methods are very useful method for the management of potatoes disease. A variety of biological controls such as Trichoderma, Pseudomonas, Bacillus etc. are available for use, but further development and effective adoption will require a greater understanding of the complex interactions among plants, people, and the environment. These bio-agents help in not only managing the diseases but also increasing the crop yield, give protection to the crop throughout the crop period, they do not cause any toxicity to the plants. So, biological control is the safest and cheapest method for managing the diseases. Nature and practice of biological control as it is applied to the suppression of plant diseases. Therefore, the use of bio-agents for biological management of potato crops is the focused research area worldwide. Briefly outline future directions that might lead to the development of more diverse and effective biological controls for plant diseases management.

Key words: Bio-agents, potato, diseases, biological control

***

T-01.9 ROLE OF MICRO-ORGANISMS IN FOOD SECURITY AND SAFETY OF HORTICULTURE CROPS

Pooshpendra Singh Dixit*, Mahendra Chaudhary, D. P. Singh and Ankit Singh Chauhan

Department of Vegetable Science,

C. S. Azad University of Agriculture and Technology, Kanpur, U.P.

**Corresponding author e-mail: ipushpendrasingh@hotmail.com*

Abstract

Horticultural crops, whether they are fruit crops, vegetable crops, flower crops, or spice crops, suffer attacks from various kinds of pests and pathogens which reduce the marketable yields and quality of the produce. To protect their crops and ensure a bountiful harvest, farmers apply a number of pesticides during the crop growth period. Considering the dissipation rate of the pesticide on a particular horticultural commodity, the minimum pre-harvest interval (PHI), i.e. the time required from the time of application of the pesticide till its residue level has fallen below the specified MRL at harvest, is determined. It is well known that many microbes play an important role in the control of diseases and insect pests. Quite a few of these belonging to Trichoderma and Bacillus genera are generally regarded as safe for use in agriculture. In India, foliar application of Trichoderma has provided good control of postharvest decay in grapes; its soil application-controlledPhytophthora diseases in many horticultural crops like mandarin, black pepper, cardamom etc.Botrytis cinerearot in strawberry and postharvest losses in mango. Application of such micro-organisms on horticultural crops will be a safe, effective and

economically feasible method for enhancing in-situ degradation of pesticides and bringing their terminal residues to as low as possible levels.

Key words: Horticultural, diseases, Trichoderma, Phytophthoraand microorganisms.

***

T-01.10 INTERRELATIONSHIP BETWEEN CLIMATE CHANGE, BIODIVERSITY AND HEALTH

Nisha Meena[1,*] and Rakesh Kumar Meena[2]

[1]Assistant Professor, Jagannath University, Jaipur)

[2]Ph.D. student Entomology, RARI (SKNAU, Jobner)

Corresponding author e-mail- nisha.meena@jagannathuniversity.org

Abstract

Biodiversity provides numerous ecosystem services that are crucial to human well-being at present and in the future. Climate is an integral part of ecosystem functioning and human health is impacted directly and indirectly by results of climatic conditions upon terrestrial and marine ecosystems. Longterm changes in climate affect the viability and health of ecosystems, influencing shifts in the distribution of plants, pathogens, animals, and even human settlements. Biodiversity provides many goods and services essential to life on earth**.** The management of natural resources can determine the baseline health status of a community. Environmental stewardship can contribute to secure livelihoods and improve the resilience of communities. The loss of these resources can create the conditions responsible for morbidity or mortality. Biodiversity supports human and societal needs including food and nutrition security, energy, development of medicines and pharmaceuticals and freshwater, which together underpin good health. It also supports economic opportunities, and leisure activities that contribute to overall wellbeing. Land use change, pollution, poor water quality, chemical and waste contamination, climate change and other causes of ecosystem degradation all contribute to biodiversity loss and, can pose considerable threats to human health. Human health and well-being are influenced by the health of local plant and animal communities and the integrity of the local ecosystems that they form. Infectious diseases cause over one billion human infections per year, with millions of deaths each year globally.Approximately two thirds of known human infectious diseases are shared with animals, and the majority of recently emerging diseases are associated with wildlife.

Key words: Climate change, global warming, disease incidence, pest infestation, mitigation strategies.

***

T-01.11 IDENTIFICATION OF NEW SOURCE FOR FUSARIUM WILT RESISTANCE IN BRINJAL (*SOLANUM MELONGENA* L.)

Partha Saha[1*], B.S. Tomar[1,] Y.A. Lyndoh[1], A.D. Munshi and Shanmugam

[1]Division of Vegetable Science,

[2]Division of Plant Pathology, ICAR-Indian Agricultural Research Institute, New Delhi

**Corresponding author e-mail: hortparth@gmail.com*

Abstract

Fusarium wilt caused by soil borne fungus *Fusarium oxysporum* f. Sp. *melongenae* is one of the most devastating diseases in brinjal. The identification of resistance source is the major breeding objective to develop resistant variety (s). The present investigation was carried out at Division of Vegetable Science, ICAR-IARI, New Delhi. A total of 20 breeding lines were evaluated in sick plot in randomized block design with three replications. Observations were recorded from each line based on standard scoring protocol and data were analyzed. Significant differences were observed between all the lines tested. Out of twenty brinjal lines, 7 were found resistant (R), 8 moderately susceptible (MS) and 5 lines were found susceptible (S). The resistant lines obtained in the present study can be used in crossing programme to develop resistant varieties.

Key words: Brinjal, fusarium wilt, breeding lines, resistance

***

T-01.12 FARMER'S INNOVATION OF CYCLE MOUNTED AGRI-INTERCULTURAL IMPLEMENT FOR THE LINE SOWING VEGETABLES SPECIALLY MENTHA CROPS IN ALIGARH DISTRICT: A CASE STUDY

Vinod Prakash[1,*] and A. K. Singh [2]

[1]Scientist (Extension),

[2]Additional Director Extension (Horticulture),

C.S.A. University of Agriculture & Technology, Kanpur, U.P.

**Corresponding author e-mail: vpkvk10@gmail.com*

Abastrct

All the lighter and finer operations carried out on the soil, between sowing had harvesting are termed as intercultural operations. They include weeding, fertilizer application, mulching, etc. The machineries and implements used for this purpose are called as inter cultural equipments.

Farmers who adopted Mentha and vegetables cultivation were facing problems in mainly intercultural operation. Intercultural implements are available on much costly and heavy in handling. Moreover, the intercultural operation faces a number of emerging challenges, including having labour intensive, time consuming, increasing demand and unavailability of labour. In this context, the need to develop innovative approaches to meet the needs of the rural people is all too evident. The process by which people develop new and better ways of doing things - using their own resources, on their own initiative and based on own problem. An innovation is thus embodied in a technique, technology or practice that is an outcome of this process. Farmer innovation in Northern Malaw (2012). Sri Navendra Kumar Chauhan is an innovative farmer has designed and developed a Cycle mounted Agri-intercultural implements for intercultural operation in the line sowing crops. It is light in weight, low cost and farmer's friendly. The total cost is only Rs. 750-1000 and approximate weight of 4-5 kg. It is feasible, acceptable and economically for saving time and money in the intercultural operation. It is economically feasible for the farmers where vegetable growing is predominant. The benefits obtained through this device are in term of saving on cost/scarcity of labour and time. If it is done by the labour then cost of intercultural was Rs. 9000/ha in 12 days/ labour whereas with the help of this implements is Rs. 1500/ ha. in 3 days/labour. The overall benefits are Rs.7500.00 per hectare. The implement has been disseminated and is being used by 45 farmers in the village and out of village which are growing vegetables cultivation and especially Mentha crop. Area is covering approximate 150.00 ha.

Key words: Intercultural operation, Agricultural implements, doubling farmers' income (DFI), innovation and dissemination technology.

***

T-01.13 AGROBIODIVERSITY OF VEGETABLE CROPS: ASPECT, NEEDS AND FUTURE PERSPECTIVES

G. Sangeetha*, G. Subash and S. Karthickeyan

AAIT, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India,

**Corresponding authors' e-mail: neelayathakshisangaakash@gmail.com*

Abstract

Agro-biodiversity represents biodiversity of the agro-ecosystems, and it plays a fundamental role in maintaining the resilience of crops. Vegetables are an important commodity with diversity at several levels such as organ consumed, grade of transformation after harvesting, etc. However, the modern cultivars, by decreasing their agro-biodiversity exhibit, reduced resilience to pests and climatic changes and may, in several cases, show lower levels of bioactive compounds. Moreover, agro-biodiversity should not be evaluated, but also the underlying services beneath it should be carefully taken into account. To overcome such

problems, a reappraisal of agro-biodiversity is essential, as it allows the 'genetic bottleneck' induced by modern varieties to be expanded and an increased range of vegetable products made available. In this, after some considerations of the importance of vegetables and their distribution across the world and how agro-biodiversity has decreased, mainly due to the adoption of modern varieties, and suggest some innovative use of 'novel' vegetable products with an added value for human health and wellness.

Key words: Agro-biodiversity, agro-ecosystems, genetic bottleneck, novel vegetable products, climatic changes

***

T-01.14 APHIDS AND THEIR BIO-CONTROL AGENTS ON DIFFERENT CROP ECO-SYSTEMS

Rashmi Gauraha and Jayalaxmi Ganguli

Department of Entomology, College of Agriculture,

Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh. 492012

**Corresponding authors' e-mail*: *rashuritu@yahoo.co.in*

Abstract

Aphids are sap feeding insects & that emerge early in the spring. They have piercing & sucking mouth parts & spread plant disease. There are several naturally occurring species of predators that feed on aphids. Aphids are soft bodied & their colour varies depending on the species. Lady bird beetles are probably the most well-known beetles that eat aphids are widely distributed in different agro ecosystem. Most commonly recorded species are Menochillussexmaculata feeds on cowpea aphids, Micraspisunivittatta were observed on Rice & Parthenium weeds. Coccinella transversalis & Propylladisecta were recorded on Indian bean & cowpea ecosystem. Brumoidessuturallis were recorded on Parthenium and other weed crops. Scymnus grubs were observed on Callotrophis plants feeding on Aphis nerri.

Key words: Aphid species, eco-system, crops

***

T-01.15 BIODIVERSITY OF VEGETABLE CROPS

***B. Sakthivel and *K. Ramkumar**

*Research scholar, Department of Horticulture, Annamalai University, Annamalai nagar, Tamilnadu, India

**Corresponding author e-mail: lakshmixeroxcdm@gmail.com*

Abstract

Diversity of vegetables is more than a local acceptability – it plays an important role in ensuring adequate levels of nutrition and the challenges of agricultural production posed by climate change and soil degradation. Many traditional vegetables like as Moringa, Agathi, etc. are known to have higher nutritional value than their commercial counterparts, and are well-adapted to local conditions, exhibiting resistance to drought, pests, diseases and marginal soil conditions. Lack of information about traditional vegetables is, however, a major barrier to their use and promotion because it hampers a wider recognition of their values and understanding of management aspects of best to grow process and market them.

Key words: Diversity, vegetables, stress, management

***

T-01.16 INTEGRATED PEST MANAGEMENT OF BRINJAL SHOOT AND FRUIT BORER (*LEUCINODES ORBONALISGUENEE*)

Munna Yadav[1,*], Sountharya R[2], Dhyanananda Kumari[3], Mina Kumari[4], Naaserah Zeeshan[5], Rajendra Prasad[6] and Shambhu Roy[7]

[1]ICAR-IINRG, Namkum, Ranchi, Jharkhand

[2]Department of Entomology, Tamilnadu Agricultural University, Coimbatore

[3]Department of Horticulture (Pomology), BAU, Sabour, Bhagalpur

[4]Ph.D. Research Scholar, Department of Plant Pathology, RPCAU, Pusa, Samastipur

[5]LPD, ICAR-IINRG, Namkum, Ranchi, Jharkhand

[6]SMS (Agronomy), Krishi Vigyan Kendra, Sheohar, RPCAU, Pusa, Samastipur

[7]Senior Scientist and Head, KVK, Lakhisarai, BAU, Sabour, Bhagalpur, Bihar, India

**Corresponding authors' e-mail- munnayadavrau@gmail.com*

Abstract

Brinjal is one of the important vegetable crops grown in India and all throughout the world. Among the various pests and diseases of brinjal, the brinjal fruit and shoot borer, *Leucinodes orbonalis* Guenee creates huge losses and is a huge menace to the brinjal production throughout the world. It is regarded as one of the key pests of brinjal. Because of the pest's devastating nature, it is of prime importance to manage the pest by utilizing various pest control strategies. The usual method of control preferred by farmers is application of chemical insecticides. Besides, the pest can also be managed by employing a variety of strategies like cultural, biological, and bio-rational methods, etc. There are also IPM packages for effective management of the pest and to increase the yield of brinjal. Few studies have been conducted by using combinations of more than one source of pest control so as to assess their compatibility and effectiveness towards IPM programs. Such combinations also bring out the synergistic effect, enhancing their potency but for that they need to be tested in a scientific experimental setting. Strategies that are recommended to the farmers include combinations of botanical insecticides along with chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC and

emamectin benzoate 5 SG, combination of Trichogrammachilonis and cypermethrin.Integrated pest management strategies are also devised for brinjal growing farmers since brinjal shoot and fruit borer is a major pest causing heavy losses in yield and a few studies have been done to test their effectiveness against the pest. IPM strategies had been promoted through front line demonstrations in 10 farmer fields to avoid ill effects of insecticides. The IPM strategies promoted include clipping and disposal of infested shoots, removal of fruits with boreholes, installation of pheromone traps @ 12/ ha, release of Trichogrammachilonis @ 8 cc/ ha for 4 times at weekly interval, spraying of Bacillus thurinjiensis @ 1 kg/ha and flubendiamide 20 WDG 7.5 g /10 lit. In terms of yield alsothe IPM practices showed better results to when recommended to the farmers. IPM field was found to be giving high fruit yield to the tune of 32.8 t/ha with high B:C ratio (4.05) when compared to farmers practice (Non IPM with B:C ratio of 3.1). The strategies can be combined into IPM strategies against the pest and such standard packages are need of the moment in our combat against the pest.

Key words: Shoot and fruit borer, integrated management, brinjal, B:C ratio

***

T-01.17 INTRODUCING E-COMMERCE WEBSITES IN LOCAL VEGETABLE MARKETS

Shivam Kumar[1*] and Bipul Kumar Singh[2]

Department of Extension Education, Bihar Agricultural College, Sabour (Bhagalpur), Bihar

Young Professional-II, Biotech KISAN Hub, Bihar Agricultural College, Sabour (Bhagalpur), Bihar

**Corresponding author e-mail*: *shivamextn@gmail.com*

Abstract

The year 2020 has been probably the toughest year for mankind. The spread of novel corona virus, SARS-CoV-2, and the COVID-19 disease has caused unprecedented impacts on all spheres of life. Vegetable market has not been any exception. Vegetable being a perishable good is consumed fresh but sanctions, lockdown and lack of transportation in local markets in wake of corona virus has hindered its fresh availability to the consumers. Vegetable growers are facing high volatility in the prices of vegetables. This has incurred heavy losses to vegetable growers at all levels. It is depressing for farmers and prolonged situation like this may force them out of business. Clearly this whole situation needs an alternative way to market the vegetable produce, if the problem persists. E-commerce deliveries can come as aid to the farmers in any similar situations in future. A number of e-commerce companies have already been operating at local levels in different parts of India including some e-commerce giants like Big Basket, Reliance Fresh, etc. Their modus operandi being procurement of vegetables from local vegetable growers and selling the produce at their authorized stores. They also have

system of delivering vegetables to orders placed online via Mobile apps and Websites. The need of the hour is to develop such user-friendly and convenient e-commerce websites and applications and train the farmers to use these e-commerce platforms. Government initiatives in this regard can bear fruitful results. This will help the farmers to sell their produce hassle-free in local areas. It will also give boost to Bihar Government's ambitious project of setting up of 'Organic Farming Corridors' along both sides of River Ganga in 12 cities of Bihar by availing readymade online market to sell organic produce that has low demand in local or village markets. World is changing at a shocking pace, its high time we change too.

Key words: COVID-19, vegetable growers, organic farming corridor, e-commerce companies.

***

T-01.18 SURVEY OF *MELOIDOGYNE INCOGNITA* INFESTATION IN DIFFERENT DISTRICTS OF BIHAR, INDIA

***Kshitiz and Nishi Keshari**

Department of Nematology, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

**Corresponding author e-mail: rituverma36@gmail.com*

Abstract

Capsicum growing polyhouses were surveyed in four districts, viz. Samastipur, Vaishali, Darbhanga and Muzaffarpur districts of Bihar, to study the infestation and nematode population of root knot nematode, Meloidogyne incognita in capsicum during 2019-20. Five samples from each district comprising of soil and roots from 10 randomly selected spots from the depth of 10-15 cm rhizosphere region with the help of a scoop, were collected and composite representative sample of 200 g of soil along with roots, was collected and sealed in polythene bag, and a tag having information about polyhouse location, district and date of sample collection, was pasted. Plants for sampling were selected, based on typical symptoms, i.e. yellowing and stunting of plants. Plants were brought to the laboratory for assessing crop infestation and the parameters, like nematode population/200 g soil, egg masses per gram of soil, eggs/ eggmass, number of females, were observed and root knot index was calculated. The results indicated that although in every district, the root knot infestation was found in some samples but, maximum number of nematode population/200 cc soil, egg masses per gram of soil, number of females per plant and root knot index was found in Muzaffarpur district (3205.4, 5, 124 and 3.2 respectively) followed by Samastipur, Vaishali and Darbhanga. Minimum infestation was observed in Darbhanga district. The eggs per eggmass was found maximum (104.8) in Vaishali district. Thus, it can be concluded that maximum infestation of root knot nematode in capsicum polyhouses, was found in Muzaffarpur district and minimum in Darbhanga district.

Key words: Root knot nematode, capsicum, eggmasses, survey and polyhouse

***

T-01.19 MANAGEMENT OF BRINJAL SHOOT AND FRUIT BORER, *LEUCINODES ORBONALIS* GUENEE, THROUGH NEWER INSECTICIDES IN BIHAR

Manoj Kumar[1], Shriti Moses[2], Vikram Bharati[3], Shyam Babu Sah[4] and Munna Yadav[5]

[1]Assistant Professor, Department of Entomology, RPCAU, Pusa (Samastipur) Bihar

[2]Ph.D Research Scholar, Deptt. of Entomology, Uttar Banga Krishi Viswavidyalaya, Cooch Behar,West Bengal

[3]Assistant Professor, Department of Agronomy, TCA, Dholi, RPCAU, Pusa (Bihar)

[4]Assistant Professor-cum-Junior Scientist, Department of Entomology, MBAC, Agwanpur, Saharsa (Bihar)

[5]Senior Research Fellow, ICAR-IINRG, Namkum, Ranchi, Jharkhand

**Corresponding author e-mail*: *manojraupusa2015@gmail.com*

Abstract

Brinjal shoot and fruit borer (BSFB), *Leucinodes orbonalis* Guenee is the most destructive pest of brinjal (Solanum melongena L.) in all brinjal growing areas of Bihar. Its immature fruits are used as vegetable and extensively used in various culinary preparations. It is highly productive and usually finds its place as the poor man’s vegetable. Some medicinal uses of brinjal include treatment of diabetes, asthma, cholera, and bronchitis. The brinjal crop is attacked by about 140 species of insect pests Dwivedi *et al.,* 2014. In India, this pest has a country wide distribution and has been categorized as the most destructive and most serious pest causing huge losses upto 40-60% in brinjal Patil, 1990. Larva bores into tender shoots and causes withering of terminal shoots or dead hearts also bores petioles of leaves, flower buds and developing buds, causes withering of leaves, shedding of buds and make fruits unfit for consumption. A single caterpillar may destroy as many as 4-6 fruits. The attacked fruits are with boreholes plugged with excreta and the fruits become out of shape also. Among management strategies, chemical control has its own effectiveness due to its rapid knock down effect. Avoid continuous cropping of brinjal and rationing. Grow resistance varieties like Pusa purple round, Pusa purple Long, Pant Samrat, ArkaKusumakar. Collect and destroy the damaged tender shoots, fallen fruits and fruits with bore holes to prevent population build up. Use light traps @ 1/ha to attract and kill the moths. Release of egg parasitoids Trichogrammachilonis @1.0 lakh/ha. Among the chemical insecticides spray any one of the insecticides starting from one month after planting at 15 days interval. Carbaryl 50 WP 2 kg + wettable sulphur 50 WP 2 kg, Neem oil 1.5 L, Quinalphos 25 EC 1.5 L + Neem oil 1.0 L, NSKE 5%, Azadirachtin 1.0% 1.0-1.5 L or Fenpropathrin 30 EC 250-340 ml or Thiodicarb 75 WP 625-1000 g Flubendiamide 20 WG, 375 g with 500 – 750 L water/ha. Avoid using insecticide at the time of fruit maturation and harvest. Uproot and burn old plants before planting new plants since they harbour pest and carry over infestation.

Key words: Brinjal shoot and fruit borer, newer insecticides, management.

***

T-01.20 EFFECT OF WATER SOURCE AND VERMICOMPOST ON UPTAKE OF ARSENIC IN VEGETABLE CROP

Prakash Chandra Gupta*

Krishi Vigyan Kendra, Agwanpur, Barh, Patna, Bihar, India

**Corresponding author e-mail:pcguptauas@gmail.com*

Abstract

We examined food material of our society, not only cereal and pulse, vegetable crop also uptake higher arsenic amount. In area where the arsenic (As) contaminated ground water used for irrigation, crops can uptake arsenic along with another nutrient. This can negatively affect the vegetative growth and reproductive growth of the crop. Applications of source of organic matter like vermicompost, in comparison to control. A significant differencewas detected in the concentration of total as in leafy vegetable (Amaranthus)> steam vegetable (Potato) > root vegetable (Radish)> fruit vegetable (Tomato) under corresponding vermicompost application. It has been observed that addition of organic matter reduced total as content in all vegetable 16% to 22%. Fresh weight of vegetable drastically reduced with increasing arsenic content in soil. Arsenic content of different vegetables grown with as containing irrigation water were found in the descending order of: Amaranth (0.534 ppm) > Potato (0.083 ppm) > Radish (0.051 ppm) > Tomato (0.021 ppm). The content of arsenic was found higher in the vegetables grown with arsenic contaminated irrigation water than those grown with vermicompost. The trend of arsenic accumulation was higher in leafy vegetables and lower in fruity vegetables. Arsenic uptake by different crops is physiologically variable. An addition of vermicompost reduced accumulation of arsenic in crop are due to low availability of the as from soil.

Key words: Arsenic, vermicompost, vegetable crop

***

T-01.21 PROCESSING OF VEGETABLE CROPS TO INCREASE THEIRAVAILABILITY IN OFF SEASON

Vikash Singh

Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj (Ayodhya), Uttar Pradesh**.**

**Corresponding author e-mail*: *-singhvks2296@gmail.com*

Abstract

India is bestowed with a wide range of agro-climatic and soil conditions. Therefore, almost all types of vegetables can be grown in one or other part of the country. Indian farmers grow an amazing number that is 175 different vegetables which is highest in the world. Vegetables play an important significant role in human nutrition by providing compounds related to health

promotion and disease prevention. Vegetables, being the cheapest source of vitamins, minerals, are the high valued source of nutrition to the poor family. Vegetables also control many lifestyle diseases such as cardiovascular, cancer, renal and gastric diseases to greater extent. Due to change in lifestyles, changing demography at workplace and reduced time available for cooking, the demand for high quality processed vegetables are increasing. The demand for ready-to-eat, easy-to-cook vegetables is increasing. Processed vegetables are very popular as it saves time, labour and having extended shelf life. In this context low cost vegetable processing and value addition is very important to minimize huge post-harvest losses to a greater extent for nutritional security of large section of population. During the pandemic attack of COVID 19 inadequate storage, transport, handling and processing has led to unacceptable level of wastage and value loss. This pandemic attack of COVID 19 had attracted our focus towards vegetable processing. In current situation when people cannot go outside to buy fresh vegetables, the processed vegetables could be a better option. Vegetable processing not only reduces the losses of vegetables but also increases their availability throughout year. Processing empowers the farmers and other weaker sections of society specially women through gainful employment opportunities and revitalize rural communities. Low cost processing technologies of vegetables with good aesthetic values are very important to cater the demand of urban population. Consumers can be attracted to these low-cost processing technologies for serving the needs of offseason vegetables. Furthermore, consumers in cities have very little time to peel and cook vegetables daily and cater the nutritional and sensory perception of vegetables. The demand for minimally processed vegetables like bagged spinach, cut vegetables, onion powder, ginger garlic paste, canned tomatoes, frozen vegetables and dehydrated cauliflower is increasing day by day.

Key words: Processing, canning, technology, shelf life.

***

T-01.22 PRODUCING VEGETABLES INSIDE LOW COST STRUCTURES: ITS BENEFITS AND TASKS AHEAD

Raktim Das [1]*, Ajay Bhardwaj [1], Kunal Anand [1], Divyani Raj [2]

[1] Dept. of Horticulture (Vegetable & Floriculture) Bihar Agricultural University, Sabour, Bhagalpur

[2] Dept. of Horticulture (Fruit & Fruit Technology) Bihar Agricultural University, Sabour, Bhagalpur

**Corresponding author e-mail:raktim.maan.95@gmail.com*

Abstract

Horticulture nowadays forms a thickened part of food, economic and nutritional security. Acceptance of horticulture by the small and marginal farmers has fetched enrichment in

numerous territories of the country as India is syntactic with an extensive variety of agro-climatic situations & enjoys a desirable position in the horticulture map of the world. Protected cultivation of different vegetables offers individual advantages of specific quality, productivity and fortunate market price to the growers. Growers can substantially increment their income by protected cultivation of off seasoned vegetables in off-season so far, the vegetables produced during their normal season usually do not bring excellent returns due to massive availability of such vegetable in the markets. Protected cultivation increases the income of the growers in off- season as compared to normal season. One of the most lucrative technologies under Northern Plains of India is off season cultivation. Low plastic tunnels are one of the utmost remunerative technologies under northern plains of India especially for the off-season cultivation of cucurbits. For less initial cost walk-in tunnels are also worthy and useful to enhancement off-season nursery and off-season vegetable cultivation. Especially for virus free cultivation of tomato, chilli, sweet pepper and other vegetables mainly grows in the Insect proof net houses during the rainy season. Such type of low-cost structures is also competent for growing pesticide free green vegetables. For cultivation of the various high qualities' vegetable for long term (6-10 months) especially in the peri-urban areas of the country low cost greenhouses can be used to get the analogical price of produces. The urban and peri-urban vegetable production (UPVP) systems grant farmers improve market convenience with excellent economic returns. UPVP systems significantly avail to urban food supplies, particularly of vegetables. The ability of UPVP systems is restricted by a number of factors along with various insect pests and disease problems.

Key words: Greenhouse, poly tunnel, protected cultivation, off-season vegetables.

***

T-0123 EFFECT OF BIOAGENTS AND SOIL SOLARIZATION IN THE MANAGEMENT OF ROOT KNOT NEMATODE IN CAPSICUM GROWN UNDER PROTECTED CULTIVATION

K. Kranti K.V.V.S.[1] and G. Narendra Kumar[2]

[1]AICRP Nematodes, LBS Building, ICAR-IARI, New Delhi, India

[2]National Plant Quarantine Station, Vasant Kunj Enclave, Near KendriyaVidyalaya, Nangal Dev Road, Rangpuri, New Delhi-37 India

**Corresponding author e-mail: krantihau@gmail.com*

Abstract

Root knot nematode species mainly *Meloidogyne incognita* causes devastating problem in polyhouses as well as net housesthroughout India. AICRP (Nematodes) has conducted survey in NCR region it was observed that most of the crops in polyhouses were infected with this nematode. Mostly vegetables are grown in protected cultivation and are good host for root knot

nematode. During survey at Panipat village Badoli, oneof the polyhouses growing capsicum was found heavily infected with root knot nematode. The population recorded was 7 J2 /gm soil. In the month of May- June the soil of polyhouse was covered with polythene sheet having 25-micron thickness followed by light irrigationleaving one block uncovered as untreated control. The polyhouse was sealed completely for two months. The soil population and plant growth in terms of height (in cm) was recorded after the completion of soil solarization periodically (every month) till the harvest of capsicum. The treatments were T1: Solarization +*Trichoderma viridae*, (2×10^8CFUs per cc) @ 2 Kg/ton FYM; T2: Solarization + *Pseudomonas fluorescens* (2×10^{12} CFUs per cc) @ 2 Kg/ton FYM; T3: Solarization + *Purpureocillium lilacinum* (2×10^8 CFUs per cc) @ 2 Kg/ton FYM; T4: Solarization + combination of all three bioagents; T5: only solarization and T6 as control. These treatments were applied before 15 days of transplanting of capsicum crop. It was observed that soil solarization alone reduced root knot nematode population whereas FYM fortified with three biocontrol agents increased the plant growth, fruit weight and quality of capsicum. The combination of three biocontrol agents (T4) was not more effective when compared to single application in combination with solarization (T1, T2, T3). The population of root knot nematode remained non detectable till harvest of the crop and the population of free-living nematodes increased in solarized beds compared to control. Also, there was 50 percent increase in income from the solarized polyhouse to the farmer.

Key words: Capsicum, *Meloidogyne incognita,* protected cultivation, soil solarization.

***

T-01.24 POTENTIALITY OF GROWING EXOTIC VEGETABLES

Sangeeta Kumari[1,*], Rajesh Kumar[2] and Kavita[3]

[1]Department of Horticulture (Vegetable and Floriculture),

[2]Department of Soil Science, Agricultural Research Institute, Lohiyanagar, Patna, Bihar, India

[3]Department of Botany, Plant Physiology and Biochemistry

Dr.Rajendra Prasad Central Agricultural UniversityPusa, Samastipur, Bihar, India

**Corresponding author e-mail: sangeeta6b@gmail.com*

Abstract

Vegetablecrops considered as protective food are the main drivers in achieving global nutritional security by providing nutrients, vitamins and minerals to millions of people and the cultivation is a profitable venture that assured better returns to the farmers in terms of higher yield, better quality produce and higher economic returns. This spectacular growth in vegetable production has increased and this was possible due to development of improved varieties/ hybrids/production and protection technologies through systematic research coupled with large scale adoption by the farmers. Vegetables can be eaten either raw or cooked and play an

important role in human nutrition, being mostly low in fat and carbohydrates, but high in vitamins, minerals and fiber. The importance of vegetables in providing balance diet and nutritional security has been realized world over. Vegetables are now recognized as healthy food globally and play important role in overcoming micronutrient deficiency and providing opportunities of higher farm income. The major objectives of reducing malnutrition and alleviating poverty in developing countries through improved production and consumption of safe vegetables will involve adaptation of new vegetables i.e., exotic vegetables. Selection of non-traditional varieties such as red cabbage, Chinese cabbage, lettuce, broccoli, brussels sprouts etc., can bring a see change in economic return as well as solving the nutritional problems. All these exotic vegetables can be grown successfully in Bihar if transplanted in the first week of November. In the present work we have demonstrated some potential non-traditional vegetables that will ensure profitability, prosperity and economic development to the farmers of Bihar. It could be concluded that exotic crop diversity could be more important for future nutrition, health and food security.

Key words: Exotic vegetables, nutritional security**,** economic return

***

T-01.25 BIODIVERSITY IN VEGETABLE CROPS FOR HEALTHIER LIFE

V. D. Rathva, A. J. Patel, S. D. Ninama and I. N. Bhabhor

Anand Agricultural University, Anand-388 110

**Corresponding author e-mail: vijayrathva07@gmail.com*

Abstract

India support more than 17 % of the population with only 2.4 % land share. At the global level, it appears that we are slowly moving towards global food crisis. One of the world's greatest challenges is to secure universal access to sufficient, healthy and affordable food that is produced sustainably. Current nutrition trends do not reveal a situation in which populations are well nourished, and the sustainability of how we produce, distribute and consume food is also a subject of concern. Serious levels of both under nutrition and overweight/obesity are reported for 57 out of 129 countries in the world. Intensive agriculture has generally resulted in higher productivity, but also in a trend towards decreasing levels of agro-biodiversity, which preservation represents a key-point to assure adaptability and resilience of agro-ecosystems to the global challenge to produce more and better food in a sustainable way. Many components of agro-biodiversity would not survive without the human interference, but human choices may also represent a threat for the agro-biodiversity preservation. The biodiversity in vegetable crops is composed by the genetic diversity, as species diversity (interspecific diversity) and as diversity of genes within a species (intraspecific diversity) referring to the vegetable grown varieties, and by the diversity of agro-ecosystems (agro-biodiversity). Intraspecific diversity is very ample in vegetable crops and is not reflected, at least not to the same extent, in other

groups of crops. The labor operated by farmers over centuries of selection has led to the creation of a plurality of local varieties, following domestication of cultivated forms, and wide agro-biodiversity, a precious heritage both from a genetic and a cultural-historical point of view. Therefore, the agro-biodiversity related to vegetable crops has assumed very articulated connotations. It is also important to specify that a “local variety” (also called: landrace, farmer’s variety, folk variety) is a population of a seed or vegetative-propagated crop characterized by greater or lesser genetic variation, which is however well identifiable and which usually has a local name.

Key words: Biodiversity, interspecific, intraspecific, sustainability, intensive

***

T-01.26 VEGETABLE PROCESSING IN INDIA: OPPORTUNITIES AND CHALLENGES

Pappu Lal Bairwa[1], Pravin Kumar[2] and Shoji Lal Bairwa[3*]

[1]Department of Horticulture (Vegetable), I.G.K.V., Raipur,

[2]Indian Institute of Forest Management, Bhopal,

[3]Dr. Kalam Agricultural Colleges, Kishanganj

**Corresponding author e-mail: smabm.bhu@gmail.com*

Abstract

Vegetable cultivation is an important component of farming across the country. Farmers keep vegetable as a major element of their farm farming as vegetables have nutritional values as well as their daily requirement of life. In other words, vegetables are an item of daily consumption as they are essential in human diet for healthier life. In world, India has second position and produced around 162.187 MTs of vegetables which accounts for nearly 14.0% of country’s share in the world production of vegetables. Indian farmers have the ample scope of production and productivity but the post-harvest losses and other marketing related problems create barriers for better realization of remunerative prices. Indian agriculture is dominated by smallholders and marginal farmers and they constrained by lack of capital, inputs, technology, services, and access to markets. Indian agricultural marketing system has number of inefficiencies like post-harvest losses, large no. of intermediaries, non-transparent price setting, dispersed markets, and deprived markets, high losses during handling, storage and lack of processing facilities. Cultivation of vegetables is generally concentrated around towns and cities due to their perishable nature and high demand. The loss of vegetables can be minimized and make available to consumers throughout the year by the processing and post-harvest management. Improved practices, technology-based operations, better transportation, storage, handling, and processing are important for achieving the goals of mitigation of post-harvest management. Vegetable can be converted in processed vegetables like canned, frozen, purees,

sauce, dehydrated, and pickled products. Thus, the processing of vegetable can minimize the losses and increases the availability of vegetable in various processed products throughout the year to the consumers but the improved marketing and processing infrastructure are the prime facie requisite for getting the goal of vegetable processing in the country. The government and policy maker should be concentrated and focused on creating environment for processing industries and infrastructure for processing of various vegetables in the country.

Key words: Vegetable processing, processed products, marketing and post-harvest losses.

***

T-01.27 ECONOMICS OF MARKETING OF MAJOR VEGETABLES IN BARAUT BLOCK OF BAGHPAT DISTRICT OF UTTAR PRADESH IN PANDEMIC SITUATION OF CORONA CRISIS

***Lalit Kumar Verma[1], Nitin Kumar Nag[1], and Shashank Tomer[2]**

[1]Department of Agricultural Economics, J. V. College, Baraut, Baghpat, U.P., India

[2]Department of Horticulture, J. V. College Baraut, Baghpat, U.P., India

**Corresponding Author e-mail: verma.lalitkumar49@gmail.com*

Abstract

India is second largest producer of fruits and vegetables in world. India produces about 14% of world's vegetables from 15% world's area. The vegetable productivity in India is less than the world average productivity. Nearly 30-40% vegetables were wastage during the supply chain i.e. reaching from producer to consumer. Most of the marketing of vegetables in India is done in unorganized sector and very little quantity is marketed through organized sector. Present study was an attempt to study the marketing channels and to examine the marketing efficiency of organized retail chain. The Baraut blocks of Baghpat district was selected purposively for the present study. A total of 35 farmers, 4 intermediaries, 01 retailer and 50 consumers were selected. Vegetables *viz* tomato, potato, onion, okra, brinjal, and green chilli were selected for the study in present pandemic period. Among the organized supply chain i.e. channel II, the cost incurred per kg of vegetables was much lower than the cost incurred in the traditional supply chain i.e. channel-I. In channel-I, the net return and marketing efficiency was higher for channel II than channel I for all the vegetables under study. At the same time organized supply chain was found to be smallest price spread. Hence organized supply chain (channel-I) was found more efficient as compared to unorganized supply chain (Channel-II). Hence it is advisable to the farmers to sell their produce through modern supply chain i.e. channel II as it is more efficient because the commodity was purchased directly from the producer.

Key words: COVID-19, marketing channel, marketing efficiency, policy reform, policy.

***

T-01.28 NUTRITIONAL SECURITY THROUGH HOMESTEAD GARDENING: A POSSIBLE VENTURE FOR UP-SCALING

Arindam Nag*

Dr.Kalam Agricultural College, Kishanganj,

Bihar Agricultural University, Sabour, Bihar, India

Corresponding author e-mail: arindam.apdj@gmail.com

Food security in terms of nutritional security is often considered as most important by the development professionals. Achieving nutritional security through availability, accessibility and affordability of required nutritional food is important not only for tackling food insecurity and malnutrition; but also for achieving proper growth and development of individuals. In this aspect, the role of nutritional garden in homestead area is having greater importance. Proper planning and utilization of growing of seasonal vegetables (including leafy vegetables), fruitplants, medicinal plants in surrounding areas of home, as well as utilizing the rooftop area of home for vegetables for supplying season round nutrition are few of the important activities under nutritional garden. Proper skilling of women for maintaining homestead garden makes them empowered with a sense of ownership which helps to reduce the gender bias in allocation during food consumption. Socio-cultural and biological factors make women as an important agent of food security status in family. So, designing, implementation, skilling and monitoring of nutritional gardening activity focused around gender relations are essential for removing barriers of achieving nutritional security. Thus Homestead gardening in this aspect a possible tool for achieving family nutritional security.

Key words: Homestead garden, nutritional security, women empowered

***

T-01.29 TIME SAVING THROUGH STEPPED VARIABLE APPLICATION RATE IN SPRINKLER IRRIGATION FOR VEGETABLE CROP IN FINE SANDY LOAM SOILS

Jitendra Kumar* and Bholanath Saha

Dr. Kalam Agricultural College, Bihar Agricutural University, Kishanganj, Bihar

Corresponding author e-mail: jitendra.kumarc@gmail.com

Abstract

The study was conducted to develop a theory for time saving by stepped variable application rate over constant application rate in Sandy loam soil. A mathematical equation was developed

for variable application rate based on infiltration rate and application rate of sprinkler. To apply a given depth of irrigation, the time saving was calculated by stepped variable application rate over constant application rate. Different sprinkler models were selected for this study. Five sprinkler models, i.e., 100 BSSP model, 100 BSTP model, 400 triple model, Meghdoot model and Indra model were taken with recommended operating pressure range. For each type of sprinkler model, four different nozzle diameters with three spacings of sprinkler were selected. The developed theory was applied for different short time intervals viz., 15 minutes, 30 minutes and 60 minutes. The time saving with all these parameters was calculated. The time saving increased with increase in nozzle size. The range of the time saving was 1.5 hrs to 9 hrs for fine sandy loam soils to apply 10 cm depth of water.

Key words: Vegetable crop, application rate, time saving infiltration rate

***

T-01.30 ARSENIC TOXICITY IN VEGETABLES

Bishun Deo Prasad[1*] and Sangita Sahni[2]

[1]Dept. of Molecular Biology and Genetic Engineering, Bihar Agricultural College, Sabour, BAU, Sabour, Bhagalpur, Bihar; [2]Dept. of plant Pathology, TCA, Dholi, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar

*E. mail: bdprasadbau@gmail.com

Abstract

Arsenic (As) is a highly toxic as well as carcinogenic element exists in nature. The increasing level of As in soil and water has led an unprecedented situation across the globe. However, its contamination in Southeast Asia including India is a major catastrophe, the consequences of which exceed most other man-made disasters. The sources of As exposure in human include drinking water and foodstuffs. Several schemes have been launched to mitigate As poisoning in drinking water. However, no effective strategy has been employed to mitigate As from soil and irrigated water. Widespread uses of As contaminated irrigation water has lead another major exposure route in crops. As from soil and irrigated water enters into plants through roots and translocate throughout the plants parts, which further enters in the food chain and affect food safety. Apart from cereals, the increasing trends of production and consumption of vegetables are evident in India. A plethora of reports indicates the As concentration in vegetables grown in As contaminated areas exceeded the maximum permissible concentration. Reports indicate that potatoes had the highest As accumulation even more than that in rice. However, the distribution of As in vegetable tissues was observed to be species dependent. The high amount of As accumulation was observed in leaves of tomato and spinach. The higher accumulation of As was observed in vegetables grown under flood irrigation compared to non-flood irrigation. Both organic (e.g., monomethylarsonic acid (MMA), and dimethylarsinic acid (DMA) etc.) and inorganic species of As (iAs) are prevalent in nature, the latter being more toxic and mobile than organic As species. Recent reports suggests that organic As undergo limited metabolism and hence less toxic to humans. The variation in the levels of inorganic and organic As species

in different vegetable crops influence the associated As toxicity. Therefore, it is necessary to reduce the iAs concentration in vegetable crops to avoid the potential risk to human health.

Key words: Arsenic, Monomethylarsonic acid (MMA), Dimethylarsinic acid (DMA), Carcinogenic, Vegetable

***

T-01.31 ECONOMIC ANALYSIS OF MENTHOL MINT CULTIVATION IN ROHTAS DISTRICT OF BIHAR

Ratan Kumar[1], Rajeev Singh[2,*], Ram Pal[1], and R.K. Sohane[3]

[1]Krishi Vigyan Kendra, Rohtas

[2]Krishi Vigyan Kendra, Manpur, Gaya

[3]Directorate of Extension Education, BAU, Sabour

**Corresponding author e-mail: singhrajeev79@gmail.com*

Abstract

The present study has been carried out in the Rohtas district of Bihar on economic analysis of menthol mint cultivation in the year. The economics has been worked out by comparing costs and returns at different stages by the conventional method. The linear production functions have been found to be 2.85, which indicate a higher profit for farmers on less investment in mint cultivation. The socio-economic and resource structure was found that average family size was 7.54 in Dawath and was 7.83 in Dinara block. The average landholding size was found 1.10 ha and 1.18 ha in Dawath and Dinara block respectively. The cost structure of mentha cultivation was found that in operational cost the maximum share was of hired labour (35.8%) followed by the inter-culture operation (18.75%), distillation charges (12.61%) and irrigation was 9.99%. It was also found that the farmers got about 3.66 is highest B:C return in two blocks. But mentha oil from crop in one hectare of land which amounted net return 93100 in Dawath and 94200 in Dinara block. The independent variables like human labour, machinery, manures and fertilizer, irrigation charges and intercultural operations have shwon a positive and significant impact on the returns of mentha crop in the study area. The major problems faced by the farmers are high input cost, erratic supply of electricity, lack of adequate information, infrastructural facilities, regulated markets and energy-efficient distribution units.

Key words: Menthol mint, Medicinal and aromatic plants, Mentha crop, Rohtas, Economic analysis.

***

T-01.32 FARMER'S INNOVATION OF CYCLE MOUNTED AGRI-INTERCULTURAL IMPLEMENT FOR THE LINE SOWING VEGETABLES SPECIALLY MENTHA CROPS IN ALIGARH DISTRICT: A CASE STUDY

Vinod Prakash[1,*] and A. K. Singh[2]

[1]Scientist (Extension) and

[2]Additional Director Extension (Horticulture)

CSA University of Agriculture & Technology, Kanpur, UP

**Corresponding author e-mail: vpkvk10@gmail.com*

Abastrct

All the lighter and finer operations carried out on the soil, between sowing had harvesting are termed as intercultural operations. They include weeding, fertilizer application, mulching, etc. The machineries and implements used for this purpose are called as inter cultural equipments. Farmers who adopted Mentha and vegetables cultivation were facing problems in mainly intercultural operation. Intercultural implements are available on much costly and heavy in handling. Moreover, the intercultural operation faces a number of emerging challenges, including having labour intensive, time consuming, increasing demand and unavailability of labour. In this context, the need to develop innovative approaches to meet the needs of the rural people is all too evident. The process by which people develop new and better ways of doing things - using their own resources, on their own initiative and based on own problem. An innovation is thus embodied in a technique, technology or practice that is an outcome of this process. Farmer innovation in Northern Malaw (2012). Sri Navendra Kumar Chauhan is an innovative farmer has designed and developed a Cycle mounted Agri-intercultural implements for intercultural operation in the line sowing crops. It is light in weight, low cost and farmer's friendly. The total cost is only Rs. 750-1000 and approximate weight of 4-5 kg. It is feasible, acceptable and economically for saving time and money in the intercultural operation. It is economically feasible for the farmers where vegetable growing is predominant. The benefits obtained through this device are in term of saving on cost/scarcity of labour and time. If it is done by the labour then cost of intercultural was Rs. 9000/ha in 12 days/ labour whereas with the help of this implements is Rs. 1500/ ha. in 3 days/labour. The overall benefits are Rs.7500.00 per hectare. The implement has been disseminated and is being used by 45 farmers in the village and out of village which are growing vegetables cultivation and especially Mentha crop. Area is covering approximate 150.00 ha.

Key words: Intercultural operation, Agricultural implements, doubling farmers' income (DFI), innovation and dissemination technology.

***

T-01.33 BIO-EFFECTIVENESS OF SABUJ GOLD AS ORGANIC MANURE ON CHILLI, BROCCOLI AND FRENCH BEAN

Eggadi Ramesh* and Subhamoy Sikder

Uttar Banga Krishi Viswavidyalaya,

Pundibari, Cooch Behar, West Bengal

**Corresponding author e-mail: eggadiramesh@gmail.com*

Abstract

The present study on "Bio-effectiveness of SABUJ GOLD as organic manure on Chilli, Broccoli, and French bean" was carried out at the Instructional Farm, Faculty of Horticulture of Uttar Banga Krishi Vishwavidyalaya, Pundibari, Cooch Behar during rabi season of 2017 - 2018. The experiment trial was on the organic manure as well as plant nutrient supplement product "Sabuj Gold" on different growth, yield and quality-related traits of three major *Rabi* season crops namely chilli, broccoli, and French bean. Results showed that all the growth, yield, and quality parameters were improved significantly. Maximum plant height was63.91cm (Chilli), 52.86cm (Broccoli) and55.24cm (French bean), the highest fruit yield per hectare was 18.74tonnes (Chilli), 7.21 tonnes (Broccoli)and 8.94 tonnes (French bean) per ha, the highest ascorbic acid content were 47.85mg/100g and β carotene content was 1.37 mg/100g (Broccoli) recorded with the application of Sabuj gold as organic manure.

Key words: Broccoli, Chilli, French bean, Growth, Organic manure, Quality, Sabuj gold, Yield.

***

T-01.34 INTEGRATED MANAGEMENT OF POST HARVEST DISEASES OF VEGETABLES

Erayya*, Subhashish Sarkhel, Shyama Kumari and Kalmesh Managanvi

Assistant Professor cum Junior Scientist

Dr. Kalam Agricultural College, Kishanganj (BAU, Sabour)

**Corresponding author e-mail: erayyapath@gmail.com*

Abstract

Losses due to post harvest disease may occur at any time during post harvest handling, from harvest to consumption. While estimating post harvest losses in vegetable due to diseases, it is important to consider reductions in quantity and quality, as some diseases may reduce marketability of the produce. Apart from direct economic considerations, disease produced may also pose a potential health risk.A country-wide study measuring crop losses revealed that

5.8%-18.1% fruits, and 6.9%-13% vegetables were lost during harvesting, post-harvest activities, handling and storage. A number of pathogens such as *Penicillium, Botrytis, Alternarta, FusariumRhizopus, Mucor, Erwinia* etc. produce some toxins or metabolites which cause food poisoning.Important genera of postharvest pathogens include *Penicillium*ssp.(blue mould), *Aspergillus*ssp. (black mould), *Geotrichum*ssp. (fruit rot), *Botrytis* ssp. (grey mould), *Fusarium*ssp. (rot), *Alternaria*ssp. (rot),*Colletotrichum* (anthracnose), Phomopsis (blight), Phytophthora (wet rot), Pythium (rot), *Rhizopus*ssp. (soft rot), *Mucor*ssp. (soft rot), *Monilinia*ssp. (fruit rot), *Sclerotinia*ssp. (rot), *Erwinia*ssp. (soft rot), and *Xanthomonas*ssp. (black rot). While diseases caused by these pathogens are primarily field diseases, thedevelopment of symptoms often accelerates after harvest. Correct identification of the pathogen causing post harvest disease is much important for selection of appropriate disease management strategy.The post harvest diseases can be effectively managed by, post harvest fruit/vegetable treatment with fungicide (benomyl and thiabendazole), fumigation (sulphur dioxide or ethyl di bromide), manipulation of the postharvest environment (cold storage at $<10^0$C, increasing CO_2 concentration in the storage chamber), maintenance of hygiene at all stages during production and postharvest handling (sanitation, proper handling to avoid damage to the produce, removal of infected or damaged fruits), Heat treatment (hot water or hot air), radiation treatment (gamma rays), biological control (Trichoderma, Psuedomonas), Constitutive and induced host resistance (salicylic acid, methyl jasmonate and phosphonates), use of natural fungicides (chitosan).Increasing consumer concerns over the presence of pesticide residues in foodhave prompted the search for non-chemical disease control measures.

Key words: Vegetable, biological control, disease, post harvest, management.

***

T-01.35 DISEASES MANAGEMENT IN ORGANIC VEGETABLES

Erayya*, Subhashish Sarkhel, Kalmesh Managanvi and Ayon Alipatra

Assistant Professor cum Junior Scientist

Dr. Kalam Agricultural College, Kishanganj (BAU, Sabour)

**Corresponding author e-mail: erayyapath@gmail.com*

Abstract

Organic Farming is recognized as a potential area in view of the growing concern of people on environmental pollution due to increased awareness about the impact of the indiscriminate use of pesticides. The ill effects of agro-chemicals on the human beings, natural enemies, animals, soil microbes, food chain and environment as a whole are the prior concerns. Consumers are preferred to choose organic foods due to the perception that they are healthier than those conventionally grown. Vegetable crops are vulnerable to wide range of pathogens including fungi, bacteria, virus and nematodes that reduce crop yield by killing the plant or damaging the

plant product, thus making it uneconomical. Diseases are one among the major factors contributing to low yields in organically growing crops. Alternative to chemical pesticides there are many other methods that can be used to manage the diseases in organic vegetable crops which includes, the application of biocontrol agents against plant diseases, growing of plants with allelopathic effects, modification in agronomic practices, mechanical destruction of pathogen/ inoculum, clean cultivation, bio-fumigation, use of organic pesticides and encouragement of natural enemies, growing of cover /trap crops, application of heat treatment strategies, cold storage, solar heat treatment, application of organic amendments to stimulate antagonistic activities of native microorganisms etc.Decomposition of organic matter in soil leads to the accumulation of specific compounds or acids which are having antifungal or bactericidal activity. Need based utilization of these alternative methods can be conveniently used to manage the crop diseases effectively, economically and sustainably. With the growing demand for organic vegetables, it is necessary to identify and develop non-chemical means of crop disease management strategies.

Key words: Vegetable, bio-control, sustainability, organic farming, crop disease.

***

Theme – II

Recent techniques for enhancing the productivity and quality of vegetables crops

T-02.1 RECENT TECHNIQUES FOR IMPROVEMENT VEGETABLE CROPS

Roopendra Kumar* and Kriti Gupta.

Department of Horticulture (Fruit and Fruit Technology)

Bihar Agricultural University, Sabour, Bhagalpur (Bihar) – 813210

**Corresponding author e-mail: roopendrakkumar40*@gmail.com

Abstract

Vegetables are considered essential for well-balanced diets and fulfil nutritional demand since they supply vitamins, minerals, dietary fiber, phytochemicals and antioxidants. Vegetables are commonly called "Protective food" because of their protective effects against degenerative diseases. Vegetable improvement has to address and satisfy the needs of both the consumer and the farmer. Need for improvement because of to reduce diseases and insect- pest effects, shorten bearing periods, suitability of different climatic conditions etc. Genetic improvement can be achieved through conventional as well as non-conventional approaches. Under conventional methods progeny inherit genes for both desirable and undesirable traits from both parents. In non-conventional methods now-a-days some important practices responsible for crop improvement such as Biotechnology as a tool for improvement of vegetable crops, Transgenic or Genetically modified crop, Molecular Marker assisted breeding, Tissue culture etc. Other than this some important technologies also improving the production and productivity of vegetables crops like Arka Microbial Consortium improves seedling vigour and can be used for organic production, Furrow irrigated raised bed (FIRB) planting (it saves 36% water over flood irrigation), mulching, Growing vegetables under rain shelters, lath house, tunnel house, poly house as well as grafting of different vegetables which reduces time as compare to seeding methods. We have to envisage future vegetable crops with higher tolerance to diseases and insect-pest, wider adoptability, high salt tolerance, high antioxidant and nutritional content and with improved processing quality. In future conventional breeding in conjunction with molecular biology has bright prospects of developing vegetable varieties with high nutraceuticals and bio active compounds suitable for fresh market.

Key words: Poly house, protective food, transgenic crops, tissue culture.

***

T-02.2 EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH, YIELD AND QUALITY OF TOMATO (*SOLANUM LYCOPERSICUM* L.) VAR. KASHI AMRIT.

Ravi Pratap Singh* and Anshuman Singh

Collage of Horticulture and Forestry, A.N.D.U.A. &T, Ayodhya, U.P.

**Corresponding author e-mail:-rp93123*@gmail.com

Abstract

An investigation on tomato (*Solanum lycopersicum* L.) var. Kashi Amrit" was conducted at department of horticulture farmofUdaipratapcollege, Varanasi during 2018-19 in winter season. The study consisting of 12 treatments with and without bio-fertilizers along with Recommended Dose of Nutrient (RDF 250 kg each of NPK ha^{-1}) with 3 replications was laid out in RBD. The growth parameters *viz.*, plant height (72.24, 83.24 and 98.37 cm) and number of branches (13.40, 15.00 and 16.20) was highest in combined application of 100 % RDF + *Azotobacter*+ PSB + VAM (T_{11}) at 30, 60 and 90 days after transplanting respectively. The yield, economics and quality characters *viz.*, fruit weight (80.12 g), number of fruits per plant (44.60), fruit yield per plant and fruit yield ha^{-1}(3.57 kg and 794.07 q ha^{-1}) benefit: cost ratio (6:10), TSS (4.21^0brix), ascorbic acid (15.93 mg/100 g), lycopene content (6.95 mg100 g) and shelf life (20.40 days) were maximum with the same treatment combination (T_{11}). All the growth, yield and quality characters were lowest in the treatment T_1 i.e. RDF (250 kg each of NPK ha^{-1}). By the study it can be concluded that the Integrated approach with both inorganic and bio fertilizers is economically viable with regard to growth, yield, and quality of tomato compared to application of RDF alone.

Key words: tomato, bio fertilizers, treatments, benefit: cost ratio

***

T-02.3 STUDY OF GENETIC DIVERGENCE FOR YIELD TRAIT IN COWPEA [*VIGNA UNGUICULATA* (L.) WALP.]

Udit Kumar and Pramila

Department of Horticulture, Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar

**Corresponding author e-mail*: *udithort@gmail.com*

Abstract

The genetic divergence analysis, using Mahalanobis D^2 statistics, was carried out in thirty-three cowpea genotypes including one check for sixteen characters. All the characters under study showed considerable divergence and the genotypes were grouped into five clusters. The clustering pattern had no parallelism between genetic diversity and geographical distribution, suggesting that the selection of parental genotypes for hybridization will be more appropriate based on genetic diversity. The thirty-three cowpea genotypes were taken for genetic divergence analysis and displayed marked divergence accordingly grouped into five clusters following Tocher's method of clustering. Cluster I had eight genotypes. Cluster II had three genotypes. Cluster III had eleven genotypes. Cluster IV had nine genotypes and Cluster V had two genotypes. The mean intra-cluster and inter-cluster D^2 values among the five clusters were compared. The results revealed that intra-cluster D^2 values ranged from 0.00 in cluster II, cluster III, cluster IV and cluster V to 16.12 in cluster I. The inter-cluster D^2 values of five

clusters revealed that highest inter-cluster generalized distance (44.50) was between cluster V and cluster III. Followed by cluster V and cluster II (38.32), cluster V and cluster I (32.29), cluster IV and cluster II (30.80), cluster V and cluster IV (27.65), cluster IV and cluster III (27.50), cluster IV and cluster I (23.83), cluster III and cluster II (21.17), while the lowest (20.12) was between cluster II and cluster I. Based on our findings, it can be concluded that during selection emphasis may begiven to seed germination percentage, peduncle length, and average pod weight to enhance the yield of cowpea. For obtaining the heterotic recombinants, genotypes placed in cluster V, cluster II and cluster III may be used in the crossing program. Further, it can be recommended that heterotic recombinants may be obtained for enhancing peduncle length, average pod weight, and seed germination percentage.

Key words: Cowpea, genotype, divergence, mahalanobis D^2, clusters

***

T-02.4 EFFECT OF INDOLE-3 BUTYRIC ACID APPLICATION ON MICROPLANTS OF POTATO (*SOLANUM TUBEROSUM* L.)

Kumari Meenakshi

Department of Botany, School of Basic and Applied Science,

Career Point University, Kota Rajasthan, India

**Corresponding author e-mail*: *meenakshi1585@gmail.com*

Abstract

The effect of plant hormone on potato (*Solanum tuberosum* L.) micro-plants were studied using *in vitro* cultured single node cutting. The higher concentration of IBA in combination (0.3 mg/l) showed an increased in parameters like number of leaves, number of nodes, internode length, shoot length and root length. The concentration of IBA (0.02 mg/l) led to decrease in all parameters as compared to IBA at (0.3 mg/l) treatments in both the varieties. This result indicates that IBA is a dominant regulation in micro-plants formation. IBA at (0.3 mg/l) concentration gave best results for all parameters and also help in overcoming difficulties of conventional vegetative propagation.

Key words: *In vitro* plantlets, potato varieties, IBA *in vitro* plant.

***

T-02.5 GENETIC VARIABILITY STUDIES IN COWPEA (*VIGNA UNGUICULATA* L.)

Meena Wankhade, Priyanka Ugale, Ambika More and Akshata Shinde

Department of Agricultural Botany, V.N.M.K.V., Parbhani

**Corresponding author e-mail: meenawankhade81@gmail.com*

Abstract

A field experiment was conducted to estimate the genetic variability and genetic divergence in Cowpea.Thirty one genotypes were sown in a randomized block design with two replications, during *kharif* 2018 at Research farm, Department of Agricultural Botany, V.N.M.K.V. Parbhani.The objective of the experiment was to identify divergent to be used as donor parents in hybridization programmes.The observations were recorded on 12 characters *viz.*, Plant height (cm), number of primary branches per plant, days to 50% flowering, number of pods per plant, number of seeds per pod, mean pod weight (g), pod length (cm), pod width (cm), days to first pod harvest, 100 seed weight (g), pod yield per plant (gm), pod yield per hectare (Kg).Analysis of variance and mean performance for pod yield and its components revealed significant differences among all the genotypes for all the characters there by indicating presence of variability in genotypes studied.GA as per cent of mean, GCV and PCV values were at par with one another for most of the characters. It indicated that the influence of the environment on the trait was vey negligible.The genotypic and phenotypic coefficient of variation were height (>20%) for the characters pod yield per hectare, plant height, number of primary branches per plant, pod length. Moderate (10-20%) for number of pods per plant, number of seeds per pod, 100 seed weight and low (<10%) for day to 50% flowering, mean pod weight, pod width, days to first pod harvest and pod yield per plant. The differences between PCV and GCV values were less indicating that these traits were less influenced by environment and could be improved by following phenotypic selection.High heritability was coupled with high genetic advance as per cent of mean was observed for all growth, flower attributes, earliness attributes and pod attributes except days to 50% flowering and pod width indicating that these characters were less influenced by environmental effects and these characters were governed by additive genes and selection will be rewarding for improvement of such traits.

***Key words*:** Variability, genotypes, selection, cowpea and heritability.

***

T-02.6 GENETIC VARIABILITY FOR YIELD AND IMPORTANT AGRONOMIC TRAITS IN GARLIC (*ALLIUM SATIVUM* L.) UNDER DHAMPUR CONDITIONS IN UTTAR PRADESH

Deepak Kumar[1], S.L. Pal[1], Ravi[2*], Shoraj Singh[3]

[1]Department of Horticulture,

[2]Department of soil science &Agril.Chemistry,

[3]Department of Agri. Botany

R.S.M. (PG) College Dhampur, Bijnor (U.P.)

**Corresponding author e-mail: ravidhanker.rsm@gmail.com*

Abstract

21 genotypes of garlic (*Allium sativum* L.) were evaluated in a RBD trial at horticulture research farm of RSM College, Dhampur (Bijnor) during *Rabi* 2019-2020 to estimate the genetic variability for bulb yield and other important agronomic traits. On the basis of mean performance, the genotype G-41 was found to be the highest yielder followed by G-384 and Bareilly local. These genotypes may further be utilized in breeding programs aimed at improving bulb yield in garlic. Analysis of variance indicated presence of considerable variability for all the fifteen characters. The estimates of phenotypic co-efficient of variation (PCV) and the genotypic co-efficient of variation (GCV) were found to be higher than the environmental co-efficient of variation (ECV) for almost all the traits, which revealed that there was very less influence of the environment on the traits studied. Both GCV and PCV were observed to be high for Number of cloves per bulb, polar diameter, weight of dry bulb, weight of fresh bulb, width of leaf and length of leaves.

Key words: Garlic, genetic variability, bulb yield

***

T-02.7 GENETIC VARIABILITY AND DIVERGENCE STUDIES FOR YIELD AND ITS COMPONENT TRAITS IN BRINJAL (*SOLANUM MELONGENA* L.)

Vitthal L. Mangi[1,*], Mallesh Sanganamoni[2], and Shivappa M. Karadi[4]

[1]Assistant professor (Horticulture), Department of Horticulture

College of Agriculture, Vijayapura

University of Agricultural Sciences, Dharwad, Karnataka, India

[2]Assistant Professor (Vegetable Science), College of Horticulture

Rajendranagar, SKLTSHU, Telangana, India

[3]Research Associate (Horti.), ZBNF, ORP Project, Vijayapura

College of Agriculture, Vijaya Pura

University of Agricultural Sciences, Dharwad

Karnataka, India

**Corresponding author e-mail: mangivl@uasd.in*

Abstract

A field investigation was carried out to assess genetic variability, heritability, genetic advance and genetic diversity of 17 brinjal genotypes at Department of Horticulture, College of Agriculture, Vijayapura during *kharif* season of 2018. High GCV and PCV (>20%) were observed for plant height, plant spread (at 90 DAT), fruit diameter, fruit length-diameter ratio,

average fruit weight, number of fruits per cluster, number of fruits per plant, total yield per plant, yield per hectare and phenol content indicating the existence of broad genetic base, which would be amenable for further selection and High heritability (>60%) coupled with high genetic advance over mean (>20%) was noticed for above mentioned traits indicates that their is a predominance additive gene action. The genotypes were grouped into Six diverse clusters on the basis of D^2 statistics and maximum number of genotypes (4) was found in clusters I and II with the maximum intra-cluster distance was recorded in cluster V (D^2=3998.63). The maximum inter-cluster distance was observed in clusters III and cluster VI (D^2=46,144.38). Hence, genotypes belonging to these clusters may be utilized for involving in hybridization programme for crop improvement. The characters like fruit diameter (61.76%), number of fruits per plant (22.06%) and yield per plant (12.50%) contributed more for genetic divergence.

Key word: Brinjal, heritability, genetic variability, D^2 statistics and genetic diversity

***

T-02.8 STUDIES ON HETEROSIS FOR YIELD AND ITS CONTRIBUTING TRAITS IN ZAID SEASON BOTTLE GUARD [*LAGENARIA SICERARIA* (MOLINA) STANDL.]

Shweta Srivastava*, G.C. Yadav,

Department of Vegetable ScienceCollege of Horticulture and Forestry

Acharya Narendra Dev University of Agriculture and Technology, Ayodhaya, Uttar Pradesh.
**Corresponding author e-mail: shweta.srivastava.sdc@gmail.com*

Abstract

The present investigation was carried out with the objective to assess the magnitude and direction of heterosis for seventeen quantitative traits viz. Days to first male and female flower anthesis, node number to first male and female flower appearance, days to first fruit harvest, vine length (m), number of primary branches per plant, fruit length (cm), fruit circumference (cm), early yield/plant (kg), number of fruits, fruit yield per plant (kg), total soluble solids(0B), ascorbic acid(mg/100g fresh fruit), reducing sugars (%), non-reducing sugars (%) and total sugar (%) . Seven parents were crossed in half-diallel fashion to develop 21F1 hybrids. Heterosis for fruit yield per plant ranged from -25.58 to 131.66 per cent over better parent and -4.45 to 182.90 per cent over standard variety ndbgh-4. For number of fruits and early yield per plant it ranged from -30.50 to 122.78 per cent and -56.36 to 175.71per cent over better parent and 0.00 to 170.53 per cent and 62.86 to 608.00 per cent over standard parent, respectively. The heterosis for days to first fruit harvest as most important maturity trait ranged from -6.35 to 1.66 per cent and -6.87 to 1.65 per cent over better parent and standard variety, respectively.

Key words: Bottle gourd, heterosis, better parent, hybrids

***

T-02.9 ADVANCES IN VEGETABLE IMPROVEMENT THROUGH BIOTECHNOLOGICAL APPROACHES

Raktim Das[1,*], Kunal Anand[1], Divyani Raj[2] and Joy Rudra Paul[3]

[1]Dept. of Horticulture (Vegetable & Floriculture), Bihar Agricultural University, Sabour, Bhagalpur,

[2]Dept. of Horticulture (Fruit & Fruit Technology), Bihar Agricultural University, Sabour, Bhagalpur,

[3]Dept. of Horticulture, Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar,

**Corresponding author e-mail: raktim.maan.95@gmail.com*

Abstract

The advent of present biotechnology embellishes a recent track of breeding in vegetable crops. The term plant biotechnology mainly deals with various aspects of genetic engineering, molecular markers and plant tissue culture that serve biological essence or system to generate new and necessary products and processes. It is being chronic to address different problems in areas of vegetable production and processing. Plant biotechnology has been used to increase and stagnate yields of vegetables to enhance pests resistance, diseases and a-biotic stresses such as flood, drought and cold; and to raise the nutritional content of vegetables. Genetically engineered crops may conduct to ultimate resistance to biotic and abiotic stresses and moreover prolong quality rich genotypes. Transgenic varieties like FlavrSavr in tomato, New Leaf in potato, etc. have been developed. The use of molecular markers in selection waned the time needed for improvement of varieties and also ensure the appearance of desirable genes. According to Prasanna *et al.* in the year 2014 they used SCAR markers to identify *Ty2* and *Ty3* resistant sources in tomato. Tissue culture techniques offer a abundant scope for creation, conservation and utilization of genetic variability for the enhancement of vegetables like sweet pepper, tomato, chili, onion and especially the imperiled species. Some primary techniques of tissue culture such as doubled haploid, anther/microspore culture, embryo culture, somatic hybridization and meristem culture are being absorb to create needful genetic variability for present incremental progress in commercial cultivars. According to Foolad in 2007have been developed high density molecular maps by using various molecular markers using population derived from crosses of cultivated and wild tomato accessions. The use of biotechnological tools can complement the conventional breeding, make it accurate and amplify the genetic base of cultivated vegetables and swiftness the process of betterment of vegetables.

***Key words*:** Vegetables, genetic engineering, molecular markers and tissue culture.

***

T-02.10 AGRONOMIC BIOFORTIFICATION OF VEGETABLE TO FIGHT HIDDEN HUNGER

Pankaj Kumar Ray[1], Ashutosh Singh[2], Amit Kumar Pandey[2] and Umesh Singh[2]

[1]Krishi Vigyan Kendra, Agwanpur, Saharsa, Bihar (India)
[2]Mandan Bharti Agriculture College, Agwanpur, Saharsa, Bihar (India)
**Corresponding author e-mail: pankajveg@gmail.com*

Abstract

Biofortification is the practice of deliberately increasing the content of an essential micronutrients, vitamins and minerals in a food, so as to improve the nutritional quality of the food supply and provide a public health benefit with minimal risk of health. Various biofortification programme including iron biofortification of beans, sweet potato and cassava; zinc biofortification of beans and sweet potato; pro vitamin A carotenoid biofortification of cassava and amino acid and protein biofortification of cassava are in progress around the world. Biofortification can be observed through three categories including agronomic biofortification. Application of fertilizers to increase the micronutrients in edible parts plays a key role in agronomic biofortification. Most suitable micronutrient for agronomic biofortification is zinc, iodine, selenium, iron and copper. Tomato plants can tolerable high level of iodine stored both in vegetative tissues and fruits and is an essential crop of iodine biofortification. The use of fertilizers "Riverm" during the cultivation of sweet potato and tomato help to be enriched by zinc. Se enriched *S. pinnata* is valuable as a soil amendment for enhancing broccoli and carrot. Agronomic biofortification with K can raise the nutritional value of the Solanaceae vegetables. Selenium biofortification of amaranthus is a proven technology for improving dietary nutrition. In lettuce, I and Se biofortification has been achieved by the application of KIO_3 and Na_2SeO_4 as foliar spray. Similarly, carrot leaves and storage roots have been supplemented with I and Se by application of both as fertilizers. In addition to fertilizers, soil microorganisms like different species of genera a *BacillusPseudomonas*, *Rhizobium*, *Azotobacter* etc. can also be utilized to increase the phyto availability of mineral elements. Many crops are associated with Mycorrhizal fungi that can release organic acids, siderophore sans enzymes capable of degrading organic compounds and increasing mineral concentration in edible produce.

Key words: Agronomic, biofortification, vegetable, hidden hunger

***

T-02.11 EXTENT OF HETEROSIS IN BOTTLE GOURD [*LAGENARIA SICERARIA* (MOL.) STANDL.]

G. C. Yadav, C. N. Ram, Pradip Kumar and Anoj Yadav*

Department of Vegetable Science
ANDUA&T Kumarganj, Ayodhya, U.P., India
**Corresponding author e-mail:anojyadav005@gmail.com*

Abstract

The present investigation entitled 'Studies on heterosis in bottle gourd [*Lagenaria siceraria* (Molina) Standl.]' was conducted at the Main Experiment Station of the Department of Vegetable Science,A.N.D. University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.) during the summer 2007. The experimental materials for the present study comprised of eight promising and diverse inbred lines/ varieties of bottle gourd *viz*., Pusa Naveen (P_1), NDBG-104 (P_2), NDBG-129 (P_3), NDBG-509 (P_4), NDBG-517 (P_5), NDBG-613 (P_6), NDBG-627 (P_7) and NDBG-5008 (P_8). These eight parental lines were crossed in all possible combinations, excluding reciprocals, during summer 2006 to get 28 F_1 hybrids. All the 36 genotypes (eight parental lines and 28 F_1 hybrids) were evaluated in a Randomized Complete Block Design with three replications in a single row of 3.0 m x 3.0 m plot size with row to row spacing of 3.0 m and plant to plant distance of 50 cm. Heterosis for fruit yield per plant ranged from -24.93% to 31.58% over better parent and -24.66% to 43.07% over standard variety Pusa Naveen. For number of fruit and fruit weight it ranged from -42.29% to 43.74% and -34.89 to 54.58% over better parent and -39.06% to 48.97% and -19.14% to 45.99% over standard parent, respectively. Regarding fruit length, the heterosis ranged from -24.95% to 20.89% over better parent and -2.34% to 51.71% over standard variety. Days to first harvest as most important maturity trait ranged from -13.61% to 16.10% and -6.90% to 25.04% over better and standard variety, respectively. Six crosses namely, P_7 x P_8 (43.07%), P_2 x P_5 (33.73%), P_1 x P_8 (21.79%), P_1 x P_5 (18.52%), P_6 x P_8 (17.40%), P_4x P_8 (14.64%), P_1 x P_2 (14.30%) and P_3 x P_8 (11.49%), which showed standard heterosis for fruit yield also found significant over better parent with different magnitude. The top three crosses were also found to have very attractive fruit shape and significantly heterotic either for fruit number or fruit weight all together but late in maturity. Out of top three heterotic F_1 with attractive fruit shape crosses P_7 x P_8 and P_1 x P_8 were also found to bear fruit with medium length, weight and high number of fruits per plant. However, 2^{nd} ranker hybrids P_2 x P_5 possessed long and heavy fruit size but less number of fruits per plant.

Key words: Heterosis, bottle gourd or Lagenaria *siceraria*

***

T-02.12 EDIBLE AGAR BASED FILMS FOR CHILLI FRUITS PRESERVATION AND RIPENING

Jaya Ganesh Thiruvengadam Nandagopal* and Shanmugam Girija

Department of Biotechnology, Bharathiar University, Tamilnadu.

**Corresponding author e-mail:tnjayaganesh@gmail.com*

Abstract

Agar is a food grade biopolymer has been widely used as an edible coating for extending the shelf life of fruit and gelling agents in fruit jams. The techniques which developed for low cost and long shelf life of agricultural products is always entertained in agribusiness. In this

perspective, we are the world's largest chilli producer but we are lagging behind with poor storage techniques. Edible coating of agar on chilli (*Capsicum annuum* L.) fruits were attempted for long term storage (at 4°C) to boost up the crop value. The effect of various concentration (0.5, 1 and1.5 % w/v) aqueous formulations of agaron weight loss and ascorbic acid levels were investigated. Biochemical analyses were conducted to monitor the changes in capsaicin, carotenoids, and antioxidants. The results showed that coated fruits demonstrated fastened ripening processes and desired biochemical changes compared to the uncoated fruits. This also confirmed by the reduction in weight loss andascorbic acid increment in comparison to the uncoated chilli. Weight loss and ascorbic acid increment with increasing agar-agar concentration and 1.5% (w/v) agar-agar was proved to be the most suitable coating. This aqueous based coating process can be easily acquired by farmers. Since, chilli is a perennial crop they can assure stable supply with respect to demands throughout the year. Especially in this economic slowdown due to Covid-19 pandemic, farmers can minimise the quality loss and postpone the marketing of chillies until their desired demand raised.

Key words: Chilli, agar-agar, shelf-life, weight loss, agribusiness

***

T-02.13 BIODIVERSO: A CASE STUDY OF INTEGRATED PROJECT TO PRESERVE THE BIODIVERSITY OF VEGETABLE CROPS IN PUGLIA (SOUTHERN ITALY)

G.Sangeetha*, I. Rethinapriya, S. Karthickeyan,

AAIT, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.

**Corresponding author e-mail: neelayathakshisangaakash@gmail.com*

Abstract

Puglia region is particularly rich in agro-biodiversity, representing an example of how local vegetables varieties can still strongly interact with modern horticulture. Unfortunately, the genetic diversity of vegetable crops in this region has been eroded, due to several factors such as abandonment of rural areas, ageing of the farming population, and failure to pass information down the generations. This summarizes the objectives, methodological approach and results of the project "Biodiversity of the Puglia's vegetable crops (BiodiverSO)", an integrated project funded by Puglia Region Administration under the 2007-2013 and 2014-2020 Rural Development Program (RDP). Results were reported for each of the eight activities of the project. Moreover, the Polignano carrot (a local variety of *Daucus carota* L,) was described as a case study, since several tasks have been performed within all eight project activities with the aim of verifying the effectiveness of these actions in terms of safeguarding for this genetic resource strongly linked with local traditions. BiodiverSO is an example of protection and recovery of vegetables at risk of genetic erosion that could help to identify and valorize much of the Puglia's plant germplasm.

Key words: Puglia region, genetic diversity, BiodiverSO, rural development program

***

T-02.14 BREEDING FOR COLOUR DEVELOPMENT IN VEGETABLE CROPS

Deepak Maurya[1,*] and Menisha Rani[2]

[1]Department of Horticulture (Vegetable & Floriculture), Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

[2]Department of Vegetable Science, Punjab Agricultural University, Ludhiana, Punjab, India

**Corresponding author e-mail: mauryadeepak0777@gmail.com*

Abstract

Nutritionists of WHO-FAO suggested that vegetables are essential for balance diet, Vitamin A deficiency (VAD) is recognized as a serious public hedalth problem in India. It is estimated that 25% of the 15 million blind people globally are from India colorful fruits and vegetables have enormous nutritional and medicinal value and vitamin A are major food-related primary health problems among populations of the developing world including India where there is a heavy dependence on cereal-based diets and limited access to fruits and vegetables. Vegetable crops tomato, beetroot, and carrot, representing the most important industrial sources of the three major pigment classes for carotenoids lycopene, betalain, and anthocyanin production (Cazzonelli 2010), respectively. Currently, the conventional breeding method developed colorful varieties such as Pusa Kulfi and PusaAshita variety of carrot developed through selection, Kashi Lalima variety of okra developed through pedigree selection (iivr.org.in), Bhu Sona, Bhu Krishna, Sree Kanaka and SreeVisakham variety of sweet potato (ctcri.org), and Pusa Beta Keshri variety of cauliflower developed through pure line selection. Purple cauliflower developed through spontaneous mutation. The cross between *Cucumis sativus* L. var. *sativus* and the orange-fruited *Xishuangbannan* cucumber (*C. sativus* L. var. *xishuangbannanesis)* for a rich source of carotenoids (Simon and Navazio, 1997). PusaJamuni, PusaGulabi, and PusaMridulaColourful variety of Radish which enrichment of nutrition. PusaRidhi, Arka Vishwas, Bheema Sweta, Arka Sona, and ArkaSwadista colorful variety of onion and another important role genetic engineering or transgenic tomato plants were identical to the control plants, except for the accumulation of high levels of anthocyanin pigments throughout the fruit during maturity, thus giving the fruit a purplish color. The total carotenoids, including lycopene levels, were unaffected in the anthocyanin-rich fruits, while its antioxidant capacity was elevated (Maligeppagol 2013). Enhanced accumulation of carotenoids in sweet potato plants overexpressing *the IbOr-Ins* gene in purple-fleshed sweet potato cultivar (Park 2015). Recently, there have been several reports on the development of transgenic crops to enhance levels of pro-vitamin A content in crops like tomato, potato, cassava, sweet potato, and other vegetable crops.

Key word: Carotenoids, lycopene and anthocyanin,

***

T-02.15 CHARACTER ASSOCIATION AND PATH ANALYSIS STUDIES IN OKRA (*ABELMOSCHUS ESCULENTUS* (L.) MOENCH) GENOTYPES

Shivappa M. Karadi*, C. N. Hanchinamani and N. Basavaraja

Department of Horticulture, Kittur Rani Channamma College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot, Karnataka, India- 587 104

**Corresponding author e-mail:shivukaradi@gmail.com*

Abstract

Character association and path analysis in sixty genotypes of okra was studied for 22 important characters. The character association studies revealed that the fruit yield per plant had significant and positive association with plant height at 45 DAS (0.308 and 0.343 respectively), plant height at 60 DAS(0.323 and 0.394 respectively), plant height at 90 DAS (0.493 and 0.226 respectively) and number of fruits per plant (0.865 and 0.710 respectively). While it was negatively and significantly associated with number of branches per plant (-0.256 and -0.184 respectively), days to flowering (-0.567 and -0.378 respectively), days to fifty per cent flowering (-0.584 and -0.413 respectively) and vitamin C content (-0.364 and-0.261 respectively) at both genotypic and phenotypic level. Narrow differences between the genotypic and phenotypic correlation coefficients were observed for various traits in the present findings. This indicates the lesser influence of the environment in the expression of these traits and presence of strong inherent association among the traits. Path analysis studies revealed that significant positive association at genotypic level among the traits *viz.*, plant height at 45 DAS (0.308), plant height at 60 DAS (0.323), plant height at 90 DAS (0.493), number of leaves at 45 DAS (0.212), fruit length (0.224), average fruit weight (0.226), number of fruits per plant (0.865) and number of seeds per fruit (0.173) as these indicated significant and positive association with fruit yield per plant and important of these traits to be considered for crop improvement programme. The selection pressure in these available genotypes of okra for above traits would be rewarding in improving fruit yield per plant.

Key words: Okra, character association, path analysis, genotypes.

***

T-02.16 LINE × TESTER ANALYSIS FOR COMBINING ABILITY IN OKRA [*ABELMOSCHUS ESCULENTUS* (L.) MOENCH]

Shivappa M. Karadi*, C. N. Hanchinamani and Vitta L. Mangi

Department of Horticulture, Kittur Rani Channamma College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot, Karnataka, India- 587 104

**Corresponding author e-mail: shivukaradi@gmail.com*

Abstract

Combining ability effects were estimated for different characters in a line x tester crossing programme comprising 54 crosses produced by crossing of 18 lines and 3 testers. Parents and hybrids differed significantly for gca and sca effects, respectively. High average degree of dominance revealed predominance of non-additive gene effects for all the traits. Among the lines, L6, L16, L17, L22, L31 and L43 were found to be the best general combiners. Therefore, these lines can be used for hybridization for producing promising recombinants. This indicates that parent showing high gca for fruit yield per plant might be due to high gca for average fruit weight, fruit length, fruit diameter and number of fruits per plant. High sca effects were expressed for cross combinations L43 × T44, L22 × T36, L22 × T44, L53 × T36 and L31 × T23 were found to be the best specific crosses for yield per plant. Result showed that non additive gene action is an integral component of the genetic architecture of different characters in the material used in okra.

Key words: General combining ability, specific combining ability, okra

***

T-02.17 HILL TURMERIC TOWARDS BIODIVERSITY

Arunkumar R[1,]*, Balamurugan V[1] and S. Arunkumar[2]

[2]M.Sc.(Ag.) Agricultural Extension, Faculty of Agriculture, Annamalai University, India.

[3]M.Sc. (Ag.) Seed Science and Technology,

Faculty of Agriculture, Annamalai University, India.

**Corresponding author e-mail: arunkumarr698@gmail.com*

Abstract

Biodiversity or Biological diversity refers to the variability among living organisms which has diversity within species, between species and of their ecosystem. Turmeric, considered as the Golden Spice of the globe has considerable biodiversity including innumerable medicinal values. India occupies the first position in area and production of turmeric. Various species of Curcuma which are mostly grown in high elevations contains Curcuma rubescens, Curcuma amada, Curcuma montana, Curcuma aromatica, Curcuma angustifolia, Curcuma pseudomontana, Curcuma longa etc. Turmeric contains proteins, fat, minerals, carbohydrates. Turmeric has attracted much attention due to its significant medicinal potential. Turmeric also has antifungal properties. It has been reported to possess anti-inflammatory, antiviral and anticancer activity. The curcuma species are grown in temperature ranges 11-40^0 C that are also suitable from the hilly area for their growth and development as the region receives a well distributed rainfall during the growing season and the sloppy well drained land with good organic matter content. Hence, there is a suitability of curcuma species for their biodiversity

and conservation in the hilly areas for the exploitation of yield and also used for various medicinal purpose.

Key words: Biodiversity, ecosystem, turmeric, curcuma species.

***

T-02.18 POLLINATION TECHNIQUES FOR HYBRID SEED PRODUCTION IN MUSK MELON (*CUCUMIS MELO* L.)

Yaduram Ram*

Assistant Professor & Head of Department of Agriculture,

Cordia College (Affiliated to Punjabi University, Patiala, Punjab, India.

**Corresponding author e-mail*: yadu.1963@gmail.com

Abstract

To find out the influence of two females, four males and three techniques applied to produce hybrid seed through hand pollination. Analysis was done on factorial design (2 females x 4 males x 3 treatments). Data was recorded in respect of characters like fruit set percentage, number of fruits harvested per plant, fruit weight, seed number, seed weight per fruit, seed germination and TSS. Highest fruit set percentage was observed in control. M4 female line was superior to M3 female line used. The treatment T1 (first five female flowers pollinated in the morning) and T3 (first five female flower buds pollinated before anthesis in the afternoon) gave significantly superior performance over T2 (first ten female flowers were pollinated in the morning) for fruit set per plant. Number of fruits harvested was highest in T2.There was no significant difference in fruit weight over the two controls. Highest seed number was recorded in T1 followed byT2. It was concluded that although T2 gave highest seed yield per plant, but it also took maximum hours to produce this seed yield. Hybrid seed yield calculated on the basis of per hours was highest inT3. This treatment proved to be the time saving device. Similarly T1 was also equally promising treatment for the production of hybrid seed per hours with additional advantage of getting high seed yield combined with little more time spent compared to T3.

Key words: Musk melon, pollination, hybrid, females, males.

****

T-02.19 NANOFERTILIZERS – A NOVEL APPROACH TO INCREASE NUTRIENT USE EFFICIENCY IN VEGETABLE CROPS

Menka Pathak[*] and Sunil Kumar Dash

Department of Vegetable Science, College of Agriculture, BBSR, OUAT, Orissa, India

**Corresponding author e-mail:itsmenkapathak@gmail.com*

Abstract

The nutrient use efficiency of conventional fertilizers hardly exceeds 30–35 %, 18–20 %, and 35–40 % for N, P, and K respectively, which remained constant for the past several decades. Nano-fertilizer is an important tool in vegetable production to improve crop growth, yield and quality parameters with increased nutrient use efficiency, reduction in wastage of fertilizers and cost of cultivation. Nano-fertilizers increase crop growth up to optimum concentrations further increase in concentration may inhibit the crop growth due to the toxicity of nutrient. Nano-fertilizers provide more surface area for different metabolic reactions in the plant which increase rate of photosynthesis and produce more dry matter and yield of the crop. It is also prevent plant from different biotic and abiotic stress. Nano fertilizers are known to release nutrients slowly and steadily for more than 30 days which may assist in improving the nutrient use efficiency without any associated ill-effects. Since the nano-fertilizers are designed to deliver slowly over a long period of time, the loss of nutrients is substantially reduced vis-a-vis environmental safety. The application of SiO_2 nanofertilizer can have a positive effect on plant growth and yield of cucumber under salinity condition through improved uptake of nitrogen and phosphorous and reducing the Na content. The SiO_2 nanoparticle as foliar application avoided leaching loss of N and helped in more accumulation of nitrogen in cucumber leaf. Different nanoparticles, for example, silicon (Si), palladium (Pd), gold (Au), and copper (Cu) impact seed germination of lettuce (*Lactuca sativa*).The photosynthetic process of spinach (*Spinacia oleracea*) under both visible and ultraviolet light had been expanded by utilizing the nano-TiO_2 particles because of the crucial role of TiO_2.

Key words: Vegetables, nano-fertilizer, efficiency.

***

T-02.20 THE AGRO-BIODIVERSITY IDENTIFIED WITH VEGETABLE YIELDS AND THE HEREDITARY DECENT VARIETY

Parmanand Verma[1,*], Himanshi Verma[2] and Mamta Banjara[2]

[1]Department of Soil Science and Agricultural Chemistry, College of Agriculture, IGKV, Raipur (Chhattisgarh)

[2]Department of Plant Molecular and Biotechnology, College of Agriculture, IGKV, Raipur (Chhattisgarh)

**Corresponding author e-mail:paramverma62@gmail.com*

Abstract

The biodiversity in vegetable harvests is made by the hereditary decent variety, as species assorted variety (interspecific decent variety) and as assorted variety of qualities inside an animal categories (intraspecific assorted variety) alluding to the vegetable developed assortments, and by the assorted variety of agro-environments (agro-biodiversity). Intraspecific decent variety is adequate in vegetable yields and isn't reflected, at any rate not in a similar way, in different gatherings of harvests. The work worked by ranchers over hundreds of years

of determination has prompted the production of a majority of neighborhood assortments, following taming of developed structures, and wide agro-biodiversity, a valuable legacy both from a hereditary and a social recorded perspective. Subsequently, the agro-biodiversity identified with vegetable yields has expected extremely explained meanings. It is additionally essential to determine that a "nearby assortment" (likewise called: landrace, rancher's assortment, society assortment) is a populace of a seed or vegetative-spread harvest described by more noteworthy or lesser hereditary variety, which is anyway well recognizable and which generally has a neighborhood name. In confronting the difficulties of the cutting edge vegetable developing segment, the numerous outflows of vegetable biodiversity are a key hotspot for hereditary improvement programs, to create inventive vegetables with improved subjective qualities (crop expansion and new yields), to acknowledge all the more naturally economical agro-frameworks, to adapt to issues of environmental change, to discover better variation to peripheral soil conditions (saltiness, climatic toxins, and so forth.), not overlooking the need to recoup and keep up joins with history and society customs. Tragically, the hereditary assorted variety of vegetable harvests in numerous world districts has been dissolved, because of a few factors, for example, deserting of country territories, maturing of the cultivating populace, inability to pass data down the ages (prompting loss of information and chronicled memory), which can fluctuate comparable to the sort of hereditary asset and area.

Key words: Biodiversity, interspecific, hereditary and vegetable Crops.

***

T-02.21 SCREENING 40 GENOTYPES OF TOMATO WITH *Sw*-5 MARKER

B. Anuradha[1,*], P. Saidaiah[2], Harikishan Sudini[3] and A. Geetha[4]

[1]Department of Vegetable Science, SKLTSHU, Hyderabad.

[2]Department of Genetics and Plant Breeding, SKLTSHU, Hyderabad.

[3]Department of Plant Pathology, ICRISAT,Patancheru, Hyderabad.

[4]Department of Crop Physiology, PJTSAU, Palem, Nagarkurnool.

**Corresponding author e-mail:bheemireddyanuradha@gmail.com*

Abstract

Tomato (*Solanum lycopersicum* L.) belonging to the family Solanaceae is the native of Peru and Ecuador region. It is one of the most popular and widely grown crops of commercial and dietary significance in the world as it is a very versatile vegetable. The spotted wilt disease caused by Tomato spotted wilt virus (TSWV) is one of the major threats among viral diseases. The development of TSWV-infected tomatoes compromises tomato fruit production in both quantitative and qualitative ways, and sometimes leads to plant death.TSWV is the type species

of the genus Tospovirus, the only genus that harbors plant-infecting viruses within the family Bunyaviridae. Tospoviruses are transmitted by thrips in a propagative and circulative manner. So, far there are two known natural genetic sources that provide resistance genes suitable for commercial resistance breeding against TSWV. One of these, named *Sw*-5, was first observed in a wild tomato species from Peru, *Solanum peruvianum* L., and has allowed the development of commercial tomato cultivars resistant to TSWV for more than one decade. Meanwhile, *Sw*-5 has been cloned from *S. peruvianum* and presents a gene cluster consisting of at least five different paralogs named *Sw*-5a to *Sw*-5e. From those, only the *Sw*-5b copy has been experimentally proven to be functional against TSWV. Experiment was conducted at PG Research Block, Department of Vegetable Science, College of Horticulture, Rajendranagar, Sri Konda Laxman Telangana State Horticultural University, Hyderabad during *Kharif*, 2017-18.Forty genotypes of tomato were screened with genebased marker *Sw*-5.Screening with *Sw*-5 revealed that out of 40 genotypes, 7 genotypes showed resistance bands *viz.*, EC-211582, EC-313466, EC-631349, EC-514013, EC-315481, EC-320565 and LA-3667. Based on this result these 7 accessions can be used for developing disease resistance varieties. The present research coupled with the results of field observations, can present a starting point for MAS (Marker Assisted Selection) in tomato breeding.

Key words: Tomato, tomato spotted wilt virus, genotypes, *sw-5*

***

T-02.22 STUDIES ON GENETIC VARIABILITY IN BITTER GOURD (*MOMORDICA CHARANTIA* L.) UNDER COASTAL ECOSYSTEMS

Waikhom Jupiter Singh* and R. Kandasamy

Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar (Tamil Nadu), India.

**Corresponding author e-mail: jupiwai@gmail.com*

Abstract

Forty genotypes of bitter gourd collected from different agro-climatic regions of India were evaluated to assess the variability, heritability, genetic advance. Quantitative and qualitative characters like days to first male flower, days to first female flower, node number of first male flower, node number of first female flower, sex ratio, vine length (m), number of primary branches per vine, days to first fruit harvest, fruit length (cm), fruit girth (cm), average fruit weight (g), number of fruits per vine, seeds per fruit, TSS (Brix°), ascorbic acid content (mg/100g) and fruit yield per plant (kg) were studied. Analysis of variance revealed that there were significant differences among the genotypes studied for all the characters. In variability studies, among 40 genotypes MC 13 was identified as the best genotypes as it recorded higher yield per vine followed by MC 1, MC 20 and MC 14. Maximum phenotypic and genotypic coefficient of variation (PCV and GCV) was found for fruit yield per vine followed by the number of fruits per plant and sex ratio. High heritability was observed for all the characters.

Genetic gain was maximum for fruit yield per vine followed by number of fruits per vine. The characters like yield per vine, number of fruits per plant and sex ratio had high heritability along with high genetic gain which reveals the predominance of additive gene action of these characters.

Key words: Variability, heritability, genetic advance, bitter gourd

***

T-02.23 VEGETABLE GRAFTING IS A TOOL TO IMPROVE DROUGHT RESISTANCE

Kunal Anand, Raktim Das* and Ajay Bhardwaj

Department of Horticulture (Vegetable & Floriculture), Bihar Agricultural University, Sabour, Bhagalpur, Bihar

**Corresponding author e-mail: raktim.maan.95@gmail.com*

Abstract

The most manifested delimit factors causing envisage decrement in crop productivity, embedding the economic with the nutritional insecurity is called drought. Since from the last few years the maximum objection faced by the scientific community in the subsequent few years is to reduce the losses of the yield of various crops by drought. Drought resistance is mainly controlled by various genes due to its intricate quantitative trait. In this manner, it has been indictment to the different plant breeders to the introgression of the traits which were drought resistant into the high yielding genotypes. The using rootstocks of vegetable grafting has ejected as a quick tool in the plants which were tailoring to excellent adapt to the various suboptimal growing situation. It has initiated changes in the physiology of shoots. Grafting techniques have been elaborate mainly in those crops which were mainly grown in the arid and semiarid areas viz, cucurbits and solanaceous crops characterized by the long drought period. In this review gives in a general way of the current scientific literature on the interaction of root- shoot and rootstock wielded changes of growth, quality of fruits and the yields of the vegetable plants which were grafted under drought stress. Moreover, we demonstrate the mechanism of drought resistance of grafted vegetables at the biochemical, molecular, morphological and physiological level.

Key words: Grafting, drought resistance, vegetables, quality and yield

***

T-02.24 EFFECT OF CALCIUM SULPHATE ON IMPROVING GROWTH, YIELD AND ECONOMICS OF POTATO

R. B. Verma[1], A. P. Singh[2], M.D. Ojha[3], Vijay Kumar[3] and R. K. Verma[4]

[1]Bihar Agricultural University Sabour, Bhagalpur, Bihar

[2]N. D. University of Agriculture & Technology, Kumarganj, Ayodhya (U.P)

[3]NCOH, Noorsarai, Nalanda, BAU, Sabour Bhagalpur, Bihar

[4]KVK, Madhepura, BAU, Sabour Bhagalpur, Bihar

**Corresponding author e-mail: rbv1963@gmail.com*

Abstract

To explore the possibilities of impact of calcium sulphate on improving growth, yield and economics of potato an experiment was conducted for consecutive two years during 2007-08 and 2008-09 at N. D. University of Agriculture & Technology, Kumarganj, Ayodhya (U.P). Six treatments viz. Application of full dose of calcium sulphate @ 25kg/ha at the time of planning, application of half dose of calcium sulphate at two split doses i.e. ½ at the time of planning and ½ at the time of earthing up, application of full dose of calcium sulphate @ 25kg/ha at the time of planning +foliar spray @0.2% at 50,60 and 70days after planting, application of half dose of calcium sulphate at two split doses i.e. ½ at the time of planning and ½ at the time of earthing up + foliar spray @0.2% at 50,60 and 70days after planting, only foliar spray @0.2% at 50,60 and 70days after planting and control (NPK@150:100:120kg/ha) were arranged in randomised block design with three replication, It was observed that application of full dose of calcium sulphate @ 25kg/ha at the time of planning recorded the highest average plant height (34.40cm), number of stem/hill (4.40), number of leaves/plant (44.65) and tuber yield (25.33t/ha). However the minimum values were noted in the treatment receiving only foliar spray @0.2% at 50, 60 and 70 DAT. So for as the economics is concerned, basal application of calcium sulphate @ 25kg/ha fetched the highest average net return (Rs. 59788/ha), however the minimum average net return (Rs. 59788/ha), was noted in the treatment receiving only foliar spray @0.2% at 50, 60 and 70 DAT. It may be concluded that the Application of full dose of calcium sulphate @ 25kg/ha at the time of planning is economically viable than other mode of application of calcium sulphate in potato crop better growth, yield and economics of crop.

Key words: Potato, calcium sulphate, growth, yield, economics.

***

T-02.25 EVALUATION OF POTATO BASED CROPPING SYSTEM

R. B. Verma[1], A. P. Singh[2], M.D. Ojha[3], Vijay Kumar[3] and R. K. Verma[4]

[1]Bihar Agricultural University Sabour, Bhagalpur, Bihar

[2]N. D. University of Agriculture & Technology, Kumarganj, Ayodhya (U.P)

[3]NCOH, Noorsarai, Nalanda, BAU, Sabour Bhagalpur, Bihar

[4]KVK, Madhepura, BAU, Sabour Bhagalpur, Bihar

**Corresponding author e-mail: rbv1963@gmail.com*

Abstract

A study was carried out at N. D. University of Agriculture & Technology, Kumarganj, Ayodhya (U.P) for two consecutive years during 2007-08 and 2008-09 to explore the possibilities to find out the best profitable potato based cropping system. Three potato based cropping systems i.e. Potato=onion-maize, Potato- bottle gourd-maize and Potato- okra- maize were arranged in randomised block design replicated seven times. The varieties Kufri Ashoka in potato, NDBG-4 in bottle gourd, light Red in onion and Prabhani Kranti in okra were sown at the spacing of 60cm x 20cm, 2.4m x 50cm, 20cm x 10cm and 30cm x 20cm and fertilized with 150:100:120, 120:60:60, 80:40:40 and 80:40:40 kg/ha NPK, respectively. It was observed that notice that maximum cost of cultivation after completion of rotation was recorded under potato=onion-maize cropping system followed by Potato-okra-maize and potato-bottle gourd-maize., however, the highest average gross as well as net return was associated with potato-onion-maize cropping system followed by potato-bottle gourd-maize and potato-okra-maze cropping systems. It may be concluded that Potato-onion-maize cropping system is more remunerative than other potato based cropping system.

Key words: Potato, cropping systems, fertilizer, profitability

***

T-02.26 GENETIC DIVERSITY OF BOTTLE GOURD [LAGENARIA SICERARIA (MOL.) STANDL.] INBRED LINES BASED ON ISSR AND RAPD MARKERS AND THEIR HYBRID PERFORMANCE

Aastik Jha[1,*], Bijendra Singh[2] and Sudhakar Prasad Mishra[3]

[1]Department of Horticulture, School of Agricultural Sciences & Rural Development, Medziphema Campus, Nagaland University, Nagaland

[2] N.D.U.A.& T. Ayodhya, U.P.

[3] Mahatama Gandhi Chitrakoot Gramoday Vishwavidyalaya, Chitrakoot, Satna, M.P.

**Corresponding author e-mail: aastikiivr@gmail.com*

Abstract

Twelve inbred lines of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] were crossed to produce 66 F1 hybrids (without reciprocal) which were evaluated along with the parents for 18 growth and yield related traits, in a replicated field trial. High level of heterosis was observed among the hybrids for most of the traits examined, including yield. These inbred lines were analyzed by using 30 ISSR primers those produced 107 DNA marker bands. Out of these 65 were polymorphic and remaining 42 bands were monomorphic. Average number of bands was 3.57 per primers. The total polymorphism was found to be 66.82% while remaining 33.18% were monomorphic. A total of 57 ISSR markers were obtained with a mean of 3.57 per primer. Pair-wise genetic distance measurements ranged from 0.05 to 0.280, suggesting a wide genetic diversity for these inbreds. These inberds were also analyzed with 15 RAPD primers of which nine were informative. Although the results indicated significant positive correlations of genetic distance with hybrid performance, the ISSR based genetic distance measures and use of limited RAPD markers in present study could not effectively predict hybrid performance in this crop. The genetic variation among bottle gourd inbred lines examined, herein, defined a marker array (combined ISSR and RAPD) for the development of a standard reference for further genetic analyses, and the selection of potential parents for predicting hybrid performance and heterosis.

***Key word*:** Bottle gourd; DNA markers; Hybrid; ISSR; RAPD

***

T-02.27 HETEROSIS IN RELATION TO COMBINING ABILITY FOR FLOWERING BEHAVIORS AND YIELD TRAITS IN BOTTLE GOURD

Aastik Jha[1*], Bijendra Singh[2], Sudhakar Prasad Mishra[3] and D.K. Pandey[3]

[1]Department of Horticulture, School of Agricultural Sciences & Rural Development, Medziphema Campus, Nagaland University, Nagaland

[2] N.D.U.A.&T.Ayodhya, U.P.

[3] Mahatama Gandhi Chitrakoot GramodayVishwavidyalaya, Chitrakoot, Satna, M.P.

**Corresponding author e-mail: aastikiivr@gmail.com*

Abstract

A study was conducted at Indian Institute of Vegetable Research, Varanasi (U.P.) during 2013-215. Heterosis and combining ability studies carried out through diallel method using twelve parents with nine characters. The analysis revealed that P-1 was found good general combiner for all the characters consistently, however parent P-3, P-5, P-7, P-11 and P-12 were best general combiners for yield and flowering traits. The *gca* variances were higher than the *sca* variance for days to first male flowering, days to first female flowering, node at which first female flower appears, number of fruits per plant, fruit length fruit breadth and yield per plant.

While average fruit weight had *gca* variances lower than the *sca* variances indicating the predominance of non-additive gene effects. The maximum heterosis for node at which first female flower appears was exhibited by P-3xP-7. The selection should be made for improvement of traits like days to first male female flowering, days to first male female flowering, fruit width. While node at which first female flower appears, number of fruits per plant, average fruit weight, fruit length and yield per plant may be improved through hybridization.

***Key word**:* Heterosis, diallel, combining ability, hybridization

***

T-02.28 GENE ACTION OF YIELD AND QUALITY TRAITS IN BOTTLE GOURD [LAGENARIA SICERARIA (MOL.) STANDL]

Aastik Jha[1*], Bijendra Singh[2], Sudhakar Prasad Mishra[3] and D.K. Pandey[3]

[1]Department of Horticulture, School of Agricultural Sciences & Rural Development, Medziphema Campus, Nagaland University, Nagaland

[2] N.D.U.A.&T.Ayodhya, U.P.

[3] Mahatama Gandhi Chitrakoot Gramoday Vishwavidyalaya, Chitrakoot, Satna, M.P.

**Corresponding author e-mail:* aastikiivr@gmail.com

Abstracts

In present study, diallel cross analysis was carried out for development of hybrid in bottle gourd (*Lagenaria siceraria* (Mol.) Standl. The gene effects with respect to its nature and magnitude for yield and quality atributs (10 characters) were studied by involving 66 hybrids obtained by crossing 12 x 12 half diallel pattern. Additive as well as dominant component of variance were significant of most of the characters. The estimates of dominance component ($\hat{H}1$ and $\hat{H}2$) were higher than those of additive ($\hat{D}$) component for all the characters. Suggesting major role of dominance component in controlling the expression of character. Average degree of dominance showed over dominance for all characters in both the seasons. The ratio of dominance and recessive alleles (KD/KR) suggested that the dominant alleles were distributed frequently than the recessive for all the characters.

Key words: Gene action, diallel, *Lagenaria siceraria,* hybrids

***

T-02.29 IMPORTANCE OF LIQUID BIO-FERTILIZERS IN SOIL HEALTH MANAGEMENT AND VEGETABLE PRODUCTION

Rajendra Bairwa[1,*] and Mamta[2]

[1]Dr. Rajendra Prasad Central Agricultural University, Pusa, Samstipur, Bihar

[2]ICAR- Indian Agricultural Research Institute, Pusa, New Delhi

**Corresponding author e-mail: rkchironjsoil@gmail.com*

Abstract

The use of chemical fertilizers at high levels had an adverse effect on the accumulation of NH_4^+, NO^{3-}, $NO^{2-}$and PO_4^-etc.in vegetable product tissues. Continueduse of agrochemicals has produced soil dehydration and destruction of planttissues as well as leakage of excess fertilizers into water bodies. Therefore, clean agriculture recently depends upon using bio-fertilizers as well as organic in order to produce high yields with the best commodity quality without contamination and less accumulation with heavy metals.Microorganisms have been emerged as the potential alternative for the productivity, reliability and sustainability of the global food chain. Different fungal and bacterial strains belonging to the genera Aspergillus, Bacillus, Flavobacterium, Micrococcus and Pseudomonas have been reported to be active in the solubilization of organic and inorganic phosphate compounds (i.e., dicalcium and tricalcium phosphate and rock phosphate). The two most demonstrated mechanisms responsible of the solubilization process are the production of organic acids and the production of phosphatase. On the bio-fertilizer and soil, microbial analysis was carried out to determine the subsisting microbialdiversities. Carrier based bio-fertilizers have already proved to be the best over the agrochemicals and have been showing the great effect on the global agriculture productivity since the past two decades. Rectifying the disadvantages of the carrier based bio-fertilizers, liquid bio-fertilizers have been developed which would be the only alternative for the cost effective sustainable agriculture.The liquid bio-fertilizers are believed to be the best alternative to synthetic fertilizers and conventional carrier based bio-fertilizers in the modern agriculture due to their high moisture retaining ability, longer shelf life than carrier based bio-fertilizers, better survival on the seed and nodulation, ease of handling, storage and transportation all favouring sustainable agricultural system of high productivity vegetable crops.

Key words*:* Soil health, liquid bio-fertilizer, productivity, microbial diversity.

***

T-02.30 ROLE OF BIOFERTILIZER IN SUSTAINABLE VEGETABLE PRODUCTION

Archana Verma[*], Priyanka Kumari and Satdev

[1]Department of Soil Science and Agricultural Chemistry, BAU, Sabour, Bhagalpur, Bihar, India, 813210

**Corresponding author e-mail: varchana976@gmail.com*

Abstract

Indiscriminate use of conventional fertilizers has been led to the poor soil fertility and loss of productivity and in such situation, biofertilizers are boon for us, which can be an alternative to the harmful chemical fertilizers. Harmful impact of chemical fertilizers can be seen in vegetables. So, to mitigate the problem of contamination through chemical fertilizers in vegetables, biofertilizers can be used. Bio-fertilizers are the preparations containing latent cells of efficient strains of various nitrogen fixing, phosphate solubilizing or cellulolytic micro-organisms used for application to seed, soil or composting areas for increasing number of such micro-organisms and accelerate those microbial processes which enhance the availability of nutrients that can be easily assimilated by plants. Depletion of non-renewable energy sources and higher cost of fertilizers has been led to depletion in soil fertility, environmental hazards and low vegetable production. It also showed threat to sustainable agriculture. On other hand, use of biofertilizers is safe for environment and eco-friendly. Further long term use of these may be more efficient, productive and affordable by small and marginal farmers over chemical fertilizers. Application of Bio-fertilizers will play an important role in improving the supply of nutrients, organic carbon, accumulation of soil enzymes, future productivity, economy of farmers, sustainability in natural soil ecosystem and vegetables crops availability in long term use.

***Key words*:** Soil fertility, productivity, non-renewable energy, sustainablity.

***

T-02.31 STUDY ON MULCHING USED FOR AGRICULTURAL PRACTICES

Smita Singh[1], Amita Gautam[2], Pushpraj Diwan[2] and S. V. Jogdand[3]

[1]D.B. Degree Girls College, Raipur (C.G.)

[2]Ph.D Scholar (FMPE), SwamiVivekanand CAET&RS, IGKV, Raipur (C.G)

[3]Professor (FMPE), SwamiVivekanand CAET&RS, IGKV, Raipur (C.G)

**Corresponding author e-mail: pushprajdiwan@gmail.com*

Abstract

Mulching is one of the trending techniques all over world in agricultural practices due to climate change and water scarcity. Many types of mulches are available now days but mainly it is grouped organic and inorganic mulches .Plastic mulches (inorganic mulch) are continuously improved according to the requirement of different crops and environment conditions. Plastic mulches affect the yield, maturity period, insect, weeds many other things over field and also improve the irrigation facilities. We have many advantages and disadvantages of the plastic mulching. Fast growing and high yield, reduction in evaporation, reduced weed problem, efficient fertilizer use, less intercultural operations, reduce drowning of crops are the some advantages of the mulching technique, where it create problem during removal and disposal of plastic after use and high initial investment. Transparency, thickness and color of mulches have important role which significantly affect the product parameters. Black plastic helpful to

absorbed the heat of the sun and increase the temperature of soil at different depth compare to bare soil, where silver mulch reflect sun rays to canopy and decrease soil temperature. So it would be used according to different season to provide favorable condition to the plant. Color of mulches also control insect which increased or decreased according the color used.Organic materials are available in the field such as bark, grass clipping, dry leaves, straw, manure, sawdust and newspaper used as organic mulches. This all are adopted according to availability in field and requirement. Handling of organic material is not easy but ecofriendly. Selection of mulches is done on the basis of cost of material, crop, time period and season which improve the biological, chemical and physical properties of soil on the field.

Key word: Mulching material, inorganic mulch, organic mulch, effect.

***

T-02.32 ASSESSMENT OF DIFFERENT TECHNIQUES OF NURSERY RAISING ON THE ECONOMIC VIABILITY OF VEGETABLE SEEDLINGS THROUGHOUT THE YEAR IN RED AND LATERITIC ZONE OF PURULIA DISTRICT IN WEST BENGAL

Chinanshuk Ghosh*, P. Biswas, B. Mahato, D.C. Mahato, L. Maity, S. Thakur, D. Datta, V. Pradhan, S. Patra, C. Nag, A. Chakraborty, S.K. Bhattacharya and M.K. Bhattacharjya

Krishi Vigyan Kendra Kalyan, Purulia, West Bengal

**Corresponding author e-mail:* chinanshuk.ghosh@gmail.com

Abstract

An experiment was conducted by Krishi Vigyan Kendra Kalyan, Purulia in the farmer's field during 2019 to assess different techniques of nursery raising on the economic viability of vegetable seedlings round the year. Three treatments comprised of 1. Farmers Practice: Seed Bed Preparation in open field with application of FYM; 2. Technology Option –I: Use of germination tray for nursery raising in open field condition and application of Fungicide as foliar spray @ 2gm lit-1 after sowing of seeds at 7 days interval (3 times); 3. Technology Option-II: Use of germination tray for nursery raising inside low cost poly house and application of Fungicide as foliar spray @ 2gm lit-1 after sowing of seeds at 7 days interval (3 times) with 10 replications. Vegetable seedlings are grown in Purulia district for main season transplanting and also for income generation. In most cases it is found that nursery beds are prepared in open field and therefore seedlings die due to root rot or due to adverse weather climate. Nursery raising of different vegetable seedlings is common practice in the area with fungal attack resulting to high mortality rate. The result reveals that the number of healthy seedlings in Tech. Option-I is more as compared to Farmers Practice. The Tech. option-II performed better over Tech. option-I and Farmers practice as the use of germination tray inside the low cost poly house along with foliar spray of fungicide at 7 days interval is much more effective due to decrease in fungal attack. Use of germination tray in Tech. Option-I helped to

decrease the fungal attack and increased the number of healthy seedlings (98776) whereas nursery raising inside low cost poly house using germination tray and foliar application of fungicide decreased the number of days to germination (4 days), lowered down the fungal attack (3%) leading to decreased mortality rate (4.2%) and resulting to higher number of healthy seedlings (156730). Therefore use of germination tray for nursery raising inside low cost poly house and application of Fungicide as foliar spray @ 2 gm lit-1 after sowing of seeds at 7 days interval (3 times).

Key words: vegetable seedlings, low cost poly house, technology, economic viability.

***

T-02.33 RESPONSE OF INTRA-ROW SPACING AND DRIP IRRIGATION ON PRODUCTIVITY AND ECONOMIC FEASIBILITY OF RABI ONION

M.D. Ojha[1], Divya Tiwari[1,*], Vijay Kumar[1], Mahender Pal[1], A.P. Singh[1] and R.B. Verma[2]

[1]College of Horticulture (Bihar Agricultural University, Sabour, Bhagalpur) Noorsarai, Nalanda, Bihar

[2]Department of Hort. (Veg. & Flori.), BAU, Sabour, Bhagalpur, Bihar

**Corresponding author e-mail: dtiwari1912@gmail.com*

Abstract

Irrigation scheduling is necessary for increased onion production in an Agro-climatic zone III A and B of Bihar where water is scarce gradually and a limiting factor for onion production. Field experiment were conducted during the Rabi season of 2013-14 and 2014-15 at the experimental farm, Nalanda College of Horticulture, Noorsarai, Nalanda. The objective was to standardization of high density planting with drip irrigation and to study the yield performance and storability on onion in Nalanda region. The treatments consisted of factorial combination of three irrigation intervals (2, 4 and 6 days) and four population densities (20,00000, 13, 33, 333, 10,00000 and 6,66,666 plants/ha) corresponding to 10x5, 10x7.5, 10x10 and 15x10 cm respectively laid out in randomized block design replicated three times. Result revealed that highest marketable yield were significantly favoured by 2 days internal followed by 4 days. However, lower plant spacing 10x5 cm where found to increase plant height and minimum maturity days, consequently grass and marketable bulb yield was significantly higher with plant spacing 10x10 cm followed by 15x10 cm. The marketable bulb yield was significantly higher with interaction of T7 (10x10 cm and 2 days irrigation interval) 1000000 plant density and 2 days irrigation interval than other treatment combinations. The results of study concluded with 2 days interval recommended irrigation with a plant density of 1000000 (10x10cm) plants per hectare for maximum onion bulb yield.

Key words: Onion, irrigation scheduling, plant density, yield

***

T-02.34 EFFECT OF DIFFERENT MULCHES ON GROWTH AND YIELD OF TOMATO (*SOLANUM LYCOPERSICUM* L.)

Saurabh Raghuvansi[1], M.D. Ojha[2], Mahender Pal[2,*], A.P. Singh[2], Divya Tiwari[2], S.R.P. Singh[2] and R.B. Verma[3]

[1]Institute of Agricultural Science, Bundelkhand University, Jhansi
[2]College of Horticulture (Bihar Agricultural University, Sabour, Bhagalpur) Noorsarai, Nalanda, Bihar
[2]Department of Hort. (Veg. & Flori.), BAU, Sabour, Bhagalpur, Bihar
**Corresponding author e-mail: mahendra1977@yahoo.co.in*

Abstract

The field experiment was conducted at Agriculture Research Farm of Institute of Agricultural Sciences, Bundelkhand University, Jhansi during spring season of 2012. Geographically experimental location Jhansi is located at 250 .27" N latitude and 780 .35 E longitudes at an altitude of 271 meters above the mean sea level in semi-arid tract of central India. Seven mulching treatments with three replications in Randomized Block Design were compared towards its effect on growth and yield attributes of Tomato. Plants with highest plant height (72.10 cm) were obtained in treatment T3-Mulching with Black Polythene, maximum leaf numbers (117.67), fruits per plant (21.33), Fruit yield per plant (1.29kg/plant) and highest fruit yield (q/ha) was also noted with black polythene mulch (418.50 q/ha). On the basis of the findings of the present investigation it can be concluded to apply priority wise Black Polythene mulch followed by Rice straw mulch and Farm yard manure mulch as a mulching material in tomato fields to obtain higher yield with quality fruits and higher returns of the tomato crop in growing conditions of water scare areas of the Uttar Pradesh.

Key words: Tomato, mulches, growth, yield.

***

T-02.35 IMPACT OF MULCHING BY THE STRAW MANAGEMENT MACHINERY (HAPPY SEEDER) ON SOIL PHYSICAL PROPERTIES IN VARIOUS MULTI-LOCATIONS OF LUDHIANA

Vishnu Ji Awasthi[1,*], Rajat Mishra[2], Dhiraj Kumar[3], Ashiesh Kumar[2], Dilwar Singh Parihar[1]

[1]Department of Farm Machinery and Power Engineering, Punjab Agricultural University, Ludhiana
[2]Department of Soil and Water Engineering, Punjab Agricultural University, Ludhiana
[3]Department of Renewable Energy Engineering, Punjab Agricultural University, Ludhiana
**Corresponding author e-mail: vawasthi92@gmail.com*

Abstract

The present investigation contemplates on the mulching effects by happy seeder on various soil physical properties conducted at different multi-locations of Ludhiana. The fields having average straw load of 6 ton/ha were selected for conducting mulching experiments by happy seeder which supports the retention of mulch on the soil surface (sandy loam). The field trials were performed on mainly three locations farmer's fields, agroforestry sites and research farms of PAU, Ludhiana, Punjab. The research study focuses on the consequence of mulch on soil physical properties including porosity, bulk density, moisture capacity, water stable aggregates and field capacity moisture. The effects of non-mulch and mulch application were deliberately considered. The study revealed that there was a significant effect of mulch on moisture capacity, porosity and bulk density. The increased application of mulch on various parts of the fields has resulted in significant rise in porosity and it was assessed as 45%, 53% and 43% for research farms, farmer's fields and agroforestry sites. The average moisture capacity (cm^3/cm^3) and bulk density (Mg/ha) was examined as 0.32, 0.35 and 0.35 and 1.33, 1.36 and 1.45 respectively for the mentioned locations. The average field capacity moisture (cm^3/cm^3) was observed as 0.52, 0.59 and 0.47 respectively and the percentage of water stable aggregates (%) was 64, 71 and 61 respectively for the selected locations. It was concluded that there was a significant impact of mulch retention on soil physical properties for farmer's fields and research farms but not significant for agroforestry areas. The results of mulching by happy seeder on farmer's fields were found to be feasible and remarkable as it enhances the soil physical properties and improves the edaphic environment.

Key words: Happy seeder, mulching, soil physical properties, straw management

***

T-02.36 OPTIMIZATION OF NUTRIENT MANAGEMENT ON BOLTING AND YIELD OF RABI ONION IN NALANDA DISTRICT

Kumari Vibha Rani[1,*], Suraj Prakash[2], Umesh Narayan Umesh[1], Jyoti Sinha[1] and Brajendu Kumar[1]

[1]Krishi Vigyan Kendra, Harnaut, Nalanda, Bihar

[2]Bhola Paswan Shastri Agricultural College, Purnea, Bihar

**Corresponding author e-mail: kumarivibhaa1@gmail.com*

Abstract

The onion (*Allium cepa* L.) is one of the important bulb crop belongs to family Amaryllidaceae. It belongs to genus Allium. It is one important bulb crop that is used in raw and processed form. The contribution of Bihar is 5.96% with production of1247.34 thousand metric tones during 2015-16. In the same financial year the total production of rabi onion was 136 lakh tones and kharif onion was 73 lakh tones (Source: State department of horticulture and agriculture). In Nalanda district 5.99 thousand hectare area comes under onion cultivation with production of 164.37 thousand tones during financial year 2013-14 (Source: Department of agriculture, Government of Bihar). The onion is heavy feeder of fertilizer. Potassium plays

major role in different plant metabolism for better yield and quality of onion. The sudden increase in temperature is one important factor to influence bolting in onion although nutrient status of soil also play major role in it. The trial conducted in Birampur village of eight farmers plot of Nalanda district. We got the following findings as the bulb weight of onion is increased upto 46.73 gm by the application of 110 kg DAP/ha, 80 kg Urea/ha, 100kg MOP/ha alongwith foliar spray of 1 % solution of NPK (18:18:18) as compared to farmers practice (control) is 39.30 gm/bulb, increase in yield upto 76.66 q/acre in comparision to farmers practice (control) is 67.91Q/Acre and reduction in bolting percentage upto 1.03% in comparision to 5.46% in farmers practice (control).

Key words: Onion, bulb crop, bolting, fertilizer, production

***

T-02.37 EFFECTS OF DIFFERENT LEVELS OF FERTILIZERS AND SPACING ON GROWTH, YIELD AND QUALITY OF POINTED GOURD (*TRICHOSANTHES DIOICA* ROXB.)

Sushree Choudhury and Debasis Sarangi
Krishi Vigyan Kendra Ganjam-II,
Odisha University of Agriculture and Technology, Odisha, India
**Corresponding author e-mail: sushreec77@gmail.com*

Abstract

The present study pertains to the effects of different levels of Fertilizers and spacing and its interaction On Growth ,Yield and quality Of Pointed Gourd (*Trichosanthes dioica* Roxb.) was undertaken at the farmer's field in the village Giria of Hinjilikatu block of Ganjam district of Odisha , India during 2017-18. An experiment was carried out consisting four levels of fertilizers(F_1 :75% RDF, F_2:100% RDF, F_3: 125% , F_4: Control) and four levels of spacing (S_0: 1.0m x 0.5m , S_1: 1.0m x 1.0m, S_2: 1.5m x 1.5m , S_3: 1.5m x 1.0m) in factorial randomized block design replicated thrice. So all total there are 16 different treatment combinations which are as follows (T1)- F_1S_0 : 75% RDF + 1.0m x 0.5m, (T_2)- F_1S_1 : 75% RDF + 1.0m x 1.0m, (T_3) -F_1S_2 : 75% RDF + 1.5m x 1.5m,(T_4)-F_1S_3 : 75% RDF + 1.5m x 1.0m ,(T_5)-F_2S_0 : 100% RDF +1.0m x 0.5m, (T_6)- F_2S_1 : 100% RDF + 1.0m x 1.0m, (T_7)- F_2S_2 : 100% RDF + 1.5m x 1.5m, (T_8)-F_2S_3 : 100% RDF + 1.5m x 1.0m , (T_9)- F_3S_0 : 125% RDF +1.0m x 0.5m, (T_{10})- F_3S_1 : 125% RDF + 1.0m x 1.0m, (T_{11})- F_3S_2 : 125% RDF + 1.5m x 1.5m, (T_{12})-F_3S_3 : 125% RDF + 1.5m x 1.0m, (T_{13})- F_4S_0 : Control + 1.0m x 0.5m ,(T_{14})-F_4S_1 : Control + 1.0m x 1.0m , (T_{15})- F_4S_2 : Control + 1.5m x 1.5m, (T_{16})- F_4S_3 : Control + 1.5m x 1.0m. The results of present investigation indicated that application of 100 per cent recommended dose of NPK (F2) and spacing (S_3) have maximum yield of pointed gourd. Interaction effect due to fertilizer combinations and spacing on growth and yield parameters was found to be significant. Among the treatment combinations of N,P,K levels and spacing, the treatment combination (T_{11})-F_3S_2 : 125% RDF + 1.5m x 1.5m recorded maximum values for main vine length and number of branches per plant, however (T_8)-F_2S_3 : 100% RDF + 1.5m x 1.0m , recorded maximum values for yield and quality parameters viz. number of nodes per vine , fruit length, fruit diameter , weight of edible fruit , fruit yield per vine, and fruit yield per hectare.

Key words: Fertiliser levels, spacing, pointed gourd, growth and yield

***

T-02.38 POTASSIUM NUTRITION IN VEGETABLE CROPS

Ashutosh Singh[1], Amit Kumar Pandey[2] and Ragini Kumari[3]
[1&2]Assistant Professor-cum-Junior Scientist, Mandan Bharti Agriculture College, Agwanpur, Saharsa, Bihar (India)
[3]Assistant Professor-cum-Junior Scientist, Bihar Agriculture College, Sabour, Bhagalpur, Bihar (India)
**Corresponding author e-mail: dr.ashusingh1984@gmail.com*

Abstract

The vegetable are more demanding in potassium and some species such as tomatoes require it in greater quantity than nitrogen. The factors that contribute to high requirement, in generally are a brief cycle and short absorption period related to high demand of nutrient. High potassium concentration in cell can improve cold stress tolerance by reducing the osmotic potential of cells and decreasing the freezing point of sap, preventing cell dehydration. Adequate potassium nutrition increases plants capacity to remove the reactive oxygen species. It is produced during the thermal stress and improving the efficiency of water use, these factors make plants less sensitive to heat. Potassium nutrition is effective in minimizing the phytotoxic effects of surplus NH_4^+. Potassium performance a very significant role in the mitigation of biotic stresses to which plants are susceptible by reducing the accumulation of soluble sugars, organic acids and amides of which pathogen are fed. Potassium takes a close association with post harvest quality of vegetables because post harvest parameters such as fruit size, soluble solids, lycopene and vitamin C concentration are influenced by this nutrient. In tomato fruits, the potassium nutrition increased the lycopene which decreases the appearance of cancers and avoiding the onset of heart diseases. Higher concentration of vitamin C as a role of potassium nutrition were found in peppers and chilli soluble solids present in tomato include important compound responsible for taste is related with K-nutrition. Deficiency of potassium leads to changes in gas exchange, with reduction of CO_2 diffusion and photosynthesis. Presence of chlorsois in sugarbeet is the result of omission of K. Thus, the main biotic and abiotic stresses can be mitigated by potassium nutrition.

Key words: Potassium, nutrition, vegetable, crops

***

T-02.39 COMPARISON OF COMPLETE AND INCOMPLETE BLOCK DESIGNS ON THE EXPERIMENTS IN VEGETABLE CROPS

Basudev Kole* and D. P. Saha
Dr. Kalam Agricultural College, Kishanganj, Bihar
**Corresponding author e-mail: basudevkole@gmail.com*

Abstract

The statistical inference of every experimental result is the most important part to conclude any research process. Therefore, statistical understanding is expected in every research for valid interpretation. Planning and implementing of any field based research in vegetable crops become difficult due to specific aspects like, intensive management and huge labour requirement, heterogeneity of the experimental unit and uneven fruit maturation. All these factors are controllable sources of variability which can be reduced by proper experimental planning and implementation. Proper planning and selection of suitable design for a particular research objective is the basis of all successful experiments. In agricultural field experiment where the experimental units are more heterogeneous, classification of Experimental designs in to complete block and incomplete block designs become more important. This classification is completely based on the treatment numbers found in a block. In complete block design all the treatments are present in every block while In case of incomplete block designs some treatments found in one block and some in another block. Some of the complete block designs are, CRD (completely randomized design), RCBD (Randomized complete block design), LSD (Latin square design), SPD (split plot design). And some incomplete block designs are LD (lattice design) and AD (Augmented designs). Unfortunately due to ease of analysis and desired statistical inference most of the time researchers used complete block design than the balanced incomplete block designs. But each designs had their own conditions and the level of precision depends on the fulfilment of the conditions and valid assumption. Therefore, no single design is best on all situations. The present work provides the basic comparison between concepts and implementation of complete and incomplete block designs and also compares the selection criteria.

Key words: Complete block Design, Incomplete Block Design.

***

T-02.40 GENERATION MEAN ANALYSIS OF FRUIT YIELD AND QUALITY CHARACTERS OF TOMATO

P. K. Ray[1,*], R. B. Verma[1], S. S. Solankey[1] and Anjani Kumar[2]
[1]Bihar Agricultural University, Sabour, Bhagalpur, Bihar 813 210, India
[2]Director, ICAR-ATARI, Zone-IV, Patna, Bihar 801506, India
**Corresponding author e-mail: pankajveg@gmail.com*

Abstract

Nature of gene action for fruit yield and quality characters of tomato was determined by analyzing the mean and variances of the six genetic populations (P_1, P_2, F_1, F_2, BC_1 and BC_2) of cross combinations H-86 × *S. peruvianum*. Non-additive gene action including non-allelic interactions was important for the genetic control of all the characters which indicated that yield components and fruit quality traits were predominantly under the control of non-fixable gene effects. Additive (*d*) effect and additive × dominant (*j*) gene interactions were the only significant portion of gene controlling yield per plant of the tomato. Finally, dominance gene effects were found important in controlling tomato leaf curl virus. the positive sign for the additive (*d*) effects was observed in the traits plant height (cm), primary branches/ plant, fruits/ plant, average fruit weight (g), equatorial fruit diameter (mm), number of locules/fruit, ascorbic acid content (mg/100g) and lycopene content (mg/100g), while the negative sign (*h*) was observed for leaf length (cm), leaf width (cm), days to 50% flowering, equatorial fruit diameter (mm), polar fruit diameter (mm), TSS (%), phenol content of leaf (mg/100g), ascorbic acid content (mg/100g) and per cent disease incidence of ToLCV (%).

Key words: Fruit characters, gene action, generation mean, tomato.

***

T-02.41 STUDY OF GENETIC DIVERGENCE FOR YIELD AND QUALITY TRAITS IN COWPEA [*VIGNA UNGUICULATA* (L.) WALP.]

Sanjeev Vaggar[1], Udit Kumar[1]*, K. Prasad[2], L. M. Yadav[1], Pramila[1] and B. M. Sinha[1]

[1] Department of Horticulture, Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar

[2]Department of Horticulture, TCA Dholi, Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar

**Corresponding author e-mail: udithort@gmail.com*

Abstract

The genetic divergence analysis, using Mahalanobis D^2 statistics, was carried out in thirty-three cowpea genotypes including one check for sixteen characters. All the characters under study showed considerable divergence and the genotypes were grouped into five clusters. The clustering pattern had no parallelism between genetic diversity and geographical distribution, suggesting that the selection of parental genotypes for hybridization will be more appropriate based on genetic diversity. The thirty-three cowpea genotypes were taken for genetic divergence analysis and displayed marked divergence accordingly grouped into five clusters following Tocher's method of clustering. Cluster I had eight genotypes. Cluster II had three genotypes. Cluster III had eleven genotypes. Cluster IV had nine genotypes and Cluster V had two genotypes. The mean intra-cluster and inter-cluster D^2 values among the five clusters were compared. The results revealed that intra-cluster D^2 values ranged from 0.00 in cluster II, cluster III, cluster IV and cluster V to 16.12 in cluster I. The inter-cluster D^2 values of five

clusters revealed that highest inter-cluster generalized distance (44.50) was between cluster V and cluster III. Followed by cluster V and cluster II (38.32), cluster V and cluster I (32.29), cluster IV and cluster II (30.80), cluster V and cluster IV (27.65), cluster IV and cluster III (27.50), cluster IV and cluster I (23.83), cluster III and cluster II (21.17), while the lowest (20.12) was between cluster II and cluster I. Based on our findings, it can be concluded that during selection emphasis may be given to seed germination percentage, peduncle length, and average pod weight to enhance the yield of cowpea. For obtaining the heterotic recombinants, genotypes placed in cluster V, cluster II and cluster III may be used in the crossing program. Further, it can be recommended that heterotic recombinants may be obtained for enhancing peduncle length, average pod weight, and seed germination percentage.

Key words: Cowpea, genotype, divergence, Mahalanobis D^2, clusters

***

T-02.42 ALGORITHMIC CONSTRUCTION OF TWO LEVEL SUPERSATURATED DESIGN: AN OVERVIEW

Basudev Kole
Dr. Kalam Agricultural College, Kishanganj, Bihar
Corresponding author e-mail: basudevkole@gmail.com

Abstract

Supersaturated designs are fractional factorial designs in which the number of runs (row) is less than the total number of factors (column). They are commonly used in screening experiments, with the objective of identifying screening out the important factors from a large set of potentially active variables. The huge advantage of these designs is that they reduce the experimental cost drastically, but their critical disadvantage is the confounding involved in the statistical analysis. The design is said to be balanced when each levels appear equal number of times in each factor and the design is called two level SSDs where all the factors have only two levels. There may be multi level as well as mixed level SSDs where the levels of factors are more than two for each factor but fixed to each factor or different in some factor respectively. Besides the theoretical methods of construction there are numbers of algorithm is available in literature to construct balanced as well as nearly balanced efficient two level supersaturated design for example, the algorithms proposed by Nguyen (1996), Lejeune (2003), Ryan and Bulutoglu (2007), Gupta et al. (2008) and Gupta et al. (2010). All the algorithms construct efficient SSDs based on the available lower bounds to $E(s^2)$. Several authors proposed lower bound to $E(s^2)$ recently by Das et al. (2008) for balanced and the lower bound to $E(s^2)$ given by Suen and Das (2010) for nearly balanced design in case of two level SSDs. Some algorithm has been so constructed that the generated design has less number of orthogonal pair of columns. And for nearly balanced design the constructed design is efficient for all $E(s^2)$, r_{max} and f_{max} criterion.

Key words: Supersaturated designs, fractional factorial experiments.

***

Theme – III

Impact of climate change on vegetable crops and its mitigation strategies

T-03.1 ASSESSMENT OF ENVIRONMENTAL EFFECT ON FERTILITY RESTORATION IN SWEET PEPPER (*CAPSICUM ANNUUM* L. VAR. *GROSSUM*)

Manoj Kumar Nalla, V.K. Sharma and V. Rakesh Sharma

Division of Vegetable Science, ICAR–Indian Agricultural Research Institute, New Delhi

**Corresponding author e-mail: manojkumar.nalla@worldveg.org*

Abstract

In pepper, cytoplasmic male sterility trait is important for cost effective hybrid seed production which helps in commercial hybridization without manual emasculation and pollination. Commercial use of CMS hybrid necessitates stable performance of sterile and fertile to promise genetically consistent F1 seed production and reduced the risk of incomplete fertility. Therefore, the present study was carried out to explore the fertility restoration of 20 CMS based sweet pepper (*Capsicum annuum* L. var. *grossum*) hybrids at two different locations IARI, Regional Station, Katrain, Himachal Pradesh, and IARI, New Delhi. The trials were performed in a randomized block design with three replications. In each environment, plants were assessed for pollen viability, pollen germination and number of seeds per fruit. Among the hybrids tested KTCA3 X KTCR1, KTCA3 X KTCR4, KTCA3 x KTCR5, KTCA5 X KTCR1, KTCA5 X KTCR5, KTCA5 X KTCR6, KTCA5 X KTCR9 and KTCA5 X KTCR10 showed same fertility status estimated based on mean values and were stable in both the locations. There is substantial variation among hybrids over the locations for pollen fertility. Among hybrids, KTCA5 x KTCR5 and KTCA5 x KTCR9 showed stable and good performance at both the locations. Since the mean performance of number of seeds is better in location 1 than in location 2, hence it suggests that location 1 is preferable for seed production. The pooled analysis data revealed a significant ($P \leq 0.001$) genotypes x environment interactions for all the traits. In the present study, we observed that the fertility restoration of hybrids was dependent not only on the genetic makeup of the plant but also influenced by the environment conditions of the plants grown. Moreover, our results provide a comprehensive overview for our understanding of the environment effect on the function of fertility restoration genes and to develop stable restorer line for hybrid breeding

Key words: Fertility restoration, G x E interaction, stability, pooled mean analysis

***

T-03.2 CLIMATE CHANGE LEADING TO CROP YIELD AND PREDATOR DIVERSITY LOSS

Sourav Singh, Ashish Kumar and Ankush M. Raut*

Department of Entomology, School of Agriculture, Lovely Professional University, Punjab

**Corresponding author e-mail: ankush.19876@lpu.co.in*

Abstract

Vegetables being the good sources of vitamins and minerals also play key role in ensuring food and nutritional security. One of the primary causes for the low crop yield is the change inclimate.In addition, expanding temperatures, moving of season; diminished water system water accessibility, flooding, and saltiness will be the significant restricting elements in continuing and expanding vegetable efficiency. Impacts of environmental change likewise impact the nuisance and ailment events; have microbe associations, appropriation and nature of creepy crawlies, habitat change and their overwintering limit, there by getting significant prevention to vegetable development. To relieve the unfavourable effect of climatic change onproduction and quality of vegetable, therefore, need to developed sustainable ecological engineering technology and its application awareness at ground level. Soil health, application of balance nutrient, crop phonology, healthy and certified seed, crop rotation practices and growing good insectory plant as a border crop, utilize the green label insecticides could be a effective techniques for marinating the diversity of arthropods (predators) and yield of crops.

Key words: Climate change; predator biodiversity, yield loss, sustainable agriculture.

***

T-03.3 IMPACT OF CLIMATIC CHANGE ON VEGETABLE CROPS AND ITS MITIGATION STRATEGIES

Shahnaz Jamil

Deptt. of Botany M.L.S.M. College, Darbhanga Ranjeet Kumar Gupta Research Scholer

**Corresponding author e-mail: shahnazjamil298@gmail.com*

Abstract

Vegetables play an important role in the economy of India as well as in our well balanced diet. The constituents of vegetables have good therapeutic value due to anti carcinogenic and antioxidant properties. Nature has endowed our country with vast diversity of land, soil and of varied agro-climatic conditions. But unluckily the crops productivity are being hit by the consequences of climatic change such as global warming changes in seasonal and monsoon pattern, biotic and abiotic factors under changing climatic situations crop failures, shortage of yields, reduction in quality and increasing pests and disease problems are common and they render the vegetable cultivation unprofitable. Drought and salinity are the two important consequences of increase in temperature worsening vegetable cultivation vegetable crops are very sensitive to climatic vagaries and sudden rise in temperatures as well as irregular precipitation at any phase of crop growth can affect the normal growth. For reducing malnutrition and alleviating poverty in developing countries through improved production and consumption of safe vegetables will involve adaptation of current vegetable systems to the

potential impact of climatic change. To mitigate the adverse impact of climatic change on productivity and quality of vegetable crops there in need to develop sound adaptation strategies.

Key words: Climatic change, abiotic factor, vegetables, productivity.

***

T-03.4 PROTECTED CULTIVATION OF VEGETABLES: FUTURE PROSPECTS IN BIHAR

Krishna Kant Dubey* and Mamta Kumari

[1]Krishi Vigyan Kendra, Sabour, Bhagalpur, Bihar Agricultural University, Sabour, Bhagalpur, Bihar

**Corresponding author e-mail: krishnaiari@gmail.com*

Abstract

Horticulture today forms an integral part of food, nutritional and economic security. Adoption of horticulture, both by small and marginal farmers has brought prosperity in many regions of the country as India is endowed with a wide variety of agro-climatic conditions & enjoys an enviable position in the horticulture map of the world. There are more than 55 countries now in the world where cultivation of crops is undertaken on a commercial scale under cover and it is continuously growing at a fast rate internationally. Polyhouse cultivation of vegetables is emerging as a specialized production technology to overcome biotic and abiotic stresses and to break the seasonal barrier to production. The main objectives of cultivation of vegetables in a polyhouse condition are, to protect the crop against biotic (pests, diseases and weeds) and abiotic (temperature, humidity light,) stresses and to ensure round the year production of high-value quality vegetables during the off-season. Vegetable cultivation in polyhouse not only increases the productivity but also, enhances the quality of vegetables. Protected cultivation of vegetable offers distinct advantage of quality, productivity and favourable market price to the growers. It increases their income in off- season as compared to normal season as well as virus free cultivation of Tomato, Chilli, Sweet pepper, cucumber and other vegetables mainly during rainy season. Greenhouse is also the most practical method of achieving the objectives of protected agriculture, where natural environment is modified by the use of sound engineering principles to achieve optimum plant growth and yield (more produce per unit area) with increased input use efficiency. In natural season local vegetables flood the markets substantially bringing down the prices. In the absence of storage infrastructure and vegetable processing industry in the country, off-season vegetables farming is the only viable option that can add value to the farmer produce.

Key words: 3- 5 Protected cultivation, vegetables, polyhouse, climate change.

***

T-03.5 IMPACT OF CLIMATE CHANGE ON VEGETABLE CROPS

Manish Raj*, Shweta Bharti, Sarita, Lingutla Sirisha

Department of agronomy, Bihar Agricultural University, Sabour, Bhagalpur (Bihar)

**Corresponding author e-mail: manishrajagri@gmail.com*

Abstract

In 2018-19, the total horticulture crop production in India was reported 310.74 MT under 25.61 Mha acreages, however the total vegetables and fruits production were 183.17 and 97.97 MT respectively. India's share in world production of vegetables and fruits are 10.7 and 13% respectively (Department of agriculture, cooperation & farmer welfare, 2018-19). Vegetables are a rich source of carbohydrate, vitamins,, protein and minerals. The immense potential of vegetables for providing food and nutritional security and refinement of nutrient deficiencies has been realized in every corner of world. These are the best nature's assets to get over from micronutrient deficiencies and to assist smallholder farmers with immense return and more employment per hectare than staple crops. However, vegetables are much hostile to environmental fluctuations, and generally increased temperatures and limited soil moisture are the two major reasons of low yields as they greatly affect discrete biochemical and physiological processes like, altered metabolism and enzymatic activity, decreased photosynthetic activity, heat injury to the tissues etc. Change in climate is the prime cause of for decrease in production of most of the vegetables around the world. Moreover, increasing temperatures, relative humidity, precipitation, reduced irrigation-water availability, drought, flooding and salinity will be the major limiting factors in enhancing vegetable productivity. Under changing climatic situations crop failures, less availability of produce, deduction in quality and increasing pest and disease problems are common and they cause the vegetable production not up to the mark. As many enzymatic activities and physiological processes are temperature dependent, they are at great extent affected due to change in temperature extremes. Drought and salinity are the two important consequences of increase in temperature worsening vegetable production. In India production in potato may decline due to climate change and global warming by 3.16% and 13.72 % in the year 2020 and 2050, respectively (Sing et al. 2009). In warm climate, surveillance of DBM (Diamond Back Moth) accelerated. Change in climate also influence the pest and disease surge, distribution and ecology of insects ,host-pathogen interactions, time of appearance, migration to new places and their overwintering capacity, there by becoming major hitch to vegetable cultivation.

Key words: Climate change, productivity, vegetable crop, micro nutrient

***

T-03.6 THE IMPACT OF CLIMATE CHANGE ON VEGETABLES AND ITS MITIGATION STRATEGIES

Roopendra Kumar[1,*], Devesh Kumar[2], Arjun Singh[3], Kuldeep[1], Sujeet Kumar Patel[4]

Department of Horticulture (Fruit and Fruit Technology) Bihar Agricultural University, Sabour, Bhagalpur (Bihar) – 813210,

[2]Division of Post-Harvest Technology, ICAR- Indian Agricultural Research Institute, New Delhi,

[3]Department of Vegetable Science, College of Horticulture and Forestry, RLBCAU, Jhansi,

[4]Department of Horticulture and Post-Harvest Technology (Palli Shiksha Bhavan)Vishva Bharati, Shantiniketan, West Bengal

**Corresponding author e-mail: roopendrakkumar40@gmail.com*

Abstract

Climate change is main cause to reduce production, productivity and quality of most of the vegetables all over the world. Under changing climatic situations crop failures, unsuitable in different climatic conditions and increasing pest and diseases problems are common.They are also being effect by climate change such as global warming, changes in seasonal and monsoon pattern and biotic and abiotic factors. Some important activities of various climatic factors such as High temperature, Salinity, Drought, Flooding, Diseases and Insect- pest. Other stressfactors are CO2 and Relative Humidity, air pollutants such as CH4, CO2 and CFC's are causal to the global warming and nitrogen and sulphur dioxides are causing reduction of ozone layer, UV radiation etc. So many processes like physiological, morphological and enzymatic activities are dependent on temperature and they are going to be largely effected. Though the changes in climate is a continuous process, it has become noticeable in vegetables field from the past few years when it has started significant and lasting effect on vegetable crop production. Among the all vegetables, potato is most susceptible to climate change due to its requires exact climatic for vegetative and productive processes. The different management practices for adapting climate change are Cultural practices that conserve water and protect crops, water saving irrigation managements, improved stress tolerance through grafting. Others practices under developing Climate-Resilient vegetables such as Tolerance to high temperatures, Tolerance to Drought, Tolerance to saline soils and irrigation water and Climate-Proofing though Genomics and Biotechnology are QTLs and gene discovery for tolerance to stresses and Engineering stress tolerance.AVRDC-The World Vegetable Center has developed technologies on integrated crop management and many of these approaches directly provide solutions to mitigate the effects of climate change.

Key words: Climate change, global warming, vegetable crops, biotechnology

***

T-03.7 NANOTECHNOLOGICAL STRATEGIES FOR MITIGATION OF THE IMPACTS OF CLIMATE CHANGE

Satdev[1,*], Nintu Mandal[1], Neki Ram[2], Suman Lata[1], Priyanka Kumari[1], Neeraj Bagoria[1], Rakesh Kumar[1] and Shruti Kumari[1]

[1]Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

[2]Department of Horticulture, Institute of Agricultural Sciences, BHU, Varanasi

**Corresponding author e-mail: rokanasatdev241@gmail.com*

Abstract

India facing many problem for climatically variability such as fluctuation of crop suitable temperature, rainfall shifting patterns, severe drought and devastating floods etc. Those climatically condition are drastically affected of growth and development of agricultural and horticultural crop. Fluctuation of climate temperature was affect bud drop, development of abnormal flowering, production of poor pollen, dehiscence, and viability, ovule abortion and poor viability, reduced carbohydrate availability, and other reproductive abnormalities of tomato crop (Hazra, *et al* 2007). The drought condition are adversely affects the seed germination in vegetable crop like okra and onion, tuber sprouting in potato as well as 50 % more reduction yield was reported under tomato due to water stress condition during reproductive stage (Rao and Bhatt, 2012). Nanotechnology is new innovative field in the area of agricultural and horticulture. The nanotechnolgy is most significant breakthrough technology of the new century for mitigation and as well as adaptation strategies for climate change. Nanotechnology to play significant role in developments of smart delivery of agrochemicals, development of novel superabsorbent polymers, real time monitoring of agrochemicals via nanobiosensors, increased resilience and resilience of microbes under heat stress which are very relevant in changing climate scenario. Nanotechnological were increasing input use efficiency, postively pest control and management of drought and it much important in present day agriculture and horticulture and in future also.

Key words: - Nanotechnology, climate change, input use efficiency

***

T-03.8 EFFECT OF CLIMATE CHANGE ON GROWTH OF VEGETABLE CROPS AND ADAPTATION MEASURES

Shivani Ranjan* and Sumit Sow

Department of Agronomy, Bihar Agricultural University, Sabour (Bhagalpur), Bihar

**Corresponding author e-mail: ranjanshivani54@gmail.com*

Abstract

Climate change is not in the future, it has already started to have impact. Evidences of these impacts are severe droughts, extreme precipitation, coastal flooding, heat waves. Due to this

climate change, the production of vegetable crops is decreasing. Flower drop as well as decrease in fruit setting occurs in tomato when the day temperature exceeds 30°C. In cucurbits, germination as well as production of female flowers is inhibited at a temperature of 42°C. High temperature also causes physiological disorders such as hollow stem in cauliflower, tip burn of cole crops and lettuce, blossom end rot in tomato. Chilling injury occurs when plants are exposed at a temperature of 0-10°C, freezing injury occurs at a temperature less than 0°C. Chilling injury causes water soaked lesions in cucumber and tomato. Freezing injury causes dark blue patches underneath the skin in potato. Drought also affects the growth of vegetable crops like water stress at flowering and fruit development stage in chilli and cucumber causes bitterness and deformity in fruits and setting of flowers. Mitigation strategies for this climate change are sowing of heat stress tolerant varieties such as Money maker, Red cherry of tomato, K- 1053 is cold tolerant variety of pea. Onion variety tolerant to drought like Alka Kalyan. Agronomic approaches like no tillage, crop rotation, mulching, site specific nutrient management can be adopted toget optimum yield of vegetable crops.

Key words: Climate change, fruit setting, physiological disorders, tolerant varieties

***

T-03.9 IMPACT OF CLIMATE CHANGE ON VEGETABLE SEED PRODUCTION IN INDIA

B. Venudevan*, J. Ramkumar, C. Rajababu and P. Arunkumar

ICAR-Krishi Vigyan Kendra, TNAU, Aruppukottai, Tamil Nadu.

**Corresponding author e-mail: venudevan.b@tnau.ac.in*

Abstract

The climate changes are the greatest importance for vegetable seed production and allied sectors and in this regard various reports on impact of climate change on crop cultivation area as well as species composition of forests. Food security depends on seed security and the most of the seed industries mainly give attention to production and supply the quality vegetable seed to the farmers and other seed producers because vegetable seeds are high value low volume crops. In climate change water stress and elevated temperature (abiotic stress) are important physical factor for affecting the vegetable seed yield and quality. Various authors from India was reported the effects of elevated CO_2 and temperature during vegetable seed production. In Carrot (*Daucus carota* L.) production vegetative growth was increased by elevated CO_2 as well as temperature. At 11–12^{0}C, elevated CO_2 had no effect on carrot growth, but when mean air temperature reach >25^{0}C adversally afftects the pollination, seed development and seed yield.

Key words: Abiotic stress, climate change, vegetable seed production, seed quality

***

T-03.10 CLIMATE CHANGE AND VEGETABLES

Mahendra Kumar Atal, R. B. Verma and Vijay Kumar Singh

Department of Horticulture (Vegetable & Floriculture)

Bihar Agricultural University, Sabour, Bhagalpur, Bihar- 813210

**Corresponding author e-mail: mahendrakumaratal0@gmail.com*

Abstract

Vegetables are highly perishable and very sensitive to unpredictable climatic changes. It is an important component of human diet as they are the only source of nutrients, vitamins and minerals. These are considered as protective foods because of ability to prevent diseases by supplying vitamins and minerals and moreover its nutritional quality is determined by Soil factors, temperature, light and CO_2. Climate change is the primary cause of low production of most of the vegetables worldwide; reducing average yields for most of the major vegetables. Climate change an adverse impact on productivity and quality besides aggravate the environmental stress on vegetable crops. Environmental stresses like increasing temperature, reduced irrigation water availability, flooding and salinity are thought to be the major limiting factors in enhancing vegetable productivity. Vegetable crops are very sensitive to climatic vagaries and sudden rise in temperature as well as irregular precipitation at any phase of crop growth can affect the normal growth, flowering, pollination, fruit development and subsequently decrease the crop yield. Adoption of effective and efficient measure is the only way to mitigate the adverse impact of climate change on vegetable production and particularly on their productivity, quality and yield. Like cultural management practicesincluding nutrient, tillage residue management, water management, mulching, improved pest management, and breeding approaches like development of genotypes tolerant to high temperature, salinity and moisture stress are resorted.

Key words: Vegetables, climatic changes, yield, quality

***

T-03.11 EFFECT OF COLD STRESS ON PHOTOSYNTHETIC STABILITY OF 12 CHILLI (*CAPSICUM ANNUUM* L.) GENOTYPES AND COLD STRESS ALLEVIATING EFFECT OF SELENIUM SPRAYING

Jaya Ganesh Thiruvengadam Nandagopal*, Surendran Ramasamy, Shanmugam Girija

Department of Biotechnology, Bharathiar University, Tamilnadu.

**Corresponding author e-mail: tnjayaganesh@gmail.com*

Abstract

The aim of the present investigation is to screen chilli seedlings for cold tolerance. Matured leaves of 12 chilli genotypes were used for pigment quantification. 21 days old seedlings on grow bags [soil/peat/vermiculite (1:1:1)] were kept in growth chamber at 15/10℃ d/n for 48 h to simulate cold stress. Genotype dependent decreased or unaffected levels of chlorophyll and increased levels of total carotenoids content were found during cold stress. The highest chlorophyll stability index among selected genotypes was observed in CO-1(97.95%) and the lowest in Jayanthi (51.01%). Excellent increment of leaf carotenoids was observed in F-04 (2.53mg/g) and F-707 (2.51mg/g). By cold injury index, genotypes categorized into mild injured, moderately injured and severe injured genotypes. To investigate the effect of Selenium (Se) in alleviating adversities of cold stress on leaf pigments of chilli seedlings. Under cold stress conditions, foliage applied Se stimulated photosynthetic attributes. In addition, higher increment of carotenoid levels (3.7mg/g) was recorded in Se5 treated CO-1 genotype. The increase in chlorophyll content indicated that Se spray can alleviate cold stress. These pigment content are recognized as a rapid cold injury indicator for selecting a cold tolerant genotype which can be put as a good candidate for selection criteria in chilli breeding program regarding cold tolerance.

Key words: Chilli, selenium, chlorophyll, carotenoids, cold injury

***

T-03.12 CLIMATE CHANGE MITIGATION THROUGH PROTECTED STRUCTURES IN VEGETABLE PRODUCTION

T. Lakshmi Tirupathamma[1,*], C.Venkata Ramana[2], D. Ratna Babu[3] and K. Sasikala[4]

[1]Department of vegetable science, College of Horticulture, Dr. Y.S.R.H.U, Tadepalligudem, West Godavari, A.P., India

[2]Horticultural Research Station, Dr. Y.S.R.H.U, Lam Farm, Guntur, India.

[3]Department of Genetics and Plant Breeding, Advanced P.G. Centre, Lam Farm, Guntur. ANGRU.

[4]Department of agronomy, College of Horticulture, Dr. Y.S.R. Horticultural University, V.R. Gudem

**Corresponding author e-mail: lakshmitiru57@gmail.com*

Abstract

Role of vegetables in the maintenance of human health is very well versed. These vegetables are one of the most sensitive crops for their growth and development. Varying temperature (high/low), precipitation, snow, hail and even increased rate of specific gases (co^2, methane etc.) at different stages of crop growth are reported to show many negative effects, ultimately yielding huge economical losses. Climate change can be identified by using statistical tests.

The Change in climate is determined by means or the variability values and its properties, which persists for an extended period, they may be typically decades or longer. In vegetable crops, based on severity of environmental stresses, climate will be change. Slowing down the rate of climate change, so as we have more time to get ready for its effects is known as mitigation. To minimize the effect of climate change on vegetable crops, miniature green houses or protected structures have great role, particularly in temperature fluctuation, over/under precipitation, fluctuating sun shine hours and pest or disease infestation (Singh and Satpathy, 2005). In vegetable production, farmers are gradually adopting different protected structures to combat the climatic vagaries and emerging challenges. Mostly used structures are Poly-tunnels and these are utilized for raising seedlings of vegetables during *kharif*. In India, production of cucurbits in cold desert is now possible through protected cultivation for commercial purpose. eg. Large quantity of Sarda melon was imported can now be produced with ease. In open fields, Muskmelon and watermelon (August and September) also cultivated during off season. An early crop of cucurbits like squash and long melon also be taken in poly houses. For off season cultivation, plastic low tunnels provide a cheap and better and it gives the early crop from 20~30 days over their normal season of cultivation. A low tunnel provides the healthy and early nursery. Farming community successfully utilized the protected cultivation technology and it has been extended also.

Key words: Protected structures, climate change, mitigation strategies

***

T-03.13 IMPACT OF CLIMATIC CHANGE ON VEGETABLE CROPS AND PRODUCTION

Pappu Lal Bairwa[1,*], Raju Jatav[2] and Amit Dixit[3]

[1]Department of Vegetable Science, CoA, IGKV, Raipur

[2]Department of Silviculture and Agroforestry, CH&F, Jhalawar, AU, Kota

[3]College of Agriculture & Research Station, Kurud (Dhamtari) IGKV, Raipur

**Correspondence author e-mail: plbairwa28@gmail.com*

Abstract

Regular increasing population at an alarming rate is very dangers issue because continue rise hunger and malnourishment are challenging problems for all countries, especially those countries which have less resources. Vegetables are protective foods which are providing different vitamins, essential nutrients, pharmaceutical and nutraceutical compounds that are very essential for our good health and to control diseases and disorders. Recently, the cultivation of different types of vegetables crops provides income and generates employments but the growth and development stage of crops are significantly affected by different agro-climatic factors such as temperature, rainfall, frost, snow, wind velocity, etc. Such climatic

factors are play a vital role in growth, development, quality and quantity. Sudden change in climate also change the soil fertility status, attract the diseases and many insect-pest, host-pathogen interactions to crops, microbial population & their activities in soil and pollinator's behavior, etc. That harmful effect on crops leads to completely failure of the crops. All these factors have significant effects on the vegetable cultivation and their production which is very important for vegetable crop growers. So there is a need to understand the effect of climatic change on vegetable crops because climate change is the major cause of low quantity and quality of major vegetables crops in worldwide.

Key words: Vegetable crops, employment, population, climate change

***

T-03.14 EFFECT OF CLIMATE CHANGE ON VEGETABLE PRODUCTION AND MITIGATION STRATEGIES

Tushar Arun Mohanty[1] and Poojashree Mahapatra[2]

1-Department of Plant Breeding and Genetics, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India.

2-Department of Plant Pathology, College of Agriculture, Odisha University of Agriculture & Technology, Bhubaneswar, Odisha,India

**Corresponding author e-mail:tushararunmohanty@gmail.com*

Abstract

Climate change, a global phenomenon, concerns about food and healthy food security for the elderly, expected to be 9.5 billion by the end of 2050, and has attracted global, regional and national discussions on mitigation and adaptation strategies. Potential effects are caused by droughts and floods, changes in rainfall patterns and sudden changes in temperature, which will affect crop growth, flowering, yielding and harvesting and product quality, without increasing the risk of pests and diseases. How can you address the challenges of climate change in terms of adaptation strategies and reduce the point of discussion in government programs, globally. Vegetables are one of the best sources of vitamins and minerals and play an important role in ensuring food security and healthy food security. And they are earning well for the farmer as they fetch higher prices in the market. As with other plants, they are also affected by the effects of climate change such as global warming, changes in seasonal and rainfall patterns as well as biotic and abiotic factors. Under climate change crop failures, crop failures, declining quality and growing problems of pests and diseases are common and make vegetable farming unprofitable. Since many physiological processes and enzymatic functions depend on temperature, they will be highly efficient. Drought and salt are two important effects of global warming that are detrimental to vegetable production. An increase in CO_2 can increase crop yields due to increased CO_2 emissions, but decrease after a certain amount. Anthropogenic pollutants such as CO_2, CH_4 and CFC contribute to global warming as well as nitrogen and sulfur dioxides that cause the depletion of the ozone layer and allow harmful UV radiation to

penetrate. These effects on climate change also have an impact on events and diseases, host-pathogen interactions, distribution and the nature of insects, the timing of appearance, migration to new habitats and their ability to catch more, when reverting to vegetable farming. To reduce the negative impact of climate change on the production and quality of vegetable crops there is a need to develop sound adaptation strategies. Emphasis should be placed on the development of improved hot water production systems that operate in hot and dry conditions. Plant management practices such as the consolidation of crop residues and plastic mulch help save soil moisture. Excessive moisture due to heavy rains becomes a major problem that can be overcome by growing plants in higher beds. The development of genotypes that tolerate high temperatures, humidity pressures, salts and climate testing through conventional, unconventional, breeding strategies, genomics and biotechnology etc. is required to address these challenges.

Key words- Climate change, vegetable production, Mitigation Strategies, Biotic-Abiotic factor.

***

T-03.15 IMPACT OF CLIMATE CHANGE ON VEGETABLE CROPS AND ITS MITIGATION STRATEGIES

Nikunj Joshi[1], Chirag Thakar[2] and Dipti Parmar[3]

Department of Fruit Science, College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, Mehsana, Gujarat

**Corresponding author e-mail*: *joshinikunj42@gmail.com*

Abstarct

Population growth and climate change are the challenges of the 21st Century and now it is widely accepted that the change in climate is unusual nature of environment. All quantitative assessments show that climate change will adversely affects food security and agro-ecological sector. Agriculture in developing countries lying at low latitudes is expected to be especially more vulnerable, because climate of many of these countries is already too hot. Main climate change related drivers are temperature, precipitation, sea level rise, atmospheric carbon dioxide content and incidence of extreme events may affect the agriculture sectors in many ways like reduction in agricultural productivity, limitations on water resources, exacerbation of drought periods, reduction in soil health, pest and disease outbreak etc. Climate change occurs due to change in the whether condition over longer period of time and it take place due to natural and human factors. Since the Industrial Revolution (i.e., 1750), humans have contributed to climate change through the emissions of Green House Gases, aerosols, and through changes in land use, resulting in a rise in global temperatures. Increases in global temperatures may have different impacts on agriculture, environment and life cycle of living entities. The solutions to global warming and present day climate change problems can be reduced by adoption of organic agriculture. It has been shown that the negative impact of climate on agricultural

production is region specific and is more severe in developing countries. Thus, organic agriculture could be a good option for reduce GHG emission and enhancing carbon sequestration in soils.

Key words: Climate change, vegetable crops, impacts, mitigation.

***

T-03.16 IMPACTS OF CLIMATE CHANGE ON VEGETABLE PRODUCTION AND ITS MANAGEMENT PRACTICES

Aravindh A[1,*], Arunkumar S[2] and V. Balamurugan[3]

[1]M.Sc. (Ag.) Agricultural Microbiology, Faculty of Agriculture, Annamalai University.

[2]M.Sc. (Ag.) Seed Science and Technology, Faculty of Agriculture, Annamalai University.

[3]M.Sc. (Ag.) Agricultural Extension, Faculty of Agriculture, Annamalai University.

**Corresponding author e-mail: aravindha124@gmail.com*

Abstract

Environmental change is the essential driver of low creation of a large portion of the vegetables around the world; lessening normal yields for the greater part of the significant vegetables. Additionally, expanding temperatures, diminished water system water accessibility, flooding, and saltiness will be the significant constraining elements in continuing and expanding vegetable efficiency. Under changing climatic circumstances crop disappointments, deficiency of yields, decrease in quality and expanding irritation and illness issues are normal and they render the vegetable creation unbeneficial. The same number of physiological procedures and enzymatic exercises are temperature subordinate, they will be generally affected. Dry spell and saltiness are the two significant results of increment in temperature intensifying vegetable creation. These impacts of environmental change additionally impact the irritation and infection events; have microorganism collaborations, conveyance and biology of creepy crawlies and season of appearance. To relieve the antagonistic effect of climatic change on efficiency and nature of vegetable harvests there is have to create sound variation techniques. Advancement of genotypes open minded to high temperature, dampness stress, saltiness and atmosphere sealing through traditional, non-ordinary, reproducing methods, genomics and biotechnology and so forth are basically required to address these difficulties.

Key words: Environmental change, vegetable productions and management.

***

T- 3.17 IMPACT OF CLIMATE CHANGE IN INSECT PEST INCIDENCE IN VEGETABLE CROPS

J. Ramkumar*, B. Venudevan and P. Arunkumar

ICAR-Krishi Vigyan Kendra, Tamil Nadu Agricultural University, Aruppukottai, Tamil Nadu.

**Corresponding author e-mail: jramtnau@gmail.com*

Abstract

Climate change is one amongst the main reasons for low production of major vegetables globally. The increasing global temperature, scantiness of irrigation water availability, water stagnation or flooding, soil salinity is the main restraining factors in sustainable vegetable production and productivity. Among them, extreme temperature (drought) and salinity were measured as key factors lower the vegetable production. In addition these, other abiotic stresses also directly or indirectly manipulate the pest and disease incidence, their life cycle, distribution, host-pathogen interaction, there by hinder the vegetable cultivation. The habitat ecology and biology of sucking pests *viz*., aphids, thrips were influenced by increasing temperature, with shorter life cycle and higher fecundity rate etc. Hence, the sucking insects can reproduce more generations per year. Soil temperature also alters the life cycle of some insects. So, the reproductive capacity of the few soil dwelling insect species may be affected. Most of the insects enter in to diapause stage to beat the unfavourable climatic conditions. Aestivation (resting period during higher temperature) and hibernation (resting period during lower temperature) are two types of diapauses. The polyphagous pest *Helicoverpa armigera* lie dormant due to increased temperature in winter season. The survival rate of stink bug *Nezara viridula* had considerably increased due to increased warmer conditions in winter period. The higher level of carbon dioxide accelerate the huge amount of food consumption and metabolism of the *H. armigera*, there the larvae may cause more damage to the vegetable crops. Similarly, aphids population also increased due to elevated carbon dioxide.

Key words: Climate change, *Helicoverpa armigera*, alien species, carbon dioxide.

***

T-03.18 EFFECT OF CLIMATE CHANGE ON VEGETABLE PRODUCTION AND STRATEGIES TO MITIGATE THE EFFECTS

Vishal Sonawane and Satish K. Gharde*

Department of Entomology, School of Agriculture, Lovely Professional University, Punjab

**Corresponding author e-mail:satish.23455@lpu.co.in*

Abstract

Climate is an important factor for vegetable production and decreasing the yield in vegetables. Change in temperaturescause reducing water availability, flooding, salinity will be major limiting factors in sustaining and increasing vegetable productivity. Climate changeaffect physiological processes such as respiration and photosynthesis can acclimate to increasing atmospheric CO_2 and temperatures. The effect of increased CO_2 on vegetables is mostly beneficial for production, but may alter internal product quality and photosynthetic regulationas well. Heat stress reduces fruit set of fruiting vegetables, and speeds up development of determinate vegetables, shortening their time for photo assimilation.Under changing climatic condition crop failures, shortage of yields, reduction in quality and increasing pest and disease problems are common and they render the vegetable production unprofitable.

Drought and salinity are the two important consequences of increase in temperature worsening vegetable production. These effects of its also influence the pest and disease occurrences, host-pathogen interactions, distribution and ecology of insects, time of appearance, migration to new places and their overwintering capacity, there by becoming major setback to vegetable cultivation. To mitigate the adverse impact of climatic change on productivity and quality of vegetable crops there is need to develop sound adaptation,breeding of new heat, drought and pest tolerant cultivars; secure water resources; increase the use of renewable energy sources;stimulating new ideas in innovative technologies; development of new approaches to secure stable yields and improve the product quality of vegetables for a cleaner production.The emphasis should be on development of production systems for improved water use efficiency adoptable to the hot and dry condition. The crop management practices like mulching with crop residues and plastic mulches help in conserving soil moisture. Excessive soil moisture due to heavy rain becomes major problem that can be overcome by growing crops on raised beds. Development of genotypes tolerant to high temperature, moisture stress, salinity and climate proofing through conventional, non-conventional, breeding techniques, genomics and biotechnology etc. are essentially required to meet these challenges.

Key words: Climate change, Vegetable production, Yield, Pest and Sustainable agriculture.

***

T-03.19 POTENTIAL IMPACTS OF CLIMATE CHANGE ON VEGETABLE PRODUCTION AND PRODUCT QUALITY

B. J. Shelshiya*, G. Sangeetha and S. Karthickeyan

AAIT, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.

**Corresponding author e-mail: shelshiya2001@gmail.com*

Abstract

Vegetables are highly consumed by humans due to their high production and taste. Physiological processes such as respiration and photosynthesis can acclimate to increasing atmospheric CO_2 and temperatures. The effect of increased CO_2 on vegetables is mostly beneficial for production, but may alter internal product quality or result in photosynthetic-down regulation. Heat stress reduce fruit set of fruiting vegetables and speeds up development of determinate vegetables, shortening their time photoassimilation. In both cases, yield losses result with an impaired product quality , thereby increasing production waste. A longer growing season arises from warmer temperatures , allows a greater number plantings to be cultivated, contributing to greater annual yields. However, some vegetables need a period of cold accumulation to produce a harvest. Despite the increasing potential for winter cultivation in future, perennials like asparagus might increasingly suffer from a lack of winter chilling. In cauliflower, higher temperatures will cause insufficient vernalization delaying head induction. This may contribute in improving the adaptation strategies of vegetable production to climate change for sustainable horticulture due to an effective risk management by meeting the problems of possible waste increase; breeding of new heat, drought and pest tolerant cultivars; secure water resources; increase the use of renewable energy sources; stimulating new ideas in innovative technologies; development of new approaches to secure stable yields and improve the product quality of vegetables for cleaner production.

Key words: vegetable, production, temperature.

***

T-03.20 NITROGEN MANAGEMENT – A BETTER WAY OF CLIMATE RESSILIANCE IN VEGETABLE PRODUCTION

Suman Lata[1*], Anuradha Sinha[2], Satdev[1], Priyanka Kumari[1]

[1]Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

[2]Department of Horticulture (Vegetable and Floriculture), Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

**Corresponding author e-mail: suman.lata272@gmail.com*

Abstract

Vegetable production is recognized as an important anthropogenic source of nitrous oxide (N_2O) emission. N_2O emission from vegetable production areas varies greatly depending on the climate, soil, agronomic practices, and crop species. A high dose of N fertilizer (global average of 220kgNha^{-1} per season) is widely applied in vegetable crop production to maximize crop yield, as vegetable crops are more profitable than cereal crops but it causes severe environmental problems, such as nitrate leaching, nitrous oxide (N_2O) emissions, and ammonia volatilization, many current intensive systems of vegetable production are not sustainable. Emissions of yield-scaled N_2O in response to inorganic N application rate differed among the

different vegetable types. The global average seasonal emission factor for vegetable field is around 0.94% of applied N fertilizer. Emission of this, increases the gobal greenhouse gas budget which lead to the climate change. Thus, it promotes the innovation for climate smart cropping. Various decisive factors in the overall N balance of field vegetable production systems and the different tools are available to increase, fertilizer use efficiency and consequently reduce N losses to the environment. Use of organic fertlizers are one of the best practice with synchronization of N mineralization with crop N demand to avoid yield loss and/or minimize the risk of N losses. This practice not only improves N mineralization in soil but also improves the physical and biological condition of soil which directly affect the production of vegetables. Judicious and site specific application of inorganic fertlilizer also an important way to prevent the loss of nitrogen and increases the nutrient use efficiency. Thus, there is need to include all those practices for nitrogen management that would be user friendly and directly implemented in farmers practices.

Key words: N_2O emission, N-fertilizer, organic fertilizer, nitrogen management.

***

Theme – IV

Vegetables as immunity booster and for nutritional security

T-04.1 NUTRITIONAL SECURITY THROUGH VEGETABLES

T. Tejaswini* and T. Thomson

College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, Tadepalligudem, West Godavari, Andhra Pradesh

**Corresponding author e-mail: tejabhaskar61@gmail.com*

Abstract

Vegetable is defined as a herbaceous plant or parts of the plant which is used either in the form of raw purpose, cooked, table purpose. Vegetables provide an abundant, cheap source of fibre and several vitamins and minerals. Vegetables are increasingly recognized as essential for food and nutrition security. Vegetables are mankind's most affordable source of vitamins and minerals needed for good health. Vegetables are an important nutritive component of the daily diet and the nutritive value of vegetables as a vital source of micronutrients has been well recognized. They are particularly important source of micronutrients, *viz.*, provitamin A, vitamin C, B_6, E as well as folic acid, iron and magnesium. In addition to these constituents, vegetables also supply fair amounts of carbohydrate, protein and energy. About 90% of human dietary vitamin C and 50% of vitaminA requirement is fulfilled from fruits and vegetables. Although vegetables do not contain an active vitamin A, instead they are rich source of carotenoids (pro-vitamin A), which are readily converted into active retinol (vitamin A) in the body. Furthermore, vegetable crops also provide many nutritionally less defined, yet important components of our diet, such as fibre and antioxidants. The diversified and highly nutritive vegetables are of great importance in alleviating hunger and malnutrition. The significance of vegetables in human diet and nutrition is well recognized and the number of vegetarians is increasing in the world due to greater awareness of good health and nutritious healthy food. At present India has a total population of more than a billion and the consumption of vegetables per caput per day is about 250 g which is below the recommended nutritional requirement of 350-400 g per caput per day. The recommended dietary allowances by the Indian Council of Medical Research include Green leafy vegetables (125 g), other vegetables (75 g) and root and tubers (100 g).

Key words: Vegetables, vitamins, antioxidants, health.

***

T-04.2 MEDICINAL USES OF VEGETABLES

T. Tejaswini* and T. Thomson

College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem, Tadepalligudem, West Godavari, Andhra Pradesh

**Corresponding author e-mail: tejabhaskar61@gmail.com*

Abstract

The plant or plant parts of few vegetables have been used as crude drugs and in drug formulations in indigenous medicine systems, ayurvedic and homoepathic. Aquous extract of bitter gourd fruits has been used to treat cataractogenesis in diabetic cataract. Bitter gourd is also helpful in lowering blood sugar in case of diabetes. Cucurbitacins present in cucurbits have been reported to have purgative pharmacodynamic, antineoplastic and anti-inflammatory properties. A few species of solanum used in stomach disorders, asthma and for improving apetite. Chillies and hot pepper contain capsaicin used in medicine and ointments. Green fruits of chillies contain rutin which has medicinaluses. Okra is a rich source of iodine and helps to prevent goitre. Radish increases appetite and prevents constipation. The corms of elephant foot yam have medicinal uses in ayurvedic system. The tubers of greater yam are anthelmintic and help in curing leprosy, piles dysentery and gonorrhea. Onion increases appetite and prevents formation of gas and sunstroke in summer. It has phenolic compound catechol which has antifungal properties. Garlic reduces cholesterol in the blood and garlic pills and capsules are also used as medicine. Cucumber prevents constipation and helps to cure jaundice. Bottle gourd has cooling effect and prevents constipation. Smooth gourd helps in curing malaria and fever. Round gourd is useful in dry cough and better blood circulation. The seeds of kheksa are used as aperients and for curing ulcers, sores and liver and spleen problems. Fenugreek is carminative and tonic. The steroid diosgenin present in the seeds is used in preparation of contraceptives. The leaves of basella are also used as poultice for boils and swellings.

Key words: Vegetables, indigenous medicine, ayurvedic, homoepathic

***

T-04.3 TUBER CROPS: THE NUTRITIONAL SECURITY AND LIVELIHOOD IMPROVEMENT OF TRIBALS

Nandita Jena*

Institute of Agricultural Sciences, SOA DU, Bhubaneswar, Odisha, INDIA.

**Corresponding author e-mail: nanditajena2007@gmail.com*

Abstract

Agriculture is the measure livelihood of tribals in India. Indigenous Tuber crops, like Elephant foot yam (*Amamphophallus*) and *Dioscoria* play a valuable role to uplift the socio and economic status of people of tribal areas (tribal farmers) in terms of nutritional security and livelihood. In every year rural India subject to wide spread of poverty, malnutrition, infant mortality, rate. Ecological degradation, erratic rainfall and drought are the principal causes of food insecurity in these tribal areas resulting migration and periodic starvation. So under erratic climate, tuber crops (*Amarphophallus* and *Dioscorea*) played a crucial role as life support crops to combat hidden hunger. *Amarphophallus paeoniifolious* and *Dioscoria alata*, important

tropical tuber crops are excellent dietary staple for low-income consumers in tribal areas, better opting tuber crop cultivation rather than forest produces. *Aamarphophallus* contains nutrients as carbohydrates 70.1%, protein 5.1%, dietary fiber of 3.2%, and minerals 3.2% where as *Dioscoria* contents the carbohydrate 71.5%, protein 4.5%, fiber 3.0% along with various nutritional supplements. Both crops are well grown in the fertile sandy loam soil with yield of 25-35t/ha still it can grown in all soil types at pH range of 5.5 to 8.0 with comparatively low yield. But these crops can withstand long periods of drought and low fertility levels. *Amarphophallus* and *Dioscoria* both are suitable for mixed farming with crops like millets, maize, Arhar and successively inter-culture with coconut, mango, pomegranate, guava, sapota etc. with low investments and maintenance. Under rainfed conditions both life support crops suitable for planting at the last week of May to minimize the irrigation cost and their dormancy periods varies 45-60 days. So to achieve food and nutritional security, increasing household income, the amendments like availability of quality planting materials, technology transfer methods, and improved cultivation practices may uplift tribal livelihoods in India.

Key words: Tuber crops, erratic climate, tribal areas, low investments

***

T-04.4 VEGETABLES USED AS ETHNO-MEDICINAL PLANTS BY LOCALS IN THE SIWALIK HILLS OF BHADDU, DISTRICT KATHUA, JAMMU AND KASHMIR, INDIA

Sanjeev Kumar Gupta*

Associate Professor & Head, Department of Botany,

Govt. Degree College Billawar, Jammu and Kashmir, India

**Corresponding author e-mail: sanjeevbotany@gmail.com*

Abstract

Humans in this hilly terrain of Siwalik Hills are heavily dependent on plant resources to meet out their basic necessities of life. The district Kathua of Jammu and Kashmir is geographically situated in the north-western Himalayan region of India. It is mostly a mountainous region inhabited by people of different races, religions and cultures including some nomadic tribes. They are primarily dependent on their own traditional knowledge of medicinal plants in order to get rid of health related disorders. The aim of study is to unravel the ethno-medicinal plant wealth of the region exclusively used by the local inhabitants within and adjoining the forest. Through this comprehensive exploratory research work an attempt is made to bring to light some healing herbs of this area. The present study was carried out through field survey involving rural men preferably elderly men as well as women It is a systematic exploration of medicinal plants. The study revealed documentation of 47 plant species used by forest dwellers of the region. The documented species categorized into 13 angiospermous families and 35 genera. *Amaranthus viridis, Artemisia nilagirica, Chenopodium album, Luffa cylindrica,* *Momordica charantia, Lagenaria siceraria, Portulaca oleracea, Rumex dentatus, Terminalia bellirica,* and *Zanthoxylum armatum* are the commonly used medicinal species. *Ajuga integrifolia* is considered indispensable in curing some chronic and serious skin ailment including kalpattra. It is found that many plant species are indispensable to the people of area inhabiting difficult hilly terrain. One species, *Zanthoxyllum armatum* is in the category of threatened taxa due to its over-exploitation in the area.

Key words: Hilly terrain, basic necessities, healing herbs, ailment

***

T-04.5 A STUDY ON THE DIVERSITY OF MUSHROOMS IN BIHAR

Puja Kumari[1,*], Sunil Kumar Choudhary[2] and Arvind Kumar[3]

[1]Ph.D. Research Scholar, P.G. Department of Biotechnology, Tilka Manjhi Bhagalpur University, Bhagalpur.

[2]Former Dean Faculty of Science and University Head P.G. Department of Botany

T.M. Bhagalpur University, Bhagalpur.

[3]Regional Director, Agricultural Research Institute, Patna.

Corresponding author e-mail: pkumari402@gmail.com*

Abstract

Mushroom is the special biological gift of our natural environment. Mushroom belongs to the group of organisms known as macrofungi under the phylum Ascomycotina and Basidiomycotina. Mushroom is the fleshy and spore - bearing organ of the fungi that called as fruiting body. Mushrooms are seasonal fungi, which occupy diverse niches in dense plantation areas/ forest. They mostly occur during the rainy season, particularly in forests, where the dense canopy shade from trees provide a moist atmosphere and decomposing organic material such as leaf litter, and favors the germination and growth of mushrooms. We have studied botanical and zoological garden of Tilka Manjhi Bhagalpur University campus. Mushroom species belonging to several families were recorded in this study. The species was found in families Pleurotaceae, Agaricaceae, Ganodermataceae, Polyporaceae, Psanthyrellaceae Mycenaceae and Tremellaceae. So, it is the need of the hour to conserve this mushroom biodiversity and promotes its value-added products for their commercialization. Mushroom cultivation and their commercialization will be a brightful steps for rural people and also for all sector of industry.

Key words: Edible, Medicinal, Poisonous mushrooms etc.

***

T-04.6 IMPORTANCE OF VEGETABLES IN ENSURING BOTH FOOD AND NUTRITIONAL SECURITY

Suhail Altaf[1] and Shaheen Kousar Jan[1]

[1]Division of plant Pathology, SKUAST-K ShalimarSrinagar, J&K, India

**Corresponding author e-mail: suhailaltaf474@gmail.com*

Abstract

A nutritious and varied diet is a critical means by which good health can be maintained. Consumption of lessthan 200 g of vegetables per person per day in many countries today is common and this low amount, often in conjunction with poverty and poor medical services, is associated with unacceptable levels of mortality and malnutrition in preschool children and other vulnerable groups. An increase in the availability, affordability and consumption of nutrient-dense vegetables and pulses is one way malnutrition may be substantially reversed—yet nutritional security appears to be less valued than food security by key decision makers, and vegetable crops thus receive inadequate research investment. Opportunities exist for the poor to improve their access to vegetables, particularly if they are willing to grow home gardens. Research continues on defining appropriate nutrient-dense vegetables for such activities, but these efforts may be compromised by failure to adopt good agricultural practices, resulting in contamination and unhealthy produce for producers and consumers. The scientific community is ready to play its role in battling malnutrition and hunger, but unless the political resolve can be found to support the causes of both food and nutritional security together, it is unlikely that the Millennium Development Goals will be achieved in a timely fashion. Redressing the current imbalance in agricultural investment can improve efficiency in food production and ensure nutritious diets can be areality for all people.Broccoli is supercharged with vitamins and minerals. Packed with vitamins A, C, and E, as well as many other antioxidants and fiber.Spinach made our list not just because it's rich in vitamins. It's also packed with numerous antioxidants and beta carotene, which may increase the infection-fighting ability of our immune systems.

Key words: Nutritional security, indigenous vegetables, nutrient-density, malnutrition

***

T-04.7 NUTRITIONAL VALUE OF NON-CONVENTIONAL VEGETABLES PREPARED BY FAMILY FARMERS IN RURAL COMMUNITIES

Balamurugan V[1,*], Arunkumar R[2] and A. Aravindh[3]

[1]M.Sc.(Ag.) Agricultural Extension, Faculty of Agriculture, Annamalai University.

[2]M.Sc.(Ag.) Agricultural Extension, Faculty of Agriculture, Annamalai University.

[3]M.Sc.(Ag.) Agricultural Microbiology, Faculty of Agriculture, Annamalai University.
*Corresponding author e-mail: balamuruganvasu2198@gmail.com

Abstract

Non-regular vegetables are vital for human taking care of since they may give nutrients, dietary fiber, sugars, minerals and proteins. These foods are considered non-traditional in light of the fact that they are as of now devoured by just a couple of individuals, ordinarily in confined regions or networks. What's more, non-customary vegetables have a tactile trademark that makes their utilization simpler and they can be utilized in crude plates of mixed greens, soups, puree and omelets. Cooking decreased a few minerals focus in the non-traditional vegetables, however expanded nutrients and carotenoids fixations. The vegetables introduced high substance of minerals yet low protein fixation and complete vitality content. Non-traditional vegetables can be considered of magnificent dietary benefit and successive utilization of these vegetables can add to improve the taking care of ranchers and their families. Cooking strategies rely upon the way of life and dietary patterns of populace and networks in every nation and district. Furthermore, the food planning strategies fluctuate broadly among urban and rural territories because of various propensities and accessible hardware.

Key words: Nutrition, vegetables and rural communities.

***

T-04.8 IMPORTANCE OF VEGETABLES TO BUILD NUTRITIONAL IMMUNITY AND FOR ENSURING FOOD SECURITY

Sumit Sow* and Shivani Ranjan

Department of Agronomy, Bihar Agricultural University, Sabour (Bhagalpur), Bihar

*Corresponding author e-mail: sumitsow19@gmail.com

Abstract

In the view of increasing population, a nutritious diet with varition is a need for the maintenance of good health. Consumption of vegetables below 200 g per person in a day is common in India. This low amount with abundance of carbohydrates and inadequate proteins, often along with helpless and poor medical services leading to an increase in the mortality rate as well as malnutrition. An expansion in accessibility, moderateness and consumption of different vegetables enriched with nutrients is a viable solution to malnutrition. Urban people should be encouraged to grow vegetables at their rooftop and rural people can grow it in their home garden. Everyone should be encouraged to adopt good agricultural practices and new technologies like aeroponics, hydroponics to get fresh vegetables easily. Apart from this, biofortified varieties rich in Vitamin A, iron and zinc concentrates will boost the immunity of

the people to fight against covid-19 pandemic and other diseases. Diet consisting of cereals like rice, wheat, maize etc. or different carbohydrate rich staples alone is not sufficient. We should gurantee that all are not only fed individually, but also get nourishment. So, vegetables play an important role in order to accomplish food as well as nutritional security for each and every person.

Key words: Aeroponics, biofortified, good agricultural practices, malnutrition

***

T-04.9 NUTRITIONAL SECURITY AND MULTI DIMENSIONAL ASPECTS OF KITCHEN GARDEN VEGETABLES

Nitu Kumari*

Department of Horticulture, V.K.S. College of Agriculture, Dumraon, Buxar, Bihar

**Corresponding author e-mail: nitsvegag@rediffmail.com*

Abstract

Malnutrition is becoming a serious problem in rural areas while hidden hunger is also a common problem in cities due to modern culture; affecting growth and development of body and brain in human being. Vegetables are identified as rich source of Vitamins and minerals. Although, Vitamins and Minerals are required in very trace amount by the human body to function properly, deficiency of these vitamins and minerals cause different serious disorders in body. Deficiency of Thiamine causes beri-beri and loss of appetite, deficiencyof Riboflavin causes Cracks at the corners of mouth, glossy tongue, etc., deficiency ofPyridoxin causes ulceration in oral cavity, Vitamin C deficiency causes scurvy and many more disorders by deficiency of different food factors. Besides providing different kind of vitamins and minerals, vegetables are also rich source of basic food factors like tapioca, sweet potato, potato are rich in energy, legume vegetables in protein, fat, iron and vitamins, green and leafy vegetables in Folic acids, vitamins, coloured vegetables in anti-oxidants. Kitchen garden or backyard garden; one of the most ancient type of garden; has vital potential to provide nutritional security to the folk both in urban as well as rural areas. Vegetables cost a good amount in the household budget, and thereby the kitchen garden grown vegetables also saves money. Vegetables grown in the garden are fresh and create a sense of satisfaction among the family members. It recreates and strengthens bondage in the family through sense of cooperation during different agricultural operations in the kitchen garden. Home grown vegetables also protect us from health hazards of the residual effects of different chemicals used during cultivation of vegetables commercially. It creates a sense of healthy neighborhood through sharing of products from the kitchen garden. It is an essential source of food security along with nutritional security among the rural people living below poverty level in different nooks and corners of the world.

Key words: Malnutrition, vegetables, vitamins, kitchen garden

***

T-04.10 NUTRITIONAL EFFECTS ASSOCIATED WITH THE USE OF GARLIC (*ALLIUM SATIVUM* L.) AND ITS ROLE IN BOOSTING IMMUNITY

Kowsalya Nallapotala* and Ravi Kumar Telugu

Department of Horticulture, College of Horticulture, Dr.YSR Horticulture University, Anantharajupeta, Kodur, (Andhra Pradesh), India.

**Corresponding author e-mail: kowsi.nallapotala@gmail.com*

Abstract

Garlic is one of the important bulb crops grown in India, with a 50% of its production from Rajasthan followed by Uttar Pradesh, Gujarat and Punjab. India occupies second position in production of garlic after China. It is mainly used for flavouring and seasoning various dishes. Garlic is rich in its nutritive value among other bulb crops. It is rich in proteins (6.36 g), vitamin A (12.2 IU), vitamin C (42.4 mg), phosphorus (153 mg), potassium (401 mg), calcium (181 mg) and magnesium (25 mg). Garlic is one of the most widely used medicinal plants since ancient times, as it contains compounds with potent medicinal properties. Allicin, diallyl disulphide and S-allyl cysteine are the compounds plays major role in garlic's health benefits. Garlic is used to treat cough and common cold as a natural antibiotic. Allicin reduces blood pressure and improves circulation. It is also used to treat rheumatism, arthritis, gout and diuresis. Garlic contains allicin, which is an antioxidant that checks the oxidative damage and support the body's protective mechanisms further reducing oxidative stress and common brain diseases like alzheimer's and dementia. Antioxidant compounds present in garlic appear to reduce 10- 15% of total and LDL cholesterol, which may lower the risk of cardiovascular diseases. It can also fight various infectious chronic diseases and boosts dysfunctional immune systems. The sulphur compounds in garlic protects body organ damage from heavy metal toxicity. Daily consumption of garlic prevents stomach and colorectal cancers and strengthens the immunity of the body against cancer.

Key words: Garlic, vitamin, antibiotic, antioxidant, immunity

***

T-04.11 MUSTARD GREEN AS NUTRITIONAL SECURITY

Sima Sinha[1,*] and Alok Kumar[2]

[1]Department of Plant Breeding & Genetics,

Bihar Agricultural University, Sabour, Bhagalpur

[2]College of Horticulture, Noorsarai, Nalanda

**Corresponding author e-mail: simasinha11@gmail.com*

Abstract

Mustard is one of major component which is used throughout the year in the Indian kitchen, while mustard green is available in winter. Mustard green as vegetables are one of the important components for balanced diet. Consumption of vegetables in Indian context is not up to mark. Thus, deficiency of vitamins and minerals are prevalent. Mustard green offers a solution to this problem. During winter, it is one of the important veggies for health benefit. Its top vegetative parts are full of vitamins and mineral vit A, K carotene and flavonoid. Mustard green belongs to the family Brassica which also includes cabbage, broccoli, Brussels sprouts etc. It is also known as Indian mustard. There are many different types of mustard greens, varied in leaf size, shape and colour which are green, red, and purple. Some cultivars are grown for consumption of green mustard while some for oilseed consumption. Many parts such as leaves, seeds, and stem of the plant of Mustard have been used in Indian, Chinese, Japanese, and African cuisines. It has spicy, peppery Mustard flavour due to presence of glucosinolates. This leafy green plant is more acrid than the closely related greens such as cabbage, kale etc. Mustard greens, like all green leafy vegetables, contain antioxidants that protect our body from free radical damage. It is also a great source of fibre, which helps to lower the cholesterol levels and regulate digestive tract. Apart from their peppery taste, cooked mustard greens are also a good source of vitamins, minerals, and nutrients. It is also the staple diet of state of Punjab, often consumed along with corn chapattis.

Key words: Brassica, vitamins, peppry, leaf

***

T-04.12 IMPACT OF LEAFY VEGETABLE SPINACH (*SPINACIA OLERACEA* L.) IN BOOSTING IMMUNITY

Ravi Kumar Telugu and Kowsalya Nallapotala

Department of Horticulture, College of Horticulture,

Dr.YSR Horticulture University, Anantharajupeta, Kodur, (Andhra Pradesh) India.

**Corresponding author e-mail: ravikumar.horti@gmail.com*

Abstract

Spinach is a cool season annual vegetable crop. The rosette of leaves produced during vegetative phase is used as vegetable. These tender and delicious leaves are used in various dishes. It is right to eat every day because it was on top of the super food list and for good reason with high nutritional value and delectable taste. It was no wonder that it had sneaked way into many people’s favorite food list. This super food is famous worldwide and is lauded both for its health and taste. Spinach was more popular in central and northern India. This dark green vegetable is super low in calories and rich in antioxidants and ß- carotene, which improve our immune system against various infections. It also benefits in reducing oxidative stress,

blood pressure levels and improves eye health. Spinach has a high dose of vitamin A (5580 IU), vitamin C (28 mg), folic acid (123 mg) and minerals *viz.,* iron (17.4 mg), calcium (190 mg) and phosphorous (42 mg) per 100 gm. Spinach is also rich in proteins and fiber while providing you with all the essential nutrients. Spinach with an abundance of vitamins and minerals, which help fight off infections as well as replenish the blood cells known as lymphocytes and phagocytes therefore results in give a boost to the immune system.

Key words: Spinach, nutritional value, super food, immune system.

***

T-04.13 ROLE OF VEGETABLES IN HUMAN NUTRITION AND DISEASES PREVENTION

Aman Kumar Gupta*

Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221005, U.P., India

**Corresponding author e-mail*: *amangupta16160@gmail.com*

Abstract

Vegetables play an important role in boosting immune system of human and as well as prevent from some diseases. Vegetables contain vitamins (like, vitamin-A, vitamin-C, vitamin-E), minerals, phytochemical compounds and fibers content therefore they are very important for the human health. VitaminA found in carrots, sweet-potato, winter squash, spinach and kale which keeps eye and skin healthy and also helps to protect against infection. Vitamin-C found in broccoli, cauliflowers, red peppers, tomatoes and white potatoes which help in heal cuts and wounds and keep teeth and gum healthy. Minerals found in banana, tomatoes, potatoes, sweet potatoes and in green vegetables, such as spinach and broccoli which are most important for the human health. Now day peoples are using more chemicals on vegetables crops to boost their productivity but theses vegetables are harmful for the human health. Organic vegetables help in increasing farmer income as well as good for human health. The prices of organic vegetables are more than normal vegetables therefore the incomes of farmer are increased. Many vegetables having their own medicinal value and also they are helps in preventing from the different diseases. World health organization (WHO) recommended that consumption 400- 600 g of fruits and vegetables in daily basis reduce risk of micro nutrient deficiency causing vascular diseases, cancer and other nutritional health risk. Consumption of vegetables in daily basis can reduce the risk of heart diseases prevent from some type of cancer, lower risk of eye and digestive problems and have a positive effect upon blood pressure.

Key words: Vegetables, vitamins, WHO, organic vegetables

***

T-04.14 VEGETABLE AS IMMUNITY BOOSTER AND FOR NUTRITIONAL SECURITY

Divyani Raj[1] and Raktim Das[2,*]

[1]Dept. of Horticulture (Fruit & Fruit Technology), Bihar Agricultural University, Sabour, Bhagalpur,

[2]Dept. of Horticulture (Vegetable & Floriculture), Bihar Agricultural University, Sabour, Bhagalpur,

**Corresponding author e-mail: raktim.maan.95@gmail.com*

Abstract

A good health can be maintained by a nutritious and several diets are a ticklish means. At present situation including India and so many countries consumption of vegetables less than 200 g is very common and such low amount, frequently in combination with impoverishment and unprivileged medical service which is amalgamated with impermissible levels of fatality and malnutrition in preschool children and other penetrable groups. An enhancement in the presence, affordability and consumption of vegetables which were nutrient dense is single way malnutrition may be capsize substantially still nutritional security occur to be less worthy than the food security by primary decision markers and vegetable crops in this way accept insufficient research investment. Convenience stands for the unprivileged to enhance their penetration to vegetables, especially if they are intending to generate home gardens. Continues research on ascertain adequate nutrient dense vegetables for certain functions, still these exertion may be a accomplished by failure to accept good agricultural practices, resulting in desecration and morbid produce for both the producer and consumer. The community belongs to scientific which is ready to play its preface in discord hunger and malnutrition, still the political determination can be found to clinch the reason of both food and nutritional security together, it is impossible that the Millennium Development Goals will be acquire in a seasonable fashion. Covering the present asymmetry in Agricultural and horticultural investment can raise proficiency in the production of food and assure nutritious diets which can be a verity for all people.

Key words: Nutritional security, indigenous vegetables, nutrient density, malnutrition

***

T-04.15 USE OF DIFFERENT VEGETABLES FOR BOOSTING IMMUNITY

Shikha Jain[1] and Parul Mehra[2]

[1]College of Agriculture, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand

[2]College of Agriculture, Jabalpur, Jawaharlal Nehru KrishiVishwavidayala, Jabalpur

**Corresponding author e-mail: jain64235@gmail.com*

Abstract

Fruits and vegetables contain vitamins, minerals, fibre and other health-promoting phyto-chemicals which are required to keep our bodies healthy by regulating metabolism of body and boosting immunity and capacity to fight disease causing agents. WHO recently recommends a minimum of 400 gram of fruit and vegetables per day for prevention against various dreaded disease. Fruits and vegetables are also termed as Protective foods . Vitamin C rich vegetables are Broccoli, cabbage, tomato etc. Dark green vegetables (spinach , collards) ; orange vegetables (carrot , pumpkin , sweet potato) are rich in Vitamin A . Green leafy vegetables possess abundant amount of iron and folic acid which can help prevent some major birth defects of the baby's brain (anencephaly) and spine (spinabifida). Leafy vegetables are essential for fresh blood production and keeping blood impurities at bay. Garlic has been used from centuries as the early civilization realized its infection-fighting properties. Garlic's immune-boosting properties come from a heavy concentration of a sulphur-containing compound called allicin. These immunity-boosting foods are rich in antioxidants and other nutrients that help in keeping the cells active and healthy. Therefore it can be concluded that vegetables play a significant role in increasing the immunity power and also provides nutritional security against different diseases and disorders.

Key words: Phyto- chemicals, dreaded, anencephaly

***

T-04.16 LONG CORIANDER- LESSER KNOWN VEGETABLE WITH LOTS OF MEDICINAL PROPERTY

Shashikala Kolakar and Sadashiv Nadukeri

Assistant Professors, College of Horticulture, Mudigere, Karnataka
**Corresponding author e-mail: shashikala.gpb@gmail.com*

Abstract

All the vegetables have one or other medicinal property while some of the vegetables have high potential medicinal property but we know very little about them due to non cultivation of these crops on commercial scale and also harvest extensively from the wild hence these crops are under threat. One such example for this is long coriander botanically its *Eryngium foetidum* L. belongs to the family apiaceae. It is also called as wild coriander and pricky coriander in English. It is very common species found growing in Western Ghats of Karnataka, Kerala, Tamil Nadu and Maharashtra. It is a biennial herb, which is used extensively as a medicinal plant in most of the tropical region. Though this coriander is considered as multipurpose crop but conservation and cultivation work on this crop is meagre hence we have collected the four long coriander genotypes from different growing places and evaluated in the College of

Horticulture, Mudigere during 2019-20. Among the four genotypes evaluated for growth and leaf yield, maximum plant height above the collar region (18.5 cm), number of leaves (12.5), leaf length (17.5cm), leaf breadth (3.5 cm), fresh weight of single leaf (1.20 g) was observed in the genotype Daradahalli local, maximum root thickness at collar region (0.6 cm) in the genotype Makonalli local, maximum root length (15.8 cm) was observed in the genotype Halekote local. Result of the present investigation found that, the Daradahalli local is better performer in this region.

Key words: Long coriander, medicinal property, genotypes, yield.

***

T-06.17 VEGETABLES: VITAL FOR INDIAN DIET

Shyama Kumari*, Subhashish Sarkhel, Erayya and Hari Om

Assistant Professor cum Junior Scientist

Dr. Kalam Agricultural College, Kishanganj (BAU, Sabour)

**Corresponding author e-mail: shyamabau@gmail.com*

Abstract

Indian diet is incomplete without vegetables as it is parts and parcel of everyday requirement of human body. It is rich source of protein, carbohydrate, fat, vitamins and minerals. It is also loaded with fibres, pigments, antioxidants, nutraceuticals and bioactive substances so helpful in health promotion, disease prevention and ultimately human nutrition through boosting immunity. Most of the root vegetables like potato, sweet potato, cassava, colocasia *etc.* are loaded with carbohydrate. Leguminous vegetables are superb source of protein. Leaves of drum stick, colocasia are sources of fat. Leafy greens vegetables are reservoir of essential minerals like calcium, zinc, phosphorus, iron etc. Vegetables such as carrot, pumpkin, cabbage, tomato, chilli *etc* are loaded with different vitamins. Moreover, vegetables are alkaline in nature therefore consumption of sufficient vegetables in diet neutralizes the acid formed during digestion of first class protein food like fish, meat and high energy food. Vegetables are equally important for fighting against malnutrition and hidden hunger in terms of micronutrient deficiencies. In India, large population is suffering from poverty so they cannot afford proper, nutritious and well balanced diet; in this context consumption of vegetables is very good choice. They can easily afford seasonal vegetables as it is cheaper, more abundant, have fullness of flavor, supports environmental sustainability, more nutritious, and adds variety to the diet so it supports community. Apart from maintaining nutritional security, vegetables increases delicacy and make the diet appealing. Therefore it can be concluded that if we take vegetables in our diet in the required amount, we can keep ourselves healthy, fit and enjoy a modern stress free life style.

Key words: vegetable, daily diet, vitamins, micronutrient

***

Theme-V

Role of vegetables in enhancing nutritional and livelihood status

T-05.1 VEGETABLE GARDEN FOR HEALTHIER LIFE AND LIVELIHOOD

V. Rajarajeswari*, S. Karthikeyan and S. Vinodhi

AAIT, Tamil Nadu Agricultural University, Coimbatore-3, Tamil Nadu

**Corresponding author e-mail: rajarajaeswari5@gmail.com*

Abstract

A diverse group of agricultural interventions aim to improve the nutritional status of women and children. These interventions range from the cultivation if bio- fortified crop varieties to home gardening to livestock intensification. We systemically review 42 evaluations of agricultural interventions for improved maternal and child nutrition. Using these evaluations, we identify three interventions typologies- Enhancement, diversification, and substitution -that reflect the differential impact of interventions on households live hoods and patterns of food consumption. Our typologizes allow for a nuanced approach to categorize and generalize about pathways of impact for agricultural interventions. In applying our typologies to existing evaluations, we summarize the evidence base and emphasize areas for further inquiry, particularly in terms of understanding these interventions amid complex environmental, political and economic local contexts.

Key words: Vegetables, environmental change, garden, intervention, livelihood.

***

T-05.2 POTENTIAL MINOR/ UNDERUTILISED VEGETABLE CROPS

Parul Mehra[1,*] and Shikha Jain[1]

[1]Department of Horticulture (Vegetable Science), College of Agriculture, Jabalpur, Jawaharlal Nehru Krishi Vishwavidayala, Jabalpur

[1]Department of Horticulture (Fruit Science) College of Agriculture, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttrakhand

**Corresponding author e-mail: parulmehra1995@gmail.com*

Abstract

Minor vegetables are not at all minor in terms of the essential nutrients, Vitamins and minerals they contain. Minor vegetables are not exploited up to the extent they should be. There are so many potential root, tuber and leafy vegetables which are underexploited .Some minor vegetable like Brussels sprout and Kale are rich source of Vitamin A, B_6, C and micronutrients like Mn, Ca, Mg, Cu. Kale also lowers Cholesterol. Dolichos bean, sword bean, cluster bean and winged bean are good source of protein. Drumstick pods, leaves and flower all can be

consumed, leaves are the finest source of Ca, Fe, Zn, Se and Mg. Along with the nutrients ,it is also a good source of Vitamin A, B_1, B_2, B_3, B_6, B_9 and vitamin C. Ivy gourd contains fiber, Vitamin B and iron. Ridge gourd contains vitamin C, Zn, Iron, Mg and lowers in saturated fat, cholesterol and calories. Some underutilized leafy vegetables are *Alternanthera sessilis*, *Amaranthus spinosus*, *Portulaca oleracea*, *Trigonella balansae etc* which are rich in protein, vitamins, minerals and phyto-nutrients etc. Minor vegetables contribute to improve the well-being of millions of tribal population. These can be consumed raw or as cooked vegetable and by selling these, additional income can be generated which helps in enhancing the livelihood of local people for which they need to grow these traditional crops commercially. Thus, it is concluded that the nutritional, medicinal value and increasing demand of diverse quality food can combat the various health issues and enhance the rural livelihood status.

Key words: Minor vegetable, nutritional value, additional income.

***

T-05.3 POTENTIAL ROLE OF UNDERUTILIZED VEGETABLE TO ENHANCING NUTRITIONAL FOR HUMAN BENEFIT

Yogesh Kumar[1,*], V.B. Singh[2], G.C. Yadav[3], Sharvan Kumar[4] and Udit Joshi[5]

Department of Horticulture (Vegetable Science), Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, U.P.

Department of Horticulture, Hemvati Nandan Bahuguna Garhwal University, Srinagar, Uttarakhand

**Corresponding author e-mail: upyogeshkumar@gmail.com*

Abstract

Underutilized vegetables play important role to balance human diet and they are natural, rich in vitamins (vit. A, vit. C vit. B_2, etc.) and minerals (Ca, Mg, Fe, K, etc.) and other health promoting factors including high antioxidant activity.They are traditionally used in terms of medicinal, therapeutic and nutritional values and are consumed either as row or as a cooked vegetable. Indian Council of Medical Research recommended dietary allowance (RDA) 300 g of vegetable/day (125 g green leafy vegetable, 100 g root and tuber crops and 75 g other vegetables). The per capital availability of vegetable in India is 250 g. In this concern minor vegetable crops like (asparagus, artichoke, spinach, palak, amaranthus, sweet gourd, little gourd, lettuce, celery, parsley, drumstick, bathua, agathi, rhubarb, chekkurmanis and curry leaf) are plays greater role not only to provide required nutrients but also to enhance access to food through enhanced farm profitability.These underutilized vegetables are very useful in medicinal uses like spinach is a good source of antioxidant and has one of the highest ORAC (Oxygen Radical Absorbance Capacity), in lettuce (*Lactuca sativa* spp. *virosa*)

extracted dried latex called lactucarium which useful for make a sleep inducing medicine, in drumstick ben oil is used for illumination, soap industry and highly priced for lubricating watches and computer.

Key words: Vegetable, vitamin, minerals and antioxidant.

***

T-05.4 CHEKURMANIS- A MULTIVITAMIN GREEN

Akhilraj B.C.*

M.Sc. (Hort.) Research Scholar, Department of Plantation Crops and Spices,

College of agriculture, Vellayani, Kerala Agricultural University.

**Corresponding author e-mail: bcakhilraj@gmail.com*

Abstract

Chekurmanis (*Sauropus androgynus*) also known as katuk, star gooseberry or sweet leaf and belongs to Phyllanthaceae family, is a perennial shrub, growing wildly in Southeast Asia. It is one of the most popular leaf vegetables in South Asia and Southeast Asia and is notable for high yields and palatability. In India it also known as Multivitamin Plant as it contains an excellent sources of provitamin A, Carotinoid, Vitamin B and C, protein and mineral. The leaves of chekurmanis are highly nutritious, being a very rich source of micronutrients and protein content of 6-10%. Vitamins and antioxidants play an important role in inhibiting and scavenging radicals, thus providing protection to humans against infections and degenerative diseases. Leaves of chekurmanis leaves (100g) contain protein (22.0 g), total dietary fibre (36%) iron (3.89 to 4.50 mg), zinc (1.26 to 1.48 mg), niacin (74 mg), β-carotene (7400 to 9250 µg), vitamin E (17.6 to 15.6 mg). Chekurmanis leaves contain an alkaloid content of 1740 mg/100 g. In view of its rich nutrient composition, this shrub can be explored for the development of health beneficial food products, which can also help in the prevention of micronutrient deficiencies. Chekurmanis leaf, however, is reported to contain the alkaloid papaverine in considerable amounts. Excessive consumption of the leaves especially in raw form has been reported to cause drowsiness and respiratory disorders attributable to this alkaloid. The roots and leaves are sometimes used as medicine. The leaves and roots are used to relieve fever and treat urinary problems. The juice from its leaves is dropped into the ear as a remedy for earache. In addition, the young tips and leaves are a common nutritious vegetable for cooking.

***Key words**:* Chekurmanis, yields, multivitamin, antioxidants, health

***

T-05.5 UNDERUTILIZED VEGETABLE CROPS OF INDIA – A STUDY

Pinki Kumari[*] and Amit Raj[**]

S.M.C, T.M.B.U, Bhagalpur[*], P.S.B., Visva-Bharati, Sriniketan, West Bengal[**]

**Corresponding author e-mail:amithortraj@gmail.com*

Abstract

Underutilized vegetable crops (minor) neither grown commercially on large scale nor traded widely and are indigenous, tolerant to biotic and a biotic stress, grown mainly wild, suitable for disaster and prone area, having excellent attractive colour and flavor, and being used by the local inhabitants as source of protective food since time immemorial but have not undergone any conscious phase of domestication and human selection due to unavailability of planting material, lack of awareness of its nutritional and medicinal value and lack of knowledge of production technique. So there is urgent need to start up programme on genetic resources exploration, management, utilization and improvement of underutilized vegetable crops to ensure food and nutritional security and to generate employment opportunities to rural folk for self reliant India.

***Key words**: Underutilized, minor, vegetables, nutrition, employment*

***

T-05.6 IMPACT OF UNDERUTILIZED VEGETABLES IN ENHANCHING NUTRITIONAL STATUS F OF PEOPLE

Khushboo Chandra

Department of Plant Breeding and Genetics

Dr.Rajendra Prasad Central Agricultural University, Pusa (Samastipur) Bihar – 848125

**Corresponding author e-mail: drkhushboochandra@gmail.com*

Abstract

Faction of crops including fruits, vegetables, medicinal & aromatic plants and ornamental crops would amount to hub of agro-economic strategy. Earlier research has been gratifying for production, productivity and export of horticultural produce but still challenges are confronting. India is second largest production of fruits and vegetables. Increase in per capita earnings and accelerated growth of health mindful population, demand for more horticultural produce in terms of quality and quantity. The budding health benefits and official recognition of minor vegetables would help to improve food security, nutrition and health of populations. There is need to lay bare and enumerate the benefits of the diversity of the underutilized vegetables for

livelihoods and to ensure for their well being. Diverse agro climatic conditions of India permit to grow more than 60 cultivated and about 30 lesser known vegetable crops, not much awareness has been given on underutilized vegetables known. The vegetable crops which are neither grown commercially on large scale nor traded widely are natural and rich source of vitamins, minerals and antioxidants termed as underutilized vegetable crops such as Amarnath (*Amaranthus* Spp.), Africal night shade (*Solanum scabrum*), Asian (*Solanum melogena*) and African (*Solanum aethiopicum*) eggplant, drumstick tree (*Moringa oleifera*), Water spinach (*Ipomoea aquatica*), Malabar spinach (*Basella alba*), winged bean (*Psophocarpus tetragonolobus*). The promising reasons for the low exploitation of underutilized vegetables, regardless of their recognized importance are due to lack of availability of planting material, awareness on nutritional and medicinal importance and information on production technique of these crops. There is an insistent need to take up programme on genetic resources investigation, management, utilization and upgrading of underutilized vegetable crops to make certain their nutritional security for future. It's concluded that underutilized vegetables production will meet the dearth of per capita consumption availability there by solve the nutritional problems and also generates the employment and increase the income of rural people and there by contributing to the national economy.

***Key words*:** Underutilized vegetables, nutritional value, antioxidants, economy.

***

T-05.7 UNDERUTILIZED VEGETABLE CROPS AND VEGETABLE LEGUMES FOR LIVELIHOOD AND NUTRITIONAL SECURITY

Sangeeta Shree[1]*, Randhir Kumar[2] and E. Kavya[3]

Department of Horticulture (Vegetable and Floriculture),

Bihar Agricultural University, Sabour, Bhagalpur

**Corresponding author e-mail: sangeetashreee@gmail.com*

Abstract

There are approximately over 600 species that comprise the global diversity in vegetable crops, but at the moment barely one fourth is utilized as a major vegetable crops and rest are named as minor, underutilized, rare vegetables or wild edible vegetables. Some of the underutilized vegetables commonly used in Indian context are Amarnathus (*Amranthus tricolor), Basella* sps. (*Basella alba, Basella rubra*), Pointed Gourd (*Trichosanthes dioica*), Gherkin (*Cucumis sativus* var. *anguria*), Ivy Gourd (*Coccinia grandis*), Sweet Gourd (*Momordica cochinchinensis*), Karchikai (*M. cymbalaria*), Drumstick *(Moringa oleifera),* Elephant foot yam (*Amorphophallus campanulatus*), *Nymphaea* spp., *Nelumbo nucifera*, Clove bean (*Ipomoea muricata*),Winged bean (*Psophocarpus tetragonolobus),* Sword bean and Jack Bean (*Canavalia gladiata & Canavalia ensiformis*), Velvet bean (*Mucuna pruriens*), Tree Bean (*Parkia roxburghii*),

Adzuki bean (*Vigna angularis*), Rice bean (*Vigna umbelata*), Aerial yam, Air potato (*Dioscorea bulbifera*) and Chow-Chow (*Sechium edule*). Underutilized vegetables or minor vegetables are rich in vitamins, minerals and other health promoting factors including high antioxidant activity. They play a major role in the diversification of diet leading to more balanced source of micronutrients. Their enhanced use can bring about better health and nutritional management. With the use of underutilized vegetable crops, there is a way to reduce the risk of over-reliance on very limited number of major crops. They can contribute to sustainable livelihoods through household food security as they can widen the food edibility options. They add nutrients to the diet and are sometimes convenience food for low income urban people. They are adapted to fragile environments and can contribute to the stability of agro ecosystems. They provide a broad spectrum of crops to improve productivity. Thus, underutilized vegetables are becoming more widely and effectively set to address malnutrition, poverty and economic prosperity.

***Key words*:** Underutilized vegetables, vitamins, minerals, health, micronutrients

***

T-05.8 NUTRITIVE AND MEDICINAL VALUE OF CAPPARIS DECIDUA: AN UNDERUTILIZED FRUIT VEGETABLE

Surender Meghwal[1,]* and Kanica Chauhan[2]

[1]M.Sc Student, [2]Assistant Professor

Department of Forest Products and Utilization, CH & F, Jhalawar

**Corresponding author e-mail: surendrameghwal2014@gmail.com*

Abstract

Capparis decidua is an underutilized small shrub of Thar Desert, belonging to the family Capparidaceae, 4-5 m high, which have many green vine like apparently leafless branches, hanging in bundles. It is commonly known as Kair, karel, karer, karil, karu, etc. It is distributed mostly in Gujarat, Rajasthan, Punjab and some parts of Madhya Pradesh in India and other countries such as Baluchistan, Egypt, Socotra, Arabia, Tropical Africa, and Pakistan. *C. decidua*, climbing up to 6 meters in height, is widely used in traditional medicinal system of India. According to the Unani system of medicine the plant has been used as a carminative, tonic, emmenagogue, aphrodisiac, alexipharmic; improves the appetite; good for rheumatism, lumbago, hiccough and asthma. Medicinally, young roots of the plants are applied to cure boils and swelling, the bark is said to be useful in asthma.The green immature fruits are considered good for antihelminthic, laxative, asthma, constipation, hysteria, worms and other psychological problems while as ripe fruits of *C. decidua* contained 55% of total pulp of the total fruit weight including moisture (56%), crude protein (8.6%), true protein (5.02%). total sugars (1.8%), reducing sugars (1.1%), P (0,057%), K (1.026%), Ca (0.055%), Mg (0.055%) and ascorbic acid (7.81 mg/100 g) Thus, this fruit is rich in protein and mineral matter and used in biliousness. Its seeds also containing glucocapparin from which the mustard oil methyl

isothiocyanate is released when the plant is crushed. Therefore, the present review abstract focuses on detailed profile of valuable nutrients and biochemical compounds as well as medicinal properties of this underutilized fruit vegetable.

***Key words*:** Desert crops, tonic, medicinal properties, protein, benefits

***

T-05.9 POTENTIAL USE OF UNDERUTILIZED VEGETABLES IN SUSTAINABLE FOOD SECURITY

Amit Kumar Pandey[1,*], Ashutosh Singh[1] and Ragini Kumari[2]

[1]Assistant Professor-cum-Junior Scientist, Mandan Bharti Agriculture College, Agwanpur, Saharsa, Bihar

[2]Assistant Professor-cum-Junior Scientist, Bihar Agriculture College, Sabour, Bhagalpur, Bihar

**Corresponding author e-mail: amitpandeybau@gmail.com*

Abstract

The crops of vegetable which are neither grown commercially on large scale nor traded usually may be termed as underutilized crops. The possible reason for the low consumption of underutilized vegetables, inspite of their documented importance are due to lack of availability of planting materials, absence of awareness on nutritional and medicinal importance and lack of information on cultivation techniques of these crops. Vegetables which are underutilized, are rich in vitamins, minerals and other health promoting factors including high antioxidant activity. They play a vital role in diversification of diets leading to more balanced source of micro nutrients. They posses resistance to several biotic and abiotic stresses with the use of underutilized vegetable crops, there is a way to decrease the risk of over reliance on very limited number of major vegetable crops. They may contribute to sustainable livelihoods through household food security as they can widen the food edibility choices. They are adapted to fragile environmental and can contribute to the stability of agro ecosystem, particularly in the arid, semi arid region, mountains and steppes. Changing climate and the land and water resources degradation have led to growing interest in underutilized vegetable crops that are adapted to difficult environment such as desert margins, those with poor fertile soil or degraded vegetation or matter to drought. Several underutilized vegetable crops plays an important role in keeping diversity associated with food habits, health practices, religious rituals and social

changes. Therefore, assessment of underutilized vegetable crops can become a solution to the social changes associated with health and nutrition insecurity, poverty and unemployment.

Key words: Potential use, Underutilized vegetables, Sustainable, Food security

***

T-05.10 ROLE OF MINOR VEGETABLES IN ENHANCING NUTRITIONAL AND LIVELIHOOD STATUS

Sweta Pattanaik*

B.Sc. Agiculture student, MIPS Institute of Professional Studies, Rayagada, Odisha, India.

**Corresponding author e-mail: swetapattanaik2000@gmail.com*

Abstract

Vegetables are the key component of balanced human diet and also the main drivers in achieving global nutritional security by providing nutrients, vitamins and minerals. In the changing global scenario, food, nutrition, health care and livelihood security are the matter of great concern to human, social and economic development. Access to nutritious food continue to be a cause of concern since, more than 350 million people continue to suffer from malnutrition for various types of diseases and premature death of children and women. Therefore country could only be food secured if the citizens have access to nutritious food having balanced diet to meet their need for productive and effective life. There are many vegetables which are complementary as food. Now adays practiced to have good health without medication. Many minor vegetables are nutritionally rich and are adopted to low input agriculture. The example of some vegetables are ponnanganni greens, agathi, water leaf, chow-chow, tree bean, aerial yam etc. which cures fever, diarrhea, sore throat, painful intestinal diseases etc. So increasing the horticultural crop besides improving biological productivity and nutritional standards is scope for enhancing profitability. Minor vegetables embedded with rich nutrient potentials along with ability to stand against adverse climate. With increase in per capita income and accelerated growth of health conscious population, demand for the vegetable produce is on increase which is expected to further accelerate, which will require more production. Thus, technology driven horticulture is expected to address the concern for complimentary, nutritional security and livelihood leading to ultimately economic development.

***Key words*:** Vegetables, nutrition, livelihood status, nutritional security.

***

T-05.11 ROLE OF UNDERUTILIZED VEGETABLES IN ENHANCING NUTRITIONAL AND LIVELIHOOD STATUS

Etalesh Goutam*, Bharti, D K Rana and Vivek Singh

Department of Horticulture Hemvati Nandan Bahuguna Garhwal University

(A Central University) Srinagar, Garhwal, Uttarakhand

**Corresponding author e-mail: omrajeshwary009@gmail.com*

Abstract

The self-sufficiency does not necessarily mean nutritional adequacy. Millions of people in many developing countries do not have enough food to meet their daily requirement and a further more are deficient in one or more nutrients. In fact, considerable imbalances persist in respect of the calories, proteins, minerals and vitamins availability. Minor vegetables are those underexploited and neglected crops which have a great potential to meet the nutritional security, health, poverty alleviation and can fulfil the daily diet of a nation's people. Minor vegetables have several advantages like quick growing, easy to handle, hardy and rich source of vitamins, minerals, carbohydrates, protein, fats etc. thus, protect from malnutrition. In the face of threats posed by climate change as exemplified by drastic changes in rainfall pattern, temperature, relative humidity, radiation, weeds-pests-diseases complex and general alterations in the trends of climatic elements, there is the need to discuss the future of the uncultivated but edible plant species which have served as basis of livelihood for the poor people over several years. Cultivation of these crops is restricted to specialized geographical regions mainly by poor farming communities which derive their sustenance and livelihood from such plants. Evidently, these crops of widely consumed nutritious vegetables have been relatively neglected in research and conservation. The possible reasons for the low utilization of these minor vegetables, in spite of their recognized importance are due to lack of research programs, lack of awareness on nutritional and medicinal importance and lack of information on production technique of these crops. In this context, synergistic interactions among improved technologies, institutional supports, favourable governmental policies and awakening among the farmers are necessary to tackle the various issues. Finally, it can be concluded that, minor vegetables production will meet the shortage of per capita consumption availability there by solve the nutritional problems and at the same time it generates the employment and also strengthen the income as well as the livelihood of rural people and finally it could contribute the national economy.

Key words: Employment, livelihood, self-sufficiency, synergistic, underutilized.

***

T-05.12 ROLE OF UNDERUTILIZED VEGETABLES IN FOOD AND NUTRITIONAL SECURITY

Ritu Kumari*, Sangeeta Shree and Vijay Kumar Singh

Department of Horticulture (Vegetable & Floriculture), Bihar Agricultural University, Sabour Bhagalpur, Bihar

**Corresponding author e-mail: ritukumari.bau@gmail.com*

Abstract

Indian subcontinent represents one of the richest diverse genetic resources.Vegetables are the key component of balanced human diet and also in achieving global nutritional security by providing nutrients, vitamins and minerals.Various indigenous crops can offer alternative, low-cost sources of micronutrients, vitamins, as well as other health promoting compounds e.g. Moringa and quinoa (known for their multipurpose nutrition and health benefits). The underexploited vegetables play an important part of food and nutrition of local/ tribal population across the globe. They are traditionally been esteemed for their utilization in terms of medicinal, therapeutic and nutritional values along with providing economic stability. Indigenous vegetables (IVs) like Moringa, Sword bean, *Dolichos* spp., *Luffa* spp., Colocasia, Amorphophallus, Alocasia, Xanthosoma, Cucurbits, Yam, beans, leafy vegetables and numerous others are known to be good source of micronutrients and also high in antioxidants and anti-microbial phytochemicals. Underexploited vegetables could prove to be source of low-cost quality nutrition for large mass of the population. Green leafy vegetable are considered as exceptional source for vitamins, minerals and phenolic compounds. The mineral nutrients like calcium, iron and folic acid are considerably high in green leafy vegetables. Green leafy vegetables are found as weeds in the crop fields which are resilient, adaptive and tolerant to adverse climatic conditions. It is essential that the locally available green leafy vegetables, which are inexpensive and easy to cook, be used in the diets to eradicate micronutrient malnutrition and also to prevent degenerative diseases. Many traditional vegetables and underutilized legume crops are also an essential source of vitamins, micronutrients and protein and, thus, a valuable component to attain nutritional security.

Key words: Nutritional security, underutilized, leafy vegetables, malnutrition.

***

Proceedings and recommendations of the International web conference on Biodiversity in vegetable crops for healthier life and livelihood (August 27-28, 2020)

Vegetables are functional foods rich in minerals and vitamins essential for reaching a nutritional security. Agriculture's part in fighting poverty is complex, but without the genetic diversity found within crops, it cannot fulfil its potential. India is the 2nd largest vegetable producing country in the world. Vegetable biodiversity helps ensure not only a stable and sustainable supply of sufficient quantities of food, energy and protein but also plays a major role in ensuring its quality. A direct product of crop diversity is itself considered desirable by nutritionists. Besides, the supply of vital nutrients of vitamins and minerals can be enhanced through the judicious use of genetic diversity. New varieties can be developed with improved nutritional quality, that is, with higher levels of vitamins, more readily available iron and other essential elements, better quality protein or with reduced anti-nutritional or toxic factors.

On this context the two-day International web conference on "Biodiversity in Vegetable Crops for Healthier Life and Livelihood" organised by Bihar Agricultural University, Sabour proved to be an excellent platform for exchange of knowledge and opinions. Eminent scientists and researchers like Dr. M.L. Chadha, Former Director, AVRDC-The World Vegetable Center and Chairman Madan Chadha Safe Healthy Vegetable Foundation, Dr. Ramakrishnan M. Nair, Regional Director for the World Vegetable Center South and Central Asia, Dr. Pritam Kalia, Emeritus Scientist, Former Head & Professor, Division of Vegetable Science, Indian Agricultural Research Institute, New Delhi, Dr. T. K. Behera, Professor & Principal Scientist, Division of Vegetable Science, Indian Agricultural Research Institute, New Delhi, Dr. Ranjit Chatterjee, Professor, Dept. of Vegetables and Spice Crops, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal, Dr. Rajesh Kumar, Principal Scientist, Division of Crop Improvement, Indian Institute of Vegetable Research, Varanasi, Uttar Pradesh, Dr. Sanjeet Kumar, Plant Geneticist & Breeder (Ex-World Veg, Taiwan and ICAR), Dr. Pranab Hazra, Professor, Department of Vegetable Crops, Faculty of Horticulture, and Dean Post Graduate Studies, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, Dr. A.T. Sadashiva, Former Principal Scientist & Head, Division of Vegetable Crops, ICAR-Indian Institute of Horticultural Research, Bengaluru, Karnataka, Dr. Vishwa Bandhu Patel, Principal Scientist, Division of Fruits and Horticultural Technology, Indian Agricultural Research Institute, New Delhi, and Dr. Tanmay Kumar Koley, Scientist (Horticulture), Division of Socio Economics and Extension, ICAR- Research Complex for Eastern Region, Patna, Bihar, India shared their experience, research and insights into the different aspects related to vegetable biodiversity and improving vegetable productivity. The points that came up from the web conference and/or recommendations are as follows:

- Vegetable biodiversity is one of humanity's most potent weapons for fighting against hunger and poverty.

- Vegetable biodiversity helps to ensure not only a stable and sustainable supply of sufficient quantities of food and energy as well as ensuring its quality.
- Underutilized horticultural crops could come up as potential crops for improving nutrition and food security having high medicinal values as well as playing significant role in diversification leading to farm income as well as of aesthetic value.
- Accentuating urban and peri-urban horticulture through home gardening, roof top gardening, organic production, protected and hydroponic production.
- Following good agricultural practices (GAPs) to improve vegetable produce quality and safety.
- Opening the avenue of horticultural tourism which could create opportunities for the farmers in India and provide revenues for horticultural products and environmental preservation.
- Developing a habit of eating organic vegetables through grow your own vegetables to have vegetables free from pesticides and fertilizers residue as well as conserve local indigenous vegetable biodiversity.
- Characterization and documentation of Indian chillies were utmost important for breeding point of view. Besides, utilization of wild relatives (embryo rescue or development of bridge crosses) and marker assisted breeding approach for evolving of high yielding, location/ region specific, consumers preference based, insects and disease resistant varieties/ genotypes for Indian as well as global markets was also necessary.
- Vegetable research in public-private partnership was necessary to cope up with the different challenges faced by the farming community.
- Conservation of farmers' variety was necessary which could serve as a vital resource for global food security. Besides, wild relatives should be used as donor source for quality and biotic stress resistance. Utilization of mutant genes particularly for quality of vegetables is also an important strategy.
- Multiple disease resistant varieties and hybrids would be the key players for tomato.
- Emphasis on biofortification of vegetable crops was the need of the day. Moreover, diverse vegetables in proper quantities included in diet could serve as functional food and help improve human immunity.

***

Bihar Agricultural University, Sabour, Bhagalpur (Bihar)


Dr. Kalam Agricultural College, Kishanganj

ISBN 9788193781500