Readers Shelf

VOLUME NO: 13	ISSUE NO: 12	September, 2017
No. of Pages in this issue		68 pages
DATE OF POSTING: 10-11 at RMS, Jodhpur		

Editorial Office

J. V. Publishing House

15, Gajendra Nagar, Near Old FCI Godown
Shobhawaton Ki Dhani, Pal Road, Jodhpur-342005
Ph. No.: 0291-2642287
Website: www.readersshelf.com
Email: info@readersshelf.com, jvph@rediffmail.com, readersshelf@gmail.com
Typesetting: Ankita Arpita, Jodhpur
Printed by: Manish Kumar, Manak Offset, Jodhpur

Published by

Smt. Neeta Vyas

For J.V. Publishing House, Jodhpur

RNI No.: RAJENG/04/14700
ISSN No.:2321-7405

Subscription Charges

Single Copy: Rs.40.00
Annual Subscription: Individual: Rs.400.00
Annual subscription: Institution: Rs. 800.00

Contents

1. BIOCHEMISTRY

Resistant Starch: Boost Human Health as Ingredients of Functional Food

Vivek Chandra Verma

Ph.D. Scholar, Deptt. of Biochemistry, G.B.P.U.A&T, Pantnagar- 263145, Uttarakhand

Introduction

Bioavailability of starch and its uses asingredients of food evoked the concept of resistance starch. Resistance starch provides functional properties and various applications in a variety of foods. Starch is the major source of dietary carbohydrates and it is the most abundant storage polysaccharide in plants occurs as granules in the chloroplast of green leaves and the amyloplast of seeds, pulses, and tubers. It is made up of amylose (15-20%) and amylopectin (80-85%) linked together with α-D-(1-4) and α-D-(1-6) linkage. Amylose is a linear polymer of glucose residues linked through α-D-(1-4) and amylopectin is a larger branched molecule with linkagesα-D-(1-4) and α-D-(1-6). X-ray crystallography study revealed that starch granules are of semicrystalline nature and are classified into type-A, type-B and

ISSN No.:2321-7405

type- C. The amorphous regions (70%of the mass of starch granule) contain the main amount of amylose but also a considerable part of the amylopectin. The crystalline region (30%of the mass of starch granule)consists primarily of the amylopectin. Starch can be classified on the basis of action of enzymes. They are rapidly digestible starch (converted to theconstituent glucose molecules in 20 min of enzyme digestion), slowly digestible starch (converted to theconstituent glucose molecules in 100 min of enzyme digestion) and resistant starch (converted to theconstituent glucose molecules in 120 min of enzyme digestion).

The relatively recent studies of incomplete digestion and absorption of starch in the small intestine as a normal phenomenon has raised interest in non-digestible starch fractions. These are called "resistant starches," and extensively on going research have shown them to have physiological functions similar to those of dietary fibre. The impact of digestion-resistant starches on the prevention and control of chronic humandiseases, including diabetes, colon cancer, and obesity. Hence the food industry and tremendous variety of food product require starches that can tolerate a wide range of processing techniques and preparation conditions. These demands are adequate by modifying native starches with chemical, physical and enzymatic processes which may lead to the formation of indigestible residues.

Types	Description	Example
RS1	Physically protected	Cereals and Legumes
RS2	Ungelatinized resistant granules, with type B crystallinity (amylopectin of chain lengths of 30 to 44 glucose molecules), slowly hydrolyzed by α-amylase.	Raw potatoes, Green banana, High amylose corn
RS3	Retrograded starch	Cooked and cooled potatoes, food products with repeated moist heat treatment.
RS4	Chemically modified starches with cross-linking with chemicals reagents	Modified starch has been used in food industries.

Resistant starch (RS) is indigestible by body enzymes. It is subdivided into 4 fractions: RS1, RS2, RS3, and RS4.

Impact of Resistance Starch to Prevent Diseases

As the consequence of health issues it is recommended to increase the content of resistant starch in the diet plan. Foods such as potatoes, rice, pasta, breakfast cereals and bread are low in resistant starch (<2.5%, dry matter basis). Cooked legumes, peas, and retrograde starchy foods are high in resistantstarch (5.0–15%, dry matter basis). The chronic health conditions in developed countries could be prevented or moderated by dietary changes. The most common starchy fast foods in the diet including white bread, cakes and noodles consist of a large percentage of highly digestible starch. Such digestible starch potentiating hyperglycemic response and triggering insulin secretion that uptake glucose and hence result in hypoglycaemia. Repetition of this hyper- and hypoglycemic cycle appears to result in insulin resistance and type 2 diabetes, thereby contributing to obesity. In contrast, enzyme-resistant starches pass through the upper digestive tract to the colon, where they are fermented by bacteria, producing important metabolites, including SCFAs (Small chain fatty acid). These metabolites appear to have important biological effects, including reduction of colon cancer precursors, systemic regulation of macronutrient metabolism, and altered secretion of hormones, which can lead to improved physical and mental health. Because of the health benefits related to foods with increased resistant starch and decreased glycemic index there is a growing interest in developing foods with increased resistant starch contents.

Challenges in Food Product Development

The structural characteristics of resistant starch are the major challenge for the food based industries.

Use of resistant starch in baked products is limited because of adverse quality effects of resistant starch on texture, softness and gluten network formation. RS3has been used as an ingredient in food products. Addition of RS3 resulted in decreased cohesiveness in flour. High concentrations of RS3 led to reduced structural integrity and therefore decreased quality of the product. The addition of 5–20% resistant starch to muffins contributed to overall decreased quality with chewiness, cohesiveness and volume affected. Resistant starch had an impact on acceptability and textural quality when incorporated into muffins. Although the incorporation of either RS2 or RS3 decreased muffin quality but the quality of muffins with RS2 was more acceptable than muffins with RS3. Resistant starch has been usedas probiotic compositions to promote the growth of beneficial microorganisms and behave as a growth substrate for probiotic microorganisms. Resistant starch is widely used in the encapsulation of various food components as probiotics. RS had been used to improve encapsulation of viable bacteria in yogurt. The development of food products with increased resistant starch contents and acceptable quality attributes is imperative to provide foods with increased health benefits.

References

Sajilata, M. G., Singhal, R. S. and Kulkarni, P. R. (2006). Resistant starch -A review. *Comprehensive Reviews in Food Science and Food Safety* **5:** 1–17.

Nugent A. P. (2005). Health properties of Resistance starch. *Nutrition Bulletin* **30**:27-54.

Fuentes-Zaragoza, E., Riquelme-Navarrete, M. J., Sanchez-Zapata, E. and Perez-Alvarez, J. A.(2010)Resistant starch as functional ingredient: A review. *Food Research International* **43:** 931–42.

Birt D. F., Boylston T., Hendrich S., Jane J. L., Hollis J., Li L., McClelland J., Moore S., Phillips G. J., Rowling M., Schalinske K., Scott M. P. and Whitley E. M. (2013). Resistant starch: Promise for improving human health. *Advance Nutrition*(**4**): 587-601.

2. BIOTECHNOLOGY

Agrobacterium Tumefaciens: Mechanism of T-DNA Transfer into Plant Cell

Hardik Ghevariya, J. R. Chavda, Vipul Parekh and Bimal S. Desai

Department of Basic Science & Humanities, College of Forestry, ACHF, N.A.U., Navsari

Agrobacterium tumefaciens is a gram-negative rod-shaped bacteria closely related to nitrogen-fixing bacteria which dwell at root nodules in legumes. Unlike most other soil-dwelling bacteria, it infects the roots of plants to cause Crown Gall Disease. Like many other bacteria *A. tumefaciens* makes pili which scientists have called the T-pilus. In other bacteria these structures are used to transfer genetic material between bacteria during conjugation, but this bacterium adapts it to transferring genetic material to its host. It is famous for taking advantage of its host by injecting DNA derived from its Ti (tumor inducing) plasmid into its host, causing the plant to create galls which excrete opines that the bacteria use as an energy source. *A. tumefaciens* have emerged as an important molecular tool for manipulating plants and creating genetically modified crops for research and agriculture.

Mechanism

The process of gene transfer from *Agrobacterium tumefaciens* to plant cells includes several essential steps as below.

Bacterial Colonization

Bacterial colonization is an essential and the earliest step in tumor induction and it takes place when *A. tumefaciens* is attached to the plant cell surface. The polysaccharides of the *A. tumefaciens* cell surface are proposed to play an important role in the colonizing process.

Induction of Bacterial Virulence System

The T-DNA transfer is mediated by products encoded by the 30-40 kb *vir*region of the Ti plasmid. This region is composed by at least six essential operons (*vir A, vir B, virC, vir D, vir E, virG*) and two non-essential (*virF, virH*). The only constitutive operons are *virA*and *virG*, coding for a two-component (VirA-VirG) system activating the transcription of the other *vir*genes. VirA protein can be structurally defined into three domains: the periplasmic or input domain and two transmembrane domains

ISSN No.:2321-7405

(TM1 and TM2). The TM1 and TM2 domains act as a transmitter (signaling) and receiver (sensor). The periplasmic domain is important for monosaccharide detection. Within the periplasmic domain, adjacent to the TM2 domain is an amphipatic helix, with strong hydrophilic and hydrophobic regions. The TM2 is the kinase domain and plays a crucial role in the activation of VirA, phosphorylating itself on a conserved His-474 residue in response to signaling molecules from wounded plant sites.

Generation of T-DNA Transfer Complex

The activation of *vir*genes produces the generation of single-stranded (ss) molecules representing the copy of the bottom T-DNA strand. Any DNA placed between T-DNA borders will be transferred to the plant cell as single strand DNA and integrated into the plant genome. The proteins VirD1 and VirD2 play a key role in this step, recognizing the T-DNA border sequences and nicking (endonuclease activity) the bottom strand at each border. The nick sites are assumed as the initiation and termination sites for T-strand recovery. After endonucleotidic cleavage, VirD2 remains covalently attached to the 5'-end of the ss-T-strand. This association prevents the exonucleolytic attack to the 5'-end of the ss-T-strand and distinguishes the 5'-end as the leading end of the T-DNA transfer complex.

The T-DNA Transfer by Translocation of T-DNA-Complex

The transferring vehicle to the plant nucleus is assT-DNA protein complex. Is must be translocated to the plant nucleus passing through three membranes, the plant cell wall and cellular spaces. According to the most accepted model, the ssT-DNA-VirD2 complex is coated by the 69 kDa VirE2 protein, a single strand DNA binding protein. This cooperative association prevents the attack of nucleases and, in addition, extends the ssT-DNA strand reducing the complex diameter to approximately 2 nm, making the translocation through membrane channels easier. VirE2 contains two plants nuclear location signals (NLS) and VirD2 one. This fact indicates that both proteins presumably play important roles, once the complex is in the plant cell mediating the complex uptake to the nucleus. The deletion of NLS in one of these proteins reduces, but does not totally inhibit, the ssT-DNA transfer and its integration into plant genome, evidencing that the other partner can, at least partially, assume the function of the absent protein.

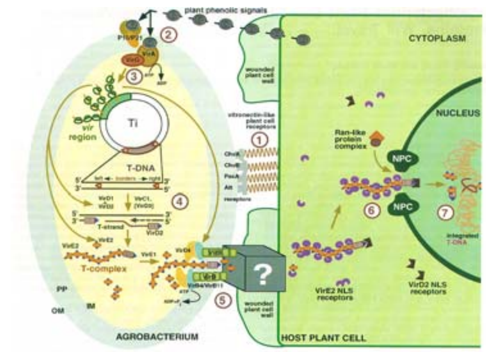


Figure 1. Agrobacterium–Plant Cell Interactions.

Integration of T-DNA into Plant Genome

The final step of T-DNA transfer is its integration into the plant genome. The mechanism involved in the T-DNA integration has not been characterized. It is considered that the integration occurs by illegitimate recombination. According to this model, paring of a few bases, known as micro-homologies, are required for a pre-annealing step between T-DNA strand coupled with VirD2 and plant DNA. These homologies are very low and provide just a minimum specificity for the recombination process by positioning VirD2 for the ligation. The 3´-end or adjacent sequences of T-DNA find some low homologies with plant DNA resulting in the first contact (synapses) between the T-strand and plant DNA and forming a gap in 3'-5' strand of plant DNA. Displaced plant DNA is subsequently cut at the 3'-end position of the gap by endonucleases, and the first nucleotide of the 5' attaches to VirD2 pairs with a nucleotide in the top (5'-3') plant DNA strand. The 3' overhanging part of T-DNA together with displaced plant DNA are digested away, either by endonucleases or by 3'-5' exonucleases. Then, the 5' attached to VirD2 end and other 3'-end of T-strand (paired with plant DNA during since the first step of integration process) joins the nicks in the bottom plant DNA strand. Once the introduction of T-strand in the 3'-5' strand of the plant DNA is completed, a torsion followed by a nick into the opposite plant DNA strand is produced. This situation activates the repair mechanism of the plant cell and the complementary strand is synthesized using the early inserted T-DNA strand as a template.

3. AGRICULTURE ENTOMOLOGY

Rugose Spiralling Whitefly (RSW), *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae): An Invasive Threat in India

Murugasridevi, K. and Shanmuga Prema, M.

Ph.D. Scholar, Deptt. of Agricultural Entomology, ACRI, TNAU, Coimbatore

Introduction

The inadvertent entry of exotic pest species have resulted in a high number of established species which led to considerable negative economic impact. So far, 116 exotic insect species have been listed in India. Among these, several insect species have invaded several countries and caused the drastic economic loss in agricultural, horticultural crops and forestry. Currently, there are 442 species of whiteflies belonging to 63 genera known from India; Of these economically important whitefly species includes the Spiraling whitefly *Aleurodicus dispersus* Russell (Hemiptera: Aleyrodidae) and the Solanum whitefly, *Aleurothrixus trachoides* Back (Hemiptera: Aleyrodidae) invaded India in 1995 and 2014, respectively. Recently, an another very destructive invasive species named, Rugose Spiralling Whitefly (RSW), *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae) have been reported from Pollachi, Tamil Nadu and Palakkad, Kerala during July-August 2016. It is an introduced pest, endemic to Central America. *A. rugioperculatus* was described in 2004 by Martin from specimens collected in Belize and the infestation was reported for the first time in Florida from MiamiDade County in 2009.

Description of the Pest

Adult females lay their eggs in concentric circles or in spiracular pattern on the under surface of the leaves and sometimes on the non-plant surfaces. Eggs are elliptical and creamy white to dark yellow colour, 0.3mm long, translucent with a short stalk and are laid singly.

RSW has five developmental stages. First instar hatches from the egg which is mobile in nature called as crawlers. They search for food and feed with needle like mouth parts by sucking the plant sap. Crawlers is moulted into immature stages which are immobile, sedentary, oval, flat in prior period that turns more convex over the advancement of life cycle.

Nymphs are 1.1-1.5 mm in size and also varies in size depending upon the instars. Nymphs are golden yellow in colour and produces thin waxy filaments and becomes dense with the progressive time. The final immature stage is the pseudo puparium, which is about 1 mm in length and is used in taxonomic identification. The pupa is typically characterised by broadly cordate vasiform orifice, operculum ventro-basally spinulose and dorsally characteristic rugose, with a pair of ventro-median fine setae and lingula head protruding beyond vasiform orifice, finely spinulose, apically acute, its four setae situated close to apex. (Sundararaj and Selvaraj, 2017). The adult whitefly looks like a very small moth, have a body length of about 2 mm and are lethargic by nature. Adults have greyish eyes. Rugose spiraling whitefly adults can be recognised by their large size and the presence of a pair of irregular light brown bands across the wings. Males have long pincer like structures at the end of their abdomen. Males have a yellowish pronotum while females have a dark one.

Hosts

Rugose spiraling whitefly was reported as a pest on gumbo limbo (*Bursera simaruba* L) in Miami-Dade county (South Florida) in 2009 by Florida Department of Agriculture and Consumer Services (FDACS), which referred to it as the gumbo limbo spiralling whitefly. RSW feeds on a wide range of host plants including

ISSN No.:2321-7405

palms, woody ornamentals and fruits. FDACS recorded the host from 2009 to 2012 reported that 22% of Rugose spiraling whitefly affected hosts were palm species, 16% were gumbo limbo, 10% were *Calophyllum* spp., 9% were avocado, 4% were black olive and 3% were mango varieties. Within the family of Arecaceae (palms), 44% of host records were from coconut. As of June 2015, Rugose spiraling whitefly has been identified on at least 118 plant species, which include a combination of edibles, ornamentals, palms, weeds, as well as native and invasive plant species.

Nature of Damage

Whitefly feeding causes stress to the host plant by removing water and nutrients and also by producing honeydew, which covers the lower leaves and results in the growth of sooty mold. Honey dew excrement, being sweet and watery, attracts ants and encourages growth of the fungus *Capnodium* spp. which causes disfigurement of hosts affecting the photosynthetic efficiency of the plant. In the recent survey conducted in heavily affected gardens, cutting across all age groups of palms, as high as 60-70% of the fronds were found infested by the pest. The prevalence of the pest was noticed from the outer whorls and slowly progressed towards the inner whorls, whereas, the emerging fronds were not infested.

Management

Effectual monitoring is extremely important in order to keep populations under Economic Threshold Level. Natural enemies such as, the predatory lady beetle *Nephaspis oculata* (Coleoptera: Coccinellidae), the parasitoid wasp *Encarsia guadeloupae* (Hymenoptera: Aphelinidae) and lacewings are found at the field level. *N. oculata* is a whitefly predator that is found in Florida, Louisiana, and Texas.

Recently in India, it was found that 50% of the whitefly was parasitized by a tiny hymenopteran parasitoid, *Encarsia* spp. (<1 mm size) from different regions of Kerala indicating the natural event of the parasitoids. This is one of the classical biological control approach and any impediment in the population buildup of *Encarsia* spp. would enormously affect the long term pest management approach. Parasitism was relatively low in pesticide sprayed gardens in Pollachi, Tamil Nadu. The parasitism percentage ranged from 25- 30% indicating the upset in distribution of parasitoid due to indiscriminate use of pesticides especially those belonging to synthetic pyrethroid. In addition, ladybird beetles belonging to *Jauravia* spp. and many spiders were also noticed.

The flight activity of the rugose spiralling whitefly was active during morning followed by the dawn. There were substantially more number of whiteflies caught on sticky traps on the east side than on the west side of the plants between 6:00-10:00, which indicates that this whitefly was strongly and positively phototactic during that time of the day. This whitefly showed a second but smaller peak of flight activity in the evening near dusk (Tarvati *et al.*, 2014). In this connection, installation of yellow sticky traps on the palm trunk and in interspaces can be prescribed to trap the adult whiteflies.

Conclusion

The present occurrence of RSW has turned the coconut growing areas in India, Since it is a polyphagous pests and spreads enormously to other hosts. As, the impact on the environment and agricultural production by invasive pest species is awful, such impacts can be drastically reduced through international exchange of information on invasive pests and their natural enemies. There is a necessity for interdisciplinary coordinated work among scientists, in identifying invaded organisms and in evaluating their ecological problems, environmental concerns in different ecosystems, economic loss and management strategies resulting in a holistic approach.

References

Sundararaj, R. and K, Selvaraj. 2017. Invasion of rugosespiraling whitefly, *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae): a potential threat to coconut in India. Phytoparasitica.

Tarvati, S., H. Glenn and C. Mannion. 2014. Daily flight activity of the rugose spiraling whitefly (Hemiptera: Aleyrodidae). *Florida Entomologist.* 97(4).

4. AGRICULTURE

Importance of Fodder Cultivation in Dairying

Umamageswari, M.[1] and K. V. S. Bhakthavatsalam[2]

[1]*Teaching Assistant, Regional Agricultural Research Station, Kerala Agrl. Univ., Ambalavayal- 673 593,* [2]*Ph.D. Scholar (Agril. Economics), Southern Regional Station, ICAR-NDRI, Bengaluru –030*

Any green matter that is available freely for animal eating is called as forages whereas any crop that is cultivated for feeding animals is called as fodder. Fodder has been classified into cereals, grasses, legumes and trees. Cholam, cumbu, maize are grouped under cereal fodder, Co4, guinea grass, kollukattai grass are called as grasses. Example for legumes are lucerne, hedge lucerne, cowpea etc whereas subabul, agathi, gliceridia are tree fodders. When cereal crop harvested as immature for either hay, silage green feed or as pasturage called as cereal fodder. The cultivated plant species which are utilized as livestock feed in the form of fodder, silage, haylage and hay are called as grass fodder. Legume fodder can take nitrogen from the air and fix it in the soil. Any green lop pings from the tree that is consumed by the animals are called tree fodder. Cultivation method of fodder is described as follows:

Multicut Fodder Sorghum CO (FS) 29

Seed rate - 5 kg/ha; spacing - 30 x 10 cm; fertilizers - 30: 20: 20 kg N, P and K / ha; harvest at 50% flowering for fodder and the yield obtained is 160-170 t/ha/year in five harvests

Fodder Cumbu CO 8

Seed rate - 10 kg/ha; spacing - 25 x 10 cm; fertilizers - 25:20:12 N, P and K kg/ha; Harvest has been performed on 40 - 45 days after sowing and the yield is 25-30 t/ha

Bajra Napier Hybrid Grass CO (CN) 4

Seed rate - 40000 stem cuttings/ha; spacing- 50 x 50 cm; fertilizers- 150:50:40 NPK kg/ha; harvest - First cut at 80 days after planting and subsequent cuts at 45 days interval and the yield is 382 t/ha/year

Guinea Grass CO 3

Seed rate - 40000 rooted slips/ha; spacing - 50 x 50 cm; fertilizers - 100: 50: 40 NPK kg/ha; First cut harvest at 75 days after planting and subsequent cuts at 45 days interval. The yield obtained is 424 t/ha/year

Special Features of Guinea Grass CO 3

It is a clonal selection from Mumbasa, a collection from Africa and high green fodder yield is 423.57 t/ha/year. The fodder is free from pest and disease and has superior ratooning ability rendering at eight cuts per year. The first cut on 70-75 days after planting and subsequent cuttings once in 40 - 45 days

Cenchrus CO 1

Seed rate is 6 - 8 kg/ha or 40,000 rooted slips/ha at the spacing of 50 x 30 cm; fertilizers- 25: 40: 20 N, P and K kg/ha; Harvesting at first cut on 70th or 75th day after sowing and subsequent 4 - 6 cuts depending on growth and the yield is 40 t/ha/year in 4 - 6 cuts.

Deenanath Grass CO 1

Seed rate - 2.5 kg/ha; spacing - 35 x 10 cm; fertilizers - 20: 25: 20 NPK kg/ha; Harvest - 55-60th day after sowing and the yield obtained is 25-30 t/ha

Lucerne CO 1

Seed rate - 20 kg/ha; spacing - 25 cm apart; fertilizers - 25:120:40 kg NPK/ha; First harvest 75 - 80 days after sowing and subsequent harvests at 25 - 30 days interval and the green fodder yield is obtained 80-100 t/ha in 12-13 cuttings/year

Cowpea CO (FC) 8

Seed rate- 25 kg/ha; spacing- 30 x 15 cm; fertilizers - 25:40:20 kg NPK/ha; Harvest 50 - 55 days after sowing (50% flowering stage). The yield obtained in irrigated condition is 20-30 t/ha whereas it is 10-15 t/ha of rainfed cultivation.

ISSN No.:2321-7405

Hedge Lucerne

Seed Rate - 20 kg/ha; Spacing - 60 x 20 cm; Fertilizers - 25:40:20 NPK kg/ ha; Harvest - First cut on 90th day after sowing and subsequent cuts at 40 days intervals. Green Fodder Yield - 125t/ha/year

Stylo

Seed Rate - 6 kg/ha and for broadcasting 10 kg/ha; Spacing - 30 x 15 cm; Fertilizers- 20:60:15 kg NPK/ha; Harvest - First harvest at 75 days after sowing and subsequent harvests depending upon the growth. Green Fodder Yield -30 to 35 t/ha/year.

Pudia Soundal

Seed Rate - 10 kg/ha; Fertilizers - 10:60:30 kg NPK/ha; Harvest - 6 months after planting. Cut at 90 to 100 cm height from ground level. Green Fodder Yield - 80 to 100 t/ha

Importance of fodder

Fodder is having high digestibility ranged from 55 to 65 per cent of intake. Fodder contains higher level of fibre, soluble carbohydrate (4 to 30 per cent) and crude protein 3 to 30 %. It has high source of vitamins and minerals and water content (80-90 %).

Importance of Green Fodder

Green fodder is the primary only source of vit- A for lactation. It helps in vision, improve reproduction, increase conception rate, prevent early embryonic mortality, maintenance of pregnancy, during lactation 2000 I.U. of Vitamin 'A' is eliminated in every litre of milk-It is to replenished. It reduces feed intake by about 3.3% for every 2.2 rise in temperature over 24^{o} C.

Basics Concepts for Feeding Animals

Green fodder must be feed 8 to 10 %, dry fodder should is 1% and concentrate must be 1% of the animals' body weight.

Present Scenario in Feeding

Farmers are having less awareness in feeding green fodder and lack of knowledge on balanced ration which has resulted in either under feeding or excess feeding.

Constrains Faced by the Dairy Farmers

Major studies revealed that 84 % of the farmers preferred to grow cash crops, 73 % of farmers lacking in green fodder availability and demand of other feed like concentrates increases and the price of it also increases. There is non availability of feed and fodder during stress condition.

Impact of under Feeding

When animals are feeding less than required level, their milk potential is not fully tapped and there is frequent occurrence of reproduction. The inter calving period is extend to more than 18 months. It makes delay in calf maturity which yields less income from milk. The health of animal becomes poor and easy outbreak of diseases.

Impact of over Feeding

Animals are faced the problems when they are fed more also, the problems occur. The problems of excess feeding led to increase in cost of feeding, fattening of animals, delay in pregnancy and reduction in milk yield which led to low returns from milk production.

References

Bashir **et al.,** Importance and Development Activities for Sown Fodder Crops in Afghanistan, FAO, Project (AFG/96/007), Islamabad. Cited from http://www.fao.org/ag/agp/agpc/doc/pasture/peshawarproceedings/importancedvpt.pdf on 11.06.2017

Requirement and Importance of Green Fodder, Carrying Capacity and Forage Cycle, cited from http://eagri.tnau.ac.in/eagri50/LPM201/lec13.pdf on 10.06.2017

5. ENVIRONMENTAL SCIENCE

Use of Natural Products for Purification of Drinking Water

M. Priyadharshini[1] and Dr. P. Rajamani[2]

[1]SRF, CARDS, TNAU, Coimbatore, [2]RA, Water Technology Center, TNAU, Coimbatore

Introduction

Food, shelter, and clothing are the basic necessities for the human. But these necessities cannot be fulfilled without utilization of water. Thus, water is the basic need for human and its availability is dwindling day by day. The quality of potable water is an important criterion to be looked into. To achieve this, developed nations have various advanced treatment facilities. But the developing nations cannot afford such techniques, which compels to search for a cost-effective and less intensive mechanism of water purification.

Around 75% of the world population is observed to live in the developing countries, which accounts that about 1.2 billion people lack potable drinking water.

Conventional Method of Drinking Water Treatment

The conventional process involved in purification of water involves coagulation-flocculation, followed by sedimentation, filtration and disinfection which are generally done by chlorine.

Various coagulants are predominantly being used for the conventional water processing treatments for the purpose of providing clean potable water. The coagulants are classified as inorganic, synthetic organic polymer and naturally occurring coagulants. Synthetic polyelectrolytes are the primary coagulants which also act as coagulant aid that amend strength of the particle aggregates, enhancing the coagulation and settling of flocs by deposition. Aluminium salts (Alum, Polyaluminum chloride, etc.) are cheaper and are widely used as coagulants in water and wastewater treatment. As for the application of synthetic polymers, the residual monomers are present in end product which is undesirable for their neurotoxicity and potent carcinogenic properties.

Alternative Methods of Drinking Water Treatment – Plant Based Coagulants

In recent years, a tremendous increase in the development and usage of natural coagulants is evident from all the studies being carried out in this field, using the products extracted from microorganisms, animals and/or plant tissues. Extensive use of Alum (aluminium sulphate), is being feared for residues of aluminium salts which are the cause of inducing Alzheimer's disease. For such reasons, naturally occurring coagulants are presumed to be safe for human health and to the environment. Studies on these have been carried out and it is observed that several natural coagulants have been extracted or purified from microorganisms, animals or plants.

These coagulants ought to be biodegradable. Additionally, natural coagulants produce low volume sludge that amounts to 20-30% sludge that of the alum-treated counterpart. The employment of natural materials of plant origin to clarify turbid raw waters can be used as a viable option in rural areas. Natural coagulants are used for the domestic household for hundreds of years in ancient water treatment in tropical rural areas.

Advantages of Plant-Based Coagulants

The major benefit of using plant based coagulants is the cost-effectiveness. Apart from it, this is a step towards a sustainable development initiative. And this does not require the employment of any skilled labour, unlike in the conventional method of water treatment.

Coagulation Mechanism Involved

Natural coagulants are polymeric which can be cationic, anionic or non-ionic. The ones with cationic and anionic charge are collectively named as polyelectrolytes and it is applied only to the situation after the ionic activity. Natural coagulants are, in general, either polysaccharides or proteins.

When coagulant acts on the solution, the aggregation of particulate matter in the solution can take place through four characteristic coagulation mechanisms, namely, (1) double layer compression, (2) sweep flocculation, (3) adsorption and charge neutralization and (4) adsorption and interparticle bridging.

Polymeric coagulants are observed to follow the mechanisms 3 and 4 as their long-chained structures (particularly the polymers with high molecular weights) increase the number of unoccupied adsorption sites. Although, numerous plant-based coagulants have been studied, only four of them are widely known. They are Nirmali seeds (*Strychnos potatorum*), *Moringa olerifera*, Tannin and Cactus.

Nirmali Seeds

Strychnos potatorum is a medium-sized tree which is seen the southern and central regions of India, Sri Lanka and Burma which finds its usage in traditional medicines. These have been reported in Sanskrit scriptures in India regarding the water purifying properties dating back to 4000 years. These seeds are anionic polyelectrolytes that work by the mechanism of interparticle bridging by destabilization of the particlesThe seed extract contains galactomannan and galactan that help in reducing 80% turbidity of a sample kaolin solution.

Moringa olerifera

Moringa olerifera is a tropical and non-toxic plant found throughout India, Africa, Asia and Latin America. The natural coagulant properties of these seeds have been widely studied, which is attributed to its cationic protein present in the seed extract. It is observed to be dimeric proteins with a molecular weight of 6.5-14 kDa and containing six amino acids, mainly glutamic acid, methionine and arginine (Sapana *et al.*, 2012). Apart from the coagulation, the seed extract also has antimicrobial properties.

Tannins

Tannin is the common name given to the large group of polyphenol compounds from natural materials, for instance, the organic extract from bark and wood of trees like *Acacia, Castanea or Schinopsis*. These polymers have a molecular weight ranging from few hundreds to tens of thousands. The efficiency of tannin as a natural coagulant in water treatment is mainly inclined by the chemical structure of tannins. The phenolic groups indicate the anionic nature of the tannins which contribute as hydrogen donor.

Cactus

This is rather a recent wing of science which utilizes cacti species for the water treatment. Usually, *Opuntia* is the widely studied genus in case of water treatment (Vijayaraghavan, 2011). *Cactus latifaria* is another species which is under observation now. The higher capability of coagulation in *Opuntia* is attributed to the presence of mucilaginous substances (viscous and complex carbohydrates) which is stored in inner and outer pads that aid in the higher water retention in *Opuntia*. The coagulation mechanism of adsorption and bridging of the particulate matter present in turbid water acts here.

References

Sapana. M., G. Chonde Sonal and P. D. Raut. 2012. Use of *Moringa olerifera* seed as Natural Absorbent and an Antimicrobial agent for Ground water Treatment. **Res. J. Recent Sci. Vol**. 1(3), 31-40.

Vijayaraghavan. G., T. Sivakumar and A. Vimal Kumar. 2011. Application of Plant based Coagulants for Waste Water Treatment. **Int. J. Ad. Engg. Res. Studies.** Vol. 1(1): 88-92.

6. AGRICULTURE BIOTECHNOLOGY

Genetic Engineering for Pollination Control through Male Sterility

Maisuria, Hemanshukumar J., Kapadia V. N. and Pitambara, Mili

B.A.C.A., Anand Agricultural University, Anand-388 110

Introduction

A prerequisite for hybrid breeding is a tight pollination control system to avoid self-pollination. Pollination control refers to the practices that prevent self- or sib-pollination of the female parent. The most efficient way of pollination control is male sterility (MS). Plant male sterility refers to the absence of functional anthers, pollen or male gametes in hermaphroditic flowers. Conventional approaches for male sterility are, (1) mechanical removal of the male part, (2) spraying chemical hybridising agents (CHA) that prevent the development of active pollen, (3) crossing of cytoplasmic male sterile line with normal line.

But this approach has certain limitations. So we have to use genetic engineering approaches to develop male sterile line which are as follow...

1. Engineered Nuclear-encoded Pollination Control Systems

Many genes have been identified for production of male sterility. This systems are easy to transferred between unrelated species and also provide the ability to maintain sterile plants, to restore fertility and to remove pollinator plants in the scope of mixed-planting hybrid production. This system includes...

a) Barnase/Barstar System

This technique facilitates premature degeneracy of the tapetum tissue by engineering nuclear-encoded male sterility systems where transgene *barnase* from *Bacillus amyloliquifaciens*, expression is controlled by an anther-specific TA29 promoter from tobacco, which produced RNase in the tapetum cells, causing their degeneration without affecting female organs. The restoration of fertility in the hybrid progeny can be done through production of tapetal cell-specific ribonuclease inhibitor, *barstar*. For example, tobacco and oilseed rape. A *barnase* gene is expressed in *B. napus* under the control of an *Arabidopsis ESJ2* promoter, resulting in a male-sterile line due to prevention of anther dehiscence. The anther stomium cells have been killed, preventing the expression of hydrolytic enzymes that are required for cell-cell separation in the stomium.

b) Split-gene System

In split-gene system, the *barnase* gene splits into complementary fragments and produce an active protein when both are present in a cell. A *barnase* gene was split into two complementary fragments controlled by a tapetum- specific promoter of the *127a* gene from tomato. Male sterile tomato plants were generated by crossing parents expressing one of the two complementary fragments. Such male-sterile plants could be used as the female crossing partners for hybrid seed production. However, both parts of the complementary *barnase* gene can freely segregate in the gametes, ultimately leading to F1 hybrids that carry both fragments are male-sterile. Transfer of this two split genes in allelic position will segregate independently and eliminate this drawback.

c) Plant Growth Regulators

Different plant hormones also have an influence on pollen development. Alteration in their production results in male sterility. For example, (1) Inhibition of jasmonic acid (JA) synthesis leads to male sterility. The silencing of *defective in anther dehiscence1* (*dad1*) gene which is essential for JA biosynthesis in *Brassica* leads to male sterility. The fertility can be restored by application of JA. Cytokinins and gibberellins (GAs) involved in the male reproductive development of flowering plants. Genes *rolB* and *rolC* of *A. Rhizogenes*, show abnormal anther development (*rolB*) and male sterility (*rolC*). Restoration of male fertility or partial male fertility can be achieved by expressing antisense *rolC* construct or by removal of the *rolC* transgene or by exogenous supply of kinetin and thidiazuron. The tapetum-specific expression of a mutated melon ethylene receptor gene, *Cm-ERS1/H70A* and *Cm-ETR1/H69A*, reduce ethylene sensitivity and result in abnormal development of the male gamete in tobacco.

d) Other Approaches

One way of inducing male sterility in plants is to degenerate tapetal cells before pollen reaches final developmental stage or to inhibit programmed cell death. For example, The suppression of the *Arabidopsis BECLIN 1* gene which is required for autophagy and apoptosis in the tapetum of tobacco or the overexpression of the endogene *AtBI-1*, which suppresses cell death, in the tapetum of *Arabidopsis* that produce MS.

2. Engineered Cytoplasmic-encoded Male Sterility (CMS) Systems

Male sterility can be caused by alteration in mitochondrial genes known as cytoplasmic male sterility. Rearrangements of mitochondrial DNA leading to chimaeric genes, results in sterile pollen. CMS can arise spontaneously, following mutagenesis, or be the result of interspecific, intraspecific and intergeneric crosses. CMS is determined by the mitochondrial genome, the sterility is inherited maternally in most angiosperm species.

In earlier attempt, The expression of *phaA* in tobacco plastids leads to premature degeneration of the tapetal layer, which affects pollen development and ultimately male sterile. A recombinant construct of the CMS candidate gene *orf239* in common bean fused with a 5' mitochondrial targeting signal sequence, and transfer to tobacco plants caused male sterility. This strategy has succeeded in functional analysis of other CMS genes, *e.g., orf79, orfH79*, and *WA352* in rice; *orf129* in sugar beet; *orf288* in rapeseed; *orf220* in mustard; and *orf456* in pepper.

The conclusive point is that genetic engineering for male sterility is very useful in hybrid production. The maintenance of sterile line is easy as well as constant in its character. Fertility restoration is also very easy and convenient. Using mitochondrial transformation is also very new approach for male sterility development in future.

References

Chen, L. and Liu, Y. (2014). Male Sterility and Fertility Restoration in Crops. *Annu. Rev. Plant Biol.*, 65:579-606.

Kempe, K. and Gils, M. (2011). Pollination control technologies for hybrid breeding. *Mol Breeding* 27:417-437.

Saxena, K. B. and Hingane, A. J. (2015). Male sterility systems in major field crops and their potential role in crop improvement. *Plant Biology and Biotechnology*,1:639-656.

7. NANO TECHNOLOGY

Development and Application in Food Processing

Butti Prabhakar[1]*, and Shivashankar Sanganamoni[2]

[1]*Teaching Associate, College of Food Science and Technology, Rudrur-503188 (Telangana).*

[2]*Ph.D. Scholar, Department of Post Harvest Process and Food Engineering, GBPUAT, Pantnagar –*

Introduction

Nanotech is the construction and use of functional structures designed from the atomic or molecular scale, with at least one characteristic dimension measured in nanometers. Their size allows them to exhibit novel and significantly improved physical, chemical, biological properties, phenomena, and processes because of their size. When characteristic structural features are intermediate between isolated atoms and bulk materials in the range of about one to 100 nanometers, the objects often display physical attributes substantially different from those displayed by either atoms or bulk materials.

Nanotech can provide us with a never before known or understanding about materials and devices and will most likely have an impact on many fields. By using structures at the nanoscale as a tunable physical variable, we can greatly expand the range of performance of existing chemicals and materials. Alignment of linear molecules in an ordered array on a substrate surface (self-assembled monolayers) can function as a new generation of chemical and biological sensors. Switching devices and functional units at nanoscale can improve computer storage and operation capacity by a factor of a million.

History

Nanotechnology is essentially a modern scientific field that has been constantly evolving as more interest in the subject has been increasing and more research is being presented to the scientific community. The first time nanotechnology was introduced to the community was in 1959 at a talk given by Richard Feynman, a physicist at Caltech on the topic "There‟s Plenty of Room at the Bottom." In the talk Feynman never really mentioned the topic "nanotechnology," Feynman sort of suggested that it will eventually be possible to precisely manipulate atoms and molecules. Nanotechnologies primary development didn‟t occur till the eighties and early nineties.

Reasons for Using Nanotech in Food Packaging

1. Contamination Sensor
2. Antimicrobial Packaging
3. Improved Food Storage
4. Enhanced Nutrient Delivery
5. Green Packaging
6. Pesticide Reduction
7. Tracking, Tracing; Brand Protection
8. Texture Enhancer
9. Flavor Enhancer

How will Nanotech be used for Food Production and Processing?

Industry analysts predict that nanotechnology will most likely be used to transform food from the atom up. Thanks to nanotechnology, tomorrow‟s food will be designed by shaping molecules and atoms. Food will be wrapped in "smart" also known as safety packaging which is able to detect spoilage or harmful contaminates. In agricultural use, nanotechnology will be used to reduce pesticide use, while improving plant and animal breeding, and creating new nano-bioindustrial products

Nanomaterials in Food Packaging

The use of nanomaterials in food packaging is already a reality. Nanotechnology can be used in plastic food packaging to make it stronger, lighter or perform better. Antimicrobials such as nanoparticles of silver or titanium dioxide can be used in packaging to prevent spoilage of foods. Another addition is the introduction of nanoparticles of clay into packaging to block oxygen, carbon dioxide and moisture from reaching the food, and also aids in preventing spoilage. Chemical giant Bayer produces a transparent plastic film called Durethan which contains nanoparticles of clay. Durethan is an engineering plastic based on polyamide. These particles offer an excellent combination of properties which include high strength and toughness, abrasion resistance, chemical resistance, and resistance to cracking. Durethan is used in various industries and applications, including packaging film for the medical field and food packaging. The nanoparticles are spread throughout the plastic and are able to block oxygen, carbon dioxide and moisture from reaching fresh meats or other foods. The advantage of using nanoclay is it also makes the plastic lighter, stronger and more heat-resistant. Durethan film material with nanoparticles combines the advantages of polyamide 6 and ethylene vinyl alcohol (EVOH) to produce an inexpensive but still very airtight packaging material. The embedded nanoparticles prevent gases from penetrating the film and also keeping moisture from escaping.

An example is bottles made with nanocomposites which minimize the leakage of carbon dioxide out of the bottle; by minimizing the leakage of CO_2 in the bottle this will cause an increase in the shelf life of a carbonated beverage without having to use heavier glass bottles or more expensive cans. Another example is food service bins made out of silver nanoparticles embedded in the plastics. The silver nanoparticles kill bacteria from any food previously stored in the bins, which will minimize harmful bacteria.

Conclusion

As we can see from all the research conducted, clearly nanotechnology offers tremendous opportunities for innovative developments in food packaging that can benefit both consumers

ISSN No.:2321-7405

and industry. The application of nanotechnology shows considerable advantages in improving the properties of packaging materials, but we are still in the early stages and will require continued investments to fund the research and development to better understand the advantages and disadvantages of nanotechnology use in packaging materials.

8. AGRICULTURE SCIENCE

Doubling Farmer's Income by 2022

[1*]Brijbhooshan, [2]Didal, V. K. and [3]Shalini

[1&2]Deptt. of Agronomy, PJTSAU, Hyderabad and [2]Department of Agronomy, GBPAUT Pantnagar

Introduction

Indian agriculture is passing through difficult times due to two consecutive drought situations in several parts of the country, thereby resulting into wide spread distress among farmers. The rural areas in these parts are facing food and livelihood crisis, more specifically the shortage of fodder and drinking water. Government needs to proactively address the situation and make more long term farmers centric policies related to irrigation, farm diversification, farm profitability and community support programs so as to socially and economically empower farmers.

The Niti Aayog recently came out with its 'Three Year Action Agenda' – a plan that covers a time period that is politically crucial as it leads up to the 2019 Lok Sabha elections. In its chapter on agriculture titled '*Agriculture: Doubling Farmer's Incomes*', the economic think-tank has put forth a four-point action plan to double the incomes of India's farmers. Although there is nothing radically new in what has been suggested by the Niti Aayog, the measures proposed are in the right direction if the farmer's incomes have to be doubled. However, various experts have cast a pall of gloom over the claim that is indeed possible to double incomes by 2022-23. This is primarily because agricultural growth in the post-reform period, barring a few exceptional years, has been stagnant and has historically failed to meet the target set by the government. For example the average annual rate of growth in agriculture and allied sector during the period from (1991-92 to 2013-14) comes at 3.2% – lower than the targeted 4%.

The Four Point Action Plan includes the Following Measures

1. Remunerative prices for farmers by reforming the existing marketing structure;
2. Raising productivity;
3. Reforming agriculture land policy; and
4. Relief measures.

It is important to see how these actions will double the income of the farmer's and to what extent the government is serious about it.

Recommendations on Doubling Farmer's Incomes By 2022

The average monthly income per capita from farming increased from Rs 1,060 in 2003 to Rs 3,844 in 2013, according to the report Situational Assessment of Agricultural Households by the NSSO, a compounded annual income growth rate of 13.7%. To double the income of farmers by 2022, in nominal (numerical) terms—which do not take inflation into account—would require a 15% compounded income growth rate, which is a marginal increase over the achieved increase from 2003 to 2013. However to increase the income in real terms would imply restructuring agriculture processes & policy interventions.

There is however, almost unanimity that the net income of farmers can surely be doubled well within the period of six years. A total of 40 recommendations for increasing incomes of farmers, have been divided into five parts, as under:

1. Increasing incomes by improving productivity
2. Water and Agri-Input policies
3. Integrated Farming System
4. Better market price realization
5. Special Policy Measures

Increasing Incomes by Improving Productivity

1. Biotechnology is set to play critical role in crop and livestock production
2. Improving agricultural productivity in rain fed regions of India
3. Bridging yield gaps among the States
4. Increased Budget on Farmers Inter-State Exposure Visits and Training Scheme of MoA.

Water and Agri-Input Policies

1. Fertilizer Subsidy and Rationalizing the NPK pricing
2. Reduce the crop losses
3. Farm Mechanisation in India
4. There is a need for integrated water use policy
5. Farmers however need to be educated on water usage systems

Integrated Farming System

1. Promotion of Integrated farming system approach
2. Dairy husbandry is a boon for small farmers
3. Promotion of intensive vegetable production

Better Market Price Realization

1. Revision of the APMC Act
2. The launch of NAM requires easing of norms of licensing
3. Reforms to the APMC Acts to permit pan-India trades
4. Agri infrastructure, storage systems and market yards
5. Reducing post harvest losses

Special Policy Measures

1. Structural reforms in agriculture pertaining to land leasing and market restrictions need to be addressed
2. Through a nationwide crops competitiveness study
3. Review of current scenario of farm credit and subsidy disbursement system.
4. Implementing ambitious Agribusiness Hubs Model
5. ICT-based agricultural extension
6. Diversification of agriculture in the First Green Revolution areas
7. Integrating all central and state subsidies
8. Strengthening Organic Food Program
9. Establishing Special Agriculture Zones (SAZ)
10. Promoting scientific agriculture micro-irrigation

Conclusion

Doubling of the incomes of farmers in nominal terms has already been happening in recent periods and it is no challenge. Doubling the income in six years, in real terms, however, is a formidable challenge and needs large scale revamping, reorientation and innovation in the initiatives. Farmer's income can increase through increasing total output and their prices, reducing production costs through lowering input use and/or reducing input prices, diversifying production mix towards more remunerative enterprises and providing earning opportunities in non-farm sector.

9. HORTICULTURE

Different Quality Parameters of Important Bulb and Root Vegetables

Akkalareddy Sumalatha and Sanganamoni Mallesh

Department of Horticulture, GBPUAT, Pantnagar- 263145 (Uttarakhand), India.

Introduction

Bulbous vegetables are primarily consumed for their distinctive flavor or their ability to enhance flavours in other foods. They also contain several sulphur compounds such as Allicin, Diallyl Disulphide, Diallyl Trisulphide and Allyl Propyl Disulphide *etc.* proved to be effective in reducing harmful blood cholesterol, heart attack and stroke. Root vegetables are also rich source of vitamins, minerals, dietary fibres and phytochemical contents like carotenoids,

ISSN No.:2321-7405

anthocyanins, ascorbic acid and phenolics.

Carotenoids are present intracellularly and their actions involve in the regulation of gene expression or effect cell functions like inhibition of monocyte adhesion and platelet activation. These biological effects have been attributed to the antioxidant property of carotenoids, through deactivation of free radicals and singlet oxygen quenching. The main physiological function of carotenoids is as precursor of vitamin A. Carotenoids such as β-carotene have attracted considerable attention because of their possible protective effect against some types of cancers. Carotenoids have been linked with the enhancement of immune system and decreased risk of degenerative diseases such as cancer, cardiovascular disease, age related mascular degeneration and cataract formation. Carotenoids have been identified as a potential inhibitor of Alzheimer's disease.

Phenolics or polyphenols have physiological functions, including antioxidant, antimutagenic and antitumor activities. They have been reported to be a potential contender to combat free radicals, which are harmful to our body and foods systems. Dietary fiber helps in prevention of constipation, regulation of blood sugar, protection against heart diseases and prevention of certain forms of cancers. Fibers play an important role in human health and diets rich in dietary fibers are associated with the prevention, reduction and treatment of some diseases such as diverticular and coronary heart diseases.

What is Quality?

Quality refers to the suitability or fitness of an economic plant product in relation to its end use. However, nowadays it can be defined as the "degree of excellence or superiority". Accepting this definition, we can say that a product is of better quality when it is superior in one or several attributes that are objectively or subjectively valued.

What are the Important Quality Traits?

1. **Morphological traits**: Traits that related to external appearance which includes shape, surface, flesh color and thickness.
2. **Organoleptic traits:** Traits related to taste, aroma, flavor and sweetness.
3. **Biochemical traits:** This includes anthocyanin, beta carotene, ascorbic acid, soluble solids and water content.

Undesirable Traits

Bolting, Sprouting, Root Cracking and Pithiness are some major undesirable quality traits. These undesirable traits affect economic plant parts adversely there by drastic reduction in quality. For example, bolting in onion results in premature seedling or flowering, *i.e.*, premature seed stalk development. This development of premature flowering stalks and seeds instead of producing storage organs (bulb) reduce the quality of marketability of these crops. Under the condition of bolting, bulbs become light red, fibrous and show very poor keeping quality.

What Will Happen if We Increase The Quality of These Crops?

More consumer acceptability, nutritional security, enables the grower to get good return, makes the produce more suitable for processing and more consumer satisfaction.

MAJOR QUALITY PARAMETERS IN IMPORTANT BULB CROPS

Crop	Picture	Important quality parameters	Major varieties bred in India for the purpose
Onion (*Allium cepa* L.)		High reducing sugar. High dry matter content, High TSS (16%) and white color bulb for dehydration. Bulb with thin neck and firm. More number of rings. Low to high pungency. High antioxidants. Single centered bulb.	Pusa Riddhi Arka Niketan Arka Pragati Phule Safed Agrifond White Arka Bindu Arka Swadhista

Crop	Picture	Important quality parameters	Major varieties bred in India for the purpose
Garlic (*Allium sativum*)		High dry matter content and white color cloves. Bulb with thin neck. Firm bulb. High phenolic acid and flavonoids. Cloves with a high dry weight and soluble solid concentrates, > 35% in both cases.	Agrifound white Yamuna Safed-1 Yamuna Safed-2 G-282 Agrifound Parvati
Leek (*Allium ampeloprasum* L.)		Dark green leaf blade. Freedom from bulbing. Long shaft length. Smoothness. Uniformity in leaf.	–
Carrot (*Daucus carota*)		High carotene, anthocyanin and lycopene content in roots. High sugar and dry matter in roots. Sweet flavor. Uniformity in root shape and size. Scarlet/orange color roots. Thick flesh roots. Thin and self-colored core in roots. Free from Pithiness and Cracking.	Pusa Vasuda Pusa Kesar Pusa Ashita Pusa Nayanjothi Pusa Yamadagni
Radish (*Raphanus sativus*)		High Ascorbic acid content in roots and leaves. Uniformity in root shape and size. White, long/stump roots with thin tap root and non branching habit. Non pithy roots. Free from cracking. Moderate Pungency. Smooth and shiny root.	Pusa Jamuni Pusa Gulabi Pusa Chetki Arka Nishant
Beet root (*Beta vulgaris*)		Round to globe shaped roots. Dark red, uniformly coloured roots. Improved colour and sweetness. Uniform root shape. Absence of internal white rings in roots. Increased betalin concentration.	Detroit Dark Red Flat Egyptian Ohio Canner Crimson Globe

Conclusion

Bulb and root crops are important vegetables known for their nutritional, medicinal and processing qualities. There is a wide genetic diversity within these groups with extremely diverse uses. To meet this versatile uses of bulb and root crops, the varieties must also be versatile with different and specific quality traits. Hence, there is a need for quality improvement in these crops. Breeding for quality attributes in these bulb and root vegetables is continuous process for increasing levels of each nutrients and also having more quality attributes in one variety.

ISSN No.:2321-7405

10. FOOD PROCESSING

Microencapsulation: Methods and Applications in Food Processing

Shivashankar Sanganamoni[1]*, Butti Prabhakar[2]

1Ph.D. Scholar, Department of Post Harvest Process and Food Engineering, GBpuat, Pantnagar –
2Teaching Associate, College of Food Science and Technology, Rudrur-503188 (Telangana)

Introduction

Micro-encapsulation is a process in which tiny particles or droplets are surrounded by a coating to give small capsules. In a relatively simplistic form, a microcapsule is a small sphere with a uniform wall around it. The material inside the microcapsule is referred to as the core, internal phase, or fill, whereas the wall is sometimes called a shell, coating, or membrane. Most microcapsules have diameters between a few micrometers and a few millimeters.

The definition has been expanded, and includes more foods. Every class of food ingredient has been encapsulated; flavors are the most common. The technique of microencapsulation depends on the physical and chemical properties of the material to be encapsulated. These micro-capsules have a number of benefits such as converting liquids to solids, separating reactive compounds, providing environmental protection, improved materialhandling properties.

Purpose of Microencapsulation

1. Stabilize an active ingredient
2. Control its release rate
3. Convert a liquid formulation into a solid which is easier to handle.

Why to Employ an Encapsulation Technology?

1. Enhances the overall quality of food products.
2. Provide barriers between sensitive bioactive materials and the environment
3. Reduces the evaporation or transfer of the core material to the outside environment.
4. Superior handling of the active agent.
5. Provides - incorporating vitamins, minerals.
6. Improved stability in final product and during processing.
7. Control release of the active components.
8. Masks the aroma, flavour, and colour of some ingredients

Limitations of Encapsulation Technology

1. High cost operation.
2. Complicated process
3. Toxicity of crosslinking agent
4. Harder optimization of wall material

Materials Used for Encapsulation

Starch and their derivatives (viz., amylose, amylopectin, dextrins, maltodextrins, and polydextrose), Cellulose and their derivatives, Fatty acids and fatty alcohols, Waxes (beeswax, carnauba wax, candellia wax), Glycerides and phospholipids, Milk and whey proteins are caseins, gelatin and gluten dextran, chitosan.

Encapsulation Techniques

Since encapsulating compounds are very often in a liquid form, many technologies are based on drying. Different techniques are available to encapsulate active agents like

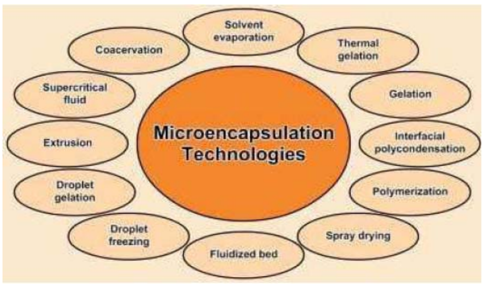
1. Spray drying
2. Fluid-bed coating
3. Spray-chilling
4. Spray-cooling
5. Melt extrusion
6. Melt injection
7. Coacervation

Table: Encapsulation methods and sizes of capsules

Encapsulation Methods	Core	Size (μm)
Physical Methods		
Spray drying	Liquid/solid	5 - 150
Spray cooling	Liquid/solid	20 - 200
Fluidized bed	Solid	>100
Co-crystallization	Liquid/solid	-
Lyophilization	Liquid	-
Physicochemical Methods		

Encapsulation Methods	Core	Size (μm)
Simple coacervation	Liquid/solid	20 - 500
Complex coacervation	Liquid/solid	1 - 500
Solvent evaporation	Liquid/solid	1 - 5,000
Liposomes	Liquid/solid	0.02 - 3

Applications of Encapsulation Technology



Conclusion

Microencapsulation has been applied in a wide variety of products from different areas, and studies have shown an enormous potential to provide the core with advantageous features, resulting in superior quality products, including in the food industry. However, much effort through research and development is still needed to identify and develop new wall materials and to improve and optimize the existing methods of encapsulation for the better use of microencapsulation and its potential applications

11. HORTICULTURE

Spine Gourd (*Momordica dioica* Roxb.): A Minor Vegetable with Extraordinary Medicinal Values

Sanganamoni Mallesh and Akkalareddy Sumalatha

Department of Horticulture, G.B. Pant University of Agriculture and Technology, Pantnagar, U.K.

Introduction

Horticultural crops are gaining importance throughout the world not only as food or economic crops but also for their raw material for value-added products and industrial uses. Minor cucurbitaceous vegetables are very nutritious with high vitamins and mineral matter besides that the specific medicinal and curative properties are very well appreciated. *Momordica dioica* Roxb a minor vegetable crop, commonly known as "Spine gourd" or "Teasle gourd" or "Kankad" or "Kartoli" is believed to have originated in Indo-Malayan region. Spine gourd is a dioecious and perennial (its vines are annual) cucurbitaceous climber with chromosome number 2n=2x=56. The crop planted once will give yield at least three to four years or so. The tubers are left in situ and they over winter. Kankad distributed throughout India, China, Nepal, Bangladesh, Myanmar, Pakistan and Srilanka. This priced vegetable is available in Northeastern states, UP, Bihar, Maharashtra, Madhya Pradesh, Kerala, West Bengal and Andaman Island of the country.

Kankoda is a nutritious vegetable crop locally known as Meetha Karela, Khekhsa, Padora, Bhaat Karela, etc in different localities. The crop is popularized among the farmers due to its vegetable nutritional value and its shelf life. If Kankoda seeds once sown in the field, plants are formed tubers. Tubers sprouted at onset of monsoon every year. A good green yield can be harvested every year and up to 5-6 years from same tubers/plants.

The teasle gourd is an important summer vegetable in Bangladesh and the Indian subcontinent. It grows in warm and humid weather and tuberous roots are planted in pits. In Bangladesh, plantation is done at the beginning of the summer and also at the beginning of the monsoon season. It begins flowering in April and fruits mature during October and November. Various plant parts are consumed in a variety of ways, viz., the delicious young tender fruits used for culinary purpose, as sole vegetable and sometimes mixed with other vegetables and prepares. Often, it can be fried with oils and used. Occasionally fruits are

ISSN No.:2321-7405

cooked with hot spices and prepared as good vegetable curry. Young leaves, flowers and seeds are also edible. It is of high market demand with a special delicacy for the people of Eastern India, it fetches premium price in the market. Organized cultivation of spine gourd is lacked, despite its demand, mainly due to its short harvesting period, low yield, tuber dormancy, dioecious nature and lack of standard propagation technique.

Commercial propagation of spine gourd is largely depending on tuberous roots, followed by stem cuttings and seeds. Propagation by tuberous roots is limited due to the low multiplication rate and occupies the valuable cultivation land until next planting season. Stem cuttings containing 2-3 nodes from dark green vines of 2-3 months old plants are planted but only 36% of the plants sprout and survive and may transmit diseases. Propagation by seeds is difficult due to unpredictable sex ratio in seedling progenies and dormancy. Male plants dominate natural populations and determination of sex is possible only when the plants start flowering. Female plants, however, are commercially more important and being a dioecious crop accommodating only 5-10% male plants in the field is imperative for good fruit set.

Nutritional value of spine gourd fruit per 100 gm edible part

Nutrient	Content
Moisture	84.1 %
Protein	31. gm
Fat	1.0 gm
Fiber	3.0 gm
Carbohydrtate	7.7 gm
Calcium	33 mg
Phosohorus	42 mg
Iron	4-6 mg
Carotene	162 mg
Thiamin	0.05 mg
Ribofalvin	0.18 mg
Niacin	0.06 mg
Energy	52 cal

The Indian Council of Agricultural Research has identified Indira Kankoda I (RMF 37) as a promising variety of Spine Gourd for commercial cultivation in Chhattisgarh, Uttar Pradesh, Jharkhand, Orissa and Maharashtra. It will be first ever variety and no varieties are available in this crop. The consumption of green fruits and tubers stimulate the activities of pancreas and control the level of sugar. Its green fruits contain 12-14 per cent protein and always sales at higher price at the approximate rate of Rs 20-60 per kg in the market.

Newly identified Kankoda or spine gourd variety Indira Kankoda I (RMF 37) is resistant to all major pests. Its green fruits are very attractive, dark green and ready ton harvest for vegetable purpose in 75-80 days from seeds in first year and 35-40 days from tubers, second year to onwards up to 5-6 years. Its single fruit weight is about 14 gram and 3-4 picking can be done for green fruits. The average green fruit yield of variety Indira Kankoda I is first year 8-10 q/ha, second year 10-15 q/ha and third year 15-20 q/ha.

Medicinal Properties

The medicinal properties of this plant are sex-specific and each sex has its own medicinal value. The leaves of female *M. dioica* are used as an aphrodisiac, to eradicate intestinal parasites, and to cure fever, conticipation, asthma, hiccups, and piles. The root of female *M. dioica* is used in the form of a medicinal paste to heal bleeding piles, also used for benefit in headaches, kidney stones, and jaundice. The fruit is considered as pungent, bitter, hot, alexiteric, stomachic, and laxative, and plays a role in cures for biliousness, asthma, leprosy, bronchitis, fever, tumors, urinary discharges, excessive salivation, and heart disease. Juice of the fruit is a domestic remedy for inflammation. Powder obtained from dried fruit is used to induce sneezing, leading to nasal clearing. Ethanol extracts of fruits are used to protect and heal the kidneys. Fruits are also used in ulcers, piles, sores and obstection of liver and spleen. It possesses several medicinal properties and is said to be good for those suffering from cough, bile and other digestive problems. The unripe fruits work as appetizer astringent in barrels. The seeds are used for chest problems and stimulate urinary discharge. The root of male *M. dioica* is used in the form of a paste to heal ulcers caused by snake bites. It is also useful to cure elephantiasis. The male plant is bitter, pungent, hot, with wound-healing properties, and it targets diseases of the blood, eyes, and heart. Apart from this, *M. dioica* is effective against acute renal failure. Ethanol and aqueous extracts of *M. dioica* shows anti-oxidant and hepato-protective activity. The ripe fruits are sweet, oily and laxative. The roots contain a tri-terpenoid saponin, which give water and can be used as a substitute for soap.

Curative Properties

Anti-diabetic, anti-cancer, anti-fertility, abortifacient, anti-inflammatory, anti-oxidant, snake bites, scorpion sting, jaundice and bleeding pile properties.

Conclusion

Even though spine gourd is rich source of many important medicinal compounds and nutrients, but still remain underutilized and underexploited in our country due to different production constraints and also lack of awareness on importance of this crop. Since, there is a need; to focus on improvement of this crop in all respects to increase the area as well as production. For this, researchers must focus their attention towards improvement of underexploited crops like spine gourd.

12. AGRICULTURE

Diseases of Vegetable Crops under Protected Cultivation

Dr. S. S. Wagh, Dr. G. S. Kotgire and Dr. A. S. Damre

Asst. Prof., NSB College of Agriculture, Markhel, Degloor, Nanded, VNMKV, Parbhani, Maharashtra

India is the second largest producer of fruits and vegetables in the world. Area and production of vegetables in the world amounts to 7980.7 thousand hectares and 129076.8 thousand tonnes respectively. Out of it India's contribution in terms of area, production and productivity is 634.4 thousand hectare, 12433.2 thousand tonnes and 19.6 t/ha respectively. Due to increasing demand and to maintain year round supply of vegetables, protected cultivation thus provides a better alternative with huge future prospects.

Polyhouse is a framed structure having 200 micron UV stabilized transparent or translucent low density poly ethylene or other claddings which create green house effect making microclimate favourable for plant growth and development. The structure is large enough for person to work inside, can be made in different shapes and sizes using locally available materials like steel, alluminium, brick or their combination for its frame. Insect poof net and shading materials are used to keep insects at bay and to lower temperatures in summer. Though greenhouse technology is more than 200 years old, but in India, the technology is still in its infancy stage. The area under green house cultivation is 2000 hactares including 500 ha net house, shed house and 1500 ha green house, which is mainly in Maharashtra, Uttarakhand, Karnataka, Jammu & Kashmir. There appears ample scope for increasing area under low cost polyhouse in many folds in peri urban areas for production of high value vegetables during off season for taking advantage of high price of available market in nearby cities. Crops like tomato, cucumber, capsicum, etc is being grown on large scale under polyhouse condition.

Fungal Diseases

Fungal diseases constitute one of the biggest group of foliar pathogens causing immense damage under protected environment. It was found that the incidence and severity of diseases vary considerably under protected environment when compared to open field. As observed in tomato, *Phytophthora infestans*, *Pseudocercospora fuligena* and *Fulvia fulva* causing late blight, black leaf mold and leaf mold respectively were observed to be of higher significance under polyhouse condition. Further, the notion of early and late blight was found to be obscure under polyhouse condition. Since it was observed that late blight appears early in the crop season whereas early blight appears late during crop season. This may be

ISSN No.:2321-7405

attributed to the fact that temperature and humidity are nearly balanced inside protected structure, even when outside field temperature is comparatively low and so on. *Alternaria alternata* is found to be a major disease affecting fruits. Capsicum on the other hand is found to be infected primarily by *Colletotricum capsici, Cercospora capsici, Pythium, Fusarium* and *Phytophthora spp., Stemphylium solani* and *Stemphylium lycopersici, Sclerotium rolfsii, Verticillum alboatrum and V. dahlie, Phytophthora capsici, Leveillula taurica* and *Botrytis cineria* causing anthracnose, leaf spot, damping off, greyleaf spot, stem rot, Phytophthora blight, powdery mildew and grey mold respectively. Cucumber also attracts a considerable quantum of fungal pathogens. Out of which downy mildew (*Pseudopernospora cubenses*), Powdery mildew (*Ersiphe cichoracirum and Sphacelotheca fuligena*), Alternaria leaf spot (*Alternaria cucumerina*), Anthracnose (*Colletotricum lagenarium*) and Damping off (*Pythium spp*) are important. Survival of pathogen is also enhanced inside polyhouse due to availability of host because of longer growing season.

Bacterial Diseases

Bacterial diseases are less frequent but under high moisture and poor irrigated condition may cause huge damage. *Erwinia carotovora ssp. carotovora* (Bacterial soft rot), *Xanthomonas campestris pv. vesicatoria* (Bacterial spot), *Ralstonia solanacearum* (Bacterial wilt). *Pseudomonas syringae* pv. *lachrymans* (Angular leaf spot), *Erwinia tracheiphila* and *Ralstonia solanacearum* (Bacterial wilt) are pronounced to name some.

Viral Diseases

Tomato, cumcumber and capsicum are very sensitive to virus diseases under protected environment. It often spreads in the plantation by insect vectors such as whitefly, thrips and aphids. The damage caused by the virus is usually much greater than the mechanical injury caused by the insect vector. Plant tissue damaged by a viral disease does not die immediately. The most important symptom of viral infections is the light (white or yellow) colour of the leaves, or a mosaic pattern of light and darker shades of green on the leaves. In many cases, viral disease leads to dwarfed growth, rosette formation or other strange stem, fruit and leaf deformations. The symptoms of viral infections are often not found everywhere in a cultivated field but rather in patches and also sometimes without symptoms. Viruses prevalent among greenhouse crops include Tobacco mosaic virus or tomato mosaic virus (TMV or ToMV), Cucumber mosaic virus (CMV), Tobacco etch virus (TEV), Potato virus-Y (PVY), Potato leafroll virus (PLRV), Tomato spotted wilt virus (TSWV), Alfa- Alfa mosaic virus, Pepper veinal mottle virus (PVMV), Pepper mild mottle virus(PMMY), Chilli veinal mottle virus (CVMV Or Chivmv), Tomato yellow leaf curl virus (TYLCV), Tomato Big-Bud mycoplasma (TBB)

Management Strategy

Proper field sanitation is the one of most important management strategy, since once the build up of innoculum occurs inside polyhouse it is very difficult to manage it. So prevention is always better than cure. Use disease-resistant varieties. Reduced incidence of leaf wetness by staking plants providing ample spacing between plants to allow for good air movement, and avoiding overhead irrigation. Judicious use of chemicals with least toxicity recommended specially for polyhouse cultivation shoud be done. Chemicals like chlorothalonil, cymoxanil and azoxstrobulin are prohibited in polyhouse grown tomato and thus should be avoided. As for viruses scout fields for the first occurrence of virus disease. Where feasible, pull up and destroy infected plants, but only after spraying them thoroughly with an insecticide to kill any insects they may be harboring. Use reflective mulches to repel insects, thereby reducing the rate of spread of insect-borne viruses. Monitor vector population early in the season and apply insecticide treatments when needed. Minimize plant handling to reduce the amount of virus spread mechanically.

References

Baker, K.F. and Linderman, R.G. (1979) Unique features of the pathology of ornamental plants, *Annual Review Phytopathology* 17, 253–277.

Bates, M.L. and Stanghellini, M.E. (1984) Root rot of hydroponically grown spinach caused by *Pythium aphanidermatum* and *P. dissotocum*, *Plant Disease* 68, 989–991.

Carrai, C. (1993) Marciume radicale su lattuga allevata in impianti NFT, *Colture Protette* 22(6), 77–81.

Castilla, N. (1994) Greenhouses in the Mediterranean area: Technological level and strategic management, *Acta Horticulturae* 361, 44–56.

Enoch, H.Z. (1986) Climate and protected cultivation, *Acta Horticulturae* 176, 11–20.

Fletcher, J.T. (1984) *Diseases of Greenhouse Plants,* Longman, London.

Germing, G.H. (1985) Greenhouse design and cladding materials: A summarizing review, *Acta*

Hanan, J.J., Holley, W.D. and Goldsberry, K.L. (1978) *Greenhouse Management*, Springer-Verlag, Berlin *Horticulturae* 170, 253–257.

Jarvis, W.R. (1992) *Managing Diseases in Greenhouse Crops,* American Phytopathological Society Press, St Paul, Minn.

Kennedy, R. and Pegg, G.F. (1990) *Phytophthora cryptogea* root rot of tomato in rock wool nutrient culture. III. Effect of root zone temperature on infection, sporulation and symptom development, *Annals of Applied Biology* 117, 537–551.

Reuveni, R., Raviv, M. and Bar, R. (1989) Sporulation of *Botrytis cinerea* as affected by photoselective sheets and filters, *Annals of Applied Biology* 115, 417–424.

Reuveni, R. and Raviv, M. (1992) The effect of spectrally-modified polyethylene films on the development of *Botrytis cinerea* in greenhouse grown tomato plants, *Biological Agriculture & Horticulture* 9, 77–86.

Reuveni, R. and Raviv, M. (1997) Control of downy mildew in greenhouse-grown cucumbers using blue photoselective polyethylene sheets, *Plant Disease* 81, 999–1004.

Tognoni, F. and Serra, G. (1989) The greenhouse in horticulture: The contribution of biological research, *Acta Horticulturae* 245, 46–52.

Wittwer, S.H. and Castilla, N. (1995) Protected cultivation of horticultural crops worldwide, *Hort Technology* 5, 6–23.

13. SOIL SCIENCE

Biofertilizers: Types and their Application

Ankush*and Vikram Singh[1]

**Ph.D. Scholar, Deptt. of Soil Science, [1]Ph. D Scholar, Deptt. of Agronomy, CCS HAU, Hisar, Haryana*

ABSTARCT: Very often microorganisms are not as efficient in natural surroundings as one would expect them to be and therefore artificially multiplied cultures of efficient selected microorganisms play a vital role in accelerating the microbial processes in soil. Use of biofertilizers is one of the important components of integrated nutrient management, as they are cost effective and renewable source of plant nutrients to supplement the chemical fertilizers for sustainable agriculture. Bio-Fertilizers are supplement to Chemical Fertilizers. Bio-Fertilizers are cheap and can reduce the cost of cultivation, fix Biological Nitrogen in the soil, which is readily available to the plant and also increases crop yield by 4-5% on an average by improving soil properties and sustain soil fertility.

INTRODUCTION: 'Biofertilizer' is a substance which contains live or latent cells of microorganism which, when applied to seed, plant surfaces, or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant. Biofertilizers add nutrients through the natural processes of fixing atmospheric nitrogen, solubilizing Phosphorus, and stimulating plant growth through the synthesis of growth promoting substances.

They can be grouped in different ways based on their nature and function:

1. N_2 Fixing Biofertilizers

- Free living - Azotobacter, Clostridium, Anabaena, Nostoc
- Symbiotic - Rhizobium, Frankia, Anabaena azollae
- Associative symbiotic - Azospirillum

2. P Solubilizing Biofertilizers

- Bacteria - Bacillus magaterium var. phosphaticum, Bacillus circulans,

ISSN No.:2321-7405

Pseudomonas striata
- Fungi - Penicillium sp, Aspergillus awamori

3. P Mobilizing Biofertilizers

- Arbuscular mycorrhiza – Glomus spp., Gigaspora spp., Sclerocystis spp.
- Ectomycorrhiza – Laccaria spp., Boletus spp., Pisolithus spp.
- Orchid mycorrhiza – Rhizoctonia solani

4. Organic Matter Decomposer

Cellulolytic and lignolytic microbes – Trichoderma viride, Trichurus spirali, Aspergillis niger, Paecilomyces fusis[porus etc.

5. For Micronutrients

Silicate and Zinc solubilizers – Bacillus spp.

6. Plant Growth Promoting Rhizobateria – Pseudomonas fluroscens

Different Types of Biofertilizers

1. ***Rhizobium*** **-** This belongs to bacterial group and the classical example is symbiotic nitrogen fixation. The bacteria infect the legume root and form root nodules within which they reduce molecular nitrogen to ammonia, which is readily utilized by the plant to produce valuable proteins, vitamins and other nitrogen containing compounds. The site of symbiosis is within the root nodules. It has been estimated that 40-250 kg N / ha / year is fixed by different legume crops by the microbial activities of Rhizobium. **Table 1**shows the N fixation rates.

Table 1: Quantity of biological N fixed by Liquid Rhizobium in different crops

Host Group	Rhizobium Species	Crops	N fix kg/ha
Pea group	*Rhizobium leguminosarum*	Green pea, Lentil	62-132
Soybean group	*R. japonicum*	Soybean	57-105
Alfafa Group	*R. mellilotiMedicago Trigonella*	Melilotus	100-150
Beans group	*R. phaseoli*	Phaseoli	80-110
Clover group	*R. trifoli*	Trifolium	130
Cowpea group	*R. species*	Moong, Redgram, Cowpea, Groundnut	57-105
Cicer group	*R. species*	Bengal gram	75-117

2. ***Azotobacter*** - It is the important and well-known free living, aerobic, chemo-heterotrophic nitrogen fixing bacterium. It is used as a Bio-Fertilizer for all non-leguminous plants especially rice, cotton, vegetables etc.
3. **Azospirillum**- It belongs to bacteria and is known to fix the considerable quantity of nitrogen in the range of 20- 40 kg N/ha in the rhizosphere, symbiotically associated with non- non-leguminous plants such as cereals, millets, Oilseeds, cotton etc.
4. **Cyanobacteria**- A group of one-celled to many-celled aquatic organisms. Also known as blue green algae.
5. **Azolla -** Azolla is a free-floating water fern that floats in water and fixes atmospheric nitrogen in association with nitrogen fixing blue green algae. Azolla is considered to be a potential biofertilizer in terms of nitrogen contribution to rice.
6. Phosphate solubilizing microorganisms(PSM)
7. **AM fungi**- An arbuscular mycorrhiza (AM Fungi) is a type of mycorrhiza in which the fungus penetrates the cortical cells of the roots of a vascular plant which act as a medium of nutrient supply.
8. **Silicate solubilizing bacteria (SSB)**- Microorganisms are capable of degrading silicates and aluminum silicates. During the metabolism of microbes several organic acids are produced and these have a dual role in silicate weathering.
9. **Plant Growth Promoting Rhizobacteria (PGPR)**-The group of bacteria that colonize roots or rhizosphere soil and beneficial to crops are referred to as plant growth promoting rhizobacteria (PGPR).

Benefits of Liquid Biofertilizers

The advantages of Liquid Bio-fertilizer over conventional carrier based Bio-fertilizers are given below: Longer shelf life -12-24 months, No contamination, No loss of properties due to storage upto 45° C, Greater potentials to fight with native population, Easy identification by typical fermented smell, Better survival on seeds and soil, Very much easy to use by the farmer, High commercial revenues, High export potential.

Dosage of Liquid Bio-Fertilizers in different Crops

Recommended Liquid Bio-fertilizers and its application method, quantity to be used for different crops are as follows:

Crop	Recommended Biofertilizer	Application method	Quantity to be used
Field crops	Rhizobium	Seed treatment	200 ml/ acre
*Pulses:*Chickpea, pea, Groundnut, soybean, beans, Lentil, lucern, Berseem, Green gram, Black gram, Cowpea and pigeon pea			
Cereals: Wheat, oat, barley	Azotobacter/ Azospirillum	Seed treatment	200 ml/ acre
Rice	Azospirillum	Seed treatment	200 ml/ acre
Oilseeds: Mustard, seasum, Linseeds, Sunflower, castor	Azotobacter	Seed treatment	200 ml/ acre
Millets: Pearl millets, Finger millets	Azotobacter	Seed treatment	200 ml/ acre
Maize and Sorghum	Azospirillum	Seed treatment	200 ml/ acre
Forage crops and Grasses: Bermuda grass, Sudan grass, Napier Grass, ParaGrass, StarGrass etc.	Azotobacter	Seed treatment	200 ml/ acre
Agro-ForestRY/Fruit Plants	Azotobacter	Soil treatment	2-3 ml/plant at nursery
All fruit/agro-forestry (herb, shrubs, annuals and perennial) plants for fuel wood fodder, fruits, gum, spice, leaves, flowers, nuts and seeds puppose			
Leguminous plants/ trees	Rhizobium	Soil treatment	1-2 ml/ plant

Application of Biofertilizers

1. **Seed treatment:** One packet of the inoculant is mixed with 200 ml of rice kanji to make a slurry. The seeds required for an acre are mixed in the slurry so as to have a uniform coating of the inoculant over the seeds and then shade dried for 30 minutes. The shade dried seeds should be sown within 24 hours. One packet of the inoculant (200 g) is sufficient to treat 10 kg of seeds.
2. **Seedling root dip:** This method is used for transplanted crops. Two packets of the inoculant is mixed in 40 litres of water. The root portion of the seedlings required for an acre is dipped in the mixture for 5 to 10 minutes and then transplanted.
3. **Main field application:** Four packets of the inoculant is mixed with 20 kgs of dried and powdered farm yard manure and then broadcasted in one acre of main field just before transplanting.
    a) **Rhizobium:** For all legumes Rhizobium is applied as seed inoculant.
    b) ***Rhizobium*** (only seed application is recommended)

S. No.	Crop	Total requirement of packets per ha
1	Soybean, Groundnut, Bengalgram	5
2	Blackgram, Greengram, Redgram, Cowpea	3

ISSN No.:2321-7405

Azospirillum/Azotobacter

In the transplanted crops, Azospirillum is inoculated through seed, seedling root dip and soil application methods. For direct sown crops, Azospirillum is applied through seed treatment and soil application.

Precautions

1. Bacterial inoculants should not be mixed with insecticide, fungicide, herbicide and fertilizers.
2. Seed treatment with bacterial inoculant is to be done at last when seeds are treated with fungicides.

References

Weil, Ray R. and Brady, Nyle C. Nature and properties of soils, 15^{th} edition. *Pearson*.

14. SOIL SCIENCE

Soil Health Card

[1]Didal, V. K., [2*]Brijbhooshan and [3]Shalini

[1&2]Department of Agronomy, PJTSAU, Hyderabad [2]Department of Agronomy, GBPUAT, Pantnagar

Introduction

It is a Government of India's scheme promoted by the Department of Agriculture & Co-operation under the Ministry of Agriculture. It will be implemented through the Department of Agriculture of all the State and Union Territory Governments. A Soil Health Card (SHC) is meant to give each farmer soil nutrient status of his holding and advice him on the dosage of fertilizers and also the needed soil amendments, that he should apply to maintain soil health in the long run.

Soil health card is a printed report that a farmer will be handed over for each of his holdings. It will contain the status of his soil with respect to 12 parameters, namely N, P, K (Macro-nutrients); S (Secondary- nutrient); Zn, Fe, Cu, Mn, Bo (Micro - nutrients); and pH, EC, OC (Physical parameters). Based on this, the SHC will also indicate fertilizer recommendations and soil amendment required for the farm.

The soil health card evaluates the health or quality of a soil as a function of its characteristics, plant and other biological properties. The card is a tool to help the farmer to monitor and improve soil health based on their own field experience and working knowledge of their soils. Regular use will allow them to record long term trends in soil health and to assess the effects of different soil management practices. It provides a qualitative assessment of soil health. Its purpose is to use indicators that assess each soil's ability to support crop production within its capabilities and site limitations. The card, which will carry crop-wise recommendation of fertilizers required for farm lands, will help farmers identify health of soil and judiciously use soil nutrients. Farmer wise/ land parcel wise soil health card with the information consisting of slope, erosion, soil depth, colour, texture, organic carbon, pH, electrical conductivity, macro and micro-nutrients, degradation type, etc. can guide the farmers, planners and executors for selecting right land use, right agro-techniques on well-defined parcel of land.

The card will contain an advisory based on the soil nutrient status of a farmer's holding. It will show recommendations on dosage of different nutrients needed. Further, it will advise the farmer on the fertilizers and their quantities he should apply, and also the soil amendments that he should undertake, so as to realize optimal yields.

It will be made available once in a cycle of 3 years, which will indicate the status of soil health of a farmer's holding for that particular period. The SHC given in the next cycle of 3 years will be able to record the changes in the soil health for that subsequent period.

Soil samples will be drawn in a grid of 2.5 ha in irrigated area and 10 ha in rainfed area with the help of GPS tools and revenue maps. The State Government will collect samples through the staff of their Department of Agriculture or through the staff of an outsourced agency. The State Government may also involve the students of local

Agriculture/Science Colleges. Soil Samples are taken generally two times in a year, after harvesting of *rabi* and *kharif* crop respectively or when there is no standing crop in the field. Soil Samples will be collected by a trained person from a depth of 15-20 cm by cutting the soil in a "V" shape. It will be collected from four corners and the centre of the field and mixed thoroughly and a part of this picked up as a sample. Areas with shade will be avoided. The sample chosen will be bagged and coded. It will then be transferred to soil test laboratory for analysis.

Soil testing laboratory is a facility for testing the soil sample for 12 parameters. This facility can be static or mobile or it can even be portable to be used in remote areas. The soil sample will be tested as per the approved standards for all the agreed 12 parameters in the following way:

- At the STLs owned by the Department of Agriculture and by their own staff.
- At the STLs owned by the Department of Agriculture but by the staff of the outsourced agency.
- At the STLs owned by the outsourced agency and by their staff.
- At ICAR Institutions including KVKs and SAUs.
- At the laboratories of the Science Colleges/Universities by the students under supervision of a Professor/ Scientist.

Uses of Soil Health Card

- Using this report, farmers can increase the productivity of crops.
- Using the reports and support from the experts farmers can find out the exact type of fertilisers required.
- Using the required fertilisers only, the quality of soil will be better.
- Understanding the soil contents will help the farmers to cultivate the crop that suits the soil type the most.
- Ultimately this scheme will help the farmers to increase the productivity as well the quality of the crop.
- A Soil Health Card is used to assess the current status of soil health and, when used over time, to determine changes in soil health that are affected by land management.
- A Soil Health Card displays soil health indicators and associated descriptive terms. The indicators are typically based on farmers' practical experience and knowledge of local natural resources.
- The card lists soil health indicators that can be assessed without the aid of technical or laboratory equipment.

Steps followed for Generating Soil Health Card

1. Generating DTM, contour and drainage map.
2. Developing slope and Land use/ land cover map.
3. Designing sampling scheme (DAC, GOI)
   a) One sample for every 10 hectare area under rainfed condition and
   b) One sample for every 2.5 hectare area under irrigated condition
4. Sample Collection and Analysis
   a) One sample for every 10 hectare area under rainfed condition, and
   b) One sample for every 2.5 hectare area under irrigated condition.
   c) Portable Digital Assistance (NBSS&LUP Mrida Sangrah) based sample collection.
   d) Laboratory analysis for pH, EC, organic carbon, macro (N, P, K, S) and micronutrients (Fe, Mn, Zn, Cu, B).
5. Data Entry and mapping in GIS
   a) Primary level analytical data entry in MS-Excel format.
   b) Geo-statistical interpolation technique (Krigging)
   c) Attaching cadastral information with the maps
6. Farm wise Soil database
   a) Data classification based on Soil Testing based Crop Response (STCR) thresholds.
   b) Printing and Distribution of Soil Health Card

ISSN No.:2321-7405

15. SOIL SCIENCE

An Overview of Pre-Plant Fertilization

Ankush*and Vikram Singh[1]

**Ph. D Scholar, Deptt. of Soil Science, [1]Ph.D. Scholar, Deptt. of Agronomy, CCS HAU, Hisar, Haryana*

Abstarct

Pre-plant fertilizer application is the application of fertilizers before sowing or we can say few days after sowing when growth is almost very little. Its main role is to maintain nutrient status of the soil so that plant can easily take up nutrients direct form the soil under prevailing conditions. It also build up the microbial status of the soil which are very essential for soil fertility as well as for the nutrient availability, ultimately enhances the crop growth. Pre-plant fertilization ensure adequate meet of nutrients to the plants so that initially plant could grow better, attain a healthy root system along with, thereafter it will be able to compete for the survival. Methods come under fertilization methods are broadcasting or placement of fertilizers depending on the type of soil, nutrient status and soil health card. Basically, it is very important for ensuring better nutrient status, crop growth and for getting optimum yield.

Introduction

A fertilizer is any material of natural or synthetic origin (other than liming materials) that is applied to soils or to plant tissues (usually leaves), supply one or more essential plant nutrients required for growth of plants. Fertilizers enhance the growth of plants especially in 2 ways *i.e.* addition of nutrients to the soils, increase the effectiveness of soil by improving its water retention and aeration. Pre-Plant fertilization can bring the soil to a good nutrient level, before the crop is planted. To ensure better crop growth and higher yield, growers need to make sure that they apply fertilizers at right rate and at right time because applying the required nutrients too soon might result in nutrient losses, fertilizer waste and even in damage to the crop due to salinity. On the other hand, if required nutrients are applied too late, the crop will not be able to reach its yield potential and deficiencies will occur (Hassanuzzaman, 2017).

Kind of Nutrients Applied with Pre-Plant Fertilization

Pre-Plant fertilization should be based on soil testing. Soil testing helps us to decide which nutrient is to apply and what their application rates should be. As different nutrients vary in their mobility in the soil, the application rate of each nutrient should be considered individually:

- Nitrogen present in nitrate form (NO_3^-) is very mobile in soil and tends to leach down with irrigation or rainfallwater below the root zone. Pre-Plant fertilization of nitrogen increases the risk of nitrogen losses due to leaching and volatilization, before the crop can use it.
- Phosphorus is not mobile in the soil and remains at the place of application, unless surface runoff occurs. Therefore, it can be applied at relatively higher rates, sometimes even up to 100% of the crop requirement.
- The mobility of potassium in soil is intermediate – it is more mobile than phosphorus, but much less mobile than nitrogen.

Placements Methods

The placement method can significantly affect the efficiency of the Pre-Plant fertilization. Various methods of fertilizerplacement for Pre-Plant fertilization (Mahler, 2001):

Broadcast: It refers to spreading fertilizers uniformly all over the field. The main objectives of broadcasting the fertilizers at sowing time are to uniformly distribute the fertilizer over the entire field and to mix it with soil. Suitable for crops with dense stand, the plant roots permeate the whole volume of the soil, large doses of fertilizers are applied and insoluble phosphatic fertilizers such as rock phosphate are used. Fertilizers are applied uniformly to the soil surface. Broadcasting can be followed by incorporation into the soil.

Placement: It refers to the placement of fertilizers in soil at a specific place with or without reference to the position of the seed. Placement of fertilizers is normally recommended when the quantity of fertilizers to apply is small, development of the root system is poor, soil have a low level of fertility and to apply phosphatic and potassic fertilizer.

The most common methods of placement are as follows:

Plough sole placement: In this method, fertilizer is placed at the bottom of the plough furrow in a continuous band during ploughing. Every band is covered as the next furrow is turned. This method is suitable for areas where soil becomes quite dry upto few cm below the soil surface and soils having a heavy clay pan just below the plough sole layer.

Deep placement: It is the placement of ammoniacal nitrogenous fertilizers in the reduction zone of soil particularly in paddy fields, where ammoniacal nitrogen remains available to the crop. This method ensures better distribution of fertilizer in the root zone soil and prevents loss of nutrients by run-off.

Localized placement: It refers to the application of fertilizers into the soil close to the seed or plant in order to supply the nutrients in adequate amounts to the roots of growing plants. The common method to place fertilizers close to the seed or plant is as follows:

Drilling: In this method, the fertilizer is applied at the time of sowing by means of a seed-cum-fertilizer drill. This places fertilizer and the seed in the same row but at different depths. Although this method has been found suitable for the application of phosphatic and potassic fertilizers in cereal crops, but sometimes germination of seeds and young plants may get damaged due to higher concentration of soluble salts.

Advantages of Placement of Fertilizers

When the fertilizer is placed, there is minimum contact between the soil and the fertilizer, and thus fixation of nutrients is greatly reduced, Residual response of fertilizers is usually higher, Utilization of fertilizers by the plants is higher, Leaching loss of nitrogen is reduced, Being immobile, phosphates are better utilized when placed.

Banding: Fertilizer is applied in bands (strips), prior to planting/seeding, near to where the seeds or seedlings are about to be placed.

When deciding on the right placement method, there are a few initial considerations to take:

Soil type – Sandy soils hold less nutrients than coarse-textured soils. Therefore, lower rates of Pre-Plant fertilization in such soils are recommended.

Climate history and weather forecast – Rainfall increases the risk of nitrogen leaching. Warm weather will increase risk of nitrogen volatilization.

Advantages and Risks of Pre-Plant Fertilizer Application (Katyal, 2003; Nayyar and Sudhir, 2012)

Advantages

Enhance crop development -Pre-Plant fertilizer application can ensure that nutrients are available to the crop according to their need, from the very beginning and plant roots obtain nutrients from the soils and enhance plant growth. From doing so, even individual plant can compete with weeds for nutrients and water therefore it results in higher germination and ultimately higher yields.

Incorporate nutrients into the soil - Potassium and phosphorus are major nutrients that are not readily mobile in the soil. When applied after the crop is established these nutrients tend to remain in the upper layer of the soil and do not reach the active root zone. Nitrogen for example, applied as Urea tends to leach. So Pre-Plant fertilization increase the availability of nutrients after incorporation fertilizers into the soil.

Relatively easy to apply – Since there are no plants in the field, equipment can be entered into the field without fearing of doing any damage to the plants.

Risks

Risks related to nutrient losses- Nutrient losses occurs after Pre-Plant fertilizer application can be the following:

Leaching – It is the moving down of nutrients along with the flowing water vertically Nutrients, and nitrate nitrogen (NO_3^-) in particular, move down in the soil profile with

ISSN No.:2321-7405

water. Heavy rainfall or application of large amounts of irrigation water results in leaching of nutrients to below the root zone. This might occur especially in light-texture soils.

Run-off - Applied phosphorus might be lost with run-off if not incorporated properly into the soil.

Volatilization of nitrogen as ammonium – When ammonia is applied close to soil surface, it will volatilize and not be available to the plants.

Damage to seedlings and crop - Fertilizers are salts and as such, they increase the salinity of the soil. Application of high rates of fertilizers may affect the development of the crop. When applied incorrectly, Pre-Plant application might result in poor germination and injure seedlings.

Increases the risk of environmental pollution - Nitrogen leached to ground water, or phosphorus washed by runoff are considered to be a major environmental problem.

Use the optimal Pre-Plant fertilizer rates at right time by adopting right method, while taking into consideration the dynamic factors of our field, for higher yields.

Conclusion

Pre-Plant fertilizer application is commonly misused due to guesswork, which can results in decreased yields, fertilizer waste, damage to soils and groundwater contamination. The proper use of Pre-Plant fertilization can be crucial for the development of the crop, and appropriate use of Pre-Plant fertilization methods can bring greater efficiency, better yields and save costs.

References

Hassanuzzaman M. (2017). Time and methods of fertilizer application. Department of Agronomy, Sher-e-Bangla University, Available at www.hasanuzzaman.webs.com

Katyal, J.C. (2003). Soil fertility management – A key to prevent desertification. *Journal of Indian Society of Soil Science*, **51**: 378-387.

Mahler, Robert L. (2001). Fertilizer placement. *Coopertaive Extension System, University of Idaho,* pp: 502-506.

Nayyar, V.K. and Sudhir, K. (2009). *Soil fertility Management* (2nd Edition), Indian Society of Soil Science, pp: 623-628.

16. AGRICULTURE

Mechanisms of Variability in Plant Pathogens and its Assessment

Anupam Maharshi[1*], Priyanka Swami[2], and Prachi Singh[1]

[1]*Department of Mycology and Plant Pathology, Institute of Agricultural Sciences, BHU, Varanasi;*
[2]*Department of Agrometeorology, GBPUA&T, Pantnagar- 263145*

Introduction

Variability is the property of or ability of an organism to modify its characteristics from one generation to another. The structural and evolutionary progress of population of phytopathogenic organisms is affected by variability. Variability in plant pathogens play important role to overcome novel sources of disease resistant in crops and acquire tolerance of toxic chemicals. Knowledge about extent, evaluation and frequency of variability in pathogen is important for sustainable disease management through host plant resistant (HPR) or fungicides. Biodiversity is an important aspect of the population achieved by the genetic variability, because without variability, it becomes difficult for a population to adapt to environmental changes and therefore makes it more sensitive to extinction. It is also an important factor for evolution as it affects an individual's response to environmental stress and thus can lead to differential survival of organisms within a population due to natural selection of the fit variants. Genetic variability also underlies the differential susceptibility of organisms to diseases and sensitivity to toxins or drugs. Virulence pattern as well as aggressiveness of the pathogen gets changes towards the host plant by modifying its genetic consequent through variability.

Stages of Variation in Plant Pathogens

The group of individuals in a particular population that has certain morphological and other phenotypic characteristics in common and makes up the species of pathogen, such as *Puccinia graminis*, the cause of stem rust of cereals. However some of these individuals within the species has the property to infect only specific host like wheat, barley, or oats, and these individuals make up groups that are called varieties or special forms (formae specialis) such as *P. graminis* f. sp. *tritici* or *P. graminis tritici*, P. *graminis hordei*, and *P. graminis avenae*. In case of bacteria pathovar term is used instead of formae specialis such as *Xanthomonas compestris* pv. *compestris*, canker causing pathogen in citrus. Even within each special form, however, some individuals attack some of the varieties of the host plant but not others, some attack another set of host plant varieties, and so on, with each group of such individuals making up a race. Thus, there are more than 200 races of *P. graminis tritici* (race 1, race 15, race 59, and so on). Due to some variability some of the offspring individual suddenly get ability to attack a new variety/cultivar or can cause severe symptoms on a variety/cultivar that it could rarely infect before. This individual is called a variant. The identical individuals produced asexually by the variant make up a biotype. Each race consists of one or several biotypes (race 15A, 15B, and so on). The appearance of new pathogen biotypes may be very dramatic when the change involves the host range of the pathogen. If the variant has lost the ability to infect a plant variety that is widely cultivated, this pathogen simply loses its ability to procure a livelihood for itself and will die without even making its existence known to us. Variability leads the various stages in the that are mentioned in table 01.

Table 01: Stages of variability in pathogens

Distinguishing characteristics	Fungi	Bacteria	Viruses
Morphology and biochemistry	Genus	Genus	Genus (Formerly group)
Morphology and biochemistry	Species	Species	Species (Virus name)
Host	Formae specialis	Pathovar	Type*
Differential varieties or symptoms	Race	Race	Strain
Localized field population	Isolate	Isolate	Isolate
Clonal population	Single spore derived biotype	Single colony derived strain	Single local lesion isolate

*Sometimes strain is used instead of type. (Agrios, 2005)

Mechanisms of Variability in Pathogens

Pathogens have a wide range of flexible mechanism for producing variability. Chen *et al.* (2009) reported that mutation is the cause for differences in the composition of races, distribution frequency, and diversity among different isolates of *Puccinia striformis f. sp. tritici* collected from different regions. Three types of mechanisms of variability, namely mutation, recombination and gene flow, occur in both plants and pathogens.

1. General Mechanisms of Variability
   a) Mutation
   b) Recombination
   c) Gene Flow
2. Specialized Mechanisms of Variability in Pathogens
   a) Mechanism of variability in Fungus
      i) Heterokaryosis
      ii) Parasexualism
      iii) Saltation
      iv) Heteroploidy
   b) Mechanism of variability in Fungus
      i) Conjugation
      ii) Transduction
      iii) Transformation
      iv) Sexduction
   c) Mechanism of variability in virus
      i) Recombination
      ii) Pseudo-recombination
      iii) Complementation

ISSN No.:2321-7405

Characters used to Detect and Assess Variation in Population of Plant Pathogenic Fungi

1. Pathogenicity
2. Virulence behavior
3. Aggressiveness
4. Fungicide resistance
5. Vegetative compatibility
6. Cultural characteristics
7. Nuclear DNA polymorphism – RFLPs, RAPDs

References

Agrios G.N. (2005) Genetics of plant disease. Plant Pathology *page 125-170*.

Chen, W.Q., Wu. L.R., Liu, T. G., Xu, S. C., Jin, S. L., Peng, Y. L. and Wang, B. T. (2009). Race dynamics, diversity, and virulence evolution in *Puccinia striformis F. sp. tritici*, the causal agent of wheat stripe rust in china from 2003 to 2007. *Plant Disease.* **93:** 1093-1101.

17. BIOTECHNOLOGY

Artificial Chromosome Constructions and its Uses

Devender Sharma*[1] and Parul Sharma[2]

[1]*Ph.D. Scholar, Dept. of Genetics and Plant Breeding, G.B.P.U.A & T. Pantnagar – 263145*
[2] *Ph.D. Scholar, Department of Crop improvement, College of Agriculture, CSK Himachal Pradesh*

A functional chromosome constructed by genetic engineering, having a centromere (and a telomere at each end, if linear rather than circular) and thus transmissible in cell division after introduction into a cell.

Types of Vectors

- Bacterial artificial chromosome (BAC).
- P-1 derived artificial chromosome (PAC).
- Yeast artificial chromosome (YAC).
- Mammalian artificial chromosome (MAC).
- Human artificial chromosome (HAC) vectors.

YAC (Yeast Artificial Chromosome)

YAC was first described in 1983, by Murray and Szostak**.** A yeast artificial chromosome (YAC) is a vector used to clone DNA fragments larger than 100 kb and up to 3000 kb. A YAC is built using an initial circular plasmid, which is typically broken into two linear molecules using restriction enzymes; DNA ligase is then used to ligate a sequence or gene of interest between the two linear molecules, forming a single large linear piece of DNA.

YAC Constructions

- TEL: The telomere which is located at each chromosome end protects the linear DNA from degradation by nucleases.
- CEN: The centromere which is the attachment site for mitotic spindle fibers "pulls" one copy of each duplicated chromosome into each new daughter cell.
- ORI: Replication origin sequences which are specific DNA sequences that allow the DNA replication machinery to assemble on the DNA it can also called autonomously replicating sequence (ARS).

Also it Contains Few other Specific Sequences

- Yeast selectable marker A and B**:** selectable markers that allow the easy isolation of yeast cells that have taken up the artificial chromosome.
- Bacterial selectable marker: such as Ampicillin resistance marker.
- Recognition site: for the two **restriction enzymes EcoRI** and **BamHI.**

Cloning Process Using YAC

- The YAC vectors are linearised by restriction digestion.
- The recombinant DNA is then transformed into the protoplast of the yeast cells "a double auxotrophic mutant, *ura3* and *trp1*⁻, yeast strain is used"
- Transformants are selected on the minimal medium in which uracil and tryptophan remains absent.

Examples: pYAC2, pYAC4, pJS97, pJS98, pCGS966 pRML2, pRML1 etc.

Uses

- Useful for the physical mapping of complex genomes and for the cloning of large genes.
- Can be used to express eukaryotic proteins that require posttranslational modification.
- Maximum length of DNA that can be cloned into vectors"1000 Kb" and larger YACs are more stable than shorter ones, which favors cloning of large stretches of DNA.

HAC (Human Artificial Chromosome)

- A human artificial chromosome (HAC) is a mini-chromosome that is constructed artificially in human cells. Using its own self-replicating and segregating systems, a HAC can behave as a stable chromosome that is independent from the chromosomes of host cells.
- A human artificial chromosome (HAC) is a micro chromosome that can act as a new chromosome in a population of human cells.
- That is, instead of 46 chromosomes, the cell could have 47 with the 47th being very small, roughly 6-10 mega bases in size, and able to carry new genes introduced by human researchers.
- They are useful in expression studies as gene transfer vectors and are a tool for elucidating human chromosome function.
- Grown in HT1080 cells, they are mitotically and cytogenetically stable for up to six months.
- Harrington *et al*., first described human artificial chromosomes. They were first synthesized by combining portions of alpha satellite DNA with telomeric DNA and genomic DNA into linear micro chromosomes.

Components of HAC

- Replication origin from which the duplication of DNA begins,
- centromere which functions in proper chromosome segregation during cell division,
- telomere which protects the ends of linear chromosomes.

Uses

- The ability to carry large gene inserts.
- HAC vector may be useful not only for gene and cell therapy, but also for animal transgenesis.

BAC (Bacterial Artificial Chromosome)

- Developed by **Mel Simon.**
- Maintained in *E. coli* as large single copy plasmids.
- Contain inserts of < 300 kb.
- Contain F-plasmid origin of replication.
- F-plasmid gene controls plasmid replication and plasmid copy number.

Common Gene Components

- OriS, F-plasmid origin of replication.
- repE, encodes a Rep protein that specifically binds to oriS to initiate replication.
- parA, parB and parC loci that are involved in regular partitioning of F plasmid during cell division. Loci parA and parB encode proteins that bind parC locus and link to cell membrane; this ensures a regular partitioning of F plasmid/BAC.
- CMR, chloramphenical resistance.
- cosN, lambda phage cos site.
- loxP, site on phage P1 genome where extensive recombination occurs; the recombination is catalyzed by a specific protein.
- lacZ, β-galactosidase gene.
- T7, bacteriophage T7 RNA polymerase-driven promoter.
- SP6, bacteriophage SP6 RNA polymerase-driven promoter.
- Restriction enzyme recognition site B and H shown in the example are BamH1 and Hpa1.

Examples of BAC: pBAC 108L, pBeloBAC11, pBACe3.6, pCC1BAC etc.

Uses of BAC

- Used to clone 150-350 kb DNA insert.
- Used to sequence the genome of organisms in genome projects, for example the Human Genome Project.
- Utilized to detect genes or large sequences of interest and then used to map them onto the human chromosome using BAC arrays.

MAC (Mammalian Artificial Chromosome)

- Similar to YACs, but instead of yeast

sequences they contain mammalian or human ones.

- Used to clone DNA fragments larger than **100 kb** and up to **3000 kb.**
- In this case the telomeric sequences are multimers (multiple copies) of the sequence TTAGGG, and the commonly used centromeric sequence is composed of another repeated DNA sequence found at the natural centromeres of human chromosomes and called alphoid DNA(consists of very large arrays of tandemly repeating, non-coding DNA.).
- Because the alphoid DNA is needed in units of many kilobases, these MAC DNAs are grown as YACs or, more recently, as BACs.
- Can carry large fragments of DNA representing an intact eukaryotic split gene with exons and introns permitting its normal expression regulated by the associated promoter sequences
- MACs are considered to be suitable for gene therapy, where the inserted DNA will be expressed, yet stably maintained without affecting host genome.

PAC (P1-Derived Artificial Chromosome)

- Developed by **Loannou et al.** (1994)
- In a PAC vector, inserts of size 100-300kb can be cloned
- It is devoid of problems such as chimarism and instability of cloned DNA
- These vectors incorporated features of both P1 and F-factor systems and can be transformed into *E. coli* host by electroporation
- Several micrograms of cloned DNA can be recovered from 5-10ml of the exponential phase of *E. coli.*

Two Types of P1 Vectors

- pNS583tet14Ad10
- pAd10sacBII

Both Vectors Contain Genes

- Contain gene - resistance to the antibiotic kanamycin.
- Plasmid, origin of replication.
- loxP site (the cis-acting site specific recognition signal for the P1 recombinase)
- Gene that allows resistance to tetracycline.
- Inserts cloned -tetracycline resistance.

References

Murray, A. W. & Szostak, J. W. E-Resource Login. Nature (1983).

Harrington, John J. Van Bokkelen, Gil. Mays, Robert W. Gustashaw, Karen. Willard, Huntington F. (1997). "Formation of de novo centromeres and construction of first-generation human artificial microchromosomes" (PDF). *Nature Genetics*. 15 (4): 345–355.

Monaco, A.P. and Larin, Z. (1994) YACs, BACs, PACs and MACs: artificial chromosomes as research tools. Trends in Biotechnology 12: 280–286.

18. GENETICS AND PLANT BREEDING

In vitro Haploid: A Novel Tool for Vegetable Breeding

Pampaniya A. G. and Rathod A. J.

Department of Genetics & Plant Breeding, N. M. College Agriculture, NAU, Navsari- 396450

Introduction

Vegetables play a significant role in human diet by making it balance and supply most important natural elements *viz*., vitamins, minerals, fibres, carbohydrates and supplementary amount of protein and colour. Thus, they are important food and highly beneficial for maintenance of health and prevention of diseases. India can claim to grow the largest number of vegetable crops compared to any other country of the world and as many as 61 annual and 4 perennial vegetable crops are commercially cultivated. India is the second largest producer of vegetables in the world next to China with an estimated production of about 168.50 million tonnes from an area of 9.46 million hectares at an average yield of 17.80 tonnes per hectare (Anonymous, 2016). Though the vegetable requirement is 300g/day/person in India, we are able to meet only about 1/9th of the total requirements (Samantaray *et al.*, 2009). However, to meet this challenge, there is a need of evolving strategies for the development and breeding of suitable varieties / hybrids. The modern biotechnological tools like molecular assisted selection, double haploidy, genetic engineering etc. can be of immense importance for rapid development of superior varieties with desirable qualitative and quantitative traits.

A doubled haploid (DH) is a genotype formed when haploid cells undergo chromosome doubling. Artificial production of doubled haploids is important in plant breeding. Conventional breeding procedures take six generations to achieve approximately complete homozygosity, whereas through doubled haploidy it can be achieved in one generation.

History

The first report of the haploid plant was published by Blakeslee *et al.* (1922) in *Datura stramonium*. Subsequently, haploids were reported in many other species. Guha and Maheshwari (1964) developed an anther culture technique for the production of haploids in the laboratory. The crops of Brassica species, tobacco and barley are the most responsive crop species for double haploid production.

Genetics of DH Population

In DH method, only two types of genotypes occur for a pair of alleles A and a, with the frequency of ½ AA and ½ aa, while in diploid method three types of genotypes occur with the frequency of ¼ AA, ½ Aa, ¼ aa. Thus, if AA is desirable genotype, the probability of obtaining this genotype is higher in haploid method than in diploid method. If n loci are segregating, the probability of getting the desirable genotype is $(1/2)^n$ by the haploid method and $(1/4)^n$ by the diploid method. Hence the efficiency of the haploid method is high when the number of genes concerned is large.

Production of Doubled Haploids

Doubled haploids can be produced *in vivo* or *in vitro*. Haploid embryos are produced *in vivo* by parthenogenesis, pseudogamy or chromosome elimination after wide crossing. Then haploid embryo is rescued, cultured, and chromosome doubling produces doubled haploids. The *in vitro* methods include gynogenesis (ovary and ovule culture) and androgenesis (anther and microspore culture).

Chromosome Doubling

The most frequently used application for chromosome doubling is treatment with anti-microtubule drugs, such as colchicines, which inhibits microtubule polymerization by binding to tubulin. Although colchicine is highly toxic, used in a mill molar concentration and known to be more efficient in animal than in plant tissues, it is still the most widely used doubling agent. Other doubling agents used are oryzalin, amiprophosmethyl (APM), trifluralin and pronamide.

Applications/Uses of Double Haploids

1. Development of homozygous lines
2. Induction of mutation
3. Cytogenetic research
4. Release of the variety
5. Doubled haploid in genome mapping (MAS and QTL)

Limitations

1. Requires a "well-oiled machine" method of producing haploids
2. Success of DH method is genotype dependent
3. Frequency of haploid occurrence is low
4. Less recombination can occur compared with inbreeding
5. Frequency of haploid production impossible to predict
6. Health concerns related to handling the doubling chemical agents

Klima *et al.* (2004) studied more than 400 regenerants of R_1 generation were derived in kohlrabi, cabbage and cauliflower by means of different modifications of microspore culture technique. The highest frequency of embryogenesis and subsequent regeneration of plants were achieved in cauliflower cultivar Siria F_1, kohlrabi line P7 and some experimental F_1 hybrids of cauliflower. The percentage of plant regeneration from sub-cultured embryos in kohlrabi ranged from 11.11 to 63.64 %, in cauliflower from 23.53 to 46.19 % and in cabbage from 5.88 to 52.00 %. Ari *et al.* (2010) used irradiated pollen technique for DH study using disease resistant F_1 hybrid variety. The pollination with the irradiated pollens resulted

ISSN No.:2321-7405

up to 94 % fruit set. From the 204 harvested fruits, 280 haploid, 44 diploid and 8 mixoploid embryos were obtained. Germination rate of haploid was 96 %. The M_3 method was identified as the most successful, economic and effective one. The results are expected to lower the cost and increase the efficiency of dihaploidization in melon breeding.

Samizadeh *et al.* (2007) identified molecular markers associated with long pod loci in a doubled haploid population derived from a cross between the canola lines 'Quantum' (long pod) × 'China A' (short pod) using RAPD and bulk segregants analysis. A molecular marker linkage map of 37 loci for this population was used to identify quantitative trait loci (QTL) controlling pod length, of which two markers in two unlinked loci were selected by using an interval mapping model which explained 22 % of phenotypic variation for pod length in this population. Selection for markers at two loci for increasing pod length resulted in a group of doubled haploid lines with an average 112 mm pod length that increased 15 % of whole population mean.

Conclusion

Doubled haploid breeding is and will continue to be a very efficient tool for the production of completely homozygous lines from heterozygous donor plants in a single step. Homozygous lines are of utmost importance in breeding programmes. Androgenesis, gynogenesis, irradiated pollen techniques are the most common ways to support the development of such valuable DH lines in vegetables. In addition to fast track breeding, haploids and doubled haploids have been extensively used in genetic studies, such as gene mapping, marker/trait association studies, locating QTLs, genomics and as targets for transformations. Furthermore, the haploid induction technique can nowadays be efficiently combined with several other plant biotechnological techniques enabling several novel breeding achievements, such as fixation of complex traits with minimum efforts, gene pyramiding, varietal/hybrid breeding, backcross breeding, mutation breeding and in genetic transformation.

References

Anonymous (2016). www.indiastat.com/agriculture/ 2/ vegetables/ 17427/ totalvegetables/17459/ stats.aspx.

Ari, E., Ikten, H., Gocmen, M., Coskun, R. and Eren, A. (2010). *African Journal of Biotechnology*, **9**(33): 5347-5356.

Blakeslee, A. F., Belling, J., Farnham, M. E. and Bergner, A. D. (1922). *Science,* **55**: 646-647.

Klima, M., Vyvadilova, M. and Kucera, V. (2004). Hort. Sci., 31(4): 119-123.

Samantaray S. K., Prusty S. and Raj R. K. (2009). *Indian Res. J. Ext. Edu.*, **9** (3): 55-59.

Samizadeh, H., Samadi, B. Y., Behamta, M. R., Taleii, A. and Stringam, G. R. (2007). *J. Agric. Sci. Technol.,* **9**: 129-136.

19. NANOBIOTECHNOLOGY

Dynamics of Nanobiotechnology for Protection and Nutrition of Crop Plants

Darshna G. Hirpara and H. P. Gajera

Department of Biotechnology, College of Agriculture, Junagadh Agricultural University, Junagadh-

Introduction

Nanotechnology is defined as a technology relates to the ability to build functional devices based on the controlled assembly of nano scale objects for specific technological applications. It is an important field of modern research dealing with design, synthesis and manipulation of particles structure ranging from approximately 1-100 nm in one dimension. The term "nanoparticles" is used to describe a particle with size in the range of 1-100nm, at least in one of the three possible dimensions. In this size range, the physical, chemical and biological properties of the nanoparticles changes in fundamental ways from the properties of both individual atoms/molecules and of the corresponding bulk materials. Nanoparticles can be made of materials of diverse chemical nature, the most common being metals, metal oxides, silicates, non-oxide ceramics, polymers, organics, carbon and biomolecules. Nanoparticles exist in several different morphologies such as spheres, cylinders, platelets, tubes etc. Nanoparticles have unique physicochemical characteristics including catalytic activity, optical properties, electronic properties, antibacterial properties and magnetic properties. They are gaining the interest of scientist for their novel methods of synthesis (Mehrdad and Khalil, 2010).

Approaches for the Synthesis of Nano Particles

There are two approaches for synthesis of nano materials and the fabrication of nano structures. Top-down and Bottom-up approach. Top down approach refers to slicing or successive cutting of a bulk material to get nano sized particle. Bottom up approach refers to the buildup of a material from the bottom (atom by atom, molecule by molecule or cluster by cluster). Attrition or Milling is a typical top down method in making nano particles, where as the colloidal dispersion is a good example of bottom up approach in the synthesis of nano particles. The biggest problem with top down approach is the imperfection of surface structure and significant crystallographic damage to the processed patterns. This imperfections which in turn lead to extra challenges in the device design and fabrication. But this approach leads to the bulk production of nano material. Regardless of the defects produced by top down approach, they will continue to play an important role in the synthesis of nano structures. Bottom up approach also promises a better chance to obtain nano structures with less defects, more homogeneous chemical composition. When structures fall into a nanometer scale, there is a little chance for top down approach.

Nanoparticles can be synthesized using various methods including chemical, physical and biological. **Physical approaches:** Most important physical approaches include evaporation-condensation and laser ablation. Various metal nanoparticles such as silver, gold, lead sulfide, cadmium sulfide and fullerene have previously been synthesized using the evaporation-condensation method. The absence of solvent contamination in the prepared thin films and the uniformity of nanoparticles distribution are the advantages of physical approaches in comparison with chemical processes. **Chemical approaches:** The most common approach for synthesis of silver nanoparticles is chemical reduction by organic and inorganic reducing agents. In general, different reducing agents such as sodium citrate, ascorbate, sodium borohydride ($NaBH_4$), elemental hydrogen, tollens reagent, N, N-dimethylformamide (DMF), and poly (ethylene glycol)-block copolymers are used for reduction of silver ions (Ag^+) in aqueous or non-aqueous solutions. **Biological approaches:** Biological synthesis of nanoparticles is much more important, because of its easiness of rapid synthesis, controlled toxicity, controlling on size characteristics, reasonable, and eco friendly approach. The bioreduction of metal ions by combinations of biomolecules (enzymes, proteins, amino acids, polysaccharides and vitamins) found in the extracts of certain organisms. A sum of natural sources is there for nanoparticle synthesis, together with plants, fungi, yeast, bacteria, etc. Additionally, the unicellular and multicultural organisms are able to synthesize intracellular and extra cellular inorganic nanoparticles.

Characteristics of Nano Particles

Getting merely a small size is not the only requirement. It should have i) Identical size of all particles, ii) Identical shape or morphology, iii) Identical chemical composition and crystal structures that are desired among different particles and within individual particles, such as core and composition must be the same, Iv) Individually dispersed or mono dispersed *i.e.*, no agglomeration (Sang *et al.*, 2012).

Application of Nanotechnology in Agriculture

Major aplication of nanotechnology in agriculture are nanotech delivery systems for pests, and pathogen, NPK nanofertilizers, nanocapsules for micronutrients. In the proficient use of agricultural natural assets like water, nutrients and chemicals during precision farming, nanosensors and nano-based smart delivery systems are user friendly. It makes the use of nanomaterials and global positioning systems with satellite imaging of fields, farm supervisors might distantly detect crop pests or facts of stress such as drought. Nanosensors disseminated in the field are able to sense the

ISSN No.:2321-7405

existence of plant viruses and the level of soil nutrients. To put aside fertilizer consumption and to minimize environmental pollution, nanoencapsulated slow release fertilizers have also become a style (Wu and Liu, 2008). In agriculture, loss of nutrient elements is one of large problems. It causes the insufficient of plant nutrients, increases process cost and pollutes the environment. Controlled release is a method used to solve this problem. With the use of control released systems, nutrients are released at a slower rate throughout the season, plants are able to take up most of the nutrients without waste by leaching. Slow release fertilizers (Nanofertlilizers of NPK) are made to release their nutrient contents gradually and to coincide with the nutrient requirement of a plants. Nanocapsules can facilitate successful incursion of herbicides through cuticles and tissues, allowing slow and regular discharge of the active substances. This can be act as 'magic bullets', containing herbicides, chemicals or genes which target exacting plant parts to liberate their substance (Torney *et al.*, 2007).

References

Mehrdad F. and Khalil F. (2010). Biological and green synthesis of silver nanoparticles. *Turkish J. Eng. Env. Sci.*, **34**: 281 – 287.

Sang W. K., Jin H. J., Kabir L., Yun S. K., Ji S. M. and Youn S. L. (2012). Antifungal Effects of Silver Nanoparticles against Various Plant Pathogenic Fungi. *Mycobiol.*, **40 (1)**: 53-58.

Torney F., Trewyn B. G., Lin V. S. and Wang K. (2007). Mesoporous silica nanoparticles deliver DNA and chemicals into plants. *Nat. Nanotechnol.*, **2**: 295-300.

Wu L. and Liu M. (2008). Preparation and properties of chitosan-coated NPK compound fertilizer with controlled-release and water-retention. *Carbohydr. Polym.*, **72**: 240–247.

20. SOIL SCIENCE

Techniques to Enhance Carbon Sequestration in Soil

Sahu, Vedhika

Ph.D. Scholar, Department of Soil Science & Agricultural Chemistry, IGKV Raipur

Introduction

Carbon is found in all living organisms and is the major building block for life on Earth. Carbon exists in many forms, predominately as plant biomass, soil organic matter, and as the gas carbon dioxide (CO_2) in the atmosphere and dissolved in seawater. Carbon sequestration is the long-term storage of carbon in oceans, soils, vegetation and geologic formations. Although oceans store most of the Earth's carbon, soils contain approximately 75% of the carbon pool on land — three times more than the amount stored in living plants and animals. Therefore, soils play a major role in maintaining a balanced global carbon cycle.

Carbon sequestration is the process involved in carbon capture and the long-term storage of atmospheric carbon dioxide (CO_2) and may refer specifically to:

- The process of removing carbon from the atmosphere and depositing it in a reservoir. When carried out deliberately, this may also be referred to as carbon dioxide removal, which is a form of geo-engineering.
- Carbon capture and storage, where carbon dioxide is removed from fuel gases (*e.g.*, at power stations) before being stored in underground reservoirs.
- Natural biogeochemical cycling of carbon between the atmosphere and reservoirs, such as by chemical weathering of rocks.

The primary way that carbon is stored in the soil is as soil organic matter (SOM). SOM is a complex mixture of carbon compounds, consisting of decomposing plant and animal tissue, microbes (protozoa, nematodes, fungi, and bacteria), and carbon associated with soil minerals. Carbon can remain stored in soils for millennia, or be quickly released back into the atmosphere. Climatic conditions, natural vegetation, soil texture, and drainage all affect the amount and length of time carbon is stored. A variety of agricultural practices that can enhance carbon storage have been proposed.

Strategies to Capture Atmospheric CO_2 in Soil

High levels of fossil fuel combustion and deforestation have transformed large pools of fossil carbon (coal and oil) into atmospheric carbon dioxide. Strategies aimed at reducing CO_2 in the atmosphere include soil carbon sequestration, tree planting, and ocean sequestration of carbon. Other technological strategies to reduce carbon inputs include developing energy efficient fuels, and efforts to develop and implement non-carbon energy sources. All of these efforts combined can reduce CO_2 concentrations in the atmosphere and help to alleviate global warming. Here are following techniques which can be used to capture CO_2 in soil:

1. **Peat production:** Peat bogs are a very important carbon store. Peat bogs act as a sink for carbon due to the accumulation of partially decayed biomass that would otherwise continue to decay completely. By creating new bogs, or enhancing existing ones, the amount of carbon that is sequestered by bogs would increase.
2. **Forestry:** As forests grow, they store carbon in woody tissues and soil organic matter. The net rate of carbon uptake is greatest when forests are young, and slows with time. Old forests can sequester carbon for a long time but provide essentially no net uptake. When forests are cut, the carbon they contain may be quickly returned to the atmosphere if the woody tissue is burned or converted to products, such as paper, that are short-lived. If the wood is used for construction or furniture, then those products retain carbon during their life-times and act as carbon sinks. A post harvest approach that reduces waste and puts most of the wood into long-lived products is an effective strategy to help reduce global atmospheric carbon. Urban forestry increases the amount of carbon taken up in cities by adding new tree sites and the sequestration of carbon occurs over the lifetime of the tree. It is generally practiced and maintained on smaller scales, like in cities.
3. **Wetland restoration:** Wetland soil is an important carbon sink; 14.5% of the world's soil carbon is found in wetlands, while only 6% of the world's land is composed of wetlands.
4. **Agriculture:** Globally, soils are estimated to contain approximately 1,500 gigatons of organic carbon to 1 m depth, more than the amount in vegetation and the atmosphere. Removing CO_2 from the atmosphere is only one significant benefit of enhanced carbon storage in soils. Improved soil and water quality, decreased nutrient loss, reduced soil erosion, increased water conservation, and greater crop production may result from increasing the amount of carbon stored in agricultural soils. Management techniques, which are successful in providing a net carbon sink in soils, include the following:
   a) **Conservation tillage** minimizes or eliminates manipulation of the soil for crop production. It includes the practice of mulch tillage, which leaves crop residues on the soil surface. These procedures generally reduce soil erosion, improve water use efficiency, and increase carbon concentrations in the top soil. Conservation tillage can also reduce the amount of fossil fuel consumed by farm operations. It has been estimated to have the potential to sequester a significant amount of CO_2.
   b) **Cover cropping** is the use of crops such as clover and small grains for protection and soil improvement between periods of regular crop production. Cover crops improve carbon sequestration by enhancing soil structure, and adding organic matter to the soil.
   c) **Crop rotation** is a sequence of crops grown in regularly recurring succession on the same area of land. It mimics the diversity of natural ecosystems more closely than intensive mono-cropping practices.

Understanding the environmental benefits directly related to carbon sequestration and getting the conservation practices implemented on the land will hasten the development of harmony between human and nature and helps in sustainable food grain production in a long run.

Conclusion

Soil organic matter is so valuable, it is referred as "Black Gold". Agriculture wins with improved food and fibre production system and sustainability. Therefore agricultural policies are needed to encourage farmers to improve soil quality by storing carbon that will lead to enhanced air, water quality and increased productivity. Soil carbon is most valuable resources and may serve as a "Second Crop" if global carbon trading system becomes a reality. There are considerable opportunities for carbon sequestration in agro-ecosystem. Though several management strategies lead to carbon sequestration, the most appropriate practices to increase C reserves are site specific.

References

Benbi, DK(2013). Opportunities of carbon sequestration in soil. PAU J Res (PAU) 49:186-192.

Benbi, DK, Brar JS (2009). A 25 year record of carbon sequestration and soil properties in intensive agriculture. Agronomy for Sust Devel 29:257-285.

Post, WM, Kwon, KC.(2000). Soil carbon sequestration and land-use change:processes and potential. Global Change Biology 6: 317-327.

21. HORTICULTURE

Crop Rotation is a Systematic Approach in Organic Farming

More S G

Ph. D. Scholar, Deptt. of Vegetable Science, College of Horticulture, S. D. A. U., Sardarkrushinagar

Introduction

Crop rotation is a systematic approach to deciding which crop to plant from one year to the next. Crop rotation is very important to organic farmers who grow crops on a large scale and of varying importance to home gardeners. There are general principles of crop rotation that can help you make these decisions, but in the end, each farmer and gardener devises a unique crop rotation plan depending on which crops they grow and in what amounts.

Crop Rotation

Crop rotation is one of the oldest and most effective cultural control strategies. It means the planned order of specific crops planted on the same field. It also means that the succeeding crop belongs to a different family than the previous one. The planned rotation may vary from 2 or 3 year or longer period.

Advantages of Crop Rotation

1. Prevents soil depletion
2. Maintains soil fertility
3. Reduces soil erosion
4. Controls insect/mite pests. Crop rotation as a means to control to insect pests is most effective when the pests are present before the crop is planted have no wide range of host crops; attack only annual/biennial crops; and do not have the ability to fly from one field to another.
5. Reduces reliance on synthetic chemicals
6. Reduces the pests' build-up
7. Prevents diseases
8. Helps control weeds

Characteristics of Good Rotation

1. It should be adoptable to the existing soil climate and economical factor.
2. It should be based on proper land utilization.
3. It should contain a sufficient number of soil improving crops to maintain and build up organic matter content of the soil.
4. It should provide sufficient fodder for live stock reared on farm.
5. It should be so arranged so as to make economy in production and labour utilization.
6. It should be so arranged as to help in control of weeds, plant diseases and pests.
7. It should provide maximum area under most profitable cash crop adopted in the

area.

The goals of crop rotation are to help manage soil fertility and also to help avoid or reduce problems with soil borne diseases and some soil-dwelling insects, such as corn rootworms.

Balancing Soil Fertility

Different crops have different nutrient requirements and affect soil balance differently. Tomato are heavy feeders that quickly deplete soil nitrogen and phosphorus. Thus, if you plant corn in the same spot year after year that plot of soil will run low on nitrogen and phosphorus more quickly than other parts of your garden will. By changing the location of same crop each year, you'll be able to renew the plot where it grew the preceding year, so your soil won't get out of balance.

There are other crops that also use up nitrogen rapidly. They tend to be the leafy and fruiting crops, such as lettuce, cabbage, and tomatoes. In contrast, root vegetables and herbs are light feeders. Peas, beans, and other legumes add nitrogen to the soil but need lots of phosphorus.

The general rule of thumb for balancing out soil nutrients is to avoid planting the same general category of crop (root, legume, and leafy/fruiting) successively in the same place. It's best to follow nitrogen-fixing legumes such as peas or beans with nitrogen-loving leaf or fruiting crops such as lettuce or tomatoes. Then, follow the heavy feeding crops with light-feeding root crops.

Disease and Pest Prevention

If you have a large area of land, you may want to plan your crop rotation on the basis of plant families rather than on nutrient needs. This can help in your overall program of avoiding diseases and pests, because crops in the same botanical family tend to suffer from the same pest and disease problems. For example, Colorado potato beetles like to eat potato plants, but they also enjoy feasting on tomato leaves and eggplant foliage. Since these beetles overwinter in the soil, if you plant eggplant in a spot where you grew potatoes the year before, you could be inviting a beetle problem for your eggplants from the day they're planted. Likewise, several serious bacterial and fungal diseases overwinter in plant debris in the soil.

Lengthy rotations are sometimes necessary to control chronic soil borne problems. Bean anthracnose fungus can persist in soil for up to three years, so a four-year rotation is needed to keep the disease at bay. The same holds true for such fungal diseases as Fusarium wilt and Verticillium wilt. A few problems, such as club root, persist in the soil for even longer, so rotation is less useful for controlling them.

Soil Nitrogen

Legumes in the rotation can be used to increase the available soil nitrogen. Symbiotic nitrogen-fixing bacteria called rhizobia form nodules on the roots of legume plants and convert or fix atmospheric nitrogen to organic nitrogen. The amount of nitrogen fixed varies with species, available soil nitrogen, and many other factors. Fixed nitrogen not removed from the land by harvest becomes available to succeeding crops as the legume tissues undergo microbial decomposition. When the legume crop is seeded, rhizobia inoculums should always be applied to the seed to ensure the most productive commercial strains are available to form nodules and that inoculating bacteria are always present. Even though indigenous bacteria may be present in the soil, research shows improved commercial strains of rhizobia have more capacity to fix nitrogen

Weed Control

Rotations can be used to cause shifts in weed populations. Populations of certain weed species can be suppressed by competition from the crop raised or by the selective use of herbicides. Grass weed populations, often a problem in small grains, can be reduced by the use of the appropriate herbicide in the previous row crop.

Choosing your Crop Rotation Plan

If you have a small area of land, you may not be able to set up an effective rotation by crop family. That's also true if you grow only a few kinds of crops. In that case, stick to a basic soil-balancing rotation. But if you have a large plot and grow many different crops, you may enjoy the challenge of setting up a rotation by crop family. Refer to the chart on the previous page to learn which crops belong to the same family.

Keep in mind that cover crops can be

ISSN No.:2321-7405

included in a rotation plan to discourage specific types of pests and to improve soil. For example, beetle grubs thrive among most vegetables, but not in soil planted in buckwheat or clover. A season of either crop can greatly reduce grub populations and at the same time will increase soil organic matter content.

Rotating Vegetable Families

Susceptibility to pests and diseases runs in plant families. Leave at least two, and preferably three or more, years between the times you plant members of the same crop family in an area. When planning a rotation scheme, refer to this rundown of the seven family groups most often planted in vegetable gardens along with ideas for rotating them.

Onions, Garlic

Rotate with legumes; avoid planting in soil with decomposed organic matter.

Carrots, Parsnips, Parsley, Dill, Fennel, Coriander

Moderate feeders. Preceed with any other plant family; condition soil with compost before planting. Follow with legumes or heavy mulch.

Broccoli, Brussels Sprouts, Cabbage, Cauliflower, Kale, Kohlrabi, Radishes, Turnips

High level of soil maintenance required for good root health. Heavy feeders. Precede with legumes; follow by first cultivating the soil to expose pests for predation, then spread compost.

Cucumbers, Gourds, Melons, Squash, Pumpkins, Watermelons

For improved pest control, precede with winter rye or wheat; follow with legumes.

Beans, Peas, Clovers, Vetches

Beneficial to soil; few pest problems. Rotate alternately with all other garden crops when possible.

Eggplant, Peppers, Potatoes, Tomatoes

Heavy feeders with many fungal enemies. Precede with cereal grain or grass; follow with legumes.

22. SOIL AND AGRICLUTRE CHEMISTRY

Vermicompost: Queen of Compost

Chetan Kumar Dotaniya[1], Rupesh Kumar Meena[2], Mahendra Singh Bhinda[3]

Ph.D. Scholars, [1]Department of Soil Science and Agricultural Chemistry, [2]Department of Agronomy, [3]Department of Plant Breeding and Genetics, COA, SKRAU Bikaner 334006

Vermicompost is a bio-fertilizer produced as the vermicast by earth worm feeding on biological waste material and plant material. Vermicasts are popularly known as 'Black gold'. This vermicompost is an odorless, clean, organic material containing adequate amount of Nitrogen, Phosphorus, Potassium and several other micronutrients which are essential for plant growth and development. In organic farming vermicompost is a preferred nutrient source, which enriches soil quality by improving, it's physio-chemical and biological properties.

Basic Materials Required

1. Crop residues 2. Weed biomass 3. Vegetable waste 4. Leaf litters 6. Waste from agro-industries 7. Bio-degradable portion of urban and rural wastes

Earthworm Species and theirs Scientific Names

1. Canadian Nightcrawler: *Lumbricus terrestris*
2. Red Wiggler: Eisenia foetida
3. European Nightcrawler: *Eisenia hortensis*
4. African Nightcrawler: *Eudrilus eugeniae*
5. Alabama Jumper: Amynthas gracilus

Methods of Vermicomposting

Vermi-composting is done by various methods, among them bed and pit methods are more common.

Vermi-Bed Method

Composting is done on the pucca / kachcha floor by making bed (6x2x2 feet size) of organic mixture. This method is easy to maintain and to practice.

Pit Method

Compost pit of any convenient dimension can be constructed in the backyard or garden or in a field. It may be single pit, two pits or tank of any sizes with brick and mortar with proper water outlets. The most convenient pit or chamber of easily manageable size is 2m x 1m x 0.75m. The size of the pits and chambers should be determined according to the volume of biomass and agricultural waste.

Steps in Preparation of Vermi-Bed

1. Vermibed is the actual layer of good moist loamy soil placed at the bottom, about 15 to 20 cm thick above a thin layer (5 cm) of broken bricks and coarse sand.
2. Earthworms are introduced into the loamy soil, which the worms will inhabit as their home. 150-160 earthworms may be introduced into a compost pit of about 10x1x0.5, with a vermibed of about 15-20 cm thick.
3. The bed should neither be dry or soggy. The pit may then be covered with coconut or Palmyra leaves or an old jute bag to discourage birds.
4. Plastic sheets on the bed are to be avoided as they trap heat. After the first 35 days, wet organic waste of animal and/or plant origin from the kitchen or hotel or hostel or farm that has been pre-digested is spread over it to a thickness of about 5 cm. This can be repeated twice a week.
5. These organic wastes should be turned over or mixed periodically with a pickaxe or a spade.
6. Handful-lumps of fresh cattle dung are then placed at random over the vermibed. The compost pit is then layered to about 5cm with dry leaves or preferably chopped hay/straw or agricultural waste biomass. For the next 30-35 days the pit is kept moist by watering it whenever necessary.

Watering the Vermibed

Daily watering is not required for vermibed. But 60% moisture should be maintained throughout the period. If necessity arises, water should be sprinkled over the bed rather than pouring the water. Watering should be stopped before the harvest of vermicomposting.

Harvesting Vermicompost

In the tub method of composting, the castings formed on the top layer are collected periodically. The collection may be carried out once in a week. With hand the casting will be scooped out and put in a shady place as heap like structure. The harvesting of casting should be limited up to earthworm presence on top layer. For free flow and retaining the quality of compost it is necessary of periodical harvesting. Otherwise the finished compost get compacted when watering is done. In small bed type of vermicomposting method, periodical harvesting is not required.

Precautions for Compost Making

1. Moisture level in the bed should not exceed 40-50%. Water logging in the bed leads to anaerobic condition and change in pH of medium. This hampers normal activities of worms leading to weight loss and decline in worm biomass and population.
2. Temperature of bed should be within the range of 25-30 ^{o}C.
3. Worms should not be injured during handling.
4. Bed should be protected from predators like red ants, white ants, centipedes and others like rats, cats, poultry birds and even dogs.
5. The organic wastes should be free from plastics, chemicals, pesticides and metallic wastes.

Nutrient Content of Vermicompost

The level of nutrients in compost depends upon the source of the raw material and the species of earthworm. A fine worm cast is rich in N P K besides other nutrients.

Parameters	Content
OC%	9.5 – 17.98%
OM%	20.46
C/N ration	11.64
Available N (%)	0.50
Available P (%)	0.30
Available K (%)	0.15 – 0.56%
Ca & Mg (%)	22.67-47.60 mg/100g
Copper	2 – 9.50 mg kg^{-1}

Advantages of Agricultural Aspects

There are several advantages of Vermicompost

ISSN No.:2321-7405

as follow:

1. It provides efficient conversion of organic wastes/crop materials/animal residues.
2. It is a stable and enriched soil conditioner.
3. It helps in reducing population of pathogenic microbes.
4. It helps in reducing the toxicity of heavy metals.
5. It is economically viable and environmentally safe nutrient supplement for organic food production.
6. It is an easily adoptable low cost technology

Economical Aspects of Vermicompost

Vermicompost for Indian Conditions

Most towns and cities in India do not have proper waste management systems and untreated solid waste is generally dumped in landfills or on the roadsides and the liquid wastes are discharged into water bodies. Domestic wastes are mostly organic and on average are about 50% of the total wastes. It is estimated that each household produces not less than 200 kg of organic solid wastes per year. This can be put to productive use rather than being thrown into the bin from where it makes its way to over loaded landfills. These wastes can be considered as a resource to produce manure for the soil using vermicomposting technology.

Vermicompost for Rural Development

The Large quantity of potential agro-industrial wastes and byproducts are thrown out as wastes/under utilized by the local population since they are not aware of its importance. The materials can be utilized profitably by vermicompost, which is a low cost technology. Unemployed rural population can do this, as part time/ full time profession if they are aware of the technical knowhow to utilize the materials. Awareness about Vermiculture and vermicompost will motivate the rural people to start Vermicompost units, which can fetch regular income.

Revenue Generation through Vermiculture and Vermicompost

Vermi-technology is popular because it is a simple methodology with low investment and does not need sophisticated infrastructure. To process one ton of organic matter daily, it would require about 1500 sq meters of space with 6 workers. It would produce about 70 tons of earthworms casting annually Innovative, interested and talented rural people can be successful entrepreneurs in vermicompost production and accruing profits will enhance their life style and income.

Conclusion

This technology is easy to practice, ecologically safe, economically sound and can create more employment opportunities for the rural people to improve their standard of living. At present vermiculture technology is all set to emerge as a big business of the next century. The organic manure obtained from different waste materials using this versatile technique will avoid pollution problems to a greater extent. India being agriculture based country, it could be easily to produce millions of tones of Vermicompost and reducing the use of chemical fertilizers.

23. PLANT BREEDING

In vivo Haploid: A novel Tool for Maize Breeding using Inducer Technique

Rathod A. J., Pampaniya A. G. and Sangani J. L.

M.Sc. (Agri.) Department of Genetics & Plant Breeding, N. M. College of Agriculture, NAU, Navsari-

Introduction

Maize (*Zea mays* L.; 2n=20) is an important cereal crop of the world. The crop is considered as a staple food crop after wheat and rice, it is the main source of calories for majority of peoples living in poverty stricken areas of Africa, Asia, and America. It has a worldwide significance as human food, animal feed and as a raw material for the manufacture of several industrial products like corn starch, maltodextrins, corn oil, corn syrup and products of fermentation and distillation industries. Maize is the only cereal that can be harvested and used at various stages of plant development. In developed countries, it is used more as an animal feed. In India, about 55 % of maize produced is used for food purposes, 14 % as livestock feed, 18 % as poultry feed, 12 % in wet milling industry and 1 % as seed (Anonymous, 2011).

Traditionally, in maize the varieties/inbred lines are developed by using conventional breeding methods, which are time consuming and genetic gains are also limited. To increase the genetic gains and to accelerate the development of improved varieties / inbred lines by reducing the time is possible by using a doubled haploid technology in maize breeding.

Double haploid (DH) is a genotype formed when haploid (n) cells successfully undergo either spontaneous or artificially induced chromosome doubling. Artificial production of doubled haploid is important in plant breeding. Conventional breeding procedures take six generations to achieve almost homozygosity, whereas through doubled haploidy it can be achieved hundred per cent in single generations (Foster and Thomas, 2005).

Why DH in Maize Breeding ?

1. Significantly shorten the breeding cycle
2. Requires less time, labour and other resources in line development
3. Accelerates the product development by allowing rapid pyramiding of polygenic traits
4. Perfectly fulfil the requirements of DUS characteristics for PPV&FR registration
5. Reduce the effort for line maintenance
6. For development of new cytoplasmic male sterile line (CMS)
7. Provides opportunities for marker trait association studies, marker based gene introgression, function genomics, molecular cytogenetics and genetic engineering

Methods of Haploid Induction

Several *in vitro* and *in vivo* methods are used to develop haploid lines in maize but due to limited success and higher cost under *in vitro* methods, researcher are preferred *in vivo* haploid induction using inducer based approach (Coe, 1959).

The haploid inducers are specialized genetic stocks which, when crossed to a diploid (normal) maize plant, result in progeny kernels in an ear with segregation for diploid (2n) kernels and certain fraction of haploid (n) kernels due to anomalous fertilization.

Types of Haploid Induction

1. Maternal haploids
2. Paternal haploids

In maternal haploid production, the inducer is used as male parent for the production of seeds with haploid embryo on the ears of the female parent, while in paternal haploid the inducer is used as female and normal diploid lines used as a pollen source. The haploid induction rate (HIR) is higher in former one.

Development and Maintenance of New Inducer Line

Khakwani *et al.* (2015) developed a new inducer line (TAILs) in Pakistan by attempting a cross F-204 x Stock 6 (1-3) using as a female and F-107 x Stock 6 (1-2) as a male and had given a emphasis on higher induction rate along with good tassel size and excellent vigor for development of new inducer suitable for tropical conditions. Sib-mating is recommended rather than selfing to maintain the vigor of the inducer.

Haploid Identification

1. R_1-n_j marker system
2. R_1-n_j system in combination with other dominant marker gene in the anthocyanin synthesis pathway (A_1, A_2, Bz_1, Bz_2, $C_1$and C_2)
3. Purple root and stem marker
4. Flow cytometry

DH based Marker Assisted Selection Scheme

A double haploid technology and marker assisted selection (MAS) scheme for combining two polygenic characters *viz*., drought tolerance and maize streak virus resistance in maize. By utilizing both the above tools in breeding programme, they speedily recovered highly drought tolerant and MSV resistant lines in maize, which was difficult to get through conventional breeding.

ISSN No.:2321-7405

Conclusion

In vivo haploid development using inducer approach is and will continue to be a very efficient breeding tool for the production of completely homozygous lines in maize with higher genetic gain in a shortest possible time. Several public as well as private sectors are commercially exploiting this technology for the rapid maize improvement with a minimum effort. Furthermore, the inducer based haploid induction technology can nowadays efficiently combined with plant biotechnological tools enabling several novel breeding achievements such as fixations of complex breeding traits, gene pyramiding, varietal / hybrid breeding and in genetic transformation.

Reference

Anonymous (2011). Single cross hybrid breeding technology in maize. Directorate of Maize Research, Pusa campus, New Delhi. Technical Bulletin no. 2011/9, pp. 39-43.

Coe, E. H. (1959). A line of maize with high haploid frequency. *American Naturalist*, 93: 381-382.

Foster, B. P. and Thomas, W. T. B. (2005). Double haploid in genetics and plant breeding. *Plant Breed Rev*. 25: 57-88.

Khakwani, K.; Dogar, M. R.; Hussain, M. A.; Asif, M. and Altaf, M. (2015). Development of Maize haploid inducer lines and double haploid lines in Pakistan. *British Biotech. J.*, **8**(3): 1-7.

24. AGRIBUSINESS MANAGEMENT

Marketing Strategies

Neelamma R Kolageri

PhD Scholar, Dept. of Agribusiness Management

According marketingmo website the marketing strategy concept is written beautifully as “Strong brands, both business and consumer brands, make an emotional connection with their market to influence behavior. It’s now the norm, instead of the exception. If you’re not trained in strategic marketing, it doesn’t have to be a mystery”. Marketing strategies are the means by which a marketing goal is achieved, generally it is characterized by a specified target market and a marketing program to reach it. Each organization has a marketing strategies which is an overall plan for the attainment of institutional goals. Chandler (1962) defined strategy as “the determination of the basic long-term goals and objectives of an enterprise and the adoption of courses of action and the allocation of resources necessary to carry out these goals. Kotler (1990) defines marketing strategies as the broad principles by which the business unit expects to achieve its marketing objectives. It consists of basic decisions on total marketing expenditure, marketing mix and marketing allocation.

Marketing strategy focuses explicitly on the quest for long run competitive and consumer advantage. Marketing develops strategy based on analysis of consumers, competitors and other environmental forces which then should be combined with other strategic inputs such as financial, research and development (R&D) and human resources to arrive at an integrated business strategy. Sound business strategy should have a marketing perspective *i.e.* marketing should provide inputs to strategy generation and the evolved strategies should be tested against the reaction of consumers, competitors and other stakeholders. In order to be successful the strategy whether driven by cost, technology, distribution, service or other competitive advantages of the firm- has to be consistent with consumer needs, perceptions and preferences.

Marketing strategy which serves a boundary role function between the firm and its customers, competitors and other stake holders. According to Peterson (1982) involves considering target consumers to purse; target-consumer desires to satisfy and marketing mix components (*i.e.*, combination of product planning, pricing, physical distribution channels. Target consumers are not the public that’s in at large but are the individuals that the organization attempts to satisfy. Determining consumer desires requires a knowledge of consumer desires the benefits that consumer seek. Designing marketing mix identifies the target consumers and discovers their desires in order to design an effective marketing mix. Firms relish the advantages of having strategies to achieve the objectives and set goals. There are various advantages of having the marketing strategy it simplifies business decisions, keeps marketing efforts proactive, keeps marketing efforts aligned with corporate goals and objectives, makes easy in evaluating new opportunities gets whole organization on the same page, helps to keep sight of the big picture, gives confidence, facilitates measurement. There are numerous kinds of marketing strategy exists according to the objectives and goals firms espouse it. Every firm relish the advantages of having strategies to achieve the objectives and set goals.

References

OLUJIDE AND BAMIDURO, Elements of marketing management II, Department of Business Administration, University of Illorin.

http://www.tronviggroup.com/category/blog/

https://en.wikipedia.org/wiki/Marketing_strategy

www.businessdictionary.com

www.easy-marketing-strategies.com

www.blog.hubspot.com

www.slideshare.net

www.marketing-schools.org

www.marketingMO.com

25. BIOTECHNOLOGY

Bioinformatics: A Modern Multidisciplinary Field of Biology

Saurabh S. Kadam[1] and Devendra V. Rasam[2]

[1,2]College of Agricultural Biotechnology, Kharawate-Dahiwali

Computational biology and bioinformatics are multidisciplinary fields, involving researchers from different areas of specialty, including (but in no means limited to) statistics, computer science, physics, biochemistry, genetics, molecular biology and mathematics. The goal of these two fields is as follows:

- **Bioinformatics:** Typically refers to the field concerned with the collection and storage of biological information. All matters concerned with biological databases are considered bioinformatics.
- **Computational biology:** Refers to the aspect of developing algorithms and statistical models necessary to analyze biological data through the aid of computers.

The first comprehensive collection of amino acid sequences was compiled in the Atlas of Protein Sequence and Structure by The National Biomedical Research Foundation. The European Molecular Biology Laboratory (EMBL) established their data library in 1980 to collect, organize and distribute nucleotide sequence data and related information. This function is now performed by the European Bioinformatics Institute (EBI), Hinxton, U.K. During early 1980s, the National Centre for Bioinformatics Information (NCBI) was established in U.S.A. NCBI serves as primary information databank and provider of information. Sometime later, DNA Data Bank was established by Japan. The National Biomedical Research Foundation established the Protein Information Resource (PIR) in 1984.

Biological data are being produced at a phenomenal rate. For example as of August 2000, the GenBank repository of nucleic acid sequences contained 8,214,000 entries and the SWISS-PROT database of protein sequences contained 88,166. On average, these databases are doubling in size every 15 months. In addition, since the publication of the *H. influenzae* genome, complete sequences for over 40 organisms have been released, ranging from 450 genes to over 100,000. Add to this the data from the myriad of related projects that study gene expression, determine the protein structures encoded by the genes, and detail how these products interact with one another, and we can begin to imagine the enormous quantity and variety of information that is being produced.

The aims of bioinformatics are threefold. First, at its simplest bioinformatics organises

ISSN No.:2321-7405

data in a way that allows researchers to access existing information and to submit new entries as they are produced, *e.g.* the Protein Data Bank for 3D macromolecular structures. While data-curation is an essential task, the information stored in these databases is essentially useless until analysed. Thus the purpose of bioinformatics extends much further. The second aim is to develop tools and resources that aid in the analysis of data. For example, having sequenced a particular protein, it is of interest to compare it with previously characterised sequences. This needs more than just a simple text-based search and programs such as FASTA and PSI-BLAST must consider what comprises a biologically significant match. Development of such resources dictates expertise in computational theory as well as a thorough understanding of biology. The third aim is to use these tools to analyse the data and interpret the results in a biologically meaningful manner. Traditionally, biological studies examined individual systems in detail, and frequently compared those with a few that are related. In bioinformatics, we can now conduct global analyses of all the available data with the aim of uncovering common principles that apply across many systems and highlight novel features.

References

Edwards K. J., Barker J. H. A., Daly A., Jones C. and Karp A. (1996) Microsatellite libraries enriched for several microsatellite sequences in plants. *Biotechniques*, **20**, 758–760.

Rozen S. and Skaletsky H. J. (2000) Primer3 on the WWW for general users and for biologist programmers.

Krawetz, S. and Misener, S. (eds), *Bioinformatics Methods and Protocols: Methods in Molecular Biology*. Humana Press, Totowa, NJ, pp. 365–386.

26. SOIL SCIENCE

Biochar: The Future of Agriculture

M. Nissi Paul[1], Biyyani Suman[1] and B. Santhosh[2]

[1]. Department of Agricultural Microbiology and Bioenergy,[2]. Department ofCrop Physiology College of Agriculture, PJTSAU, Rajendranagar, Hyderabad.

The amount of carbon in the soil is a direct indication of good quality of soil. Higher carbon stocks have a direct correlation with increased agricultural yields through improved soil health. In the current scenario of climate change and global warming, much of carbon in atmosphere has to be sequestrated into soil carbon pool so that increasing CO_2 in the atmosphere and resulting warming could be reduced.

Biochar

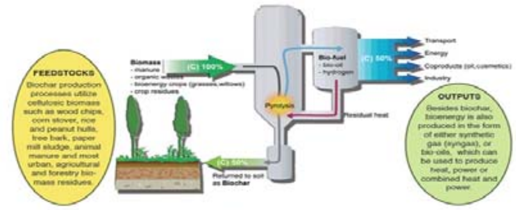
Biochar is a solid material obtained from the carbonisation of biomass. Biochar is produced through a process known as pyrolysis, means thermal decomposition of organic material (*i.e.* wood chips etc, crop waste and manure) under limited supply of oxygen, and at relatively low temperatures (<700°C). This process often mirrors the production of charcoal, which is perhaps the most ancient industrial technology developed by humankind. However, it distinguishes itself from charcoal and similar materials by the fact that biochar is produced with the intent to be applied to soil as a means to improve soil health, to filter and retain nutrients from percolating soil water, and to provide carbon storage. Due to the molecular structure of biochar, it is in a more stable form than the original carbon (*i.e.* plant biomass, manure, etc.) both chemically and biologically. As a result, it is more difficult to breakdown biochar in the soil, resulting in a product that can remain stable in the soil for hundreds to thousands of years.

Biochar Emerges as Soil Amendment for Agriculture

- Biochar, a soil amendment, has potential as a valuable tool for the agricultural industry with its unique ability to help build soil, conserve water, produce renewable energy and sequester carbon.
- Biochar, a soil amendment, is a specialized form of charcoal suitable for use in the soil.

The product can be created from a wide variety of feedstocks, including wood and plant matter and even manure.

- The gas or oil produced from heating feedstock can be used as clean energy. The carbon left behind is biochar. The production process essentially concentrates carbon that would have been released back into the atmosphere as the plant or manure decays, therefore reducing greenhouse gas emissions.
- Biochar is extremely porous which allows it to retain nutrients and water - which plant roots can access when the biochar is added to soil.
- It has been found effective in reducing the disease severity of several crop species.



A conceptual model of bio-char production

Conclusion

Biochar production holds great promise for bioenergy, a value-added manure product, and a soil conditioner. However, as there are so many variables in feedstock and biochar production, many details remain to be refined. As this new and exciting technology advances, the role of biochar in agricultural systems will probably increase. It makes the biomass a sustainable and value added product for urban and rural agriculture while managing waste disposal effectively. Though, an expensive approach for small scale growers, its soil and environmental benefits is well appreciated in poor and contaminated soils.

27. EXTENSION EDUCATION

Gender and Alternative Livelihood Options

Deepa B. Hiremath[1], Netravathi G[2] and Sumith R. Solunkhe[3]

[1]Asst. Prof., Dept. of Agriculture Economics, [2]Asst. Prof. Dept. of Agriculture Extension College of Agriculture, NAU, Bharuch, [3]Asst. Prof. Dept. of Agriculture Extension, Polytechnic in Agriculture, NAU, Vyari, Gujarat, India

Introduction

Gender refers to the economic, social, political, and cultural attributes, constraints, and opportunities associated with being women (girls) and men (boys). The social definitions of what it means to be a woman, a girl, a man, or a boy vary among cultures and change over time. It is a socio cultural expression of particular characteristics and roles associated with certain groups of people with reference to their sex and sexuality (OECD, 1998). Gender equality is a basic human right. Women are entitled to live with dignity and with have the right to freedom. Empowered women not only contribute to the health and productivity of their families and society but improve the prospects for the future generation as well. Unfortunately, Gender equality still remains an unfulfilled promise. Gender discrimination widely present all over the world is the discrimination based on a person's gender or sex, which more often affects girls and women. India, where gender inequality remains a persistent feature of rural livelihoods, is no exception. Gender equality is important, not only as a human right, but also because

ISSN No.:2321-7405

women have a key role to play in sustainable development and achieving the Millennium Development Goal's.

Indian society has fundamentally been a patriarchal society with gender discrimination deeply inherent within its roots. Traditional patriarchal norms have mostly given women secondary status both within the family and at their workplace. This drastically affects women's health, education, financial condition and political involvement. Women are generally married young, soon become mothers, and are then burdened by stringent domestic and financial responsibilities. They are frequently malnourished since women typically are the last member of a household to eat and the last to receive medical attention. Additionally, only 54 percent of Indian women are literate as compared to 76 percent of men. Women receive little schooling, and suffer from unfair and biased inheritance and divorce laws. These laws prevent women from accumulating substantial financial assets, making it difficult for women to establish their own security and autonomy. (www.fsdinternational.org).

Statistical Profile of Women in India

1. India ranks 129th out of the 146 selected countries on Gender Inequality Index (GII) of the year 2011.
2. As per Census 2011, the population of India is 1210.19 million comprising 586.47 million (48.5%) females and 623.72 million (51.5%) males. Females have a share of 48.1% in the urban population and of 48.6% in the rural population.
3. The sex - ratio (number of women per 1000 men) is 940 in 2011. Among the States, in Census 2011, Kerala has the highest sex - ratio of 1084 and Haryana has the lowest of 877.
4. Out of 150.18 million households in the rural areas in 2004 - 05, 16.67 million (11.1%) are Female Headed Households.
5. The female Infant Mortality Rate (IMR) was 49 compared with the male IMR of 46 and the overall IMR of 47 in 2010. Among the major States, the highest overall IMR of 62 was observed in Madhya Pradesh and the lowest of 13 in Kerala in 2010.
6. Life expectancy at birth; female (years) in India was last measured at 67.74 in 2011, according to the World Bank.
7. The Maternal Mortality Ratio (MMR) has come down from 254 during 2004 - 06 to 212 during 2007 - 09.
8. The workforce participation rate of females in rural sector was 26.1 in 2009 - 10 (NSS 64th Round) while that for males was 54.7. In Urban sector, it was 13.8 for females and 54.3 for males. Among the States/Union Territories, workforce participation rate of females in the rural sector was the highest in Himachal Pradesh at 46.8% and in the urban sector it was the highest in Mizoram at 28.8%.
9. In the rural sector, 55.7% females were self - employed, 4.4% females had regular wage/salaried employment and 39.9% females were casual labourers compared with 53.5%, 8.5% and 38.0% males in the same categories respectively.
10. A total of 20.4% women were employed in the organized sector in 2010 with 17.9% working in the public sector and 24.5% in the private.
11. The labour force participation rate of women across all age - groups was 20.8 in rural sector and 12.8 in urban sector compared with 54.8 and 55.6 for men in the rural and urban sectors respectively in 2009 - 10 (NSS 64th Round).
12. The unemployment rate for women of all ages was 2.4 compared with 2.0 for men in the rural areas in 2009 - 10. It was 7.0 for women and 3.1 for men in urban areas during the same period. Among the States/Union Territories, the highest unemployment rate for women in rural sector was observed in Chandigarh (51.1%) and in the urban sector in Dadra and Nagar Haveli (60.0%) in 2009 - 10.34.
13. As per Census 2011, 74.0% of the population is literate comprising 65.5% females and 2.1% males. (http://najc.ca/gender-discrimination)

Role of Rural Women and their Livelihood

In gender division of labour women usually have more diverse tasks involving longer hours sometimes doing more than one thing at a time. Men's work is usually outside the home where as in almost every household, 'women's work' includes not only reproductive work but also productive work which is often invisible to both men and women and hence not valued. However, the employment prospects of women in rural India have become more visible over the last few decades. Women mainly perform multiple duties of raising children, preparing food, looking after the elders and sick, collection of fire wood and also engage in few farm operations such as weeding and transplantation. Among the rural women work force, most of them are agriculture labour and some are cultivators. In the present scenario, men often migrate to urban areas in search of better employment opportunities while the women stay back in the villages working as farm labour or go from door to door selling vegetables. The women with better socio economic status are not directly involved in cultivation of crops or livestock but are mostly engaged with labour administration, supervision, accounting and other related activities.

Issues and Concerns of Women in Rural India

1. Access to land and other resources: Majority of women are excluded from access to and control of rural land in India. While women in India have the legal right to own land, very few do. For those women who do own land, ownership rarely translates into control of the land or of the assets flowing from the land. (http://www.fao.org/).
2. **Gender disparities**: Gender has been a significant determinant of malnutrition among young children, and malnutrition is a frequent direct or underlying cause of death among girls below the age of five. Girls are breast-fed less frequently and for shorter durations during infancy and childhood and during adulthood, while males were fed first and better.
3. **Lack of Knowledge about Dietary Pattern and Nutritional Educatio**n: Nutrition requirement depends on the age and sex of an individual. Women have a lack of knowledge about the dietary pattern best suited to different age groups. They do not know how much food they need to consume during the time of pregnancy and about the lactation period for women. Lack of knowledge thus is a cause of high maternal mortality rate among the women.
4. Political and Socio- cultural Issues: Women, constitute the weaker section of the society and face numerous socio-cultural and political problems. Today, the government has initiated various programmes related to Anti-dowry and maternal benefits, but women lack awareness about these laws and rules. A number of socio-cultural issues such as low status and underprivileged position of women resulting in lower education; little access to training; non-participation in decision making; lower income; poor nutrition and health; few property rights.

Empowering Rural Women for Sustainable livelihoods

Women empowerment is the pre-requisite to enhance agricultural production and to promote micro-enterprises. Empowering women would enable them to generate their own income and allow them to engage in various social, economic, cultural and political aspects governing their lives. There is a need to promote micro enterprises through Self Help Groups in different parts of the country. Various types of enterprises under Agriculture and Horticulture (nursery raising, grafting, bee keeping, garden management, vermicompost production, vegetable cultivation), Animal Husbandry (Pisciculture, piggery, poultry, goat rearing, dairy husbandry), Medicinal and aromatic plants / Food Processing (Papad, Pickles, Chutneys), Agro Services, Production of utility items (ropes, fishing nets, brooms, baskets, furniture) pottery, textile and handicraft, as well as other home based businesses such as papad and Pickle making should be encouraged.

Moreover, women farmers need to be taught how to profitably market their produce. Post-harvest losses need to be cut down by building local storage facilities and transportation mechanisms. Access to current market pricing information and well-functioning markets with sound infrastructure needs to be developed. There is also a need encourage co-operative approaches to marketing. Efforts must be initiated to strengthen rural women by providing training and awareness programmes for income generation activities using natural resource

ISSN No.:2321-7405

management viz. medicinal plants cultivation, organic farming and alternative high value cash crops as women are generally well aware about biological diversity and have rich in indigenous knowledge of natural resources.

Conclusion

Gender discrimination is rampant all over the world, women and girl children's being its very first victims. Gender equality is an important woman's right because women play a key role in sustainable development of a country. In agriculture women are least involved in the crop selection, financial aspects, land owner ship, resources allocation, marketing political and Socio-cultural aspects. To overcome these situations empowering women would enable them to generate their own income and allow them to engage in various social, economic, cultural and political aspects governing their lives. Many NGOs and other government organisations have progressed to deal with various social issues such as education for girls, prevention of child marriages, struggle against liquor sale, promotion of community health, sanitation, establishment of community grain banks and protest against violence of women. All these efforts should reach the target women at the necessary occasion. For that linking rural woman through increasing the number of women extension agents is essential to strengthen rural women by providing training and awareness programmes for income generation activities using natural resource management because training male extension agents to become more gender sensitive. Effective and efficient training through women extension workers can strengthen the financial, leadership and decision making qualities of women leads to increase their livelihood options and decrease the gender inequalities among them.

References

OECD (1998), DAC Sourcebook on Concepts and Approaches Linked to Gender Equality, OECD, Paris.

www.fsdinternational.org

http://www.fao.org/.

28. PLANT PATHOLOGY

Assessment of Effect of Natural Enemies

*Dr Damre A S, Dr G S Kotgire and Dr S S Wagh

*Deptt. of Agril. Entomology and Deptt. of Plant Pathology College of Agriculture Markhe, Nandede

Introduction

In an evaluation of indigenous biological control, we are interested in answering three general questions: (1) is the mortality to pest and potential pest populations from natural enemies sufficient to suppress substantially or completely the densities of the phytophagous populations, (2) which natural enemy species are responsible for the suppression and which phytophagous species do they suppress, and (3) how much mortality does each natural enemy contribute? These questions form a logical sequence for structuring a research programme aimed at assessing the role of natural enemies and the degree of control they exert. The first question seeks to reveal all of the potential biological control that exists in a cropping system in a particular region. The answer to this question is best researched by a combination of approaches typically involving the acquisition of information about the crop, its pests and the natural enemies from the literature, researchers, growers, or other sources; the conduct of a survey of the crop for natural enemies; and the conduct of a series of exclusion-inclusion experiments to determine the degree of biological control that exists in the crop. Ideally, the survey and experiments are conducted concurrently and in an area that has not had a recent history of pesticide use. These areas serve as experimental checks and the results from surveys and the exclusion-inclusion experiments conducted in these areas are compared with those from surveys and experiments in areas in which the traditional pest control practices have continued. All of the techniques described can be used to reveal some aspects of the efficacy of biological control but none of them alone can answer all aspects totally and without bias. Thus, several independent evaluation techniques are essential at each stage of the evaluation process.

Experimental techniques

Exclusion: Inclusion Techniques

Exclusion - inclusion experiments are usually most appropriate for addressing whether biological control is sufficient to suppress pest and potential pest populations. In exclusion experiments natural enemies are prevented access to a portion of the host or prey population. Populations free of predators or parasitoids are expected to increase substantially and suffer less mortality than those exposed to the entomophages in the case of inclusion experiments, entomophages are enclosed with prey or hosts.

Cages

Exclusion or inclusion techniques utilizing cages have been the commonest experimental approach for evaluating natural enemies (Kring *et al.*, 1985 and Neunschwander *et al.*, 1986). It was subsequently modified by using insecticide impregnated netting to replace the need for fumigation and reinfestation of the branches.

Insecticides

Insecticides have also been used to evaluate the impact of natural enemies and was first used as an evaluation method by DeBach (1946) and his colleagues. This method has been employed in a variety of locations to address both general and specific hypotheses. For example it has been used to determine whether resident predators in California cotton field suppressed defoliating Lepidoptera (Ehler *et al*., 1973; Eveleens *et al*., 1973), to test whether a mite feeding coccinellid limited the density of the two spotted spider mite, *Tetranychus urticae* (Koch) (Acari: Tetranychidae), in a previously unsprayed Australian apple orchard (Readshaw, 1973), and to evaluate the role of two introduced parasitoids of the olive scale, *Parlatoria oleae* (Colvee) (Hemiptera: Diaspididae) (Huffaker and Kennett, 1966).

Hand Removal

Hand removal as a means of determining the importance of natural enemies has had limited application, undoubtedly because of the labour involved.

Making and other Prey Detection Techniques

Having assessed the role of resident natural enemies in the suppression of both the pests and potential pests, the next stage in the evaluation process is to determine which species of natural enemies are feeding on which pests.

Sight or Visual Count Method

The sight or visual count method (direct observation) has several advantages over many of the other techniques used to identify predators which feed on particular prey items.

Evaluating Classical and Augmentative Biological Control

The methods discussed so far have been concerned primarily with assessing indigenous biological control. But two other types of biological control are worth assessing, (1) classical biological control in which exotic natural enemies are introduced to control either accidentally introduced pests (DeBach, 1964, 1974) or native pests (Carl, 1982), and (2) augmentative biological control in which insectary reared natural enemies are released to supplement existing biological control or to initiate natural enemy populations (DeBach, 1964; Ridgway and Vinson, 1976). Classical biological control can be spectacularly successful and its effects obvious. Under such circumstances the need to evaluate or document it seems pointless. But using successful classical biological control projects and their natural enemies as experimental systems with which to explore the attributes of an effective biological control agent can be of immense value. Choosing natural enemies for introduction in a classical biological control project has typically been guided by trial and error as modified by experience and by general theories. Although classical biological control has proven effective in a number of cases the reasons for its success (or failure) are largely unknown. However, such understanding is essential if the success rate of classical biological control is to be improved and if criteria for recognizing effective natural enemies are to be developed. Moreover, understanding why some natural enemies are effective and others are not will help us recognize effective predator-prey (parasitoid-host) interactions in indigenous field populations and in identifying biological control agents of use in augmentative or inoculative release programmes.

Conclusion

The focus of this review of experimental methods that have been used to evaluate biological control, both indigenous and introduced. These methods are meant to assess whether biological control exists, where it is sufficient to control the pests at subeconomic densities and which natural enemies are involves. Exclusion methods in many cases cannot identify which of a complex of natural enemies are critical to the control, unless other information is available or the complex consists of a few species and their effects can be partitioned out, as was the case with *P. oleae* (Huffaker and Kennett, 1966). Beyond the generalized guidelines, what specific and measurable attributes constitute an effective natural enemy remains elusive (Luck, 1990).

References

Carl, K.P. 1982. Biological control of native pests by introduced natural enemies. Biological Control News and Information, 3: 190-200.

Debach, P. 1964. Biological Control of Insect Pests and Weeds. Reinhold Publ. Corp., New York.

Debach, P. 1974. Biological Control by Natural Enemies. Cambridge Univ. Press, London.

Ehler, L.E., K.G. Eveleens and R. Van Den Bosch. 1973. An evaluation of some natural enemies of cabbage looper on cotton in California. Environmental Entomology, 2: 1009-1015.

Eveleens, K.G., R. Van Den Bosch and L.E. Ehler. 1973. Secondary outbreak induction of beet armyworm by experimental insecticide applications in cotton in California. Environmental Entomology, 2: 497-503.

Huffaker, C.B. and C.E. Kennett. 1966. Studies of two parasites of the olive scale, Parlatoria oleae (Colvee). IV. Biological control of Parlatoria oleae (Colvee) through the compensatory of two introduced parasites. Hilgardia, 37: 283-335.

Ridgway, R.L. and S.B. Vinson. 1976. Biological Control by Augmentation of Natural Enemies: Insect and Mite Control with Parasites and Predators. Plenum Press, New York.

29. ENTOMOLOGY

Pod Borer in Pulses and their Management

Subhashree Dash [1] and Sumita Das[2]

Ph.D. Scholar Department of Entomology[1], Ph. D Scholar Department of seed science and technology[2] College of Agriculture, OUAT, BBSR-751003

Gram pod borer, *Helicoverpa armigera* is the most damaging pest where pulse crop is grown. It is a major pest of cotton, pigeonpea, chickpea, sunflower, tomato, maize, sorghum, pearl millet, okra, *Phaseolus* spp., vegetables, tobacco, linseed, a number of fruits (*Prunus, Citrus,* etc.), and forest trees. In recent years, *H. armigera* damage has been reported in carnation, grapevine, apple, strawberries, finger millet, etc.

Biology and Damage symptom

The moth is stoutly built and is yellow brown in colour. There is a dark speck and a dark area near the outer margin of each fore wings. The fore wings are marked with greyish wavy lines and black spots of varying size on the upper side and a black kidney shaped mark and a round spot on the underside. The hind wings are whitish and lighter in colour with a broad blackish band along the outer margin. *Helicoverpa* female lays upto 750 eggs singly on tender part of leaves, flowers, and young pods. The eggs are spherical in shape and creamy white in colour. The egg incubation period depends on temperature, and varies between 2 to 5 days. After hatching the larvae causes damage and when full grown it is about 3.5 cm in length. Young caterpillars feed voraciously on the foliage of young leaves and then bore into pods and feed on the developing grains with their bodies hanging outside. They move from pod to pod and are full fed in 13 to 19 days. Larval size in the final instar ranges from 3.5 to 4.2 cm in length. The full grown larvae come out of pod and under goes pupation. Before pupation the larvae spin a loose web of silk. The pupation takes place in soil. Pupae are dark tan to brown in colour and 14 to 22 mm long and 4.5 to 6.5 mm wide. Body is rounded both anteriorly and posteriorly, with two tapering parallel spines at posterior tip. *Helicoverpa armigera* exhibits a facultative diapause, which enables it to survive adverse weather conditions in both winter and summer. It enters a true summer diapause when the larvae are exposed to very high temperatures (43°C for 8 h daily), although the proportion of females entering diapause is nearly half compared to that of males. At these temperatures, non-diapausing males are sterile.

Management

Deep summer ploughing should be done which destroys the hibernating pupal stage of the insect.

H. armigera population can be effectively managed in chickpea if intercropped with either linseed or coriander in 4:2 ratio (Reena, *et al.*, 2009). Coriander in chickpea attracts the parasitoids like *Campoletis chlorideae*.

The pest population can be effectively managed in pigeon pea if intercropped with sunflower in 9:1 ratio and planting of maize as border crop.

In pulses like chickpea, sowing *i.e.* between second fortnight of October and 1st fortnight of November not only evades the outbreak of gram pod borer, *Helicoverpa armigera,* but also enhances the yield

Helicoverpa preferred the 2nd and 3rd leaf for oviposition on chickpea (Patnaik and Senapati, 2002) and the practice of nipping tender leaves help to reduce the *Helicoverpa* menace considerably as most eggs of the pest is removed through nipping in the early stage of the crop.

In pigeon pea at pod initiation stage, when 1-2 larvae per plant are noticed, shake the plants gently with a polyethylene sheet below the crop canopy. This gentle shaking can dislodge most of the caterpillars (85-97%) from the plants.

In chickpea, it has been reported that a small flocks of 3 to 13 cattle egrets can consume 4 to 37 larvae per sq.meter (Patnaik, *et al.*, 1995). Since, the birds are potent predators of larval stages of insects, erection of bird perches @ 25/ha facilitate predation of insects.

If all the above methods are unable to keep the insect population below economic damage level then need based application of following insecticides are to be done to suppress the pest population.

Name of insecticides	Doses per hectare (ml/g)
Bt var kurstaki	1000
Beauveria bassiana	3000
HaNPV	250-500
Emmamectin benzoate 5% SG	220
Benfuracarb 40% EC	2500
Chlorantraniliprole 18.5 SC	500
Deltamethrin 2.8 EC	500
Ethion 50% EC	1000
Flubendiamide 39.35 SC	100
Indoxacarb 14.5 SC	350
Lambda-cyhalothrin 5% EC-	500
Lufenuron 5.4% EC -	600
Novaluron 10% EC -	750
Quinalphos 25% EC	1000
Spinosad 45.0% SC	125
Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC	200

Helicoverpa armigera represents a significant challenge to pulses cropping systems in many parts of our country and for their management farmers take the help of synthetic insecticides in discriminately manner. However, the extensive use of insecticides for combating *H. armigera* populations is of environmental concern. So always we should keep the chemical control as the last option in our pest management schedule when all other non chemicals methods are failed to control the pest.

References

Reena, Singh, S. K., Sinha, B.K. and Jamwal, B. S. 2009. Management of gram pod borer, *Helicoverpa armigera* (Hubner) by intercropping and monitoring through pheromone traps in chickpea. *Karnataka J. Agric. Sci*., **22**(3-Spl. Issue): 524-526.

Patnaik, H.P., Senapati, B. and Mohapatra, R. 1995. Observatins on the Predation of *Helicoverpa armigera* by Cattle Egrets in Chickpea. *International Chickpea and Pigeonpea News letter*, **2**: 38.

ISSN No.:2321-7405

30. ENTOMOLOGY

Recent Advances in Conservation of Natural Enemies

V. K. Mishra[1], Deepika Chauhan[2], Sambhrant Kumar[3] and Satyapriya Singh[4]

[1,3]Deptt. of Entomology & Agricultural Zoology, IAS, BHU, Varanasi, [2]Deptt. of Entomology, College of Horticulture, VCSG, UUHF Bharsar, Uttarakhand, [4]Div. of Entomology, ICAR-IARI, New Delhi

Introduction

Conservation NEs is the only way of using Mother Nature in a positive direction. Conservation of biological control agents emphasize the preservation and enhancement of natural enemies and are the cornerstone of all approaches to biological control. Modification of environment or existing practices to protect and enhance specific natural enemies or other organisms to reduce the effect of pest. So, conservation of natural enemies should be the first consideration in biological pest suppression as it prevents measures that destroy natural enemies. Conservation of NEs can attract and improve the fitness of natural enemies and decreased pest damage, increased crop yield or quality and improved economic profit for growers (Dent, 2002; Jonsson *et al.,* 2008)

Conservation of Natural Enemies

Conservation is the identification and modification of any number of factors to increase the effectiveness of natural enemies. Enhancing or protecting the environment for natural enemies or preserving the natural enemies already existing. Conservation involves manipulation of the environment to enhance the survival, fecundity, longevity, and behavior of natural enemies to increase their effectiveness (Khan *et al.,* 2008)

Strategies for Conservation of NEs

Avoiding Insecticide Use

- **Physiologically safer pesticides:** Insecticides like phosalone, oxy-demeton methyl, cypermethrin, fenvelrate are considered safe. Spinosad is considered as compatible to most of the natural enemies
- **Reduced dose & Selective formulations:** Use of granular formulations, systemic insecticides, non-persistent insecticides, pathogen derived materials, plant derived materials (alkaloids) or mineral compounds (cryolite) do not damage predators and parasitoids. Encapsulated pyrethroids were also found safe to predatory mites.
- **Limiting the area of applications:** Treatment of alternate rows in apple and cotton enhance parasitism.

Maintaining Biodiversity

- **Entomophage park:** In entomophage park an area is kept undisturbed and free from insecticidal application. Natural enemies are conserved in situ. Serve as reservoir of natural enemies which can be utilized for control of insect pests. Also ensure good genetic traits in the natural enemies.
- **Inter cropping:** In quantification studies herbivore populations were reduced in 56 % of cases, increased on 16 % of the cases and unaffected in 28 % of the cases of studies where intercropping was done.

Push-Pull Technology

The crops such as molasses grass *Melinis minutiflora* and a legume species, silver leaf, *Desmodium uncinatum* were grown as inter crops as repellant crops. Push pull trials resulted in the reduction in stem borer incidence, increased levels of parasitism resulting in significant increase in maize yield. The trap crop and inter crop plants also provide valuable forage for cattle in association with subsistence cereal production. Planting *Melinis minutiflora* between the rows of maize not only caused a dramatic reduction in stem borer infestation by acting as a repellent plant but also significant increase in parasitism of stem borer larvae by the indigenous parasitoid *Cotesia sesamiae.*

Habitat Management

Habitat management can be considered as

subset of conservation biological control method that alters habitats to improve availability of the resources required by natural enemies for optimal performance. Increasing attention has been paid to conservation practices that seek to alter the quality of the natural enemies habitat. Some successful examples are as follows (Landis *et al.*, 2000).

- **Planting straw:** Straw bundle @ 20 bundles/ha in paddy fields enhance the spider population, which is most important predator of paddy field.
- Turn around flower pot, filled with straw attracts Dermaptera species.
- **Non crop vegetation:** Planting of water chestnut (*Eleocharis* sp) in rice fields maintains the parasitoid, *Tetrastichus shoenobii* against *Scirpophaga incertulas* in rice crop, which also parasitized the *Scirpophaga* sp in water chestnut.
- **Resources adjacent to crops:** Cereal fields with strips of weeds and wild flowering increased the food availability and reproduction in carabid *Poecilus cupreus*. Higher levels of leafhopper parasitism occurs when wild *Rosa* sp. and *Rubus* spp. which harbor alternate leafhopper hosts for egg parasitoids occur nearby vineyards.
- **Refuges during unfavourable conditions:** Artificially created, grass sown raised earth banks in cereal fields provided overwintering sites for predators of cereal aphids, enhancing their numbers in adjacent crop areas the following (Griffiths *et al.*, 2008)
- **Beetle bank:** These are grassy strip (usually *Dactylis glomeratus)* are planted across the field. These banks provide suitable over wintering sites for predatory beetles in the families Carabidae & Staphylinidae & for Spiders also.
- **Provision of supplementary food:** Adult natural enemies often need nectar and pollen as a source of nourishment and moisture. Interplanting of certain crops has been used to provide nectar and pollen sources for natural enemies. Some observations are as follows (Wade *et al.*, 2008)
- **Crop residue management:** Several parasitoids, *Epiricania melanoleuca* (Fletcher), *Ooencyrtus papillonis* (Ashmead) of *Pyrilla perpusilla* (Walker) can be conserved if crop residues of sugarcane were left unburned.
- **Plant extracts**: Aqueous extracts of *Amaranthus viridis* was found to increase the parasitization of *Trichogramma pretiousm* on the eggs of *Helicoverpa armigera*.
- Tomato extracts when applied increased the rate of parasitism of *Trichogramma* sp. on corn.

Conclusion

After facing the hazards of pesticides of pesticides farmers are becoming more aware of dangers of 4-Rs (Insecticide Resistance, Resurgence, Replacement and Residue) and seriously seeking for more sustainable solution to their pest problem. So, consevation of NEs is the only sustainable, cheapest and eco-friendly way to keep parasitism/predation rate higher and pest population below the economic threshold.

References

Dent, D. (2002). IPM. CAB international, Wallingford, U.K.

Griffiths, G.J.K., Holland, J.M., Bailey, A. And Thomas, M.B. (2008) Efficacy and economics of shelter habitats for conservation biological control. *Biological Control.* 45, 200–209.

Jonsson, M., Wratten, S.D., Landis, D.A. and Gurr, G.M. (2008). Recent advances in conservation biological control of arthropods by arthropods. *Biological Control.* 34: 172–175.

Khan, Z.R., James, D.G., Midega, C.A.O. and Pickett, J.A. (2008). Chemical ecology and conservation biological control. *Biological Control.* 45: 210–224.

Landis, D.A., Wratten, S.D. and Gurr, G.M. (2000). Habitat management to conserve natural enemies of arthropod pests in Agriculture. *Annu. Rev. Ent.* 175-201

Wade, M.R., Zalucki, M.P., Wratten, S.D. and Robinson, K.A. (2008b). Conservation biological control of arthropod using artificial food sprays: current status and future challenges. *Biological control.* 52,185-199

ISSN No.:2321-7405

31. SEED SCIENCE AND TECHNOLOGY

Effects of Climate Change on Wheat Development and Grain Quality

Sumita Das[1*] and Subhashree Dash[2]

[1]. Deptt. of seed science and Technology [2]. Deptt. of Entomology, College of Agriculture, OUAT, BBSR

Wheat (*Triticum aestivum*) accounts for 21% of the world's food supply and is grown on 200 million hectares (494 million acres) of farmland globally. By 2020, the demand for wheat is expected to increase by 1.6% per year meaning the average yield will need to increase in the next 25 years from39 bu/acre to 52.5 bu/acre.

Effect of Temperature

Temperature and precipitation affect plant growth directly and can induce or alleviate stress, while alterations in atmospheric gases and temperature will effect assimilate supply and grain quality. Increases in winter and spring temperatures can accelerate early development of tillers and is positively correlated with straw yield. High temperatures (>86° F) before flowering can decrease seed number and after flowering can reduce duration of grain fill leading to yield loss in wheat. Research has shown that low grain fertility was induced by exposure to temperatures above 86° F for as little as one day during critical periods between booting and flowering (Ferris et al., 1998). Production of pollen grains and transfer to stigma, as well as germination and fertilization of the zygote are all temperature sensitive events. Male and female sterility can occur in wheat at high temperatures (>86-89°F) (Saini and Aspinall, 1982). High temperatures greater than 86° F can cause stress and reduce grain set or grain fill. According to the US Global Change Research Program, night time temperatures have been rising more rapidly than daytime temperatures and are expected to continue to rise in the future (Karl et al., 2009). Increased night time temperatures are particularly critical for the reproductive phase of development due to increased respiration rate and the reduction in the amount of carbon uptake from photosynthesis during the day being retained in the grain. Increased night time temperatures resulted in decreased photosynthesis after 14 days of stress (night time temperatures above 57.2 °F) causing grain yields to decrease linearly. Night time temperatures above 68 °F caused a decrease in spikelet fertility, grains per spike, and grain size.

Effect of Atmospheric Gas Concentration

- C3 plants, like wheat, will experience increased rates of photosynthesis and growth by as much as 35% from increased CO_2 levels. This enhanced photosynthesis is due to the decrease in rates of photorespiration.
- According to Lobell (2007), each additional ppm of CO_2 results in ~0.1% yield increase for C_3 crops so a ~17% increase in wheat yields would be predicted if CO_2 levels increase from the current 380 ppm to 550 ppm as expected by 2050.
- Spiertz and Schapendonk (2001) reviewed wheat experiments across multiple sites and years and reported an increase in average yield of 30% due to doubled CO_2 levels (550 ppm) while simulation models predicted an average increase of 25-40%. Higher CO_2 is expected to increase the rate of photosynthesis, resulting in higher biomass yield coupled with increased water use efficiency due to stomatal regulation.
- Exposure of wheat to elevated levels carbon dioxide and ozone can result in significant trade-offs between grain yield and grain quality.
- Under projected elevated CO_2 concentrations increased nitrogen fertilization will be necessary to maintain grain quality due to evidence of CO_2 -induced impairment of nitrate uptake. This result occurs when the increase in biomass is larger than the increase in N acquisition.
- The lag in N acquisition is caused by a failure of the root system and shoots to keep

pace with the necessary nutrient uptake required for the increased growth seen in higher CO_2 gas concentrations.

- Under realistic agronomic conditions future grain quality is likely to decline with projected increases in CO2 and could be further exacerbated by decreased nitrogen supply. Studies suggest that reductions in grain protein concentrations as a result of increased CO2 will have consequences for the wheat processing industry. Specifically nutritional and processing quality of flour will be reduced for cereals grown under elevated CO2 and lower nitrogen fertilizer.
- Gluten quality has also been observed to vary depending on mean temperature during grain filling (Moldestad et al., 2011). A reduced gluten quality was observed 14 when diurnal temperature was below 64 °F from heading to midway through the grain fill period. Higher temperatures were positively related to gluten quality. Exposure to elevated levels of CO2 will cause nutritional and processing quality of flour to be reduced.

References

Kimball, B. A., C. F. Morris, P. J. Pinter, Jr., G. W. Wall, D. J. Hunsaker, F. J. Adamsen, R. L. LaMorte1, S. W. Leavitt, T. L. Thompson, A. D. Matthias, and T. J. Brooks. 2001. Elevated CO2, drought and soil nitrogen effects on wheat grain quality. New Phytologist 150, 295-303.

Lobell, D. and C. B. Field. 2007. Global scale climate-crop yield relationships and the impacts of recent warming. *Environmental Research Letters* 2:1-7.

Miglietta, F. and J. R. Porter. 1992. The effects of climatic change on development in wheat-analysis and modeling. *Journal of Experimental Botany* **43**(253):1147-1158.

32. AGRONOMY

Green Cane Trash Blanketing: A Way to Sustainable Sugarcane Production

Dr. Mangesh R. Thakur[1] and Dr. Sunil S. Patil[2]

[1]*Asst. Res. Scientist, Soil & Water Management, NARP Phase II, N.A.U., Achhalia*[2]*Asst. Professor, College of Agriculture, N.A.U., Bharuch-, NAU, Gujarat*

Sugarcane is an important commercial crop worldwide and one of the principal source of crystal sugar, jaggery and numerous alcoholic beverages globally. Its by-products are also used as a fodder to feed livestock in many countries. India is the world's second largest sugarcane producer, produce 3,41,400 TMT of sugarcane annually and is one of the largest exporters of sugar worldwide. The country exports sugar to Sri Lanka, Bangladesh, Somalia, Sudan, Indonesia, and the UAE. As a world's second largest sugarcane producer, changes in sugarcane management in particular sugarcane trash management in India can affect the environment to a great extent.

Sugarcane residue represents 11% of the worldwide agricultural residues. Pre-harvest burning of sugarcane is one of the most sensitive environmental issues faced by cane growers. In several cane-producing countries, it is common to burn the cane fields before the harvest, because burning of the dense leaf biomass (trash) facilitates the manual cutting of the stalks. This system eliminates practically all of the trash produced in the sugarcane field. On the other hand, in the harvest system of green cane (un-burnt), the trash is left on the soil surface as mulch. This modifies the environment positively in several aspects.

Losses in trash Burning

When sugarcane is burnt either pre- and/or post-harvest, 70–95% of the dry matter and N are lost from the system. The pre-harvest burning of sugarcane reduced the return (recovery) of dry matter by 22%, N by 23%, Ca by 12%, Mg by 18%, P by 22%, K by 30% and S by 22% than green cane trash blanket (GCTB). While both pre and post harvest burning in sugarcane field reduced the recovery of the dry matter by 5%, N by 3%, Ca by 10%, Mg by 13%, P by 11%, K by 21% and S by 11% over GCTB (Mitchell *et al*., 2000). These figures indicates strong linear relationships between dry matter and nutrient recovery and significant loss of nutrient due to burning in sugarcane field.

The trash burning increase the susceptibility of soil to erosion due to heavy rainfall event or flood irrigation to the tune of 8.3 to 23.2 t ha^{-1} $year^{-1}$ depending on the soil type and topography. Residues burning in sugarcane equivalent to 1.21 ton of CO_2eq for each burnt hectare, responsible for 44% of total GHG emission in sugar production sector (Figueiredo et al., 2010). Thought burning is standard practice and farmers acquired great expertises in burning limited area but many times it imperil their neighbours crops or their own because of uncontrolled wind direction and velocity.

In sugarcane-producing areas, soil compaction is a major problem because of low soil organic matter due to trash burning, movement of heavy machinery and flood system of irrigation. This hampered the root penetration because of increased soil density due to a reduction of its volume and also leads to the expulsion of air from the soil pores, affecting the equilibrium in the relationship between soil gases and the water and nutrient availability to plants, limiting crop yields.

What is Trash Blanketing?

Covering of the field with cane leaves, tops and other organic matter remaining on the ground after cane has been harvested.

Benefits of Trash Blanketing

- Maintaining the trash over soil surface in ratoon crop reduces soil erosion losses.
- The presence of trash on fields results in sequestration of carbon.
- The trash-blanketed soils act as a sink for CH_4 because soil bacteria oxidise CH_4 to CO_2, which is a much less potent GHG (Weier 1996).
- Trash mulching significantly reduces evaporation rates and avoid surface crust formation (Ball Coelho et al., 1993).
- Trash blanket help to suppress weed growth in ratoon crop, reducing the need for frequent cultivation and herbicide spray.
- Increase gravimetric moisture content thus increases the irrigation intervals and reduces the number of irrigation and consequently total irrigation requirement of ratoon crop.
- Reduces the soil resistance to root penetration which otherwise occurred due to the effects of subsoil compaction by agricultural machinery for harvesting, fertilization and other crop management practices thus helps in better proliferation of root system.
- Reduces the bulk density and increases the water holding capacity of soil and thus reduces the water requirement of sugarcane ratoon.
- Increases the topsoil content of stable macro aggregates.
- Increases the soil carbon pool (which is the system that has the capacity to store or release carbon) as a mechanical green harvesting results gradual increase in organic matter in the surface layer, reflecting the amount and quality of plant residue accumulated over the years.
- Increases the stalk density up to 9.5% and yield by 11.4% (Flavio *et. al,* 2013) as the left over crop residue increases the soil organic matter and positively affects the soil physical, chemical and biological properties.
- Keeping trash over the soil increase soil N stock and N recovery by sugarcane, reaching equilibrium after 40 years with recovery of approximately 40 kg ha^{-1} $year^{-1}$ of N.
- Trash incorporation in long tern increase the mineralization of labile forms of organic Phosphorus in soil.
- Increased CEC compared with burnt cane.
- Increase the recovery of macronutrients and subsequently increase their concentration and availability in the soil.
- Increased the microbial activities.

Constraints

Green cane harvesting and trash blanketing cannot be used successfully on every farm due to climatic and technical constraints. Increased volume of leaf matter on soil interferes in manual cane cutting and loading, similarly increases the labour requirement and expenditure for same. Increase pest and disease problems. Research is developing new technology aimed at overcoming present obstacles.

Why Scientific Management is Necessary

Sugarcane trash consists of dry leaves, tops and variable amounts of cane stalks, weight about 10 to 20 t ha^{-1} with high C to N ratio (80 to 110:1) and contains 30 to 80 kg ha^{-1} of N. The high C/N ratio of trash results in significant N immobilization due to increased microbiological activity caused by energy input into the soil, leading to slow rates of N release in the short term (Meier et al., 2006). N recovery by sugarcane from crop residues varies between 3 to 15 %. That's why scientific approach for trash management in sugarcane is required.

Conclusions

The maintenance of sugarcane trash on the soil surface increased the sugarcane yield and soil organic carbon, representing an important practice from the point of view of sustainable management and soil conservation. The significant reduction in greenhouse gas emissions from sugarcane areas could be achieved by switching to a green harvest system, that is, to harvesting without burning. The conversion of sugarcane burning system to green harvest could reduce emissions in this sector.

References

Flavio, C.D., Morel, P.C., Rafael, M., Marcelo A. and Edjair A.D.B. (2013). Physical attributes of an Oxisol linear and spatially correlated with millet + pigeonpea intercropping. Rev. Bras. Cienc. Solo., 37:1709-1719.

Meier, E.A., Thorburn, P.J., Wegener, M.K. and Basford, K.E. (2006). The availability of nitrogen from sugarcane trash on contrasting soils in the wet tropics of North Queensland. Nutrient Cycling in Agroecosystems, 75:101-114.

Mitchell, R.D.J., Thorburn, P.J. and Larson, P. (2000). Quantifying the immediate loss of nutrients when sugarcane residues are burnt. Proc. Aust. Soc. Sugar Cane Technol., 22:206–211.

Ball Coelh, B., Tissen, H., Stewart, J.W.B., Salcedo, I.H., Sampaio, E.V.S.B. (1993). Residue management effects on sugarcane yield and soil properties in Northeastern Brazil. Agronomy Journal. 85:1004-1008.

Weier, K.L., McEwan, C.W., Vallis, I., Catchpoole, V.R. and Myers, R.J.K. (1996). Potential for biological denitrification for fertiliser nitrogen in sugarcane soils. Aust. J. Agric. Res., 47: 67-79.

De Figueiredo, E.B., Panosso, A.R., Romao, R., and La Scala, N. (2010). Greenhouse gas emission associated with sugar production in southern Brazil. Carbon Balance and Management, 5(1):3. http://doi.org /10.1186/1750-0680-5-3

33. AGRICULTURAL BIOTECHNOLOGY

Impact of Molecular Markers in Horticultural Crops

R. K. Kalaria and Hiren V. Patel

[1]*ASPEE Shakilam Agri Biotechnology Institute, NAU, SURAT (GUJARAT) 395 007*

Horticulture, an important division of agriculture, has recognized its importance in many aspects of innovation, improving land use, promoting crop diversification, and providing nutritional security to the nation. It is prominent agricultural sector which has maximum foreign exchange earnings for country economy. Indian horticulture is plagued with a numerous of problem in production, protection and post-harvest management as most crop commodities are low yielding, susceptible to various biotic or abiotic factor. Against challenging threat demand, using precise farming and modern biotechnology including genetic engineering and tissue culture are some of the attractive practises. These are globally accepted to overcome this problem to some extent. Recently Molecular Marker approaches play very important role in horticulture crop. In conventional breeding, the process of developing new crop varieties against biotic and abiotic factor involves many steps and takes several years. In recent times, biotechnological advances have helped in reducing these significantly. Apart from the techniques of tissue culture and genetic engineering, one of the tools which are making it easier for scientist to identified particular plant trait and help it in introgression of these trait in another plant with using specific molecular marker. Molecular marker is a stretch of nucleic acids sequences that makes up a segment of DNA and is also close together on the same chromosome. This is called genetic linkage, which helps scientist to predict whether a plant will have the desired gene or not. Various molecular markers has been used to developed linkage maps for many important trait in various horticultural crop species (Table: 1).

Table: 1 Illustrative of specific trait in different horticultural crop for marker association

Sr. No.	Specific Trait	Crop
1	Fusarium wilt resistance	Banana
2	Male sterility Late bloting Genic male sterility Flowering time	Crucifers
3	Downy mildrew resistance	Cucumber
4	Downy mildrew resistance	Grapes
5	Fusarium wilt resistance ZYMV resistance	Melon
6	Sex determination	papaya

In general molecular marker can be used for characterization of any germplasm, identification of variety, evaluation of genetic diversity, validation of genetic relationship and Marker assisted selection. These have extensive application in management of germplasm as well as in breeding programmes. In the area of horticulture, this is a very useful tool in tree breeding or forest breeding where the breeder has to wait for several years for phenotypic expression of the desired trait. A molecular marker also provided a rapid technique to screen parental germplasm for genetic variation, develop genetic linkage maps and tag genes controlling chief traits in horticultural crop. With high density genetic maps and markers linked to traits can assist in selecting breeding progeny carrying desirable alleles. Thus, molecular markers bring a competent beginning to traditional breeding, enhancing its precision and expediting the process. In addition, a better understanding of the genetic and genomic control of horticultural traits achieved through molecular markers can help design more efficient breeding strategies and map based isolation of genes aided by DNA markers can provide clones of specific genes for genetic engineering of horticultural crop species. Marker are also helpful in some fruit crop to identification for sex determination of male, female and hermaphrodite plant in early stage without waiting upto the fruiting stage. A number of DNA marker technologies are now accessible and rapid advances are being made day by day in the improvement of more sensitive marker technologies. The selection using molecular markers can be enhanced, and the competence of the molecular marker will be higher if the markers are closely linked to the genes controlling quantitative and qualitative. Progress in crop improvement has been reached by manipulating the genetic variation within populations. Currently, novel molecular tools as the molecular markers have started to demonstrate their utility into realistic plant breeding facilitating the identification, characterization and manipulation of the genetic variation on important agronomic traits in horticultural crops.

Some Major Application of Molecular Marker in Horticulture Crop

1. **Genetic Diversity:** A number of reports are available on the use for molecular markers to assess genetic diversity among species of several horticultural crops, as well as validation of genetic relatedness among them. This has significant application, especially for difficult to breed woody perennials crop. Using RAPD, ISSR etc markers the wide variability were observed in Mango, citrus, Pomegranate etc.
2. **Quantitative Trait Loci** (QTLs): Many important hereditary characters are a consequence of the joint action of several genes. Several characters of plant species, among which are agronomic importance traits are inherited quantitatively. The genetic loci for such characters have been referred to as QTLs. Molecular markers provide opportunity by making it feasible to identify, map and measure the effects of

genes underlying quantitative trait. In grape QTLs were use for features such as like Critical Photoperiod, growth cessation, or dormancy, bud break (BB) and winter hardiness.

3. **Varietal identification or classification:** It is nothing but DNA fingerprinting. Molecular markers are capable of producing patterns that are unique for each individual genotype. Their patterns, whether they are generated by PCR or by hybridization with single copy, multicopy, or repeated sequences are referred to as genetic fingerprintings. Few examples of DNA markers used for varietal identification are done by RAPD, RFLP, SSR etc in Apple, Blackberry, Grape, Mango etc.
4. **Diagnostic Techniques:** Molecular markers have develop **diagnostic techniques** to identify pathogen with an unprecedented accuracy and speed to knock genes from as diverse sources such as microbes, plants and animals to enable the researchers to develop plants resistant to diseases. ie Peach root knot nematodes resistance in Peach cv. '*Juseitou*'.
5. **Sex Determination**: Molecular markers have robust contribution in sex determination in some important horticultural crop like Datepalm, Papaya etc. in early identifying male, female or hermaphrodite plant at seedling stage.

Thus markers have instant applications in encouraging research for advanced breeding programmes. The major application of markers lies in the considered research for rapid understanding of basic genetic mechanisms and genome organization at molecular level. However, these applications have not been implemented in breeding programmes effectively. Although molecular markers have been developed for important traits in several horticultural crops, they have been hardly used in actual breeding programmes for marker assisted selection. There is need to adopt this approaches more aggressively and effectively in research on horticultural crops. Another are that merits attention in horticultural crop is to develop molecular maps using effective mapping population depending on the requirement. Using Bioinformatics approaches, it is possible to identify polymorphic loci directly when sequence of the same gene are available from more than one variety. Thus, the success of molecular marker technology for bringing genetic improvement in fruit crops would depend on close contact between plant breeders and biotechnologists, availability of skilled man power and significant financial investment on research.

Reference

Hanur, V. S. and Aswath, C. (2013). Towards nutritional security through horticultural biotechnology, *Current Science*, **105**(4):439-440.

Ibitoye, D. O. and Akin-Idowu, P. E. (2010). Marker-assisted-selection (MAS): A fast track to increase genetic gain in horticultural crop breeding. *African J. Biotechnol.*, **9** (52):8889-8895.

Keshavachandran, R.; Nazeem, P. A.; Girija, D.; John, P.S. and Peter, K. V. (2007) Recent Trends in Horticultural Biotechnology, New India Publishing Agency, pp 1-482.

Srivastava, P. S.; Narula, A. and Srivastava, S. (2005). Plant Biotechnology and Molecular Markers, Springer pub. pp-1-415.

IMPORTANT NOTICE

In line with the communication sent earlier in June 2017 from when we increased the number of pages but assured to all that the rates will be revised later on *i.e.* from September but we have now decided to increase the price from October 2017 onwards.

It is therefore, for the information of all the readers that the charges of subscription from October 2017 *i.e.* from Volume No. 14 Issue no.01 onwards shall be Rs. 500.00 for one year. The individuals who shall submit subscription form after 01.10.2017 will be required to remit Rs.500/- in place of Rs.400/-. New subscription from shall be uploaded on site from 30.09.2017.

Editor