MASTERS' SEMINAR

ABSTRACTS-2017

COLLEGE OF HORTICULTURE

KERALA AGRICULTURAL UNIVERSITY

VELLANIKKARA,THRISSUR-680656

MASTERS' SEMINAR ABSTRACTS-2017

Course teachers and editors

Dr. Haseena Bhaskar
Professor and PI
AINPAA, Dept. of Agril. Entomology
College of Horticulture, Vellanikkara

Dr. Meera V. Menon
Professor, (Agronomy, AICRP on weed control)
Dept. of Agronomy
College of Horticulture, Vellanikkara

Dr. Saji Gomez
Assistant Professor
Dept. of Processing Technology
College of Horticulture, Vellanikkara

Compiled by

Abid V
Megha L.M.
Amjath.T
Rammya Molu.K.
Shahanaz M.R.
Sophia Baby
T.P. Anseera

College of Horticulture
Kerala Agricultural University
Vellanikkara, Thrissur-680656

CONTENTS

SI. No.	Name	Topic	Page No.
Agricultural Economics			
1	Reshma Sara Sabu 2016-11-046	Agricultural loan waiver in India - A paradox	1
2	Athira. E 2016-11-057	Demonetization and its impact on Indian agriculture	3
3	Swathy Sugathan P.2016-11-084	Water quality issues in Kerala: socio-economic dimensions	5
4	Athira B. 2016-11-091	Fertilizer policies and pricing of NPK fertilizers in India	7
Agricultural Entomology			
5	Nimisha T. 2016-11-019	Nanotechnology applications in insect pest management	9
6	Shahanaz M. R. 2016 - 11 – 036	Egg dumping: survival mechanism in insects	11
7	Kavya Yadav G. A. 2016-11-120	Insects as bioindicators - doomsayers on six legs?	13
Agricultural Extension			
8	T. P. Anseera 2016-11- 003	Information communication technologies for management of natural resources	15
9	Visakha. T 2016-11-039	Organic farming and smallholder farmers: opportunities and challenges	17
10	Roshni Thampi 2016-11-043	Women agripreneurship : prospects and challenges	19
11	Nagendra 2016-11-092	Massive Open Online Courses (MOOCs) in Agriculture	21

12	Ashwini T. 2016-11-093	Capacity Building for Agripreneurship: Methods and Techniques	23
Agricultural Meteorology			
13	Athira Ravindran 2016-11-093	Weather forecasting through indigenous technical knowledge	25
14	Navyashree S. 2016-11-119	Impact of climate change on food quality	27
Agricultural Microbiology			
15	Shilpa P. 2016-11-047	Bacteria mediated abiotic stress tolerance in plants	29
16	Reshma Francis 2016-11-065	Microbial pigments and their application	31
17	Fazeedhibinu Khaleel. T 2016- 11- 110	Endophytic microorganisms in plant disease management	33
18	Rima K. R. 2016-11-126	Rhizosphere engineering for enhancing sustainable plant ecosystem	35
Agronomy			
19	Nayana V. R. 2016-11-002	Deficit irrigation: Save each drop	37
20	Anitrosa Innazent 2016-11- 037	New Perspectives of Intercropping in Modern Agriculture	39
21	Akshatha V. 2016-11-045	Tillage system: a referee on weed seed bank	41
22	Abid V. 2016-11-048	Nutrient dynamics in aquaponics	43
23	Sreethu M.J. 2016-11-049	Resurrection plants: Survivors of drought	45
24	Jeen Shaji 2016-11-056	Salt tolerance mechanisms in plants	47

25	Santhiya K. 2016 - 11- 095	Sprouted fodder - A revolution in livestock feed	49
Department of Plant Biotechnology			
26	Midhuna M. R 2016- 11- 106	Stress management: cross- talk between membrane and storage lipids	51
27	Anushree Bachhar 2016-11-107	It's in the genes! - Unraveling plant resistance to insects	53
28	Athulya S. Nair 2016-11-108	Designer organelle: peroxisome and its application in biotechnology Abstract	55
29	Niranjana Menon C. 2016-11-109	Molecular mechanism of virus - vector interaction	57
30	Pooja S.J. 2016-11-111	Elicitation for *in vitro* secondary metabolite production	59
31	Faiza Mohamed 2016-11-112	Biotechnological interventions for artemisinin production	61
Department of Plant Breeding and Genetics			
32	Chakravarthi Marri 2016-11-015	Robotics in plant phenotyping	63
33	Megha L.M. 2016-11- 016	Passage through the plant circadian rhythm: Genetics decoded	65
34	Anju M. Job 2016-11-020	Molecular farming for plant made pharmaceuticals	67
35	Juby Baby 2016-11-042	Centromere mediated speciation-revisited	69
Department Of Plant Pathology			
36	Rahila Beevi M.H.2016-11-004	Climate change effects on plant pathogens : genomes to ecosystems	71
37	Stella Doncy P. P	Highways in the sky: atmospheric transport of plant pathogens	73

	2016-11-005		
38	Atheena Harish 2016-11-009	Plant virus detection : Progress and challenges	75
39	Aswathi M. S. 2016-11-018	Imaging sensors: a potential tool for detection of plant diseases	77
40	Divya Jayakumar V. J. 2016 - 11 - 117	Antiviral principles in plant disease management	79
Department of Plant Physiology			
41	Athira K. A. 2016-11- 069	Eco- physiological significance of Cryptogamae	81
42	Amjath .T 2016- 11-103	Photorespiration in plants – Boon or Bane	83
Department of Seed Science and Technology			
43	Athmaja S 2016-11-017	Longevity of recalcitrant seed: An enigma	85
44	Adersh S 2016-11-060	Automated computer imaging system- a boon to seed industry	87
45	Reshma P.K. 2016-11-083	Plasma treatment and seed quality	89
46	Bennett Thomas K 2016 - 11- 125	Biophysical stimuli : Insights on germination and seedling growth	91
Department of Soil Science and Agricultural Chemistry			
47	Nisha Paul 2016-11-010	Novel fertilizers for enhanced nutrient uptake	93
48	Shaniba M. 2016-11-011	Bio-intervention of silicate minerals – an alternative source of potassium	95
49	Sophia Baby 2016-11-041	Biological soil crust: a multifunctional principle in terrestrial ecosystems	97

50	Diya P.V. 2016-11-066	Land configuration for the management of waterlogged-saline soil	99
Department of Olericulture			
51	Remzeena A 2016-12-001	Pollination management in vegetable crops	101
52	Aruna S 2016-12-002	Recent trends in the genetic improvement of onion	103
53	Shilpashree N 2016-12-021	Breeding for nutritional quality improvement in vegetable crops	105
Department of Plantation Crops and Spices			
54	Shibana S. N. 2016-12-003	Adulterants in spices	107
55	Anila Peter 2016-12-006	Herbal spices as healers	109
56	Sreelekshmi S. 2016-12-007	Flavour chemistry of cocoa and cocoa products	111
57	Dharini Chittaragi 2016-12-027	Bio-colours from Spices	113
Department of Floriculture and Landscaping			
58	Priya Philip 2016-12-009	Value addition in rose: the blooming potential	115
59	Athira Baburaj 2016-12-013	Floral waste management	117
Department of Pomology			
60	Dhanyasree K. 2016-12-008	Rootstocks in fruit production: Making better the best	119
61	Lakshmi K.S. 2016-12-013	Flowering and fruiting cycle management in fruit crops	121
62	Amal Premachandran 2016- 12- 025	Less is better: Strategies and prospects of seedless fruits	123

63	Mohammed Murthala C. N. 2016-12-026	Role of Volatile Organic Compounds (VOCs) in fruit crops	125
Department of Processing Technology			
64	Archana Unnikrishnan 2016-12-005	Taste the diversity of fruit wines	127
65	Geethu M. 2016-12-014	Smart packaging for quality and safety	129
Department of Community Science			
66	Amitha Elias 2016-16-003	Food based strategies for polycystic ovary syndrome (PCOS)	131
67	Rammya Molu K. 2016-16-002	Modified starches and their applications	133

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agricultural Economics

AG ECON 591: Master's Seminar

Name : Reshma Sara Sabu

Admission No : 2016-11-046

Major Advisor : Dr. Anil Kuruvila

Venue : Seminar hall

Date :04-01-2018

Time : 9.15 a.m

Agricultural loan waiver in India - A paradox

Abstract

Loan waiver is the waiving of the real or potential liability of a person or party who has taken a loan. The first ever nation-wide farm loan waiver in India, the Agricultural and Rural Debt Relief Scheme (ARDR), was announced in 1990 by the National Front government and the cost of this scheme to the exchequer was Rs. 10,000 crore. Thereafter, on 29th February 2008, loan waiver of Rs.60,000 crore was given to farmersby the United Progressive Alliance government under the Agricultural Debt Waiver and Debt Relief Scheme (ADWDRS). In 2014, the governments of Telangana and Andhra Pradesh waived loans amounting to Rs. 17,000 crore and Rs. 22000 crore respectively, with the intention of providing support for farmers whose crops were severely damaged by the cyclone, 'Phailin'. Similar loan waivers of Rs.5,780 crore in Tamil Nadu during 2016 and Rs. 36,000 crore in Uttar Pradesh during 2017 were declared.

There were several shortfalls in the implementation of the ARDR scheme of 1990. It took several years for the banks to clear off the loan accounts, the farmers who repaid loans before implementation of the scheme felt cheated and the beneficiaries as well as the subsequent borrowers expected write-off from time to time. In the ADWDRS, the entire eligible amount was waived for small and marginal farmers and debt relief was given for 'other farmers' with more than 2 ha, in which 25 per cent of the eligible amount was rebated, if the farmer pays balance 75 per cent of the loan amount (GOI, 2008). This scheme did not address the indebtedness of 23 per cent households of the country having access to informal credit. Out of 9,334 accounts audited across nine states, it was found that 13.46 per cent accounts were eligible but not considered for the waiver. It was also found that out of the 80,299 accounts granted debt waiver and debt relief, 8.5 per cent of beneficiaries were ineligible for the scheme (CAG, 2013). The Non-Performing Assets (NPAs) of agricultural loans in banks reduced to two per cent in 2008-09, due of the clearing up of bank books by the government. But the NPAs in agriculture rose to about 5 per cent by 2011-12 due to moral hazard in the repayment behavior of farmers (RBI, 2017). Salve

and Biradar (2014) reported that there were regional disparities in the distribution of benefit of ADWDR scheme as well as reduction in credit flow.

In June 2017, there were agitations and protests by the farmers of Madhya Pradesh, Maharashtra and Tamil Nadu due to fall in price of the agricultural commodities, liquidity issues related to demonetization and ban on cattle trade. Consequently, the farmers of these states demanded loan waivers and with the exception of Madhya Pradesh, all other state governments succumbed to this demand.

Loan waivers are temporary solution for the persisting agrarian distress in India. Moreover, it will affect the credit discipline and the national balance sheet. A better alternative to loan waiver is restructuring and rescheduling of the loans. The root causes of agrarian distress need to be addressed at the farm level which calls for proper administration of Minimum Support Price, better coverage of crop insurance across states and farmers, promoting the use of warehousing facilities and warehouse receipts as negotiable instruments for getting credit and strengthening of market intelligence and ICT enabled extension services.

References

CAG [Comptroller and Auditor General of India]. 2013. Report of Comptroller and Auditor General of India on Implementation of Agricultural Debt Waiver and Debt Relief(ADWDR) Scheme, 2008 [on-line]. Available: http://cag.gov.in/sites/default/files/audit_report_files/Union_Performance_Civil_Sector_3_2013.pdf [4 Dec. 2017].

GOI [Government of India]. 2008. Agricultural and Rural Debt Relief (ADWDRS) scheme [on-line]. Available:http://financialservices.gov.in/sites/default/files/DebtWaiverScheme2008_0.pdf [10 Dec. 2017].

RBI [Reserve Bank of India]. 2017. Lessons from Agricultural Debt Waiver and Debt Relief (ADWDRS) Scheme of 2008 [on-line]. Available: https://rbidocs.rbi.org.in/rdocs/content/pdfs/Dr.%20R.%20Ramakumar_Paper(31082017).pdf) [20 Nov. 2017].

Salve, T. N. and Biradar, J. P. 2014. An Impact of Government's Agricultural Debt Waiver and Debt Relief (ADWDR) Scheme. *J. Commerce Manag. Thought* 5: 635-643.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agricultural Economics

G ECON 591: Masters' Seminar

Name : Athira. E

ID No : 2016-11-057

Major Advisor : Dr. K.Jesy Thomas

Venue : Seminar hall

Date : 09/11/2017

Time : 9.00 A.M

Demonetization and its impact on Indian agriculture

Abstract

Demonetization can be defined as "the act of stripping off the currency unit of its status as legal tender". Demonetization was introduced in India on 8th November, 2016, with immediate withdrawal of high value denominations (500 and 1000 rupee notes) as legal tender" (Basu, 2016). It was mooted as a move to unearth black money, remove counterfeit currency from circulation and to prevent terror financing. The demonetization experiments have been conducted across many countries in the world with the objectives of controlling inflation, curbing black money and black marketing, fighting against organized crime, preventing counterfeiting, fighting corruption, managing banking crisis and financing fiscal deficit.

As a result of demonetization Rs. 15.28 lakh crore of the high-value currency returned to the banking system. This is around 99 per cent of the total value of the withdrawn currency at the time of demonetization (RBI 2017).The recent politico-economic experiment of demonetization has left a deep impression on the socio-economic activities of all the economic agents in the economy as well as sectors. This has resulted in increase in deposits of savings and current accounts of commercial banks which could be utilized further for lending purposes. Demonetization has thus enhanced the cash flow for the banks and markets.

The shortage of cash has led to a decline in demand and there was disruption in production activity due to temporary loss of work in the unorganized sector. This has resulted in a decrease

in production leading to a fall in GDP growth(GOI 2017).Share prices of cash intensive sectors such as automobiles and real estate declined sharply in November and December 2016. There has been a significant improvement in the use of digital modes of payments post demonetization.

Demonetization can affect agriculture directly in four ways. These include area sown, crop pattern, productivity and market. The trend and pattern in sowing and marketing of crops during the period following the announcement of demonetization provide useful indications to discern effect of demonetization on agriculture sector (Chand and Singh, 2017). As a result of demonetization there were disruptions and breaks in the supply chains which resulted in reduction in sales of agricultural goods. This move has the potential of bringing about transformational changes in the long run like better access to credit for farmers, elimination of middlemen, and direct transfer of subsidies to farmers and ultimately linking the Indian farmer to the global agricultural market.

References:

Basu, K. 2016. In India, Black Money Makes for Bad Policy. New York. Available: Times,http://www.nytimes.com/2016/11/27/opinion/in-india-black-money-makes-for-bad-policy.html?_r=0 [27 Nov.2017]

Chand, R. and Singh, J. 2017. Agricultural growth in aftermath of demonetization. http://niti.gov.in/content/agricultural-growthaftermath-demonetization [22 Oct 2017].

GOI [Government of India] 2017. Demonetization: To deify or demonize? Economic Survey. 2016-17; (4), 53-81.

RBI [Reserve Bank of India] 2017. Macroeconomic Impact of Demonetisation - A Preliminary Assessment, Reserve Bank of India, Mumbai, pp.30-38.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agricultural Economics

Ag Econ 591: Masters' Seminar

Name : Swathy Sugathan P.
Admission number: 2016-11-084
Major advisor : Dr. P. Indira Devi

Venue : Seminar hall
Date : 07/12/2017
Time : 11.30 a.m.

Water quality issues in Kerala: socio-economic dimensions

Abstract

Water is a prime necessity for the survival of life. Despite abundant rainfall and water bodies in Kerala, the per capita availability of water is less than that of national average and shows continuous decline. Coupled with that, there are worrying reports on quality threats. Water quality is mainly decided by the physical, chemical and biological parameters, the desirable limits of which are fixed by BIS (Bureau of Indian Standards) in India. If these parameters go beyond the permissible limit, it leads to an adverse effect on plants, animals and human beings(BIS, 2016).

Physical parameters of water quality are measured mainly through the colour, taste, odour and turbidity. However the appearance alone cannot be taken as indication of good quality. Chemical dimensions of water quality are measured mainly by the concentration of elements like fluoride, iron, arsenic, chloride, nitrate and heavy metals. In Kerala, fluoride content was detected above the permissible limits in Palakkad and Alappuzha districts. Fluorosis is the major health problem due to fluoride contamination (Karthick *et al.,* 2010).

Biological contamination, which is more commonly reported, is due to the presence of bacteria, virus, protozoa and algae, beyond the permissible levels. Diarrhoea, pneumonia, cholera, typhoid, hepatitis and gastrointestinal illness are the diseases associated with biological contamination. Raj and Kumar (2014) reported high level of coliform bacteria from Thiruvananthapuram district. Around 45,000 diarrhoeal cases are also been reported in 2016. Water related health damages often scale up to community level and are often reported from lower economic strata. The social cost for the population associated with such diseases are reported as high as Rs. 16.49 crores (Dasguptha, 2007).

There are several reports of contamination of water bodies in the state. The rivers are affected by pollutants from domestic, industrial and agricultural sectors. Periyar and Chaliyaar rivers are polluted due to industrial effluents. Almost 260 million litres of industrial effluents are dumped into the rivers every day. Heavy metals like mercury, copper, zinc, and lead were detected in the river water. Chalakkudy, Periyar, Muvattupuzha, Meenachil, Pampa and Achenkovil rivers are polluted mainly because of bacterial contamination (Chakrapani, 2014).

Government of Kerala has taken up water quality monitoring programmes since 2000 in 128 stations through the Kerala State Council for Science, Technology and Environment (KSCSTE) and Centre for Water Resources Development and Management (CWRDM). The programmes facilitate the efforts to check the level of pollution.

Water quality concerns gain more significance in an era of water scarcity and fast economic development. The efforts to address the issue may be taken up at domestic and society levels through legal and policy mechanisms. Proper waste management forms the basis of the approach.

References

BIS [Bureau of Indian Standards] 2016. *Drinking Water Specifications*[on line]. Available: http://www.bis.org.in/sf/fad/FAD25(2047)C.pdf [18 Nov 2017].

Chakrapani, R. 2014. *DomesticWater and Sanitationin Kerala: A Situation Analysis*. Forum for Policy Dialogue on Water Conflicts, Pune,89p.

Dasguptha, P. 2007. Valuing health damages from water pollution in urban Delhi, India: a health production function approach. PhD (Econ.) thesis, Jawaharlal Nehru University, New Delhi, 249p.

Karthick, B., Boominathan, M., Ali, S., and Ramachandra, T.V. 2010. Evaluation of the quality of drinking water in Kerala state, India. *Asian J. Water Environ. Pollut.* 7: 39-42.

Raj, D. and Kumar, R.B.B. 2014. Judgement of ground water quality around Trivandrum civil station, Kerala, India: a GIS based approach. *Nat. Env. Pollut. Tech.* 14: 157-160.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agricultural Economics

Ag Econ591: Master's Seminar

Name	: Athira B.	Venue	: Seminar Hall
Admission No	: 2016-11-091	Date	: 09/11/2017
Major Advisor	: Dr. Chitra Parayil	Time	: 11.15 A M

Fertilizer policies and pricing of NPK fertilizers in India

Abstract

Fertilizer is one of the major inputs used in the agricultural production process.Total fertilizer consumption in India was found to be about 85.98 million tonnes. So the per hectare consumption of fertilizer in India is found to be 144 kg. This is less when compared to other countries (GOI, 2015).

In an agrarian economy like India, government plays vital role in the development of agriculture sector in the form of input subsidies like fertilizers, seeds, electricity, irrigation, credit etc. For sustained agricultural growth and to promote balanced nutrient application, it is imperative that fertilizers are made available to farmers at affordable prices. With this objective, urea being the only controlled fertilizer, is sold at statutory notified uniform sale price, and decontrolled Phosphatic and Potassic fertilizes are sold at indicative maximum retail prices (MRPs). The difference between the cost of production and the selling price/MRP is paid as subsidy/concession to manufacturers (GOI, 2015).

Several policies have been attempted by the government of India in the fertilizer sector starting from the 1940s. These timely and effective policies have made India one among the largest producers and consumers of fertilizer in the world. In future, some changes like subsidy intervention from the input side may improve the policy regime, since the availability of the feed stocks and raw materials are the major constraints faced by the industry.

Major problems faced by the fertilizer industry in India are price difference between phosphatic and pottasic fertilizers, gross under-budgeting for the fertilizer subsidy in the successive Union Budgets, imbalanced use of fertilizers*etc.* subsidy leakage is another major issue i.e., out of total allocation of subsidy to the fertilizer sector, only 35 per cent reaches the small farmers (Sharma,2009).This issues are solved by different Government policies like decanalization, rationalization of fertilizers *etc*. (FAI, 2014)

Over the years the policy makers in India have adopted a wide range of strategies to ensure supply of fertilizers equitably by providing it at an affordable price. The major fertilizer policies implemented, including the retention price scheme, decontrol of prices, nutrient based pricing, nutrient based subsidy etc., could not ensure a steady balanced use of fertilizers. Hence it is important to trace the evolution of fertilizer policies and suggest some measures to improve the overall availability at affordable prices and at the right time to the farmers of our country.

References

FAI [Fertilizer Association of India]. 2008. Fertilizer Statistics 2007-08 and earlier issues [on-line] Available:https://aijsh.com/shop/articlepdf/2017/09/15042513842abstract.pdf [7 Sept. 2017].

GOI [Government of India]. 2015. Subsidy on food and agriculture [on-line]. Available: www.indiastat.com/.../subsidy/.../subsidyonfoodandagriculture19762015[1 Nov. 2016].

Sharma, V.P. and Thaker, H. 2009. *Fertilizer subsidies in India: Who are the beneficiaries* [on-line].Indian Institute of Management, Ahmadabad working paper series no. 2009-07-01. Available:www.iimahd.ernet.in/publications/data/2009-07-01Sharma.pdf[01 Nov. 2016].

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agricultural Entomology

ENT. 591 Master's Seminar

Name : Nimisha T. Venue : Seminar Hall

Admission No. : 2016-11-019 Date : 17-11-2017

Major Advisor : Dr. Deepthy K.B. Time : 10.45 A.M.

Nanotechnology applications in insect pest management

Abstract

Feeding the ever growing human populations is a great challenge today which is further complicated by concerns about the risks of environmental pollution and human health associated with conventional pesticides. The indiscriminate use of pesticides has created an array of problems like pesticide residue in food, resistance development in pests and above all several health hazards to human beings and animals. Among the recent technological advancements, nanotechnology shows considerable promise to combat this challenge. Problems such as harmful solvents, poor dispersion, and drift losses. can be very well addressed by nanotechnological interventions.

Nanotechnology is defined as the branch of science which deals with the characterization, fabrication and manipulation of materials at nano scale *ie*., 1-100 nm (Hanford *et al*., 2014). It has wider application in various fields such as pharmaceutical industries, information technology and agriculture. Revolutionary changes in agriculture was made with the introduction of nanofertilizers, nanopesticides and nanosensors which improved crop production, resource utilization efficiency, safer application of pesticides and detection of pesticide residue. Nanopesticides are developed either through directly processing into nanoparticles or by loading pesticides with nano carriers in delivery systems (Ghormade *et al*., 2011). Important nanoformulations include nanoparticles, nanoemulsion, nano encapsulation and nanogel. The treatment of hydrophobic silica nanoparticles (SNPs) with the seeds of pulse crops like red gram, *Cajanus cajan* (L.) Millsp. horse gram, *Macrotyloma uniflorum* (Lam) Verdc. and black gram

Vigna mungo (L.) Hepper aginst pulse beetle, *Callosobruchus maculates* (Fab.) infestation revealed a significant reduction in oviposition, and adult emergence (Arumugam *et al*., 2016). Higher mortality to *Plutella xylostella* (Linn.) was obtained when nanoparticles are used as carriers with extracts of *Azadirachta indica* A. Juss. (Forim *et al*., 2013). Nowadays, pesticide residue detection is a major concern of consumers and food safety experts and a rapid pesticide residue detection method is very much essential. Recent research conducted by Verdian, 2017 developed an aptamer (an oligonucleotide) based nanosensor (aptasensor) for the residue estimation of acetamiprid.

As far as pest management is concerned, these novel nano agricultural products will provide multiple benefits such as reduced use of chemical pesticides, lower environmental pollution and pesticide residual contamination in food and other commodities.

References

Arumugam, G., Velayutham, V., Shanmugavelu, S. and Sundaram, J. 2016. Efficacy of nanostructured silica as a stored pulse protector against the infestation of bruchid beetle, Callosobruchus maculatus (Coleoptera: Bruchidae). *Appl. Nanosci*. 6: 445-450.

Forim, M., Costa, E., Silva, M., Fernandes, J., Mondego, J. and Junior, A. 2013. Development of a new method to prepare nano / macroparticles loaded with extracts of Azadirachta indica their characterization and use in controlling *Plutella xylostella*. *J. Agric. Food Chem*. 61: 9131-9139.

Ghormade, V., Deshpande, M.V. and Paknikar, K.M. 2011. Perspectives for nano-biotechnology enabled protection and nutrition of plants. *Biotechnol Adv*. 29: 792-803.

Handford, C.E., Dean, M., Henchion, M., Spence, M., Elliot, C.T. and Cambell, K. 2014.Implication of nanotechnology for the agri-food industry: Opportunities, benefits and risks. *Trends in food sci. technology* 40: 226-241.

Verdian, A. 2017. Apta-nanosensors for detection and quantitative determination of acetamiprid-a pesticide residue in food and environment. *Talenta*. 35: 456-464.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agricultural Entomology

ENTO. 591: Masters' Seminar

Name : Shahanaz M. R.

Admission No. : 2016 - 11 – 036

Major advisor : Dr. Berin Pathrose

Venue : Seminar hall

Date : 22/12/2017

Time : 10.00 a.m.

Egg dumping: survival mechanism in insects

Abstract

Egg dumping is a term that was originally used to describe the behaviour of females laying eggs in others' nest. Dumping of egg by cuckoo in crow's nest is a classical example. Egg dumping behaviour is not restricted to birds alone. A number of organisms such as amphibians, fishes and insects display egg dumping behaviour. Egg dumping in insects differs from avian egg dumping in being facultative and intraspecific in nature.

Egg dumping involves two factors, namely dumping and guarding. Egg dumper places eggs under the care of conspecifics while egg guarder ends up protecting own eggs as well as that of dumper. Examples of egg dumping in insects includes the lace bug (*Gargaphia* sp.), the burying beetle (*Nicrophorus* sp.), the golden egg bug (*Phyllomorpha laciniata)*, tree hoppers, subsocial bees and wasps.

Egg dumping contributes to the fitness of the dumper, as it saves time and energy in guarding the eggs. It is also often beneficial to the guarder in reducing the chances of predation of the dumpers eggs. Such mutualistic egg dumping is exemplified in the lace bug *Gargaphia* sp. (Loeb, 2002). Egg dumping in the golden egg bug *Phyllomorpha laciniata,* however, is more of parasitic in nature (Kaitala *et al*., 2000). On the other hand *Gargaphia sp.* display kin selection in egg dumping (Loeb *et al*., 2000), which is considered as an evolutionary stepping stone to eusociality.

Egg dumping and guarding in the lace bug, *Gargaphia solani* can be manipulated by the exogenous application of juvenile hormones (JH) (Tallamy *et al*., 2002). High JH promotes egg production and egg dumping behaviour, while low JH titre terminates egg production and initiates maternal care.

Another form of egg dumping is observed in seed beetles, *Callosobruchus maculatus* (F.), where they lay their eggs on unsuitable substrates, if preferred hosts are not available. This helps the insects to enhance their chances of survival and also to expand their host range. Tendency to dump eggs varies genetically within and between populations of *C. maculatus* (Messina and Fox, 2011).

Several factors influence egg dumping. Nest architecture, nest aggregation, synchronous reproduction and maternal care in most of the insects, more often than not, serve as limiting factors for egg dumping. This could be why, in spite of its apparent benefits, egg dumping is few among insects.

References

Kaitala, A., Espadaler, X., and Lehtonen, R. 2000. Ant predation and the cost of egg carrying in the golden egg bug: experiments in the field. *Oikos.* 89: 254–258.

Loeb, M. L. G., Diener, L. M., and Pfennig, D. W. 2000. Egg dumping lace bugs preferentially oviposit with kin. *Anim. Behav.* 59: 379–383.

Loeb, M. L. G. 2002. Evolution of egg dumping in a subsocial insect. *Am. Nat.* 161: 129-142.

Messina, F. J. and Fox, C. W. 2011. Egg-dumping behaviour is not correlated with wider host acceptance in the seed beetle *Callosobruchus maculatus* (Coleoptera: Chrysomelidae: Bruchinae). *Ann. Entomol. Soc. Am.* 104(4): 850–856.

Tallamy, D. W., Monaco, E. L., and Pesek, J. D. 2002. Hormonal control of egg dumping and guarding in the lace bug, *Gargaphia solani* (Hemiptera: Tingidae). *J. Insect Behav.* 15: 467-475.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agricultural Entomology

ENT. 591 Master's Seminar

Name : Kavya Yadav G. A.

Admission No. : 2016-11-120

Major Advisor : Dr. Haseena Bhaskar

Venue : Seminar Hall

Date : 22-12-2017

Time : 11.30 a.m.

Insects as bioindicators - doomsayers on six legs?

Abstract

A bioindicator is any species or group of species whose function, population or status can reveal the qualitative status of the environment in which they live. A wide range of species are known as potential bioindicators in both aquatic and terrestrial ecosystems (Burger and Gochfeld, 2001). Insects are the most widely used bioindicators, as they are more severely and quickly affected by changes in the ecosystem than other taxa.

Insects respond to environmental changes by altering their morphology, physiology and histology. Osman *et al*. (2015) reported a decrease in population density, reduction in body weight as well as deformation of gonads and alimentary canal in *Blaps polycresta* (Coleoptera: Tenebrionidae) due to cadmium pollution in soil.

Insect bioindicators can be grouped into three categories *viz*., environmental, ecological and biodiversity indicators. Environmental indicators detect the anthropogenic impacts on the environment. A study conducted at Pala municipality, Kottayam district revealed the potential of Odonata as a bioindicator of water quality, as indicated by the highest species richness in areas with highest water quality index (Jacob and Manju, 2016). On the other hand, presence of *Chironomus* larvae in Ayad river, Udaipur, in large numbers indicated contamination with sewage (Rawal, 2014).

Ecological indicators indicate the impact of habitat disturbances and fragmentation on biota. Species richness, abundance and biomass of termites declined from protected forest to urban area as a result of land use intensification in Java, Indonesia (Pribadi *et al*., 2011). Biodiversity indicator is a group of taxa, whose diversity reflects the diversity of other taxa in

a habitat. Thus, diversity of Ithomiinae (Nymphalidae) indicates the diversity of other forestdwelling neotropical butterflies (Beccaloni and Gaston, 1995).

The diversity and abundance of natural enemies and pollinators can be good indices reflecting the ‘healthiness’ of agro-ecosystem services. Exposure of honey bees to residues of neonicotinoids, one of the widely used insecticides, was reported to cause colony collapse disorder at Boston, USA (Lu *et al*., 2014).

Indicator insects can provide early warning of environmental damage. However, a strong understanding of insects’ responses to environmental disturbances is necessary to evaluate the consequences on ecosystems.

References

Beccaloni, G. W. and Gaston, K. J. 1995. Predicting species richness of neotropical forest butterflies-Ithomiinae (Lepidoptera: Nymphalidae) as indicators. *Biol. Conserv*. 71: 77 - 86.

Burger, J. and Gochfeld, M. 2001. On developing bioindicators for human and ecological health. *Environ. Monit. Assess*. 66: 23 - 46.

Jacob, S. and Manju, E. K. 2016. Potential of Odonate (Dragonflies and Damselflies) diversity as a bioindicator of water quality. *Int. J. Sci. Res*. 5(7): 2033 - 2036.

Lu, C., Warchol, K. M., and Callahan, R. A. 2014. Sub-lethal exposure to neonicotinoids impaired honey bees winterization before proceeding to colony collapse disorder. *Bull. Insectolo.* 67(1): 125 - 130.

Osman, W., El-Samad, L. M., Mokhamer, EL-H., El-Touhamy, A., and Shonouda, M. 2015. Ecological, morphological, and histological studies on *Blaps polycresta* (Coleoptera: Tenebrionidae) as biomonitors of cadmium soil pollution. *Environ. Sci. Pollut. Res*. 22: 14104 - 14115.

Pribadi, T., Raffiudin, R., and Harahap, I. K. 2011. Termites community as environmental bioindicators in highlands: a case study in eastern slopes of Mount Slamet, Central Java. *Biodiversitas* 12(3): 235 - 240.

Rawal, D. 2014. Ecological analysis of *Chironomus* larvae (Diptera: Chironomidae) collected from Ayad river in Udaipur city. *Int. J. Fauna Biol. Stud*. 1(5): 20 - 21.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agricultural Extension

Extn. 591: Masters' Seminar

Name	: T. P. Anseera	Venue	: Seminar hall
Admission No.	: 2016-11- 003	Date	: 15/12/2017
Major Advisor	: Dr. Jiju P. Alex	Time	: 11.30 a.m.

Information communication technologies for management of natural resources

Abstract

Deterioration and depletion of natural resources of developing countries which are being attributed mostly to the resource intensive development paradigm have become key concerns of our times. In this context, management of natural resources sustainably is considered to be the most important intervention to deal with degradation of productive lands, shrinking of forests, diminishing supplies of clean water, depletion of fish resources and alarming increase in carbon emission.

Interventions to facilitate sustainable management of resources are information intensive and require careful management of data and information (Tongia *et al*., 2005).The complex nature of environmental systems and the socio-political dimensions involved in managing them have triggered wide use of Information Communication Technologies (ICTs). ICTs have the potential to improve the accessibility of environmental information. If properly applied, ICTs would be able to empower local people to make informed decisions regarding environmental issues, thus ensuring sustainable management of natural resources (Emmanuel and Lwoga, 2007).

Ranging from worldwide interventions to local level applications,ICTs for natural resource management (NRM) involve sophisticated information systems, remote sensing, Geographic Information System (GIS), simulation tools and educational tools. For instance, remote sensing and GIS have been found to be highly beneficial for creating spatio-temporal information that can be applied in flood plain mapping, urban development, land use change analysis, wildlife and vegetation tracking, wildfire detection and fire risk zone mapping (Kingra *et al*., 2016).

Several models of ICT enabled natural resource management experiences have been reported from across the world. The Forestry and Natural Resources Desktop Reference

Library (DRL) is a web-based, distance learning and information resource project developed to facilitate the transfer of research-based information on forest resource management (Bardon, 2003). Though differently employed, ICTs in marine fisheries sector could help to gain considerable insights into the behavioural pattern of marine ecosystems and have changed the conventional fishing perception into responsible fishing in Europe (EMCC, 2003). There are also ICT applications to manage river ecosystems as in the case of the MekongInfo in Southeast Asia. In Australia, water resources are managed by the Australian Water Resource Information System (AWRIS), which has provisions to forecast stream flows, assess water data and water status. In Kerala, the Land Use Board has developed a Land Resource Information System (LRIS) for delientation of various land forms and monitoring the changes in land use pattern.

Even though there are a large number of such applications, societal interface of these technologies is still in a stage too early to facilitate local level interventions. A robust ICT program should improve the knowledge and wisdom of communities to manage their natural resources scientifically with a futuristic perspective. Easy access to information on natural resources by the common man through grassroots level institutions must be an essential feature of any ICT application for sustainable NRM.

References

Bardon, R. E. 2003. Providing Knowledge at the Click of a Mouse: Forestry and Natural Resources Desktop Reference Library. *J. Ext.* 41: 53-57. Avaliable: http://www.joe.org/joe/2003june/3tot2.php [25Oct. 2017].

EMCC [European Monitoring Centre for Change] 2003. *ICT driving change in the fishing industry: a review of the years 1990-2002* [on-line]. Available: http://eu.emcc.y.fishtech/review-y1990-2002 [20 Nov. 2017].

Emmanuel, G. and Lwoga, E. T. 2007. Information Communication Technologies (ICTs) for environmental conservation: challenges for developing countries. *Univ. Dar es salaam Libr. J.* 9(2): 20-39. Available: http://dx.doi.org/10.4314/usdlj-v9i2.26665 [18Nov. 2017].

Kingra, P. K., Majumder, D., and Singh, S. P. 2016. Application of remote sensing and GIS in agriculture and natural resource management under changing climatic conditions. *Agric. Res. J.* 53(3): 295-302.

Tongia, R., Subrahmanian, E., and Arunachalam, V. S. 2005. *Information and Communications Technology for Sustainable Development.* AlliedPublishers, Bangalore, 229p.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agricultural Extension

Extn.591: Master's Seminar

Name	: Visakha.T	Venue : Seminar Hall
Admission No	: 2016-11-039	Date : 14/12/2017
Major advisor	: Dr. Jayasree Krishnankutty	Time : 11.30 A.M.

Organic farming and smallholder farmers: opportunities and challenges

Abstract

Agriculture is the principal source of livelihood for more than 58 per cent of Indian population. As per the economic survey 2015-2016, the sector shares17.4 per cent of Gross Domestic Product (GDP).

Organic farming stands for an ecologically managed production system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on the minimal use of off-farm inputs and relies on management practices that restore, maintain and enhance 'ecological harmony' (USDA, 1995).

The initiation of organic farming starts from 1940 onwards all over the world,because of the understanding that this practice had no side effects and is in harmony with nature too. Ramesh *et al.* (2010) observed that by opting for organic farming instead of conventional farming, cost of cultivation can be reduced and net returns can be increased.

Smallholder is a marginal or sub marginal farmer who owns or cultivates less than 2 hectares of land(Agriculture Census, 2010-2011). Government of Kerala defined smallholder farmers as those who own less than 1 acre. They are characterised by family focused motives such as favouring the stability of the farm household system, using mainly family labour for production and using part of the produce for family consumption.

Gupta, (2015) pointed that no organic farmer has ever committed suicide in India and smallholders who take to organic farming are stably able to save their crops, despite vagaries of the weather and market instability.

The most ambitious programme undertaken by government of India as a step towards attainment of sustainable agriculture is National Mission on Sustainable Agriculture. It had a budget outlay of Rs. 130 billion in 12^{th} five-year plan (2012-2017) which constitute about 11 per cent of the total agricultural budget of the country. It is small civil society and farmer lead initiative that is keeping the organic or sustainable agriculture movement alive.One such initiative is led by the Organic Farming Association ofIndia (OFAI).Some of the ongoing programmes for promoting organic farming are Paramparagat Krishi Vikas Yojana (PKVY), Mission for Integrated Development of Horticulture, National Project on Management of Soil Health and Fertility (NPMSHF) and Rashtriya Krishi Vikas Yojana (RKVY) (NPI, 2017).

Benefits of organic farming in the context of small holders were biodiversity conservation, soil protection, energy efficiency, high environmental resilience against climate change, poverty reduction, providing price premium. Difficulties incurred in nutrient management, certification and market barriers, low access to market and low yield are the major challengesof smallholder organic farmers (Jouzi *et al.*, 2017).

Success stories of smallholder organic farmers around world are attaining much attention in the society and this motivates more persons to engage in organic farming, as a step towards sustainability. Research and policy should be tailored considering the opportunities and challenges of smallholders in organic farming.

References

Gupta, A. 2015. India: A smallholder's world- saving crops with organic farming. [On-line]. Available:http://www.welthungerlife.de/blog/india-smallholders-world-organic farming/amp/ [5 Nov 2017].

Jouzi, Z., Azadi, H., Fatemeh,T., Kiumars, Z., Kindeya, G., Stevan, V.P., and Philippe, L. 2017. Organic farming and small-scale farmers: Main Opportunities and challenges. *Ecological Econ*.132:144-154.

NPI [National Portal of India] 2017. NIP home page [on-line]. Available:https://www.india.gov.in. [07 Nov 2017].

Ramesh, P., Panwar, N.R., Singh, A.B., Ramna, S., Sushil, K.Y., Rahul, S., and Subba, R.2010. Status of organic farming in India. *Curr. Sci.* 98(9): 1190-1193.

USDA [United States Department of Agriculture]. 1995. USDA homepage [on line]. Available: http://www.nal.usda.gov. [18 Nov 2017].

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agricultural Extension

Extn 591 : Masters' Seminar

Name	: Roshni Thampi	Venue : Seminar Hall
Admission No.	: 2016-11-043	Date : 7-12-2017
Major Advisor	: Dr. Mercykutty M.J.	Time : 10.45 A.M.

WOMEN AGRIPRENEURSHIP : PROSPECTS AND CHALLENGES

Abstract

In India, women constitute nearly 50 per cent of the population, perform two-thirds of the work and produce 50 per cent of commodities. But they earn only one-third of remuneration and own only 10 per cent of the wealth (Singh, 2013). As per the UNDP report (2013), India ranks 132nd in Gender Development Index (GDI) among 187 countries. Thus women empowerment is a prerequisite for growth and development of our economy.

Entrepreneurship has been visualized as one of the strategic development interventions to accelerate the development process in India. Agripreneurship is the practice of entrepreneurship in agricultural sector. Considering that two-thirds of the Indian population is employed in the agricultural sector, agripreneurship development is imperative for generating employment in the country. Also it has the potential to generate growth, diversify income, provide widespread employment and foster entrepreneurship opportunities in rural India (Bairwa *et al.*, 2014).

Government of India has been actively undertaking promotion of women entrepreneurs through various schemes, incentives and promotional measures. Gender mainstreaming started from the 6th five year plan onwards. Some of the ongoing centrally sponsored women empowerment programmes are Support to Training and Employment Programme for Women (STEPW), Rashtriya Mahila Kosh (RMK), Mahila Samridhi Yojana (MSY), National Mission for Empowerment of Women (NMEW), Trade Related Entrepreneurship Assistance and Development scheme for women (TREAD), Startup India scheme, Standup India scheme, Agri-clinic and Agri-business centres scheme (ACABC) and Pradhan Mantri Mahila Shakti Kendra scheme (PMMSK).

Major motivational factors influencing women to join agripreneurship are innovative ideas, abundant resources, market demand for specific products/services, willingness to help farming community, improvement in living standards, desire for empowerment and as an avenue for independence (Goswami and Thakur, 2015).

The emerging areas for women agripreneurship are agro food manufacturing units, horticultural processed products, input management and agro-service centres, agro-forestry based products, agri-tourism business, agri-clinics and agri-business centres. Many women agripreneurs are doing successfully in the areas of their choice.

Some of the national institutions promoting agripreneurship are EDI, IIE, MANAGE, SFAC, CIWA, MUDRA bank, NABARD, SIDBI and MSME. In Kerala Kudumbashree Mission, DICs, KSWDC, KIED and KAU are also doing lot of promotional activities.

Women who manage to start ventures have been cited as having challenges at the growth stages such as inadequate working capital, poor technical and managerial skills, lack of marketing techniques, lack of basic infrastructure, hostile business environments, poor project planning skills and lack of information on the available assistance programmes (Rathna *et al.*, 2016).

Women agripreneurship development leads to the empowerment of women in many ways such as socio-economic opportunities, property rights, political representation, social equality, personal right, family development, market development, community development and at last the development of national economy as a whole (Bairwa *et al.*, 2015).

References

Bairwa, S. L., Kushwaha, S., Meena, L. K., and Kumar, P. 2014. Agripreneurship development as a tool to upliftment of agriculture. *Int. J. Sci. Res. Publ*. 4: 1-4.

Bairwa, S. L., Singh, U. P., Kumar, P., and Roy, R. 2015. Women empowerment through women agripreneurship development in India. *Ann. Agri-Bio Res*. 20(1): 66-70.

Goswami, P. and Thakur, Y. S. 2015. Women entrepreneurship in micro, small and medium enterprises in India. *Int. J. Manag. Social Sci.* 3(7): 635-647.

Rathna, C., Badrinath, V., and Siva, S. C. 2016. A study on entrepreneurial motivation and challenges faced by women entrepreneurs in Thanjavur district. *Indian J. Sci. Technol*. 9(27): 1-10

Singh, A. P. 2013. Strategy for developing agripreneurship among farming community in Uttar Pradesh, India. *Academica: An Int. Multidiscip. Res. J.* 3:1-12.

UNDP [United Nations Development Programme] 2013. *Human development report 2013*. [on-line].Available:http://hdr.undp.org/sites/default/files/reports/14/hdr2013_en_complete.pdf [10 Nov 2017].

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Dept. of Agricultural Extension

Extn. 591: Master's Seminar

Name	: Nagendra	Venue	: Seminar hall
Admission No.	: 2016-11-092	Date	: 17/11/2017
Major Advisor	: Dr. S. Helen	Time	: 10 : 00 a.m.

Massive Open Online Courses (MOOCs) in Agriculture

Abstract

Education is the foundation of any social system for the development of human resources. Technology has caused the fundamental changes in all aspects of our life, including the educational system. As technology developed as distance learning, in the information era online learning made education smooth and effective. As an improvement of online learning system, Massive Open Online Courses (MOOCs) took birth in 2008 from the University of Manitoba (Canada), to provide online courses with credit and certificate (Chatterjee and Nath, 2014). Aftermath of MOOCs will be a great revolution in higher education scenario.

MOOCs are online courses aimed at unlimited participation through internet devices that use traditional e-learning resources like video lectures, in-lecture quizzes, readings, weekly quizzes and assignments along with interactive user forums to clarify the concepts and enhance learning by providing a social learning experience to the students (Luaran, 2013).

In 1960s, the early establishment of Agricultural Universities in India contributed a lot in boosting agricultural growth of the country and brought about the integration of education, research and extension. But as time advanced Agricultural Universities became inefficient due to shortage of faculty, use of traditional method of teaching, obsolete resource material and poor communication skills (Tamboli and Nene, 2013). MOOCs are becoming more popular due to their ability to reach unlimited number of students free of cost or with very minimal cost. Most Agricultural Universities are yet to explore and exploit these opportunities to enable the students' access to research infused curricula and promote high quality faculty members.

India is the second largest participant after United States and the top private MOOCs provider Course area platform has more than ten million Indian participants (Malik, 2015).The 'Commonwealth of learning's (COL) analysis shows that other than the University of Florida, no other agricultural universitys offering the MOOCs on topics relevant to agriculture, so that India has a great opportunity in this regard (Murthy, *et al*., 2016). A few government agencies like ICRISAT, MANAGE, NAARM etc. initiated MOOCs in the agricultural sector.

Building skills, competencies and capacity of human resources on a mass scale is a matter of priority in addressing the multiple challenges facing Indian agriculture. Innovations in Information and Communication Technologies (ICTs) are playing an important role in bridging the digital divide and they could successfully be deployed for this purpose (Singh, 2012).

The stakeholders in the agriculture domain such as students, extension officials, faculty members, educated farmers, entrepreneurs can exploit the potential of MOOCs according to their area of interest. At the same time, we must be equipped to face the challenges probable in implementing MOOCs in the agricultural education system such as the digital divide, lack of infrastructure, dishonesty through online education etc. It is time that the potential of the MOOCs in Indian agriculture is explored, especially in the context of the strong knowledge-to-skill oriented approach.

References

Chatterjee, P and Nath, A. 2014. Massive Open Online Courses (MOOCs) in Education – A Case Study in Indian Context and Vision to Ubiquitous Learning. In : *Proceedings of the IEEE International Conference on MOOC, Innovation and Technology in Education (MITE)* 19-20 Dec. 2014, Patiala, Punjab. Available: https://www.researchgate.net/ publication/268207410. [9 Nov. 2017].

Luaran, J. E. 2013. *Massive Open Online Course (MOOC)*. i-Learn Centre, Universiti Teknologi, MARA. 148p. Available:http://i-learn.uitm.edu.my/v2/wp-content/uploads / 2015/03/Full-MOOCs-book.pdf. [19 Oct. 2017].

Malik, S. 2015. Indian MOOCs (Massive Open Online Courses): Need of the hour. *Int. J. Appl. Res.* 1(11):930-932.

Murthy, G. R. K., Rao, D. R., Raju, D. T., Aparna, M. S. and Sugur, A. 2016. MOOCs in Agricultural Education in India – Scope and Potential. *Indian J. Open Learn*. 25(1): 41-56. Available:http://journal.ignouonline.ac.in/iojp/index.php/IJOL/article/view/1267. [01 Nov. 2017].

Singh, K.P. 2012. Growth and development of agricultural education, research, and libraries in India. *DESIDOC. J. Lib. Inf. Technol.* 32 (1): 5-14.

Tamboli, P.M., and Nene, Y. L. 2013. Modernizing higher agricultural education system in India to meet the challenges of 21st century. *Asian Agri-History.* 17(3): 251-264.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agricultural Extension

Extn591: MASTERS' SEMINAR

Name : Ashwini T. **Venue : Seminar Hall**

Admission No : 2016-11-093 **Date : 21/12/2017**

Major Advisor: Dr. Binoo.P.Bonny **Time : 10.45 a.m.**

Capacity Building for Agripreneurship: Methods and Techniques

Abstract

India is an agro-based economy,where 61.5 percent of population dependon agriculture to earn their livelihood.Even though agriculture is the primary sector in the country, it is facing many challengesin achieving the improvementoffarming community.The major problems in agriculture sector include volatility of prices, occurrence of miss-match between the agricultural production and market demand.

Lack of technological support to address the production issue,would lead the producer to produce more than the self-sufficiency and distress continues.To matchthe agricultural production with market demand the solution lies in converting the produce in to the product.This is assured through the promotionof Entrepreneurship in agriculture called Agripreunership.

Entrepreneurship is the process of identifying existing opportunities and utilizing available resources to convert an idea into the form of a productto market(Ray,1981).It generates employment,createswealth,which results in reduction of poverty and economic development of a nation.It is being used as a toolby the Ministry of Skill development and Entrepreneurshipto harness the potential of the youth.The ministry launched schemes for the entrepreneurship development and provides education,training andskills throughEntrepreneurship Development Institutions(GOI,2014).

Agripreneurship is the process where farmer as an entrepreneur,who ispassionate about farming, is willing to take calculated risks and able to make their farmsprofitable(Kahan,2013).Agri-Institutions,Entrepreneurship Development Institutes

(EDIs)are involved in capacity building of agripreneurship through various methods and techniques including training,education and awareness programmes.

Agri Business Incubators are the Institutions which are designed to create an entrepreneur friendly atmosphere and to provide platform for speedy commercialization of the technologies of agriculture(Pandey *etal.,*2014).Start-Ups are newly emerged and rapidly growing businessunits aim to meet the market demand by offering an innovative product(Singh and Kaur, 2017).

Farmer producer organisations like Tejaswini in Kannur,Entrepreneurship Development Institute(EDI) in Kalamaserry,Small Farmers Agri-Business Consortium (SFAC)in Thiruvananthapuram are the institutions in Kerala engaged in promotion of entrepreneurship and development of entrepreneurial spirit in the state.

The main aim of these Institutions is to increase the efficiency of agripreneurs and strengthening the agripreneurship.They create platform for learning, to develop entrepreneurial knowledge,attitude and skill in agripreneurs. It results in establishment of entrepreneurial ecosystemand making agriculture as a profitable job.

References

GOI [Government of India] 2014. Available: https://www.india.gov.in/website-ministry-skill-development-and-entrepreneurship. [03 Nov. 2017].

Kahan, D. 2013. *Entrepreneurship in Farming*. Food and Agriculture Organization of United Nations, Rome, 136p. Available:E-ISBN 978-92-5-107548-7.pdf [03 Nov.2017].

Pandey, P.S., Ravishankar, C.N. and Singh, N. 2014. Capacity building for entrepreneurship development through business incubation. *Indian Farming* 64(2): 24-26.

Ray, G.L. 1981.*Extension Communication and Management,*Kalyani Publishers, Delhi, 358p.

Singh, H. and Kaur, M. 2017. Start-ups in India-retrospect and prospect. *Int. J. Comm. Manag.Res.* 3(3): 101-105.

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE, VELLANIKKARA
Department of Agricultural Meteorology
AGM 591: Masters' Seminar

Name	:	Athira Ravindran	Venue	:	Seminar hall
Admission No.	:	2016 – 11 – 070	Date	:	10/11/2017
Major Advisor	:	Dr. B. Ajithkumar	Time	:	9.00 am

Weather forecasting through indigenous technical knowledge

Abstract

Weather, in spite of all the technological advances, remains an imperative factor as far as agricultural production is concerned. Since time immemorial, people had started observing changes occurring in the weather and their surrounding environment. The knowledge base that have been created among the farmers as a result of the vulnerability caused by the vagaries of the weather, helps people to overcome uncertainty and prepare for possible unfavorable events (Shankar *et al*., 2008).

According to Greneirs (1998), indigenous technical knowledge (ITK) is the "unique, traditional, local knowledge that existed within and developed around specific conditions of men and women indigenous to a particular geographical area". Farmers and elder community members are the best sources of ITK. So it is important to record this knowledge before it become extinct because ITK are usually not documented.

Babylonians were among the first to note short term weather changes as early as 650 BC. During 300 BC Chinese astronomers had prepared calendars by dividing the year into 24 festivals, each representing different weather conditions. Another milestone was the book published by Aristotle named '*Meteorologica*' during 340 BC. In India, Upanishads had accounts of processes of cloud formation and rain. *Panchangs* were in use from 1400 BC. Varahamihira in his book '*Brihatsamhita'* and Kautilya in his book '*Arthasaastra'* mentioned about different meteorological parameters (Sivaprakasam andKanakasabhai, 2009).

Weather forecasting through ITK is largely based on biotic and abiotic methods. Abiotic indicators include those based on observations, theoretical calculations and planetary

configurations. Indication of fair weather by red eastern sky at night, indication of storm by red western sky at night, occurrence of rain followed by a hot sunny day are some of the observational methods of abiotic indicators. *Panchang* is an example of theoretical method. Common biotic indicators include animals, birds, insects and trees. Sparrows, swallows, and gray wagtails are the main birds which indicate rain. Insects like ants, termites, and dragon flies also indicate changes in weather by change in their activity pattern. In 2001, Kanani and Pastakia validated the ITK that *Cassia fistula* blooms fully before 45 days of the onset of monsoon.

Work has been conducted at the Department of Agricultural Meteorology, Kerala Agricultural University for documenting and validating different weather related ITK. Proverbs prevailing in Kerala related to rainfall, wind speed and temperature were collected through survey and documented.

Efforts are called for documenting and validating the available ITK before they are lost to us forever. ITK thus validated, could complement present scientific methods in ensuring more precise weather forecasts.

References

Grenier, L. 1998. *Working with Indigenous Knowledge : A Guide for Researchers*. International Development Research Centre, Canada. 82p.

Kanani, P. R. and Pastakia, A. 2001. Everything is written in the sky: Participatory meteorological assessment and prediction based on traditional beliefs and indicators in Saurashtra. *Eubios J.Asian. Int. Bioeth.*pp. 170-176.

Shankar, K. R., Maraty, P., Murthy, V. R. K., and Ramarishna, Y.S. 2008. *Indigenous Rain Forecasting in Andhra Pradesh.* Central Research Institute for Dryland Agriculture, Hyderabad. 75p.

Sivaprakasam, S. and Kanakasabhai, V. 2009. Traditional almanac predicted rainfall – A case study. *Indian J. Tradit.Knowl.*8(4):621-625.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agricultural Meteorology

AGM 591 Master's Seminar

Name : Navyashree S. Venue : Seminar hall

Admission no. : 2016-11-119 Date : 10-11-2017

Major advisor : Dr. B. Ajithkumar Time : 9.45 am

Topic: Impact of climate change on food quality

Abstract

Change of climate is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, in addition to natural climate variability observed over comparable time periods (UNFCCC, 2006). As agricultural production is going to be affected as a climate change consequence, it becomes quite important to examine the changes happening at different stages of crop growth and development and their impact on the production either in the form of quality or quantity.

Due to warming of the earth's system, the world is frequently experiencing many unprecedented changes in climate since the last five decades. Changes as well as various projections in current climatic variables was given in the fifth assessment report of Intergovernmental panel on climate change (IPCC, 2014).

Wheat, rice, and maize are the most widely grown food crops in the world. Production of these crops accounts for over 40 per cent of global cropland area, 55 per cent of non meat calories and over 70 per cent of animal feed (FAO, 2008). Elevated temperatures have been found to cause lower amylopectin content and decreased milled rice per cent and reduce dough quality in wheat. Protein synthesis has also been found to be negatively affected by elevated temperature.

Demands for fresh fruits and vegetables all over the world has been increasing day by day . There are evidences of variations in climate, between years and regions which can have a strong effect on horticultural production worldwide. Increases in the temperature decrease

cauliflower curd weight and also causes physiological disorders (Karthika, 2010). The study on performance of strawberry in different growing conditions showed that, the fruits harvested from high ranges had better appearance and colour compared to fruits obtained from central midlands (Kurian, 2012).

Poultry is the cheapest source of protein available for human consumption. Climate variation has become one of the major threats to poultry production. Elevated temperature showed an effect on body weight and feed gain of poultry (May *et al*., 1998). Milk being a very nutritious medium to almost all kinds of microorganism, gets spoiled very quickly when it is exposed to outside environment.

There are varied risks of climate change and thus there is a strong need for successful adaptation and mitigation strategies across different scales and dimensions of impacts depending upon crops and regions.

References :

FAO (Food Agriculture Organization), 2008. Climate-related Trans Boundary Pests and Diseases, Climate Change, Energy and Food, High Level Conference on Food Security; the Challenges of Climate Change and Bioenergy. Food and Agricultural Organization, UN, Rome.

IPCC (Intergovernmental Panel on Climate Change), 2014. Summary for policymakers. In: Stocker, T.F., Qin, D., Plattner, G.K., Tignor, M., Allen, S.K., Boschung, J., Nauels, A., Xia, Y., Bex, V., Midgley, P.M. (Eds.), Climate Change. 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Karthika, V. P. 2010. Crop weather relationship in cauliflower (*Brassica oleracea* var.*botrytis* L.) MSc(Ag) thesis , Kerala Agricultural University, Thrissur, 89p.

Kurian. 2012. Performance of strawberry (Fragaria x ananassa Duch.) in different growing conditions. MSc(Ag) thesis , Kerala Agricultural University, Thrissur, 77p.

May, J. D., Lott, B. D., and Simmons, J. D. 1998. The effect of environmental temperature and body weight on growth rate and feed: gain of male broilers. *Poultry sci*, *77*(4); 499-501.

UNFCCC (United Nations Framework Convention on Climate Change), 2006. Handbook. http://unfccc.int/resource/docs/publications/handbook.pdf.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agricultural Microbiology

MICRO591: MASTERS SEMINAR

Name : Shilpa P. Venue: Seminar Hall

Admission No : 2016-11-047 Date: 16/11/2017

Major Advisor : Girija D. Time: 11. 30 AM

Bacteria mediated abiotic stress tolerance in plants

Abstract

Plant abiotic stress refers to environmental conditions that reduce growth and yield below optimum level. Depending on the agro-ecological situation, abiotic stresses can be classified broadly as those of atmospheric origin(drought, extreme temperature, light stress) and of edaphic origin (salt stress, acidity, heavy metal toxicity and nutrient deficiencies) (Lal, 1987).

Imbalance of abiotic factors in the environment can cause primary and secondary effects on plants. Primary effects directly alter the physical and biochemical properties of cells which then lead to secondary effects.

Exploitation of plant-microbe interactions can result in the promotion of plant health and can play a significant role inlow-input sustainable agriculture. The plant growth promoting rhizobacteria (PGPR) that are used as biofertilizers,themselves act as bio-protectants against stress. Certain microbial species and/or strains enhance plant tolerance to abiotic stresses such as drought, salinity, nutrient deficiencies or excess (Yang *et al*., 2008), and high contents of heavy metals. Bacteria produce ACC deaminase, exopolysaccharides, volatiles and antioxidants and also enhance the production of plant growth hormones and expression of some genes such as ERD 15 and HKT1.

The most important mechanism in many bacteria that directly stimulates plant growth is the production of the enzyme 1-aminocyclopropane-1-carboxylate(ACC) deaminase. Under stress conditions, this bacterial enzyme facilitates the growth of plants by reducing the level of ethylene,thus making the plant more tolerant to stress conditions in the environment(Glick, 2005).

According to Manjesh (2016),*Pseudomonas fluorescens* was found to confer drought tolerance in rice (var. PTB 45). Three nitrogen fixing bacterial isolates obtained from Wayanad (*Paenibacillus, Microbacterium* and *Cellulosimicrobium*)were found to impart drought tolerance in tomato plants under pot culture conditions (AINP, 2017).

Introduction of specific genes responsible for the expression of particular enzymes like ACC deaminase from microbial species directly into crop plants has received great attention in the last few decades. However genetic manipulation of ACC deaminase trait in bacteria has not been much attempted (Glick, 2005).

With the gamut of information available on the abiotic stress mitigate potential of microbes, it is important to intensify research efforts so that their potential can be unearthed to the maximum and the power of these tiny creatures can be utilized for the benefit of mankind.

References

AINP [All India Network Project] 2017. *Annual Report* 2016- 2017. Kerala Agricultural University, Thrissur.

Glick, B.R. 2005. Modulation of plant ethylene levels by the bacterialenzyme ACC deaminase. *FEMS Microbiol. Lett.* 251: 1- 7.

Lal, R. 1987. Managing the soils of sub-Saharan Africa.*Sci*. 236:1069- 1076.

Manjesh, S. 2016. Validation of identified genes for water stress in rice (*Oryza sativa* L.) mediated by *Pseudomonas fluorescens*. MSc. (Ag) thesis, Kerala Agricultural University, Thirssur, 106p.

Sheehy R, E., Honma, M., Yamada, M., Sasaki, T., Martineau, B., and Hiatt, W. R. 1991. Isolation, sequence, and expression in *Escherichiacoli* of the *Pseudomonas* sp. strain ACP gene encoding 1-aminocyclopropane-1-carboxylate deaminase. *J.Bacteriol*. 173: 5260- 5265.

Yang, J., Kloepper, J. W., and Ryu, C. M. 2009. Rhizosphere bacteria help plants tolerate abiotic stress.*Trends Plant Sci*. 14:1- 4.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agricultural Microbiology

Micro 591: Masters' Seminar

Name	: Reshma Francis	Venue : Seminar Hall
Admission No.	: 2016-11-065	Date : 06/01/2018
Major Advisor	: Dr.Surendra Gopal	Time : 10.45AM

Microbial pigments and their application

Abstract

Food colour is an important indicator of freshness and safety. In recent years, colouring of food with pigments produced from natural sources is gaining worldwide interest.

Natural pigments are basically those colouring agent which are obtained from biological sources such as plants, animals and microbes. Among microorganisms, bacteria, algae and fungi produce a variety of pigments and therefore, are promising source of food colourants. The growth and pigmentation of microorganism is greatly affected by types of fermentation such as solid state fermentation and submerged fermentation.

Velmurugan *et al.* (2014) were studied growth and pigment yield of *Monascus purpureus* in solid state fermentation at different soaking times, incubation temperature and initial substrate pH. Fungal growth was completely inhibited at pH 1 and 2. In this study, yield differed between pH 5 and 6. Maximum growth and pigment production was obtained at 30°C. According to Joshi *et al.* (2003), temperature, pH, carbon source, nitrogen source and incubation time affect microbial pigment production. Wong and Koechler (1983) modified the pigment from fungus *Monascus purpureu*s using different solvents such as ethanol, amino acetic acid, aminobenzoic acid and gelatin.An important goal of food industry is to produce food with an attractive appearance. Some fermentation derived pigments, such as β –Carotene from *Blakeslea trispora*, *Monascus* pigments from *Monascus* spp., red pigment from *Penicillium oxalicum*, riboflavin from *Ashbya gossypi*, and lycopene from *Fusarium sporotrichioides* are being used in food industry at present (Kumar*etal*.,2015).Some microbial pigments could be used as function

aldyesin the productio of coloured anti-microbial textiles. Alihosseini *et al*. (2008) characterized the bright red prodigiosin pigment from *Vibrio* spp. and suggested that it could be used to dye many fibres including wool, nylon, acrylic and silk.

Bio-pharmacological activities of microbial pigments includes anti-oxidant, anti-microbial, anti-cancer, immuno regulative, and anti-inflammatory. Many pigmented secondary metabolites of the microorganisms have significant potential in clinical applications and many research works are in progress for treating diseases like cancer, leukemia and diabetes mellitus (Kumar *et al*., 2015). Giri *et al.* (2004) tested the performance of a series of culture media and discovered that a novel seasame seed broth gave rise to a significant enhancement of prodigiosin production.

Public perception of natural colours have increased due to eco-friendly nature. Moreover, at present, none of the microbial pigment can replace synthetic pigments.

References

Alihosseini, F., Ju, K. S. Lango, J., Hammock, B. D., and Sun, G. 2008. Antibacterial colorants: characterization of prodiginines and their applications on textile materials. *Biotechnol. Prog*. 24: 742–747.

Giri, A. V., Anandkumar, N., Muthukumaran, G., and Pennathur, G. 2004. A novel medium for the enhanced cell growth and production of prodigiosin from *Serratia marcescens* isolated from soil. *BMC Microbiol.* 4: 1–10.

Joshi, V. K., Attri, D., Bala, A., and Bhushan, S. 2003. Microbial pigments. *Indian J. Biotech*., 2: 362-369.

Kumar, A., Vishwakarma, H. S., Singh, J., Dwivedi, S., and Kumar, M. 2015. Microbial pigments: production and their applications in various industries. *Int. J. Pharma. Chem. Biol. Sci*. 5(1): 203-212.

Velmurugan, P., Hur, H., Balachandar, V., Kamala-Kannan, S., Lee, K. Lee, S., Chae, J., Shea, P., and Oh, B. 2014. *Monascus* pigment production by solid-state fermentation with corn cob substrate. *J. Biosci. Bioeng.* 112(6): 590–594.

Wong, H. C. and Koecher, P. E. 1983. Production of red water soluble *Monascus* pigments. *J. Food Sci*. 48:1200-1203.

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE VELLANIKKARA
Department of Agricultural Microbiology
Micro. 591 : Master's Seminar

Name	: Fazeedhibinu Khaleel. T	Venue	: Seminar hall
Admission No.	: 2016- 11- 110	Date	: 11/01/2018
Major Advisor	: Dr. D. Girija	Time	: 9. 15 AM

Endophytic microorganisms in plant disease management

Abstract

The term 'endophyte' was first used to define bacteria, actinomycetes or fungi that occur within asymptomatic plant tissues. They live inside the plant tissues for a part of their life cycle or entire lifespan without showing any visible symptoms (Gupta *et al.,* 2016). Endophytes display ecological plasticity with lifestyles ranging from symbiosis where both the partners were benefitted, to antagonism where one partner was suppressed for the other's benefit and survival. In recent years, endophytes have emerged as promising biological control agents because of their ability to suppress plant diseases and impart fitness benefits.

The potential to colonize internal host tissues for the benefit of crop growth and disease suppression have made endophytes an important component to improve crop performance. Several mechanisms may control this suppression, either directly on the pathogen inside the plant by antibiosis and competition for nutrients, or indirectly by induction of plant resistance response (M'Piga *et al*., 1997). In some cases, they can also accelerate seedling emergence and promote plant establishment under adverse conditions and enhance plant growth and development.

Endophytes associated with plants may include bacteria or fungi that have colonized inside the plant tissues. The diversity of endophytic bacteria ranges from Gram-positive to Gram-negative bacteria, such as *Achromobacter, Acinetobacter, Agrobacterium, Bacillus, Brevibacterium, Microbacterium, Pseudomonas* and *Xanthomonas*(Sun *et al*., 2013). Bacterial endophytes are diverse in nature and are known to produce different bioactive metabolites that act as anti-microbial and anti-cancer compounds. Endophytic fungi such as *Penicillium* sp., *Torreya* sp., *Fusarium* sp., *Pestalotiopsis* sp.and *Chloridium* sp. are all known to produce strong anti-bacterial and anti-fungal drugs against numerous infectious agents (Jalgaonwala *et al*., 2017).

Several endophytes have been reported to support growth and improve the health of plants. Fungal pathogen in rice, for example, is inhibited by numerous endophytic bacteria and fungi, including several strains of *Chaetomium globosum,Penicillium chrysogenum* and *Streptomyces* sp. through the production of antimicrobial compounds (Shankar *et al.,* 2006). Furthermore, Harish *et al.* (2009) demonstrated a 52.4 per cent reduction in *Banana bunchy top virus* infection in the banana cultivar Virupakshi after the application of mixtures of rhizobacterial and endophytic bacterial isolates *viz.,Pseudomonas* and *Bacillus* spp. Similar studies were conducted by Wisnu *et al*. (2017) on control of *Pseudomonas syringe* pv. *actinidiae* (Psa) causing bacterial canker in kiwifruit using *Pseudomonas* strains isolated from manuka (*Leptospermum scoparium*)*.* The endophytic bacteria were shown to inhibit the growth of bacterial plant pathogens through the production of phenazine, 2,4-DAPG, and hydrogen cyanide.

Endophytes are a poorly investigated group of microorganisms that represent an abundant and dependable source of bioactive and chemically novel compounds with potential for exploitation in a wide variety of medical, agricultural and industrial arenas. The practical usage and commercialization of these endophytic microorganisms might provide new opportunities for a revolution in industry and agriculture.

References

Gupta, V. K., Sharma, G. D., Tuohy, M. G., and Gaur, R, 2016 The hand book of microbial bioresources. In: Majumder, D., Kangjam, B., Devi, K, J., Lyngdoh, D., Tariang, J., Thankuria, D., and Goyal, A, K. (eds), *Endophytes: an emerging microbial tool for plant disease management* (1st Ed.). CABI, 179p.

Harish, S., Kavino, M., Kumar, N., Balasubramanian, P., and Samiyappan, R. 2009 Induction of defense-related proteins by mixture of plant growth promoting endophytic bacteria against banana bunchy top virus. *Bio. Control* 51: 16-25.

Jalgaonwala, R.E., Mohite, B.V., and Mahajan, R.T. 2017. A review: Natural products from plant associated endophytic fungi. *J. Microbiol. Biotechnol. Res.* 1(2): 21-32.

M'piga, P., Bélanger, R.R., Paulitz, T.C., and Benhamou, N. 1997. Increased resistance to *Fusarium oxysporum* f. sp. *radicis-lycopersici* in tomato plants treated with the endophytic bacterium *Pseudomonas fluorescens* strain 63-28. *Physiological Mol. Plant Pathol*. 50: 301-320.

Shankar, B. N., Shashikala, J., and Krishnamurthy, Y. L. 2006. Study on the diversity of endophytic communities from rice (*Oryza sativa* L.) and their antagonistic activities *in vitro. Microbiol. Res.* 164(3): 290-296.

Sun, H., He, Y., Xiao, Q., Ye, R., and Tian, Y. 2013. Isolation, characterization and antimicrobial activity of endophytic bacteria from *Polygonum cuspidatum*. *Afr. J. Microbiol. Res.* 7: 1496-1504.

Wisnu, A. W., Eirian, E. J., Seona, C., Jana, M., and Hayley, J. R. 2017. Biological control of *Pseudomonas syringe* pv. *actinidiae* (Psa), the causal agent of bacterial canker of kiwifruit, using endophytic bacteria recovered from a medicinal plant. *Bio. Control.* 116: 103-112.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agricultural Microbiology

Micro. 591 Masters' Seminar

Name	: Rima K. R.	Venue : Seminar Hall
Admission No.	: 2016-11-126	Date : 15-12-2017
Major Advisor	: Dr. K. Surendra Gopal	Time : 10.45 A.M.

Rhizosphere engineering for enhancing sustainable plant ecosystem

Abstract

Rhizosphere is the soil compartment that is influenced by roots of growing plant. It is the most complex microbial habitat on earth, comprising of an integrated network of plant roots, soil and a diverse microbial consortium. It is referred as the second genome of the plant. Interactions between plant roots, soil and microbes change soil physical and chemical properties which in turn alter the microbial population in the rhizosphere.

There is an intimacy between plants and their environment which is essential for the acquisition of water and nutrients, also for beneficial interactions with soil microorganisms. Yet, this same intimacy may increase the vulnerability of plants to a range of biotic and abiotic stresses. Rhizosphere engineering is the manipulation of plants and their root associated microorganisms to improve plant health and productivity. Rhizosphere can be modified over short periods of a plant's growth cycle by soil amendments. However, prolonged changes in the rhizosphere can also be generated with plant breeding and genetic engineering.

Continuous monoculturing of wheat in disease suppressive soils for several years controlled take-all disease caused by *Gaeumannomyces graminis* var. *tritici.* It is an example for natural engineering of microbial populations (Weller *et al*., 2007).

Rhizosphere engineering can be used for biostimulation of beneficial microorganisms. In *Pectobacterium carotovorum*, the virulence on potato plants and tubers is modulated by N-acyl

homoserine lactones (NAHL). Application of gamma-caprolactone (GCL) stimulated the growth of indigenous NAHL-degrading bacteria in the potato rhizosphere (Tannieres *et al.*, 2011)

Rhizoligand application is a recent strategy to engineer the rhizosphere. Rhizoligand is an additive that increases the wettability of the rhizosphere and links the mucilage network to maintain intimate contact with the root surface. It helps the plant to improve tolerance to water shortage (Ahmadi *et al.*, 2017). Fluorescent pseudomonads that produce biosurfactants with zoosporicidal activities, provided significant control over *Phytophthora* foot-rot and promoted plant growth in black pepper (Tran *et al.,* 2007). Plants can be genetically engineered by manipulating H^+ efflux using a gene encoding H^+ -ATPase proteins (Ryan *et al*., 2009).

Rhizosphere engineering helps to improve plant growth and protect the plant and microorganisms from biotic and abiotic stresses. It enhances plant health, productivity and ecosystem functioning. Ultimately, it can reduce the dependence on agrochemicals in agriculture. Thus, rhizosphere engineering can be a potential strategy to enhance a sustainable plant ecosystem.

References

Ahmadi, K., Zarebanadkouki, M., Ahmed, M. A., Ferrarini, A., Kuzyakov, Y., Kostka, S. J., and Carminati, S. A. 2017. Rhizosphere engineering: Innovative improvement of root environment. *Rhizosphere* 3: 176–184.

Ryan, P. R., Dessaux, Y., Thomashow, L. S., and Weller, D. M. 2009. Rhizosphere engineering and management for sustainable agriculture. *Plant soil* 321: 363-383.

Tannieres, M., Ciroua, A., and Faure, D. 2011. Biostimulation of beneficial bacteria in the rhizosphere of *Solanum tuberosum. Procedia Environ. Sci*. 9: 174 – 177.

Tran, H., Kruijt, M., and Raaijmakers, J. M. 2008. Diversity and activity of biosurfactant-producing *Pseudomonas* in the rhizosphere of black pepper in Vietnam. *J. Appl. Microbiol.* 104: 839–851.

Weller, D. M., Raaijmakers, J. M., Gardener, B. M., and Thomashow, L.S. 2002. Microbial population responsible for specific soil suppressiveness to plant pathogens. *Ann. Rev. Phytopathol.* 40: 309-48.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE,VELLANIKKARA

DEPARTMENT OF AGRONOMY

AGRON. 591: Masters' Seminar

Name : Nayana V. R. **Venue: Seminar hall**

Admission No. : 2016-11-002 **Date : 23/11/2017**

Major advisor : Dr. C. George Thomas **Time :11.30 a.m.**

Deficit irrigation: Save each drop

Abstract

Improving crop growth and water productivity are major concern in water scarce regions. New irrigation strategies must be developed to use the limited water resource more efficiently. Deficit irrigation is one of the strategies to achieve the goal of reducing irrigation water use and at the same time maximizing water use efficiency.

Deficit irrigation refers to the application of water below full crop water requirements (Fereres and Soriano, 2007). Main approaches in deficit irrigation are sustained deficit irrigation, regulated deficit irrigation, and partial root zone drying (Chai *et al*., 2015). Sustained deficit irrigation is through the application of certain degree of constant water stress throughout the growth period, while regulated deficit irrigation is application of water deficit only at specific growth stages. In partial root zone drying, only one part of root zone is irrigated. Three types of partial root zone drying are practiced namely alternate partial root zone drying (wetting and drying sides are altered at a preset frequency), fixed partial root zone drying (drying and wetting parts are always fixed) and sub-surface irrigation (above portion of root zone is kept dry while water is supplied from below by capillary action).

The main advantage of deficit irrigation is enhanced water productivity. In tomato under deficit irrigation, water productivity increased by 38-52 percent (Topcu *et al*., 2007). Deficit irrigation enhances root-shoot ratio, secondary root production and root biomass. Partial root zone irrigated and sustained deficit irrigated maize plants had shown increased nitrogen fertilizer recovery and the least residual mineral nitrogen in soil after harvest (Kirda *et al*., 2005).Deficit

irrigation techniques are found positively influencing fruit quality. In some cases, yield maintenance or even increased yield can also be achieved. The practice also increased net returns compared to fully irrigated plants both in water limiting and land limiting conditions (Ali *et al.*, 2007).

Crop yield response factor (K_y) will help in determining whether a crop or crop growth stage is sensitive or resistant to water stress (Kirda, 2000). K_y value more than one means that crop or crop growth stage is not suitable for deficit irrigation. On relatively deep soils, with drought resistant varieties, deficit irrigation can be practiced without much yield reduction.

References

Ali, M., Hoque, M., Hassan, A., and Khair, A. 2007.Effects of deficit irrigation on yield, water productivity, and economic returns of wheat. *Agric. Water Manag.* 92(3): 151-161. Available: http://www.sciencedirect.com/science/article/pii/S0378377407001369 [30 Oct. 2017].

Chai, Q., Gan, Y., Zhao, C., Xu, H., Waskom, R., Niu, Y., and Siddique, K. 2015. Regulated deficit irrigation for crop production under drought stress. A review. *Agron. Sustain. Dev.* 36(3): 1-21.

Fereres, E. and Soriano, M. A. 2007. Deficit irrigation for reducing agricultural water use. *J. Exp. Bot.* 58(2): 147-159.

Kirda, C. 2000. Deficit irrigation scheduling based on plant growth stages showing water stress tolerance. In: *Deficit Irrigation Practices,* WaterReports 22,Food and Agricultural Organization,Rome, pp. 3-9.

Kirda, C., Topcu, S., Kaman, H., Ulger, A., Yazici, A., Cetin, M., and Derici, M. 2005. Grain yield response and N-fertilizer recovery of maize under deficit irrigation. *Field Crops Res.* 93(2): 132-141.

Topcu, S., Kirda, C., Dasgan, Y., Kaman, H., Cetin, M., Yazici, A., and Bacon, M. 2007. Yield response and N-fertilizer recovery of tomato grown under deficit irrigation. *Europ. J. Agron.* 26(1): 64-70.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agronomy

Agron. 591: Masters' Seminar

Name	:	Anitrosa Innazent	Venue	:	Seminar hall
Admission No.	:	2016-11- 037	Date	:	24/11/2017
Major Advisor	:	Dr. S. Anitha	Time	:	10.00 a.m.

New Perspectives of Intercropping in Modern Agriculture

Abstract

Intercropping is a farming practice of growing two or more crop species or genotypes, on the same field. On the fringes of modern intensive agriculture, intercropping could be one route to deliver sustainable intensification by allowing genuine yield gains without increased inputs. It has the potential to increase long term sustainability in food production. While some of the mechanisms by which they deliver agronomic benefits are understood, new knowledge from ecology and breeding offer considerable potential to improve this system. Ecological advances include better understanding of the context- dependency of interactions, the mechanism behind disease and pest avoidance and links between above and below ground system. Selecting crop combination with traits that maximize positive and minimize negative interaction and breeding specially for combination of desirable traits are two approaches for improving intercropping.

Recent plant- soil interaction studies have highlighted possibilities for improving intercropping system. Roots of complementary plant species can improve soil stability and soil structure, thereby improve resource acquisition (Hallet and Bengough, 2013). The ideotype of a particular crop is different for monocropping and intercropping. In monocropping traits in chosen crop exploit the environment exclusively for that crop. By contrast, traits for a component of an intercrop are those that optimize complementarity or facilitation (White *et al*., 2013).Pest regulation in intercropping provide an excellent example which shows a positive co-relation between fundamental ecological processes and yield benefits. And the principle behind it is, by

providing a more complex habitat with a greater diversity of resources for beneficial organism (Wackers, 2004). 73 per cent of documented studies reported reduced disease incidence in intercropping system is in the range of 30- 40 per cent compared with sole cropping (Boudreau, 2013).

Precision farming, conservation agriculture and climate smart agriculture constitutes the emerging modern innovative concepts in crop production, promoting crop diversification to build a climate resilient farming community. The biggest obstacle in adopting intercropping systems is to conceptualize the planting, cultivation, fertilization, spraying and particularly harvesting of more than one crop in the same field. Rapid improvements are also possible through the development of new agronomic practices, including mechanization of intercropping systems and improved nutrient management.

Applying all of these approaches will need a better exchange of information among ecologists, environmental scientists, agronomists, crop scientists, soil scientists and ultimately social scientists, so that the full potential of intercropping as a sustainable farming system can be realized.

References

Boudreau, M. A. 2013. Disease in intercropping systems. *Annu.Rev. Phytopathology* 51: 499-519.

Hallet, P. D. and Bengough, A. G. 2013. Managing the soil physical environment for plants. In: Gregory, P. J. and Nortcliff, S. (eds), *Soil Conditions and Plant Growth*, Chichester, U. K., pp. 238-268.

Wackers, F. L. 2004. Assessing the suitability of flowering herbs as parasitoid food sources: flower attractiveness and nectar accessibility. *Biological Control* 29: 307- 314.

White P. J., George T. S., Gregory P. J., Bengough A. G., Hallet P. D., and McKenzie B. M. 2013. Matching roots to their environment. *Annu. Botany* 112: 207- 222.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agronomy

AGRON. 591: Masters' Seminar

Name : Akshatha V.

Admission No. : 2016-11-045

Major Advisor : Dr. Prameela K. P.

Venue : Seminar Hall

Date : 08/12/2017

Time : 10.45 A.M.

Tillage system: a referee on weed seed bank

Abstract

Tillage is the oldest art associated with agriculture and one of its major objectives is weed management.Until the introduction of herbicides, it was the main method for managing weeds. Weeds are a major problem in agricultural fields, and the weed seed bank which is the reserve of viable seeds in the soil, is the main source of weeds.

Tillage exerts a great influence on nature and growth of weed species. It influences the vertical seed movement in agricultural soils (Cousens and Moss, 1990).Mouldboard ploughing resulted in uniform distribution of seeds over soil depths(Yenish *et al.,* 1992). In reduced tillage system, 85 per cent of all weed seeds were present in the upper 5 cm of soil, but only 28 per cent seeds were found in mouldboard system in the same zone (Pareja *etal.*, 1985).

Weed seed density was found to be highest in no tillage and generally declined as tillage intensity increased (Cardina *et al.,* 2002). The diversity of weed species was slightly lower for mouldboard plough (17 species), compared to the shallow tillage (21 species),and direct drill treatments (22 species) (Carter and Ivany, 2006).

Conventional tillage systems have been shown to favour annual broadleaf weeds, while no tillage system favours perennial weeds and species that can successfully germinate on the soil surface such as annual grasses (Moyer *et al.,* 1994)

Tilled soil offers better germination environmentsfor most seeds as it provides germination stimulus for weeds requiring light flashes, scarification, ambient CO_2concentration,

and higher nitrate concentration to break dormancy.Careful use of tillage can both effectively bury weed seed and prevent or reduce its subsequent exhumation to shallower depths (Yenish e*t al*., 1992).

Differential tillage practices influence the herbicide effectiveness. Higher total weed seed densities in zero tillage system may be the result of reduced herbicide availability due to absorption by crop residues. The effect of residue on weed emergence is complex and controlled by several interacting factors including type and quantity of residue, allelopathy, seed depth in the soil and environmental conditions.

Tillage practices need to be coupled with other weed management strategies for achieving better efficacy in weed management.Further studies should focus on themechanisms through which tillage systems affect seedling recruitment from the seed bank, and also on the fate of the weed seeds that fail to germinate under no tillage systems.

References

Cardina, J., Herms, C. P., and Doohan, D. J. 2002. Crop rotation and tillage system effects on weed seedbanks. *Weed Sci.* 50(4): 448-460.

Carter, M. R. andIvany, J. A. 2006. Weed seed bank composition under three long-term tillage regimes on a fine sandy loam in Atlantic Canada. *Soil Tillage Res.* 90: 29-38.

Cousens, R. D. and Moss S. R. 1990. A model of the effects of cultivation on the vertical distribution of weed seeds within the soil. *Weed Res.* 30: 61-70.

Moyer, J., Roman, E., Lindwall, C., and Blackshaw, R. 1994. Weed management in conservation tillage systems for wheat production in North and South America. *Crop Prot.* 13: 243-259.

Pareja, M. R., Staniforth, D. W., and Pareja, G. P. 1985. Distribution of weed seeds among soil structural units.*Weed Sci*. 33: 182-189.

Yenish, J. P., Doll, J. D., and Buhler, D. D. 1992. Effects of tillage on vertical distribution and viability of weed seed in soil. *Weed Sci*. 40: 429-433.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agronomy

AGRON. 591: Masters' Seminar

Name	: Abid V.	Venue	: Final year class room
Admission number	: 2016-11-048	Date	: 30/11/2017
Major advisor	: Dr. Bindhu J. S.	Time	: 09.15 a.m.

Nutrient dynamics in aquaponics

Abstract

Aquaponics is a symbiotic integration of aquaculture and hydroponics. Three groups of living organisms, namely bacteria, plants and fishes, make up an aquaponic ecosystem. It is an integrated approach towards efficient and sustainable intensification of agriculture that meets the needs of water scarce situations. According to FAO (2012), due to recycling of water, aquaponics can reduce the water required to raise both crops and fish by up to 90 per cent. As the demand for protein and crop production increases over the coming years, aquaponics is an opportunity that provides an easy source for healthy foodwith minimal land requirements.

The working principle of aquaponics is to provide nutrient-rich aquacultural water to a hydroponic plant culture unit, which in turn depurates the water that is then returned to the aquaculture tanks. The key to a successful aquaponic system is a healthy colony of beneficial bacteria. These bacteria convert fish waste into nitrate and other elements which are used by plants as they grow. Reconciling water quality parameters are essential for the survival and growth of plants, fishes and nitrifying bacteria. The recommended pH is between 6.5 and 7 to optimize the production in aquaponics

The main concept of the aquaponic system is to balance the nutrient load of the system with the density of the fish, feeding rate, and nutrient requirements of the plants, leading to optimization and better productivity of the system (Licamele, 2009). Nutrient dynamics includes estimation of biological processes occurring within the system. The nitrogen cycle is the most important process in aquaponics. Normally, aquaculture effluents contain sufficient levels of

nitrogen, phosphorus and other secondary nutrients, and micronutrients such as boron and copper, while levels of potassium, calcium, and iron are generally insufficient (Rakocy *et al*., 2006).

Most plant nutrients can be derived from fish feed through fish excretion and bio-filter nitrification, thus integrating nutrient flow. With respect to nutrient dynamics, the flow of each nutrient depends upon many factors including species, system design, bio-filter performance, re-mineralization method and feed composition. Neto and Ostrensky (2013) reported that 55 per cent of the phosphorus that entered the system through fish feed accumulated in sludge.

Nutrient dynamics can be evaluated through mass balance, nutrient budgets or system models. It provides a quantitative methodology for designers to specify the nutrient and culture requirements of plants.

In the long run, this is of great relevance, due to rising fertilizer costs as well as the demand for no-emission systems and minimizing environmental impact. Balancing the aquaponic environment for optimum growth of the three component organisms is a subject for future research and refinement.

References

FAO [Food and Agricultural Organization] 2012. How is the global demand for food evolving? Available: http://www.unwater.org/worldwaterday/faqs.html. [23 Sept. 2017].

Licamele, J. 2009. Biomass production and nutrient dynamics in an aquaponics system. PhD Dissertation, University of Arizona, 173p.

Neto, R. M. and Ostrensky, A. 2013. Nutrient load estimation in the waste of Nile tilapia *Oreochromis niloticus* (L.) reared in cages in tropical climate conditions. *Aquac. Res.* 46: 1309–1322.

Rakocy, J. E., Masser, M. P., and Losordo, T. M. 2006. Aquaponics - Integrating fish and plant recirculating aquaculture tank production systems, SRAC Publication No.454. Available: http://extension.ag.uidaho.edu/twinfalls/Aquaculture/Aqua%20Pubs/SRAC454 Aquaponic System. Pdf [23 Sept.2017].

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Agronomy

Agron. 591 - Masters' Seminar

Name	: Sreethu M.J.	Venue	: Seminar hall
Admission No	: 2016-11-049	Date	: 08/12/2017
Major Advisor	: Dr. Sindhu P.V.	Time	: 11.30 am

Resurrection plants: Survivors of drought

Abstract

Drought is the most widespread hydrometerological syndrome affecting natural resources, crop production, and people. Developing crop cultivars which can survive drought is accepted as a mitigation strategy under climate smart agriculture.

Desiccation tolerance of an organism is defined as the ability of a living structure to survive drying to equilibrium with low (< 50%) RH and maintain low intracellular water concentrations. Thus desiccation tolerance is one of the mechanisms of drought tolerance and it is exhibited by resurrection plants.

Resurrection plants are those plants which can tolerate almost complete water loss in their vegetative tissues. The desiccated plant can remain alive in the dried state for several years. Upon watering, the plants rehydrate and become fully functional within 12 - 48 hours. Most of the resurrection plant species are native to arid climates such as Southern Africa, South America, and Western Australia (Gaff, 1977; 1987). Around 330 resurrection plants have been identified, which include species from five families of pteridophytes (Actiniopteridaceae, Aspleniaceae, Pteridaceae, Selaginellaceae, and Sinopteridaceae), three families of dicotyledons (Gesneriaceae, Myrothamnacaeae, and Scrophulariaceae), and five families of monocotyledons (Boryaceae, Cyperaceae, Poaceae, Schizaeaceae, and Velloziaceae) (Porembski and Barthlott, 2000).

The mechanism which contributes resurrection ability in plants includes morphological and metabolical changes. One of the most remarkable features of a resurrection plant is its ability to shrink during dehydration. It has been estimated that leaves of *Craterostigma plantagineum* drop to around 15 per cent of their original area and in *Ramonda nathaliae,* the volume of the central vacuole was seen to significantly decrease (Hartung *et al*., 1998).

During metabolic changes, sucrose is found to be the dominant carbohydrate accumulating and it helps in stabilizing membranes and proteins in the dry state. The level of Reactive Oxygen Species (ROS) undergoes significant rise in water stressed cells which causes protein and nucleic acid denaturation and destruction of subcellular structures. Based on the strategies to defend themselves against the oxidative stress arising upon dehydration, resurrection plants are classified as homoiochlorophyllous species, which retain chlorophyll on drying and poikilochlorophyllous species that lose chlorophyll on drying (Tuba *et al*., 1994). Production of Late Embryogenesis Abundant (LEA) proteins and involvement of plant growth regulators are the other metabolic changes that occur during dehydration.

Information for desiccation tolerance is present in the genomes of all crops; however, it is switched on in the seeds alone and inorder to convey the property of resurrection, such genes are to be activated. The idea of transferring genes for desiccation tolerance into crop plants can be one of the steps in solving worldwide food shortage especially when global warming is posing threat to sustainable food production systems. Tobacco plants with *LEA* 4 group genes from the resurrection plant *Boea hygrometrica* conferred dehydration tolerance in transgenic tobacco (Liu *et al*., 2009). Studies are going on for imparting resurrection ability to food crops such as maize and teff grass at Cape Town University of South Africa.

References

Gaff, D.F. 1977. Desiccation tolerant vascular plants in southern Africa. *Oecologia* 31: 95-104.

Gaff, D.F. 1987. Desiccation tolerant plants in South America. *Oecologia* 74: 133-136.

Hartung, W., Schiller, P., and Dietz, K. J. 1998. Physiology of poikilohydric plants. *Prog. Bot.* 59: 299-327.

Liu, X., Wang, Z., Wang, L., Wu, R., Phillips, J., and Deng, X. 2009. *LEA* 4 group genes from the resurrection plant *Boea hygrometrica* confer dehydration tolerance in transgenic tobacco. *Plant Sci.*176: 90-98.

Porembski, S., and Barthlott, W. 2000. Granitic and gneissic outcrops (inselbergs) as centres of diversity for desiccation tolerant vascular plants. *Plant Ecol.* 151: 19-28.

Tuba, Z., Lichtenthaler, H. K., Csintalan, Z., Nagy, Z., and Szente, K. 1994. Reconstitution of chlorophyll and photosynthetic CO_2 assimilation upon rehydration in the desiccated poikilochlorophyllous plant *Xerophyta scabrica*. *Planta* 192: 414-420.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

DEPARTMENT OF AGRONOMY

AGRON. 591: Masters' Seminar

Name	: Jeen Shaji	Venue	: Seminar hall
Admission No.	: 2016-11-056	Date	: 30/11/2017
Major advisor	: Dr. Deepa Thomas	Time	: 10.45 a.m.

Salt tolerance mechanisms in plants

Abstract

Salinity is a soil condition characterized by a high concentration of soluble salts. According to standard definition, saline soils are those in which the saturation soil-paste extract has an electrical conductivity (EC) of more than 4 dS/m at 25 ^{0}C, which corresponds to approximately 40mM NaCl, and generates an osmotic pressure of approximately 0.2MPa (Munns and Tester, 2008). According to the FAO (2008), over 6 percent of the world's land is affected by salinity which accounts for more than 800 million ha of land.

As a consequence of salt stress, plants undergo several detrimental effects like enzyme inactivation, nutrient imbalance, membrane dysfunction, oxidative stress and osmotic stress, and finally results in significant levels of yield reduction. Biphasic growth inhibition model describes the differential responses exhibited by plants under salt stress (Munns and Termaat, 1986).

Depending upon the response to salinity, plants may be categorised as halophytes or glycophytes. Halophytes are the plants which can grow and reproduce under high salinity (>400mM NaCl), and glycophytes are those which cannot tolerate high salinity. Most of the grain crops and vegetables are glycophytes and are highly susceptible to soil salinity, even when the soil EC is < 4 dS/m.

Salt tolerance is the ability of plants to grow and complete their life cycle on a substrate that contains high concentrations of soluble salts. Plants develop various biochemical and molecular mechanisms to cope with salt stress. Under low salinity, selective accumulation or exclusion of ions takes place at root level to maintain the ion homeostasis.

At the elevated levels of ion accumulation, compartmentalization of ions occurs at both cellular and whole-plant levels. In addition, several halophytes exhibits morphological adaptations like salt glands, bladder cells and micro-hairs to avoid ion accumulation within plant.

Plants tolerate saturated levels of ion accumulation by various mechanisms like synthesis of compatible solutes (proline, glycine betaine, polyamines polyols), shift in photosynthetic pathway (C_3 to CAM), induction of anti-oxidative enzymes (SOD, peroxidase, catalase) and induction of plant hormones (ABA, jasmonic acid). Chattopadhyay *et al.* (2002) reported that exogenous application of polyamines reduced injury levels in rice grown under saline soil.

The development of salinity-tolerant crops is the need of the hour to sustain agricultural production. This can be achieved through conventional breeding and genetic engineering. Tritipyrum is a novel salt tolerant cereal developed through conventional breeding technique. Detrimental effects of salinity are more pronounced during the seedling stage in most of the crops. Seed priming is a seed enhancement method that might improve germination rate and performance of seeds under salinity stress conditions (Ibrahim, 2016).

Agronomic measures for managing salinity in the semi-arid regions of the world can also be adopted in order to sustain agricultural production.

References

Chattopadhayay, M. K., Tiwari, B. S., Chattopadhyay, G., Bose, A., Sengupta, D. N., and Ghosh, B. 2002. Protective role of exogenous polyamines on salinity-stressed rice (*Oryza sativa*) plants. *Physiologia plantarum* 116: 192–199.

FAO [Food and Agricultural Organization] 2008. Land and plant nutrition management service. Available: htpp://www.fao.org/ag/agl/agll/spush [25 Oct. 2017].

Ibrahim, E. A. 2016. Seed priming to alleviate salinity stress in germinating seeds. *J. Plant Physiol.* 192: 38–46.

Munns, R. and Termaat, A. 1986. Whole plant responses to salinity. *Aust. J. Plant Physiol*. 13: 143–160.

Munns, R. and Tester, M. 2008. Mechanisms of salinity tolerance. *Ann. Rev. Plant Biol.* 59: 651–681.

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE
Department of Agronomy
AGRON. 591: Masters' Seminar

Name	: Santhiya K.	Venue	: Seminar hall
Admission No.	: 2016 - 11- 095	Date	: 04/01/2018
Major Advisor	: Dr. Usha K.E.	Time	: 10.45 A.M.

Sprouted fodder - A revolution in livestock feed

Abstract

Green fodder is the most important and profound input in livestock diet. For economic and sustainable animal husbandry, fodder production round the year is highly essential. Small land holdings, scarcity of land, water and unavailability of quality seeds are some of the constraints faced by the farmers. Green fodder produced by growing seeds without soil but in water or nutrient rich solution is known as sprouted fodder or hydroponic fodder and it is an alternative to the conventional method of green fodder production. Compared to conventional methods, it requires less space and less labour, produces highly nutritious fodder.

Hydroponic fodder production was started in India during the 1980s. Rice, wheat, barley, oats, maize, sorghum, pearl millet, minor millets and legumes like horse gram, cowpea, moth bean, alfalfa and lucerne can be used for this system. Farmers prefers fodder maize due to its easy availability and good biomass production (Naik *et al*., 2015).

Hydroponic fodder can be produced under fully automated hydroponic fodder machine, hi - tech greenhouse and low cost greenhouse. It requires a frame work of shelves on which plastic trays are stacked. After soaking overnight, a layer of seeds is spread over the base of the trays. During the growing period, the seeds are kept moist, but not saturated. Moisture is supplied through spray equipments. Holes in the trays facilitate drainage of excess water.

The seeds usually sprout within 8 to 12 hours after soaking and will reach to a height of 20 to 25 cm within 8 days. The time required for germination was 7 hours for wheat and pearl millet, 14 hours for maize, 6 hours for barley and oats (Lamnganbi and Surve, 2017). Gebremedhin *et al*. (2015) recommended an optimum seed rate of 6 to 8 kg m^{-2} for fodder maize. According to Karaki and Hashimi (2011), hydroponic fodder requires only 3 to 5 per cent of water over conventional fodder. It is much more easily digestible, full of nutrients and enzymes so that the energy spent on digestion process would be far less and the resultant extra energy will be diverted to milk production and growth. Feeding of hydroponic maize and barley upto 40 per cent substitution of dry matter intake increased the digestibility and body weight of growing goats (Kide *et al*., 2015). According to Limba *et al*. (2017), hydroponic fodder maize improved the digestibility and could replace the concentrate mixture in lactating cows.

There is a great potential for developing hydroponics technology for sprouted fodder production. Though it cannot replace the green fodder and hay completely since it contains less fibre, it can be a better substitute for concentrate.

References

Gebremedhin, W. K., Deasi, B.G., and Mayekar, A. J. 2015. Nutritional evaluation of hydroponically grown maize fodder. *J. Agric. Eng. Food Technol*. 2(2): 86-89.

Karaki, G. N. and Hashimi, M. 2011. Green fodder production and water use efficiency of some forage crops under hydroponic conditions. *Int. Scholary Res. Network* 31(4): 47-51.

Kide, W., Desai, B., and Dhekale, J. 2015. Feeding effects of maize and barley hydroponic fodder on dry matter intake, nutrient digestibility and body weight gain of Kongan Kanyal goats. *Life Sci. Inter. Res. J*. 2(2): 96-101

Lamnganbi, M. and Surve, U. 2017. Biomass yield and water productivity of different hydroponic fodder crops. *J. Pharmacognosy Phytochemistry* 6(5):1297-1300.

Limba, A. K., Dhuria, R. K., Sharma, T., and Nehra, R. 2017. Feed intake and digestibility of nutrients as affected by feeding of hydroponics maize fodder in Rathi cows. *Indian J. Anim. Nutr.* 34(1):114-117.

Naik, P. K., Swain, B. K., and Singh, N. P. 2015. Production and utilization of hydroponics fodder. *Indian J. Anim. Sci*. 84 (8): 880-883.

KERALA AGRICULTURE UNIVERSITY
COLLEGE OF HORTICULTURE, VELLANIKKARA
Centre for Plant Biotechnology and Molecular Biology

MBB 591: Masters' Seminar

Name	: Midhuna M. R.	**Venue**	: Seminar hall
Admission number	: 2016- 11- 106	**Date**	: 04- 01- 2018
Major advisor	: Dr. Minimol J. S.	**Time**	: 10:00 am.

Stress management: cross- talk between membrane and storage lipids

Abstract

Plants are exposed to a plethora of biotic and abiotic stresses in natural environment. The reactions that help the organisms to adapt to stressful conditions follow a programmed series of events. When plants suffer from life threatening insults, they have their own mechanism for stress management.

Plant lipids include fats, waxes, steroids, phospholipids, free fatty acids and their salts, *etc.* They are the major and vital constituents of a cell, as they provide structural basis for the cell membranes and energy stock for metabolism. Plasma membrane primarily perceives the stress stimuli and has a cross talk with membrane lipids and they undergo remodelling resulting in the generation of vital lipid signaling molecules. These signaling molecules will trigger different pathways producing different bio molecules and they in turn will develop an innate mechanism in plants to manage stress.

Major signaling molecules include lysophospholipids, fatty acids, phosphatidic acid, inositol phosphate, diacylglycerol, oxylipin, sphingolipid and N- acyl ethanolamine. Many scientists have studied the role of signaling molecules in response to various stresses. Lysophospholipids are formed by the action of the enzyme phospholipase C on glycerolipids. Application of a microbial elicitor on cultured cells of california poppy induced the production of the antimicrobial compound phytoalexin (Viehwegar *et al*., 2002).

Phosphatidic acid is produced by the direct hydrolysis of phospholipids by the action of the enzyme phospholipase D and by the combined action of the enzymes phospholipase C and diacylglycerol kinase on inositol phosphates. Arisz *et al*., (2013), studied the phosphatidic acid accumulation in *Arabidopsis* as a result of cold stress. Formation of diacylglycerol occurs by two pathways that is, by the action of enzyme phospholipase C on

inositol phosphates and phospholipids. In *Arabidopsis*, during oxidative stress, diacyl glycerol is formed which in turn acts as the precursor of phosphatidic acid (Peters *et al*., 2010). Oxylipins are formed from free fatty acids by the action of the enzyme phospholipases. Jasmonic acid is the best known oxylipin involved in the activation of various defense responses. Jasmonic acid dependent anti herbivore defense occurs in wild tobacco (Demkura *et al*., 2010).

Cuticular wax biosynthesis is activated as a result of cross talk between membrane and lipids directly without any intermediate signalling molecules which will directly take part in stress management. Lipidome is an emerging field that has been driven by rapid advances in technologies and can be coupled with the recognition of role of lipids in defense reactions. Also, the approaches of transgenics, coupled with lipidomics, can give valuable insights in to the role of these signaling pathways in defense mechanisms of plants.

References

Arisz, S. A., Wijk, R. V., Roels, W., Zhu, J. K., Haring, M. A., and Munnik, T. 2013. Rapid phosphatidic acid accumulation in respo.02nse to low temperature stress in *Arabidopsis* is generated through diacylglycerolkinase. *Frontiers Plant Sci.* 4: 1-15.

Demkura, P. V., Abdala, G., Baldwin, I. T., and Ballare, C. L. 2010. Jasmonate dependent and independent pathways mediate specific effects of solar ultraviolet B radiation on leaf phenolics and antiherbivore defense. *Plant Physiol.* 152: 1084-1095.

Peters, C., Li, M., Narasimhan, R., Roth, M., Welti, R., and Wang, X. 2010. Nonspecific phospholipase C NPC4 promotes responses to abscisic acid and tolerance to hyperosmotic stress in *Arabidopsis. Plant Cell* 22: 2642-2659.

Viehweger, K., Dordschbal, B., and Roos, W. 2002. Elicitor-activated phospholipase A(2) generates lysophosphatidylcholines that mobilize the vacuolar H(+) pool for pH signaling via the activation of Na(+)-dependent proton fluxes. *Plant Cell* 14: 1509-1525.

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE, VELLANIKKARA
Department of Plant Biotechnology
MBB. 591 Master's Seminar

Name : Anushree Bachhar
Admission No. : 2016-11-107
Major Advisor : Dr. Haseena Bhaskar

Venue : Seminar Hall
Date : 17-11-2017
Time : 11.30 am

It's in the genes! - Unraveling plant resistance to insects

Abstract

Immune receptors in plants are encoded by resistance (R) genes, the vast majority of which belong to the NB–LRR family (Nucleotide-binding, leucine-rich repeat). Extensive rearrangements in gene expression occur in plants in response to herbivory. Resistance genes in plants, upon insect attack, activate various signaling pathways involving jasmonic acid (JA), salicylic acid (SA), ethylene (ET), calcium (Ca^{+2}) *etc*. (War *et al*., 2012).

Earlier studies indicated that plant tissue damage from insect with chewing mouthparts elicits JA-based transcriptomes, whereas JA-SA-based transcriptomes are induced by insects with piercing-sucking mouthparts. However, JA-SA signaling induced by both types of herbivory, as well as JA-SA cross-talk, has recently been demonstrated. The JA pathway regulates the production of secondary metabolites that deter feeding or inhibit digestion and induced plant volatiles that can repel herbivores and attract their natural enemies (Smith *et al*., 2009).

Mir1, *PRm3* and *Mp1* gene of maize were reported to code for Mir1-CP, chitinase and maize protease inhibitor proteins which regulate JA pathway to produce resistance against armyworm. The transcription of *PR1* and *BGL2* genes, the marker genes of SA pathway, was up-regulated in tomato upon feeding by the bollworm, *Helicoverpa armigera*, leading to accumulation of high level of SA (Peng *et al*., 2004).

Upon insect attack, ET related genes are activated in plant system which regulate many physiological processes in plants. ET is also an important modulator of plant responses to other hormones, including jasmonic acid (JA) and salicylic acid. Ethylene signaling pathway is associated with brown planthopper resistance in rice (Yujie *et al*., 2006). Calcium signaling is one of the early events in insect-plant interaction, where calcium acts as a second

messenger, which in turn mediates a number of plant signaling events such as, phosphorylation and transcriptional change.

Molecular characterization of genes responsible for insect resistance involves reverse genetics and cloning based studies along with bioinformatics tools. Reverse genetics studies conducted in *Allium sativum* to characterize the mannose binding lectin gene, *Blec1* showed that the gene had significant insecticidal property against aphids (Balogun *et al*., 2012).

Genetic mapping of quantitative trait loci (QTL) offers a highly efficient molecular approach for working with quantitative traits. Host plant resistance QTL have been identified in ten crop genera for resistance to 21 insect species from the orders Coleoptera, Hemiptera, Lepidoptera, Diptera and Thysanoptera.

Progress has been made to identify the signaling pathways in host plants as well as the identification and characterization of host plant resistance gene. Extensive qualitative and quantitative high throughput analyses of temporal and spatial variations in gene expression, protein level and activity, and metabolite concentration will speed up not only the understanding of the overall mechanisms of defense, but also accelerate the identification of specific targets for enhancement of plant resistance for agriculture.

References

Balogun, N. B. A., Inuwa, H. M., Ishiyaku, M. F., Bakare-Odunoola, M. T., and Nok, A. J. 2012. Isolation and characterization of a mannose-binding insecticidal lectin gene from *Allium sativum* (garlic) and its putative role in insect resistance using bioinformatics tools. *Infection Genet. Evol.***12**:1508–1512.

Peng, J., Deng, X., Huang, J., Jia, S., Miao, X., and Huang, Y. 2004. Role of salicylic acid in tomato defense against cotton bollworm, *Helicoverpa armigera* Hubner. *Naturforsch* **59**:856862

Smith, J. L., De-Moraes, C. M., and Mescher, M. C. 2009. Jasmonate- and salicylate- mediated plant defense responses to insect herbivores, pathogens and parasitic plants. *Pest Manag. Sci.* **65:**497-503

War, A. R., Paulraj, M. G., Ahmad, T., Buhroo, A. A., Hussain, B., Ignacimuthu, S., and Sharma, H. C. 2012. Mechanisms of plant defense against insect herbivores. *Plant Sig. Behavior* **7**(10): 1306-1320

Yujie, L.U., Xia, W., Yonggen, L., and Jiaan, C. 2006. Role of ethylene signaling in the production of rice volatiles induced by the rice brown planthopper, *Nilaparvata lugens*. *Chin. Sci. Bull.* **51**:2457-65

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE, VELLANIKKARA
Department of Plant Biotechnology
MBB. 591 Master's Seminar

Name : Athulya S. Nair

Admission No. : 2016-11-108

Major Advisor : Dr. Abida P. S.

Venue: Seminar Hall

Date : 05/ 01/2018

Time : 11.30 am

Designer organelle: peroxisome and its application in biotechnology Abstract

Organelles are compartments performing specific functions, found within the cells of organisms. Designer organelles are the subcellular compartments created by tailoring an existing organelle, and thus giving them a new function. Subcellular compartmentalization is a fundamental process used extensively in eukaryotes to separate potentially incompatible biological reaction pathways and processes or the segregation of harmful products. It also enables localization of high concentrations of key pathway components within the cell.

The creation of a designer intracellular compartment would be highly desirable as it would enable non-natural pathways to be isolated from other cellular processes. Modification of existing organelles can be done by controlling the proteins that are entering into an organelle.Creating such designer organelles will provide the cell with new capabilities as they can act as customized compartments within the cell.

Efficient and sustainable production of therapeutics and other synthetic compounds without compromising the cell's native activities, designing a novel waste management system for the cell, and increasing the efficiency of existing pathway by reducing metabolic cross-talks are a few potential applications of customised designer organelles.

Though organelles such as chloroplasts, mitochondria and vacuoles are abundantly found in eukaryotic cells, peroxisomes are considered as one of the ideal organelles to create a designer organelle. Peroxisome matrix proteins are synthesized on free polyribosomes in the cytosol and are imported post-translationally. Their targeting to peroxisomes depends on short sequences known as peroxisomal targeting signal (PTS) Type 1 and Type 2 which are recognized by cycling cytosolic receptors Pex5 and Pex7 respectively (Kim and Hettema, 2015). By manipulating these signal-receptor interactions, control over peroxisome matrix protein import can be exercised. This in turn modifies the function of the organelle.

Designing peroxisomes has been done via tagging the protein sequence with PTS1 sequence, attaching the protein sequence with an enhanced PTS1 and by targeting proteins with the help of a modified PEX5*-PTS1* receptor signal pair. Lee *et al*. (2009) found that PTS1 was strong enough to overcome the carotenogenic enzymes inherent targeting program and send them to the peroxisomes. Targeting of synthetic pathways towards peroxisomes can increase the production of fatty acidderived alcohols, alkanes, and olefins (Zhou *et al.,* 2016). DeLouche *et al*. (2016) identified an enhanced PTS1sequence that can increase the efficiency of peroxisomal targeting.

Cross *et al.* (2017) developed a mutated receptor and targeting signal pairing that could be used to drive a switch in peroxisomal function, allowing import of user-specified proteins without competition from endogenous proteins. This switch in peroxisomal function could bring about a repurposing of the peroxisome within the cell for use as a novel intracellular compartment.

A lot more research needs to be conducted to create efficient designer organelles that can exist alongside conventional versions of these organelles. Modifying the chemical environment of the organellar lumen to allow catalysis of reactions that would be infeasible in the cytosol is essential. These long-term goals could one day provide unprecedented control over the chemistry within the cell.

References

Cross, L. L., Paudyal, R., Kamisugi, Y., Berry, A., Cuming, A. C., Baker, A., and Warriner, S. A. 2017. Towards designer organelles by subverting the peroxisomal import pathway. *Nat. Commun.* 8(1): 454.

DeLoache, W. C., Russ, Z. N., and Dueber, J. E. 2016. Towards repurposing the yeast peroxisome for compartmentalizing heterologous metabolic pathways. *Nat. Commun.* 7: 11152.

Kim, P. K. and Hettema, E. H. 2015. Multiple pathways for protein transport to peroxisomes. *J. Mol. Biol.* 427(6): 1176–1190.

Lee, P. C., Yoon, Y. G., and Schmidt-Dannert, C. 2009. Investigation of cellular targeting of carotenoid pathway enzymes in *Pichia pastoris*. *J. Biotechnol.* 140(3): 227–233.

Zhou, Y. J., Buijs, N. A., Zhu, Z., Gomez, D. O., Boonsombuti, A., Siewers, V., and Nielsen, J. 2016. Harnessing yeast peroxisomes for biosynthesis of fatty acid derived biofuels and chemicals with relieved side-pathway competition. *J. Am. Chem. Soc*. 138(47): 15368- 15377.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Centre for Plant Biotechnology and Molecular Biology

MBB 591: Masters' Seminar

Name	: Niranjana Menon C.	Venue : Seminar hall
Admission no.	: 2016-11-109	Date : 16/11/2017
Major Advisor	: Dr. Anita Cherian K.	Time : 11.00 a.m.

Molecular mechanism of virus - vector interaction

Abstract

Plants, being sessile organisms, are not significant transmitters of viruses except for a few instances of seed or pollen transmission. Thus, the great majority of plant viruses are dependent on so called vectors for their survival and spread. Thus, it is important to understand viral transmission by vectors that will result in diseases in agricultural crop plants.

Viral transmission consists of three stages: first, acquisition of virions when the vector feeds on a suitable virus-infected plant, second, passage of virions through specific sites within the vector, and final, inoculation of the retained virions into a suitable recipient plant during a subsequent feeding. Proteins encoded by different plant viruses have been identified to specifically interact with the respective insect vectors and facilitate virus transmission (Whitfield *et al.,* 2015).

There are two basic interactions between viruses and their biological vector. They may be taken up internally within the vector, termed persistent, internally borne or circulative, or they may not pass to the vector's interior, in which case they are termed non-persistent, externally borne, or non-circulative (Hull, 2009).

For the viruses that are non-persistently transmitted, two forms of interaction have been identified: the capsid strategy and the helper strategy. The non structural HC-Pro protein of *Potyvirus* and P2 protein of *Caulimovirus* act as a bridge between vector receptor and capsid protein enabling virion retention inside the vector. Virions in aphid hemoceol exist in association with a GroEL-like protein called symbionin produced by a primary aphid endosymbiont *Buchnera* spp. (Van dee Heuvel *et al*., 1994). Propagative viruses' outer CP P2 and a non

structural protein Pns10 are criticallyinvolved in intracellular spread in the leafhopper vector (Miyazaki *et al*., 2015).Transovarial transmission in an insect vector is related to vitellogenin (Vg),a female-specific protein synthesized and secreted into hemolymph, from where it is absorbed by the growing oocytes via receptor-mediated endocytosis (Tufail and Takeda, 2009).

Not much work has been done in plant virus - non-insect vector relationships. However, the read-through domain from the coat protein of *Beet necrotic yellow vein virus* is implicated in the fungal transmission. It is suggested that in nematode transmitted viruses, the non-structural protein might be transmission helper components analogous to those in some aphid and leafhopper virus transmission system.

For the majority of plant virus-vector interactions, viral components that are directly involved in virus acquisition are well defined. The route of viruses within the bodies of their vectors are well established, the actual molecular interactions between both remain poorly understood. The tedious processes of documenting viral proteins or protein domains that are responsible for specific recognition of the vector are being undertaken actively.

References

Hull, R. 2009. *Comparative Plant Virology* (2nd Ed.). Elsevier, California, pp.225-238.

Miyazaki, N., Higashiura, A., Higashiura, T., Akita, F., Hibino, H., Omura, T., and Iwasaki, A. K. 2015. Electron microscopic imaging revealed the flexible filamentous structure of the cell attachment protein P2 of *Rice dwarf virus* located around the icosahedral 5-fold axes. *J. Biochem*. 1-10.

Tufail, M., and Takeda, M. 2009. Insect vitellogenin/lipophorin receptors: molecular structures, role in oogenesis, and regulatory mechanisms. *J. Insect Physiol*. 55: 87– 103.

Van dee Heuvel, J. F. J. M., Verbeek, M., and Van der Wilk, F. 1994. Endosymbiotic bacteria associated with circulative transmission of *Potato leaf roll virus* by *Myzus persicae. J. Gen. Virol.* 75: 2259-2565.

Whitfield, A. E., Falk, B., and Rotenberg, D. 2015. Insect vector-mediated transmission of plant viruses. *Virol*. 479: 278-289.

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE, VELLANIKKARA
Centre for Plant Biotechnology and Molecular Biology

MBB. 591: MASTER'S SEMINAR

Name : Pooja S.J. Venue : Seminar hall
Admission No. : 2016-11-111 Date : 07/12/2017
Major Advisor : Dr. M.R. Shylaja Time : 11:00 a.m.

Elicitation for *in vitro* secondary metabolite production

Abstract

Low volume high value plant metabolites which are used as flavours, fragrances, cosmetics, insecticides and drugs are collectively called as secondary metabolites. Secondary metabolites are also known to play a key role in the acclimatization of plants to their surroundings. There is a great demand in the global market for production of plant secondary metabolites (PSM). However, production of these metabolites is very low (less than 1% dry weight) and depends greatly on the physiological and developmental stages of the plant. Research on plant secondary metabolites have been increased during last ten years.

Plant cell and tissue culture constitute the most promising approach for sustainable production of PSM on commercial scale . Production of PSM by plant cell culture technology is still facing many biological and biotechnological limitations. One of the major obstacles is the low yield of PSM in cell and tissue culture.

Elicitors are molecules which promote various kinds of defense in plant system and they also play a major role in enhancing synthesis of plant secondary metabolites (Rao and Ravishankar, 2002). On the basis of origin, elicitors can be classified as biotic and abiotic. Mihai *et al.* (2011) reported that biotic and abiotic elicitors stimulate biosynthesis and increase the production of resveratrol in *Vitis vinifera* callus cultures. The different concentrations of fungal extract (*Aspergillus niger* and *Penicillium notatum*), yeast extract and chitosan enhance the synthesis of psoralen in *Psoralea corylifolia* suspension cultures (Ahmed *et al.,* 2012).

The main factors that affect the effectiveness of elicitation are the specificity of elictors, concentration, treatment interval, culture conditions, growth stage and media composition. When a plant cell culture is treated with an elicitor, elicitor signal is perceived by the receptors localized in plasma membrane. The action of secondary messengers will further amplify the signal for downstream reactions leading to transcriptional activation of the

corresponding defense response genes which ultimately leads to the production of secondary metabolites.

Precursor feeding along with elicitors is a useful strategy for increasing secondary metabolite production in plant cell cultures (Syklowska-Baranek *et al.,* 2009). Despite the benefits of elicitor, use of higher doses of elicitors are known to have adverse effects on plant culture especially in hairy root culture (Furmanowa and Syklowska-Baranek, 2000). This limitation can be overcome by feeding growth nutrients into culture medium.The introduction of an *in situ* product removal mechanism, such as a solid adsorbent or an extraction solvent to the culture medium can often effectively induce product release from plant cells and increase the recovery of secondary metabolites (Choi *et al.,* 2001).

The elicitation approaches not only enhance the synthesis of secondary metabolites in the plant system, but also help in understanding and identifying the rate-limiting steps of complex biosynthetic pathways which can be utilized for metabolic pathway engineering. Understanding the signal transduction paths in elicitor - induced production of secondary metabolites is important for optimizing their commercial production.

References

Ahmed, S.A. and Baig, M.M. 2012. Elicitor enhanced production of psoralen in suspension cultures of *Psoralea corylifolia* L. *Saudi J. Biol. Sci.* 21(5): 499-504.

Choi, J.W., Cho, G.H., and Byun, S.Y. 2001. Integrated bioprocessing for plant cell cultures. *Adv. Biochem. Eng. Biotechnol*. 72: 63-102.

Furmanowa, M. and Syklowska-Baranek, K. 2000. Hairy root cultures of *Taxus* var. *Hicksii* Rehd as a new source of paclitaxel and 10-deacetylbaccatin III. *Biotechnol. Lett.* 22: 683-686.

Mihai, A., Cristina, S., Helepciuc, F., Brezeanu, A. and Stoian, G. 2011. Biotic and abiotic elicitors induce biosynthesis and accumulation of resveratrol with antitumoral activity in the long-term *Vitis vinifera* L. callus cultures. *Romanian Biotech. Lett.* 16: 6683-6689.

Rao, S.R. and Ravishankar, G.A. 2002. Plant cell cultures: Chemical factories of secondary metabolites. *Biotechnol. Adv.* 20:101-153.

Syklowska-Baranek, K., Pietrosiuk, A., Kokoszka, A., and Furmanowa, M. 2009. Enhancement of taxane production in hairy root culture of *Taxus* × *media* var. *Hicksii*. *J. Plant Physiol.* 166:1950–1954.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Centre for Plant Biotechnology and Molecular Biology

MBB 591: Masters' Seminar

Name	: Faiza Mohamed	Venue	: Seminar hall
Admission No.	: 2016-11-112	Date	: 16/12/2017
Major Advisor	: Dr. M. R. Shylaja	Time	: 10. 45 a.m.

Biotechnological interventions for artemisinin production

Abstract

Malaria is a parasitic infection affecting millions of people and it is listed as the most significant causes of death worldwide (WHO, 2014). The major reasons for high persistence of malaria are resistance to antimalarial drugs, climate change, migration, and movement of drug resistant parasites across continents resulting in spread of resistant alleles. In this context, WHO in 2008 suggested the use of combination therapies to treat malaria.

The discovery of artemisinin, an antimalarial compound found in glandular trichomes of *Artemisia annua* (sweet wormwood), and its use in Artemisinin based Combination Therapy (ACT) has guaranteed as an effective approach for treatment of multidrug resistant strains of *Plasmodium falciparum*. Chemically, artemisinins are sesquiterpene lactones with an endoperoxide bridge. Pharmacological action of artemisinin is now no more restricted to treat malaria alone, but also other diseases like cancer, inflammatory diseases, viral, protozoan, helminthes and fungal infections (Ho *et al.,* 2013). However, the drug is very expensive due to low artemisinin content in plants, i.e, less than 0.01 to 1.4 per cent of the plant dry weight (Liu *et al.,* 2006). Hence, production of artemisinin cannot meet the increasing demand for ACTs.

Various biotechnological strategies are used to enhance artemisinin production like *in vitro* cell culture and genetic engineering, metabolic pathway engineering, and biofarming. Feeding of precursors and elicitation have proved to be an effective way to enhance artemisinin production in plant cell cultures (Baldi and Dixit, 2008). Various environmental stresses in a moderate dose and duration can act as a potential elicitor for enhanced artemisinin production (Lulu *et al.,* 2008). Hairy roots induced by *Agrobacterium rhizogenes* are more stable artificial roots for production of artemisinin (Majdi *et al.,* 2015).

Manipulations of biosynthetic pathways to channelize the carbon flux for enhanced synthesis of a metabolite involved either upregulation of desired pathway or downregulation of competing pathways through overexpression and suppression of their respective pathway genes. The expression of genes is largely regulated by specific transcription factors (TFs). Therefore, overexpression of TFs offers an alternative and complementary strategy to upregulate biosynthetic pathway genes.

The use of genetically modified, fast growing organisms, such as genetically engineered yeast and *E. coli*, have arisen as a real alternative for production of artemisinin (Zeng *et al*., 2008). For cost-effective artemisinin production, metabolic engineering strategies are used in microbes by overexpressing artemisinin synthesis enzymes. As a consequence of the partial failure using microbial hosts, and considering that the last step in biosynthetic pathway is likely to be restricted to plants, a biofarming approach was introduced to overcome this limitation. To fulfil artemisinin's global demand, integrated use of conventional and biotechnological techniques are reliable.

References

Baldi, A. and Dixit, V. K. 2008. Yield enhancement strategies for artemisinin production by suspension cultures of *Artemisia annua*. *Bioresour. Technol.* **99**: 4609- 4614.

Ho, W. E., Peh, H. Y., Chan, T. K., and Wong, W. S. 2013. Artemisinins: Pharmacological actions beyond anti-malarial. *Pharmacol. Ther.* **142**(1): 126- 139.

Liu, C., Zhao, Y., and Wang, Y. 2006. Artemisinin: current state and perspectives for biotechnological production of an antimalarial drug. *Appl. Microbiol. Biotechnol*. **72**: 11- 20.

Lulu, Y., Chang, Z., Ying, H., Ruiyi. Y., and Qingping, Z. 2008. Abiotic stress induced expression of artemisinin biosynthesis genes in *Artemisia annua* L. *Chin. J. Appl. Environ. Biol.* **14**: 1- 5.

Majdi, M., Ashengroph, M., and Abdollahi, M. R. 2015. Sesquiterpene lactone engineering in microbial and plant platforms: parthenolide and artemisinin as case studies. *Appl. Microbiol. Biotechnol.* **100**: 1041- 1059.

WHO [World Health Organization] 2014. World Malaria Report. Geneva: World Health Organization. http://www.who.int/malaria/publications/world_malaria_report_2014/en/ [15 Nov. 2017].

Zeng, Q., Qiu, F., and Yuan, L. 2008. Production of artemisinin by genetically modified microbes. *Biotechnol. Lett.* **30**: 581- 592.

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE, VELLANIKKARA
Department of Plant Breeding and Genetics

GP 591: Master's Seminar

Name : Chakravarthi Marri | Venue : Seminar Hall

Admission No : 2016-11-015 | Date : 22/12/2017

Major Advisor : Dr. Dijee Bastian | Time : 9.15 AM

Robotics in plant phenotyping

Abstract

A robot is a machine programmable by a computer, capable of carrying out a complex series of actions automatically. The word Robot comes from a Czech word, '*robota'*, meaning 'forced labour'. Robots may be constructed to take on human form but most robots are machines, designed to perform a task with no regard to how they look. Recent advances in robotics and sensor technology make it possible to survey a large number of plants in a non-destructive and cost-efficient way. The use of robotics in phenotyping is commonly referred to as 'High-throughput plant phenotyping' (HTPP).

The terms phenotype and genotype were coined by Dutch plant scientist Wilhelm Johannsen. The term phenotyping came into usage in the 1960's and is defined as the application of methodologies and protocols to measure a specific trait, ranging from the cellular level to the whole plant or canopy level related to plant structure and function. It is the key link in understanding environmental effects and gene function, thus playing an important role in crop breeding (Zhang *et al.*, 2016). A major challenge for plant breeders is to predict the crop performance as a function of its genetic architecture. Availability of high quality phenotypic data is essential to understand the genotype to phenotype relationship. The genomics revolution and gene technology can provide solutions only when this information is comprehensively linked to phenotype under field conditions (Furbank and Tester, 2011). Currently, such data are not available and this is considered as a major bottleneck in genetic analysis.

Traditionally phenotype is recorded manually using various instruments. It is labour-intensive, tedious, destructive and biased. This necessitated the use of automated technology to record observations. Moreover, it is possible to generate continuous data using automated technology which is not possible in traditional phenotyping.

High-throughput phenotyping systems contain mainly three components *viz*, sensor, phenotyping platform, and image processing and analysis system. Sensors are used to capture images at different wavelengths. Some of the commonly used sensors are RGB imaging, infrared imaging, chlorophyll fluorescence and hyper spectral imaging. Infrared imaging sensor was used to identify genotypes for salinity tolerance in barley (Sirault *et al.,* 2009).

Various plant phenotyping platforms, including ground based and aerial based (manned and unmanned aerial vehicles) platforms, are available. Ground based platforms were developed for indoor observations (laboratory and greenhouse) with controlled environment and for field conditions. Many of these phenotyping platforms come with in-built image processing and analysis software which are useful for extracting meaningful information from the imaging data.

In India, HTPP facilities have been installed at IIHR, Bangalore, ICAR complex for NER, Meghalaya, IARI, New Delhi, and CRIDA, Hyderabad. The field of plant phenotyping is rapidly making progress. Image based plant phenotyping is beginning to prove its value in crop breeding by providing a quantitative basis for plant-environment interactions. Key to the success of this technology is the ease and applicability of modern image analysis approaches at all ontogenetical stages. Since the potential of image analysis in the context of plant breeding is far from being adequately exploited, the scientific field of plant phenotyping can be expected to continue prospering through the coming years (Klukas *et al.*, 2014).

References

Furbank, R.T., and Tester, M. 2011. Phenomics-technologies to relieve the phenotyping bottleneck. *Trends Plant Sci*.16:635-644.

Klukas, C., Chen,D., and Pape, J. 2014. Integrated Analysis Platform: An open-source information system for high-throughput plant phenotyping. *Plant Physiol*. 165:506-518.

Sirault, X.R.R., James, R.A., and Furbank, R.T. 2009. A new screening method for osmotic component of salinity tolerance in cereals using infrared thermography. *Funct. Plant Biol.* 36:970-977.

Zhang, J., Gong, L., Liu, C., Huang, Y., Zhang, D., and Yuan, Z. 2016. Field phenotyping robot design and validation for the crop breeding. *IFAC-Papers OnLine*. 49(16):242-247.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Plant Breeding and Genetics

GP 591: Masters' Seminar

Name	:	Megha L.M.	Venue	:	Seminar hall
Admission No.	:	2016-11- 016	Date	:	21/12/2017
Major Advisor	:	Dr. Rose Mary Francies	Time	:	10.00 a.m.

Passage through the plant circadian rhythm: Genetics decoded

Abstract

As the earth rotates on its axis, day and night occur. The metabolism, physiology, and behavior of most organisms change profoundly between day and night. These biological phenomena apparently oscillate to exhibit a diurnal rhythm. Even when deprived of exogenous time cues, many of these diurnal rhythms persist, indicating their generation by an endogenous biological clock. This internal awareness of time is often referred to as 'Biological clock'.

The biological clock tends to set to environmental rhythms such as seasonal (circaannual), monthly (circalunar), tidal (circatidal) or daily (circadian) changes. According to Dunlap *et al*. (2004), 'Circadian rhythms' are the subset of biological rhythms with period, defined as the time to complete one cycle of 24 hours. In 1959, this defining characteristic had inspired Franz Halberg to coin the term 'Circadian', from the Latin words 'Circa' meaning 'about' and 'dies' meaning 'day'.

Circadian rhythms are endogenously generated, self-sustaining, heritable and persist even under constant environmental conditions like light and temperature. These environmental time cues, termed 'Zeitgebers' (meaning 'time givers' in German), entrain the endogenous timing system to a period of 24 hours, precisely corresponding to the exogenous period of the earth's rotation. It is apparent that the clock regulates its own sensitivity to environmental stimuli. This varying sensitivity of the biological clock to environmental stimuli can be quantified and displayed as a phase response curve (Dunlap *et al*., 2004).

The first mention of the circadian rhythm can be dated back to the fourth century BC. when Androsthenes described the daily leaf movements of the tamarind tree (*Tamarindus indicus*). Further, scientific research on circadian rhythms gained momentum in 1729 when the French astronomer de Mairan reported that the daily leaf movements of heliotrope plant (*Mimosa pudica*) persisted in constant darkness, demonstrating their

endogenous origin. The Nobel prize in Physiology or Medicine for the current year was awarded to Jeffrey C. Hall, Michael Rosbash and Michael W. Young, jointly for their elucidation of the molecular mechanisms controlling circadian rhythm.

Unravelling the genetics of plant circadian rhythm can be dissected into three conceptual phases. It includes discovery of rhythmic output pathways, input-dependent pathways and input-dependent oscillator pathways. Initially, research efforts concentrated on deducing the factors that controlled the rhythmic occurrence of plant responses. This resulted in identification of a number of clock controlled genes (CCGs). Kloppstech (1985) observed circadian oscillation in mRNA abundance of chlorophyll binding protein gene (*LHCB* or *CAB*). The rhythemicity of *LHCB* mRNA abundance was proved through the cyclic light emission from *Arabidopsis* seedlings bearing the *LHCB:LUC* transgene (Millar *et al*.,1992).

Later, the role of zeitgibers like light and temperature as entraining factors controlling the circadian rhythm in the input-dependent pathways was proved. That the rhythmic transcription of key clock genes is inhibited by nuclear transcription of their protein products was unravelled only in the recent past (McClung, 2001). With this, the role of the clock controlled genes as the central oscillator and the regulation of the expression of these genes by a negative feedback loop became evident (Inoue *et al*., 2017).

Considerable evidences support existence of multiple oscillators in multicellular plants. These rhythms also provide adaptive fitness to plants by synchronization of an organism's internal clock with the the diurnal cycles imposed by its environment. Although the progress in unraveling the plant circadian clock mechanism is remarkable, much remains unfinished. An outline of the oscillator mechanism has emerged but remains incomplete.

References

Dunlap, J.C., Loros, J.J., and DeCoursey, P.J. 2004. *Chronobiology: Biological Timekeeping*. Sinauer Associates, Sunderland, Massachusetts, 393p.

Inoue, K., Araki, T., and Endo, M. 2017. Oscillator networks with tissue-specific circadian clocks in plants. *Cell Dev. Biol.* (in press). Available : http://dx.doi.org/10.1016/j.semcdb.2017.09.002. [10 Nov. 2017].

Kloppstech, K. 1985. Diurnal and circadian rhythmicity in the expression of light-induced nuclear messenger RNAs. *Planta* 165: 502 - 506.

McClung, C.R. 2001. Circadian rhythms in plants. *Annu. Rev. Plant Physiol. Plant Mol. Biol.* 52: 139 - 62.

Millar, A.J., Short, S.R., Chua, N.H., and Kay, S.A. 1992. A novel circadian phenotype based on firefly luciferase expression in transgenic plants. *Plant Cell* 4: 1075 - 1087.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Plant Breeding and Genetics

GP 591 Master's Seminar

Name : Anju M. Job
Admission No : 2016-11-020
Major Advisor : Dr. Biju S.

Venue : Seminar Hall
Date : 08-12-2017
Time : 10.00am

Molecular farming for plant made pharmaceuticals

Abstract

Plants have been used as sources of natural medicaments for treating various ailments. However, synthetic drugs whose evolution started with the production of aspirin in 1899, took the central stage in pharmaceutical production. Since the advent of genetic engineering in 1970s, living system such as bacteria, yeast and animal cells have been used as production systems. Due to the production constraints including low yield, poor quality, high risk of contamination and lack of post - translational process, development of plant based system has been well accepted as a promising cost - effective platform.

Plant molecular farming (PMF) refers to the production of recombinant proteins including pharmaceuticals, industrial proteins and other secondary metabolites in plants. It involves cultivation/culture, harvesting, transporting, storage and downstream processing and purification of recombinant proteins (Wilde *et al*., 2009). The technology hinges on the genetic transformability of plants, which was first demonstrated by the production of recombinant plant-derived pharmaceutical protein (human growth hormone) in tobacco.

It has been proven over the years that plants have the ability to produce even more complex functional mammalian proteins with therapeutic activity, such as human serum proteins and growth regulators, antibodies, vaccines and enzymes (Lienard *et al*., 2007). Plant expression systems have several advantages over prokaryotic and eukaryotic cell system with regard to production speed, cost, safety and post-translational modifications. The plant transformation

types include stable nuclear transformation and stable plastid transformation. Transient expression system, seed based production system, plant cell culture, moss culture and algal culture form the PMF production platforms. Transient expression system is often considered as a robust approach compared to stable transformation, due to its rapid production capacity and high protein expression (Peyret and Lomonossoff, 2015). The major classes of plant derived recombinant proteins are vaccines, antibodies, therapeutics and neutraceuticals. Hepatitis B antigen, cancer vaccine, viral vaccine mixture and TGEV capsid protein are some of the PMF derived vaccines. CaroRX, DoxoRX, RhinoRX , Fv antibodies, IgG (ICAM1), Hepatitis B antibody and Gastric lipase, Lactoferon TM (α -interferon), Interleukin, Thrombolytic drug and Insulin includes antibodies and nutraceuticas respectively.

An edible vaccine could stimulate an immune response in humans. Transgenic potatoes containing enterotoxin against diarrhea caused by *E. coli* bacterium stimulated strong immune responses in animals (Gunn *et al*., 2012).

In spite of the vast advantages of PMF over the established systems, the challenges of choosing the most suitable host plant, downstream processing as well as the biosafety issues are also being given attention.

References

Gunn, K. S., Singh, N., Giambrone, J., and Wu, H. 2012. Using transgenic plants as bioreactors to produce edible vaccines. *J. Biotechnol. Research*, 4: 92-99.

Lienard, D., Sourrouille, C., and Faye, L. 2007. Pharming and transgenic plants. *Biotechnol*. 13: 115-147.

Peyret, H., and Lomonossoff, G. P. 2015. When plant virology met Agrobacterium: the rise of the deconstructed clones. *Plant Biotechnol. J.* 13: 1121-1135.

Wilde, C. D., Jacobs, A., Peeter, K., and Peck, I. 2009. Expression of antibodies and Fab fragments in transgenic potato plants: a case study for bulk production in crop plants. *Mol. Breed*. 9: 271-282.

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE, VELLANIKKARA
Department of Plant Breeding and Genetics
GP 591: Masters' Seminar

Name	**:** Juby Baby	**Venue**	**:** Seminar Hall
Admission No.	**:** 2016-11-042	**Date**	**:** 04/01/2018
Major Advisor	**:** Dr. Minimol J.S.	**Time**	**:** 11:30 am

Centromere mediated speciation-revisited

Abstract

Mitosis is the process by which a eukaryotic cell divides to produce two daughter cells, each containing the same number of chromosomes as the parent cell. As this definition suggests, the overall process of mitosis fails if the parent cell's chromosomes do not reach their correct destinations. One structure that plays a critical role in ensuring proper cell division is the centromere. The centromere was first described by German biologist Walther Flemming in the 1880s as the "primary constriction" of the chromosome. Scientists now appreciate that the centromere is a region of specialised chromatin that provides the foundation for kinetochore assembly and serves as a site for sister chromatid attachment.

The chromosomes have been divided into four types based on the position of the centromere: metacentric in which the centromeres are present at the centre, sub – metacentric where the centromere is found a little away from the centre, acrocentric where the centromere is found at a place that is near to the end of the chromosomes and lastly, telocentric where the centromeres are found at the telomeric region of the chromosomes and normally this position of centromere is conserved within a species. The structure of the centromeres consists of mainly three parts: the centromeric chromatin, chromatin and nucleosome complex and centromeric proteins.

Even though the main function of centromere involves segregation of chromosomes, their rapidly evolving nature has led to the differentiation of new species, hence playing an important role in evolution. Many factors in centromere contribute to the speciation in organisms such as the position of centromere, which includes centromere repositioning and formation of neocentromere. The change in the centromeric position in chromosome of cucumber and melon is considered as an important reason for species differentiation (Han *et al.*, 2009).The formation of neocentromere is relatively a new subject. When the already existing centromere gets inactivated due to some reasons, a new region in chromosome

uptakes the activity of centromere and is known as neocentromere. It has been reported in many plant species (Zhang *et al*., 2014).Several other factors like protein-protein interactions, formation of holocentromere and changes in the tandem repeats also contribute to species formation (Melters *et al*., 2013).

The phylogenetic relationship between different organisms can be explained by the detailed investigation of centromere. An evolutionary study carried out in *Poaceae* family revealed that rice, maize and bajra were evolved from a common ancestor. An 80bp motif was conserved in the centromeric region of many relatives of rice as well as in maize and bajra indicating the phylogenetic relation between them (Lee *et al.,* 2005).

The best example for centromeric evolution is the comparison between human beings and chimpanzee. Although they belong to two different genera, majority of their genomic sequences are identical. The difference between their genome included nine pericentromeric inversions and one centric fusion which led to the evolution of man from chimpanzee, their closest ancestor.

Although centromere plays an important factor in mediating speciation, the area of study has not been exploited enough. Therefore, more research has to be conducted as it can provide more insights into the mechanisms of how centromere can contribute to speciation and hence evolution.

References:

Han ,Y., Zhang ,Z., Liu, C., Huang, S., Jiang, J., and Jin, W. 2009. Centromeric repositioning in cucurbit species: Implication of the genomic impact from centromere activation and inactivation. *Proc. Natl. Acad. Sci.* 106 (35) :14937-14941.

Melters, P., Bradnam, K. R., Telis, N., May, M. R., Ruby, J. G., Sebra, R., Rank, D., Smith, T., Korf, I., and Chan, S. L. 2013. Comparative analysis of tandem repeats from hundreds of species reveals unique insights into centromere evolution. *Genome Biol.* 14 : 2-20.

Lee, H.R., Zhang, W., Langdon, T., Jin, W., Yan, H., Cheng, Z., and Jiang, J. 2005. Chromatin immunoprecipitation cloning reveals rapid evolutionary patterns of centromeric DNA in *Oryza* species. *Proc. Natl. Acad. Sci.* 102 (33): 11793-11798.

Zhang, H., Koblizkova, A., Wang, K., Gong, Z., Oliviera, L., Torres, G. A., Wu, Y., Zhang, W., Novak, Z., Buell, R., Macas, J., and Jiang, J. 2014. Boom–Bust turnovers of megabase-sized centromeric DNA in *Solanum* species: Rapid evolution of DNA sequences associated with centromeres. *Plant Cell* 26 : 1436-1447.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Plant Pathology

Pl. Path. 591: Masters' Seminar

Name	:	Rahila Beevi M.H.	Venue	:	Seminar hall
Admission No.	:	2016-11-004	Date	:	23/11/2017
Major Advisor	:	Dr. Sainamole Kurian P.	Time	:	10.00 a.m.

Climate change effects on plant pathogens : genomes to ecosystems

Abstract

Climate change is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, in addition to natural climate variability observed over comparable time periods (UNFCCC, 2009). Agriculture being the primary sector affected by unprecedented changes in the climate and 30 per cent loss in agricultural production is being caused by plant diseases, the impact of climate change on plant pathogens and diseases needs to be addressed inorder to ensure global food security.

The major climate change parameters that influence plant pathogens are increased temperature, elevated levels of CO_2, altered precipitation pattern and drought. Among these, elevated temperature is the most important factor that directly affect several aspects of biology of a pathogen. Temperature governs the rate of reproduction of many pathogens. Severe epidemics are often associated with more number of infection cycles especially in case of polycyclic pathogens. Das *et al.* (2017) reported that, *Puccinia graminis tritici* completes infection cycles more quickly under high temperature. Similarly, uredospore production by *Puccinia substriata* and zoospore release by *Bremia lactucae* are found to increase with high temperature (Elad *et al.*, 2014). Furthermore, high winter temperature enhances the survival ability of fungal pathogens in temperate regions. Variation in temperature causes a shift in the geographical distribution of pathogens. It has been predicted that, as temperature increases, many pathogens may spread to new geographical areas, where they may come in contact with potential hosts, thus providing an opportunity for pathogen hybridization and evolution (Bergot *et al.*, 2004).

Elevated levels of CO_2 can also influence plant disease epidemics by enhancing the aggressiveness of pathogens. Kobayashi *et al.* (2016) reported that severity of rice blast

caused by *Pyricularia oryzae* increases with increase in CO_2 concentrations. Similarly, sporulation of *Colletotrichum gloeosporioides* is more at high CO_2 concentrations.

Most fungi and oomycetes require leaf wetness for spore germination. Thus changes in quantity and pattern of precipitation influence the diseases which are incited by *Phytophthora* sp., *Pythium* sp. and the downy mildews. Though drought and change in ozone concentration cannot be directly correlated with plant diseases, changes in host phenology induced by these factors may alter disease severity.

Owing to their shorter generation time compared to plants, pathogen can evolve faster and adapt to changed climate through genetic alterations like mutation, hybridization, horizontal gene transfer and phenotypic plasticity. However, any attempt to generalize the impact of climate change on pathogens is a challenge because the effect of climate change will differ with pathosystem and geographical regions (Santhini and Ghelardhini, 2015).

In order to tackle the impact of climate change on plant diseases, it is essential to develop better management strategies as well as new forcasting models incorporating information regarding climate change.

References

Bergot, M., Cloppet, E., Marcaiss, B., and Perarnaud,V. 2004. Simulation of potential range expansion of oak disease caused by *Phytophthora cinnamomi* under climate change. *J.Global Change Biol.*10: 1539-1552.

Das, T., Majumdar, K. M., Rajesh, T., and Devi, T. 2017. Climate change impacts on wheat rust (*Puccinia graminis tritici*) epidemiology. *SAARC J. Agri*. 14(2): 200-209.

Elad,Y., Pertot, I., and Kudela, V. 2014. Climate change impacts on plant pathogens and plant diseases. *Plant Protect. Sci.* 28(1): 99-139.

Kobayashi, T., Ishiguro, K., Nakajima,T., and Kobayashi, K. 2016. Effects of elevated atmospheric CO_2 concentration on the infection of rice blast and sheath blight. *Phytopathol.* 96:425-431.

Santhini, A. and Ghelardhini, L. 2015. Plant pathogen evolution and climate change. *Ind. J. Phytopathol*. 45: 27-32.

UNFCCC (United Nations Framework Convention on Climate Change). 2009. Handbook. http://unfccc.int/resource/docs/publications/handbook.pdf.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Plant pathology

Pl Path 591: Master's seminar

Name : Stella Doncy P. P. Venue: Seminar Hall

Admission No: 2016-11-005 Date : 14/12/2017

Major Advisor: Dr. Reshmy Vijayaraghavan. Time : 10.45 AM

Highways in the sky: atmospheric transport of plant pathogens

Abstract

Dispersal of pathogens is important not only for the spread of the disease in a population but also for the continuity of life cycle and evolution of pathogens. The living host or other organic substrates cannot indefinitely provide space and nutrition for the growing population of the pathogens. This compels them to move out to new uninhabited sites, otherwise, the pathogen would die of starvation. Based on the agents involved dispersal can be divided into active/ direct and passive/ indirect. Active dispersal involves the agency of soil, seed or other planting materials, whereas passive methods involve dispersal through man, insects, nematodes, water and air.

Aerial dispersal of pathogens involves three steps viz., take off/ removal of spores from the crop canopy, horizontal transport and deposition. In the case of passive liberation, removal of spore will be affected by wind speed and wind direction. Aylor and Lukens (1974) observed that increased wind speed enhanced spore removal of *Helminthosporium maydis* in maize. High conidial concentration of the pathogen *Pyricularia grisea* was found on the leeward side of wind in rice blast disease (Greer, 2001). While in actively liberated spores, removal of spores is independent of wind and the concentration was found high during early to mid- morning period (Aylor *et al*., 2000). According to Prussin *et al.*(2014), when the spores are carried to a distance more than 100 m from the source it is considered as long distance dispersal (LDD). Gustiness in wind, turbulence and vertical mixing of air column will aid in the better dispersal and transport of pathogens. Source strength, spore

liberation, vertical transport, horizontal transport, wind systems, tropical cyclones, dispersion efficiency and other associated weather conditions determine the efficiency of air borne spores. The final stage of aerial transport is deposition which is mostly affected by the rate of rainfall.

Various weather parameters determine the fate of survival of spores during LDD. Uredospores of soybean rust (*Phakopsora pachyrhizi*) were found to be sensitie to solar radiation and UV light during aerial transport (Isard and Dufault, 2006). Bashy and Aylor (2000) reported better survival of detached conidia of downy mildew pathogen *Peronospora destructor*, when exposed to low temperature and high humidity. Extent of aerial transport of plant pathogenic bacteria and viruses is very limited when compared to fungi.

Spread of air borne pathogens can be monitored using ground surveys, weather scans and meteorological data. The information on the aerial spread of pathogens should be made available to the farmers so that they can take appropriate measures. Common LDD routes of pests and pathogens should be critically analyzed to manage these air borne pathogens(Nagarajan and Singh, 1990).

References

Aylor, D. E., Fry, W. E., Mayton, H., Andradre- Piedre, J. L. 2000. Quantifying the Rate of Release and escape of *Phytophthora infestans* Sporangia from a Potato Canopy. *Phytopathol.* 91: 1189- 1196.

Aylor, D. E. and Lukens R. J. 1974. Liberaion of *Helminthosporium maydis* spores by wind in the field. *Phytopathol.* 64: 1136 - 1138.

Bashi, E. and Aylor, D. E. 2000. Survival of detached sporangia of *Peronospora destructor* and *Peronospora tabacina. Am. Phytopathol. Soc.* 73(8) : 1135-1139.

Greer, C. A. 2001. Occurrence, distribution, epidemiology, cultivar reaction and management of rice blast in California. *Plant Dis.*85: 1096- 1102.

Isard, S. A. and Dufault, N. S. 2006. The Effect of Solar Irradiance on the Mortality of *Phakopsora pachyrhizi* Urediniospores. *Plant Dis.* 90:941-945.

Prussin, A.J., Malla, R., Ross, S.D., and Schmalle, D.G. 2014. Monitoring the longdistance transport of *Fusarium graminearum* from field- scale sources of inoculums. *Plant Dis*. 98: 504- 511.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Plant Pathology

Pl. Path. 591: Masters' Seminar

Name	:	Atheena Harish	Venue	:	Seminar hall
Admission No.	:	2016-11-009	Date	:	09/11/2017
Major Advisor	:	Dr. Anita Cherian K.	Time	:	09.45 a.m.

Plant virus detection : Progress and challenges

Abstract

Plants once infected by viruses cannot be cured and therefore, early detection and identification of viral pathogens is very important for devising management strategies which would save the crop from severe economic damage. In the recent years, progress in the field of plant virology has witnessed major breakthroughs resulting in the development of sensitive and effective detection techniques.

The symptoms of viral diseases are often confused with those of abiotic stress, hence symptomatology is not a conclusive evidence for the presence of virus in plant. Earlier, biological indexing using indicator plants like *Chenopodium* sp. and *Gomphrena* sp. was used for virus detection and confirmation. The detection techniques were further improved with the invention of electron microscopy (EM) enabling the study of morphological features of the virus (Kausche *et al.*,1939). Later on, with the advent of immunosorbent electron microscopy (ISEM) which combined the technical advantages of EM with serology could detect even the low titre viruses (Derrick,1973).

The development of enzyme-linked immunosorbent assay (ELISA) for the detection of *Plum pox virus* and *Arabis mosaic virus* by Clark and Adams (1977) was a breakthrough in virus detection ushering in the new era of serodiagnosis. ELISA was further upgraded to techniques like dot ELISA and immuno-tissue printing which allowed *in situ* detection of viruses. Furthermore, lateral flow immune assay devices (LFIA) developed based on the principle of ELISA is an inexpensive and user-friendly technology. Recently, sero-based nanobiosensors with higher sensitivity compared to conventional ELISA were also developed. The sensitivity of these immunoassays were further enhanced with the development of nucleic acid based techniques.

The most successfully exploited molecular technique is polymerase chain reaction (PCR) and reverse transcriptase PCR for detection of DNA and RNA viruses respectively.The constraints in conventional PCR were rectified in advanced variants like immunocapture PCR, multiplex PCR and nested PCR (Jeong *et al.,*2014). Nucleic acid hybridization methods like dot –blot technique and microarrays have also proved to be highly sensitive. Nevertheless, the requirement of skilled personnel for carrying out these techniques still remains a challenge.

The development of real time PCR assays helped to avoid the risk of post-PCR contamination along with benefits of high reproducibility and accuracy. Non-thermal methods like loop-mediated isothermal amplification and recombinase polymerase amplification were found to be acceptable for poorly resourced laboratories and for *in situ* testing (Boonham *et al*.,2014).

Next generation sequencing (NGS) is the most recent technology involving sequencing and bioinformatics analysis which has revolutionized the discovery of novel viruses (Yadav and Khurana, 2016). However, the challenge remains in the development of technologies that are costeffective and affordable to underdeveloped and developing countries.

References

Boonham, N., Kreuze, J., Winter, S., Vlugt, R., Bergervoet,J., Tomilson, J., and Mumford, R.2014. Methods in virus diagnostics: from ELISA to next generation sequencing. *Virus Res.*186: 20-31

Clark, M.F. and Adams, A.N.1977. Characteristics of the microplate method of enzyme – linked immunosorbent assay for the detection of plant viruses. *J.Gen.Virol*. 34 : 475 -483.

Derrick, K.S.1973. Quantitative assay for plant viruses using serologically specific electron microscopy. *Virol*. 56 : 652 -653.

Jeong, J., Ho –jong, J., and Noh, J.2014. A review of detection methods for the plant viruses.*Res.Plant Dis*. 20(3) : 173 -181.

Kausche, G.A.,Pfankuch, E., and Ruska, H.1939. The visualization of plant virus in an over-microscope.*Nat. Sci*.27(18) : 292 -299.

Yadav, N. and Khurana, P.S. 2016. Plant virus detection and diagnosis : progress and challenges.In: Shukla, P.(ed.) *Frontier Discoveries and Innovations in Interdisciplinary Microbiology*, Springer India, pp 97 -132.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Plant Pathology

Pl. Path. 591: Masters' Seminar

Name	:	Aswathi M. S.	Venue	:	Seminar hall
Admission No.	:	2016-11-018	Date	:	24/11/2017
Major Advisor	:	Dr. Raji P.	Time	:	11.30 a.m.

Imaging sensors : a potential tool for detection of plant diseases

Abstract

Plant diseases can cause economic loss in yield and quality of agricultural produce worldwide, thus affecting food safety and productivity. The common methods for detection and diagnosis of plant diseases include visual plant disease estimation by human raters, microscopic studies and advanced molecular, serological and microbiological diagnostic techniques (Bock *et al.*, 2010). These time consuming methods demand experienced individuals. Tremendous research in this field has identified sensor based methods for the detection, identification and quantification of diseases. Now the most advanced imaging type of sensor is being used that detects and conveys the information and constitutes an image. Major types of imaging sensors are Red Green Blue (RGB), thermal, fluorescence and hyper-spectral (Mahlein, 2016).

One of the oldest and commonly used technologies for plant disease detection is the digital imaging in visible spectral region (400-700 nm) called RGB imaging. Image analysis can then be carried out with the help of softwares. ASSESS V2.0 is a popular image analysis software programme within the discipline of plant pathology and it is primarily aimed at measuring the plant disease. Infrared thermography is highly suitable for the detection of disease induced modifications in plant transpiration and water status. Thermographic assessment of scab disease on apple leaves was done by Oerke *et al.* (2011) and could identify the occurrence of disease at the pre-symptomatic stage.

Infection by pathogens can affect the photosynthetic activity of the plants and there by change in chlorophyll fluorescence. The fluorescence imaging allows detection of small

change in fluorescence and thus help in the early detection of plant stress produced by the pathogens. Infection of *Albugo candida* on leaves of *Arabidopsis thaliana* was detected by fluorescence imaging even before the appearance of visual symptoms (Chou *et al*., 2000). Hyper-spectral imaging is a highly robust technique that provides rapid analysis of imaging data. Measuring spectral reflectance by hyper-spectral cameras can be used to inform plant health status as well as quantify the disease infected areas of plant. Mahlein *et al*. (2012b) identified the spectral signatures of sugar beet leaves on infection by *Cercospora* leaf spot, powdery mildew and rust which were found to be significantly different and disease specific.

The relevant areas of application of sensors are plant disease detection in field, resistance screening and assessment of plant defense reactions. Full potential of sensor based disease detection has still not been exploited. For future research it is indispensible to link complementary research fields such as plant pathology, sensor development, informatics and machine learning. Only a highly interdisciplinary approach with a close link to practical agriculture can give a powerful solution for disease detection.

References

Bock, C. H., Poole, P. H., Parker, P. E., and Gottwald, T. R. 2010. Plant disease severity estimated visually, by digital photography and image analysis and by hyper-spectral imaging. *Crit. Rev. Plant Sci*. 29: 59 – 107.

Chou, H. M., Bundock, N., Rolfe, S.A., and Scholes, J. D. 2000. Infection of *Arabidopsis thaliana* leaves with *Albugo candida* (white blister rust) causes a reprogramming of host metabolism. *Mol. Plant Pathol*. 1(2):99-113.

Mahlein, A. K., Steiner, U., Dehne, H. W., and Oerke, E. C. 2012b. Spectral signatures of sugar beet leaves for the detection and differentiation of diseases. *Precis. Agric.*11:413–431.

Mahlein, A. K. 2016. Plant disease detection by imaging sensors – parallels and specific demands for precision agriculture and plant phenotyping. *Plant Dis*. 100 (2): 241-251.

Oerke, E. C., Fröhling, P., and Steiner, U. 2011. Thermographic assessment of scab disease on apple leaves. *Precis. Agric.*12:699–715.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Plant Pathology

Pl. Path. 591: Masters' Seminar

Name	:	Aswathi M. S.	Venue	:	Seminar hall
Admission No.	:	2016-11-018	Date	:	24/11/2017
Major Advisor	:	Dr. Raji P.	Time	:	11.30 a.m.

Imaging sensors : a potential tool for detection of plant diseases

Abstract

Plant diseases can cause economic loss in yield and quality of agricultural produce worldwide, thus affecting food safety and productivity. The common methods for detection and diagnosis of plant diseases include visual plant disease estimation by human raters, microscopic studies and advanced molecular, serological and microbiological diagnostic techniques (Bock *et al*., 2010). These time consuming methods demand experienced individuals. Tremendous research in this field has identified sensor based methods for the detection, identification and quantification of diseases. Now the most advanced imaging type of sensor is being used that detects and conveys the information and constitutes an image. Major types of imaging sensors are Red Green Blue (RGB), thermal, fluorescence and hyper-spectral (Mahlein, 2016).

One of the oldest and commonly used technologies for plant disease detection is the digital imaging in visible spectral region (400-700 nm) called RGB imaging. Image analysis can then be carried out with the help of softwares. ASSESS V2.0 is a popular image analysis software programme within the discipline of plant pathology and it is primarily aimed at measuring the plant disease. Infrared thermography is highly suitable for the detection of disease induced modifications in plant transpiration and water status. Thermographic assessment of scab disease on apple leaves was done by Oerke *et al*. (2011) and could identify the occurrence of disease at the pre-symptomatic stage.

Infection by pathogens can affect the photosynthetic activity of the plants and there by change in chlorophyll fluorescence. The fluorescence imaging allows detection of small

change in fluorescence and thus help in the early detection of plant stress produced by the pathogens. Infection of *Albugo candida* on leaves of *Arabidopsis thaliana* was detected by fluorescence imaging even before the appearance of visual symptoms (Chou *et al*., 2000). Hyper-spectral imaging is a highly robust technique that provides rapid analysis of imaging data. Measuring spectral reflectance by hyper-spectral cameras can be used to inform plant health status as well as quantify the disease infected areas of plant. Mahlein *et al*. (2012b) identified the spectral signatures of sugar beet leaves on infection by *Cercospora* leaf spot, powdery mildew and rust which were found to be significantly different and disease specific.

The relevant areas of application of sensors are plant disease detection in field, resistance screening and assessment of plant defense reactions. Full potential of sensor based disease detection has still not been exploited. For future research it is indispensible to link complementary research fields such as plant pathology, sensor development, informatics and machine learning. Only a highly interdisciplinary approach with a close link to practical agriculture can give a powerful solution for disease detection.

References

Bock, C. H., Poole, P. H., Parker, P. E., and Gottwald, T. R. 2010. Plant disease severity estimated visually, by digital photography and image analysis and by hyper-spectral imaging. *Crit. Rev. Plant Sci*. 29: 59 – 107.

Chou, H. M., Bundock, N., Rolfe, S.A., and Scholes, J. D. 2000. Infection of *Arabidopsis thaliana* leaves with *Albugo candida* (white blister rust) causes a reprogramming of host metabolism. *Mol. Plant Pathol*. 1(2):99-113.

Mahlein, A. K., Steiner, U., Dehne, H. W., and Oerke, E. C. 2012b. Spectral signatures of sugar beet leaves for the detection and differentiation of diseases. *Precis. Agric.*11:413–431.

Mahlein, A. K. 2016. Plant disease detection by imaging sensors – parallels and specific demands for precision agriculture and plant phenotyping. *Plant Dis*. 100 (2): 241-251.

Oerke, E. C., Fröhling, P., and Steiner, U. 2011. Thermographic assessment of scab disease on apple leaves. *Precis. Agric.*12:699–715.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA, THRISSUR

Department of Plant Pathology

Pl. Path. 591: Master's Seminar

Name	: Divya Jayakumar V. J.	Venue	: Seminar hall
Admission No.	: 2016 - 11 - 117	Date	: 24/11/2017
Major Advisor	: Dr. Sumiya K .V.	Time	: 10.45 am

Antiviral principles in plant disease management

Abstract

Plant viral diseases are always a great threat to crop production because they cause economic loss. An annual loss of 60 billion dollars is reported all over the world. The lack of an effective virucide is the major challenge for the management of viral diseases. However some antiviral principles (AVPs) are reported which shows some suppressive effects on plant viral diseases.

Allard (1914) first reported the presence of an AVP against *Tobacco mosaic virus* in healthy *Nicotiana glutinosa* plant extract. Since then a number of AVPs have been reported, characterized and purified from several plants such as *Phytolacca* sp., *Boerhaavia diffusa, Bougainvillea spectabilis,* and *Clerodendrum aculeatum.* Most of the AVPs are basic proteins, having a molecular weight ranges between 20 to 32 kDa.

The common extraction methods include maceration of plant material in a suitable solvent, followed by filtration and centrifugation (Devi *et al.,* 2004). And further purification by various methods like ion exchange chromatography, High Pressure Liquid Chromatography (HPLC) and Ultra high Pressure Liquid Chromatography (UPLC).

Awasthi *et al.* (2016) reported the modes of action of AVPs based on an experiment on AVP from *Boerhaavia diffusa roots* against different viruses. These includes direct inhibition, ribosome inactivation and induction of systemic resistance.

Venkatesan *et al.* (2010) reported increased activity of peroxidase, polyphenol oxidase, phenylalanine ammonia-lyase and increased content of phenol, in black gram plants treated with *Mirabilis jalapa* and *Datura metel* plant extracts which indicated induction of systemic resistance by plant extracts.

Elsharkawy and El-Sawy (2015) reported effectiveness of different plant extracts *Plectranthus tenuiflorus, Clerodendrum inerme*, *Schinus terebinthifolius* and *Mirabilis jalapa* on bean plant against *Bean common mosaic virus* (BCMV). Transgenic cucumber was developed successfully by transferring pokeweed antiviral gene (*pacPAP*) and it showed resistance against *Cucumber mosaic virus* both under field and greenhouse conditions (Cao *et al.,* 2011). These studies indicate that it will be profitable to explore these natural plant products further for effective management of plant viral diseases.

References

Allard, H. A. 1914. The mosaic disease of tobacco. *US Dep. Agric. Farmer's Bull.* 40 : 33.

Awasthi, L. P., Verma, H. N., and Kluge, S. 2016. A possible mechanism of action for the inhibition of plant viruses by an antiviral glycoprotein isolated from *Boerhaavia diffusa* roots. *J. Virol. Antivir. Res.* 5(3) : 1-8.

Cao, B., Lei, J., Chen, G., Cao, P., Liu, X., Chen, Q., and Wei, X. 2011. Testing of disease resistance of pokeweed antiviral protein gene (*PacPAP*) in transgenic cucumber (*Cucumis sativus*). *Afr. J. Biotech.* 10(36) : 6883-6890.

Devi, P. R., Doraiswamy, S., Nakkeeran, S., Rabindran, R., Ganapathy, T., Ramiah, M., and Mathiyazhagan, S. 2004. Antiviral action of *Harpulia cupanoides* and *Mirabilis jalapa* against *Tomato spotted wilt virus* (TSWV) infecting tomato. *Arch. Phytopathol. Plant Prot.* 37: 245-259.

Elsharkawy, M. M. and El-Sawy, M. M. 2015. Control of *Bean common mosaic virus* by plant extracts in bean plants. *Int. J. Pest Manag.* 61(1) : 54-59.

Venkatesan, S., Radjacommare, R., Nakkeeran, S., and Chandrasekaran, A. 2010. Effect of biocontrol agent, plant extracts and safe chemicals in suppression of *Mungbean Yellow Mosaic* (MYMV) in black gram (*Vigna mungo*). *Arch. Phytopathol. Plant Prot.* 43(1): 59-72.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

DEPARTMENT OF PLANT PHYSIOLOGY

PP. 591: Masters' Seminar

Name	: Athira K. A.	Venue	: Seminar hall
Admission No.	: 2016-11- 069	Date	: 14/12/2017
Major advisor	: Dr. T. Girija	Time	: 09.15 a.m.

Eco- physiological significance of Cryptogamae

Abstract

Sub kingdom Cryptogamae comprises plants which reproduce by means of spores. The major divisions under the sub kingdom are Thallophytes, Bryophytes and Pteridophytes. The division Thallophytes mainly consists of algae. They are the most primitive autotrophic plants that lack true leaves, stem and roots. Their size ranges from the microscopic unicellular forms like *Chlamydomonas* sp. to multicellular forms like *Macrocystis pyrifera*. Bryophytes include mosses, liverworts, and hornworts. They are the second largest group of land plants after angiosperms (Sathish *et al*., 2017). They can live both in water and land hence are known as "Amphibians of the plant kingdom". Pteridophytes are seedless vascular plants, considered as the first true land plants that evolved after bryophytes and are known as "snakes of the plant kingdom".

These primitive species can be used as a tool to understand ecosystem function and also to predict environmental changes. Shift in cryptogam component of vegetation composition can help to predict biogeochemical and climate changes, leading to large scale environmental changes. Moreover, they have a number of uses in agriculture and industry. *Azolla* sp. and *Pediastrum duplex* are excellent sources of nitrogen and can be used as components in clean cultivation (Berman and Chava, 1999).

Cryptogams serve as indicators of soil, air and water pollution. Copper content in the soil can be detected by the presence of *Scopelophila cataractae. Amblysregiun riparium* and

Scapania spp. are the indicator of polluted *water*. SO2 content in the air can contribute to browning of capsules of *Funaria hygromatica.* (Singh *et al*., 2013) Biodiesel production from *Chlorella* sp. Can serve as an alternative for fossil fuel which would help in resource conservation and pollution control. Phytoplankton in water bodies release dimethyl sulfide (DMS) in the atmosphere, which plays an important role in cloud condensation and precipitation. In addition to these, many cryptogams have a number of uses in biomedicine and pharmaceutical industry (Lone *et al*., 2016). *Physcomitrella patens* is used for electricity generation.

Despite their importance and abundance, the members of *Cryptogamae* have been neglected in the past. They have immense potential in bio-geoprospecting studies. A better exploitation of these plant species can help to mitigate many environmental problems. However scant information is available about their distribution and ecological requirements. The major risks to these plants are poor air quality and loss of critical habitats. Hence, effort should be made to conserve these primitive plant species.

References

Berman, T. and Chava, S. 1999. Algal growth on organic compounds as nitrogen sources. *J. Plankton Res*. 21(8): 1423-1437.

Lone, I. H., Kowslya, E., and Rebecca, L. J. 2016. Alginate fiber from brown algae. Available: http:// www. Scholarsresearchlibrary. com/ archive. Html. ISSN 0975- 507 [28 Nov. 2016].

Sathish, S. S., Kavitha, R., and Kumar, S. S. 2017. Bryophytes in India- the current status. *Int. J. Env. Biosci*.1(4): 20-31.

Singh, K. S., Bansal, A., Jha, M. K., and Jain, R. 2013. Production of biodiesel from waste water grown *Chlorella minutissima*. *Indian J. Chem Technol*. 20(3): 341-345.

KERALA AGRICULTURE UNIVERSITY

COLLEGE OF HORTICULTURE VELLANIKKARA

DEPARTMENT OF PLANT PHYSIOLOGY

PP 591: Master's Seminar

Name : Amjath .T — Venue : Seminar hall

Admission No. : 2016- 11-103 — Date : 08/12/2017

Major Advisor : Dr. T. Girija — Time : 9. 00 AM

Photorespiration in plants – Boon or Bane

Abstract

Photorespiration is an inevitable component of C_3 photosynthetic pathway. In earlier days it was described as "necessary evil" resulting in significant loss of recently assimilated carbon and considerable amount of previously captured energy. Recent studies have helped to unravel a number of beneficial aspects for the process. Photorespiration protects the system by consuming excess reducing equivalents and energy (ATP). It can mitigate oxidative stress under conditions of drought/water stress, salinity and chilling (Voss *et al.,* 2013). Moreover essential amino acids such as serine and glycine are synthesized through photorespiratory pathway.

Photorespiration can act as an effective electron sink in plants during drought stress. Studies in tomato indicated that photorespiration is one of the major mechanism by which the excess photosynthetic electron generated under stress condition is dissipated (Haupt herting and Fock 2002). Salinity is another environmental factor limiting plant growth and productivity. Hydroxymethyltransferase an enzyme in photorespiratory pathway plays a critical role in controlling cell damage caused by salt stress (Moreno *et al*., 2005). In rice cultivar subjected to cold stress, the upregulation of enzyme catalase in photorespiratory pathway reduce the reactive oxygen species (Guo *et al.,* 2006).

The aminotransferase enzyme present in the photorespiratory cycle is capable of improve the resistance of melon against downy mildew caused by *Pseudoperanospora cubensis* (Taler *et al*., 2003). Similarly shmt-1 gene shows resistance to *Pseudomonas syringae* in Arabidopsis plant (Moreno *et al.,* 2005).

Current studies indicate that the adaptation to climate change may much more for C_3 plants than C_4 plants (Streck, 2005). Photorespiratory cycle helps to optimize photosynthesis while protecting against oxidative stress and it also integrates the functions of chloroplast, peroxisomes, mitochondria and cytoplasm. The potential benefits of this cycle seen in these plants compel us to consider it as a bane rather than boon to the plants.

References

Guo, Z., Ou, W., Lu, S., and Zhong, Q. 2006. Differential responses of antioxidative system to chilling and drought in four rice cultivars differing in sensitivity. *Plant Physiol. Biochem.* 44: 828–836.

Herting, H.S., and Fock, H.P. 2002. Oxygen exchange in relation to carbon assimilation in water-stressed leaves during photosynthesis. *Ann of Bot*, 89: 851–859.

Moreno, J.I., Martin, R., and Castresana C. 2005 Arabidopsis shmt-1, a serine hydroxymethyltransferase that functions in the photorespiratory pathway influences resistance to biotic and abiotic stress. *Plant J.* 41: 451– 463.

Streck, N. A. 2005. Climate change and agroecosystems: the effect of elevated atmospheric CO_2 and temperature on crop growth, development and yield. *Cientia Rural.* 35:730-740

Taler, D., Galperin, M., Benjamin, I., Cohen,Y., and Kenigsbuch, D. 2004. Plant *eR* genes that encode photorespiratory enzymes confer resistance against disease. *Am. J. Plant Physiol.* 16: 172-184.

Voss, I., Sunil, B., Scheibe, R., and Raghavendra, A. S. 2013. Emerging concept for the role of photorespiration as an important part of abiotic stress response. *Plant biol*. 15: 713 – 722.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

DEPARTMENT OF SEED SCIENCE AND TECHNOLOGY

SST 591: Masters' Seminar

Name	:	Athmaja S	Venue	:	Seminar hall
Admission No.	:	2016-11-017	Date	:	03/11/2017
Major Advisor	:	Dr. Rose Mary Francies	Time	:	11.15 am

Longevity of recalcitrant seed: An enigma

Abstract

The need for the long-term preservation of plant genetic resources, particularly in the face of global climate change and habitat destruction, is indisputable. Plant genetic resources can be conserved *in situ* or *ex situ*. However, the most cost-effective way of conserving plant germplasm is through seed collections.

Robert (1973) classified seeds based on their storage behaviour into orthodox and recalcitrant seeds. Seeds like those of cereals and pulse crops, that can tolerate desiccation (moisture content as low as 5%) and can be stored at sub-zero temperatures (-18^{0}C to -20^{0}C), were categorized as orthodox. Storage life span of high-quality orthodox seeds under these conditions may extend up to decades and possibly centuries, depending on the species (Berjak *et al*., 1969).

Seeds that undergo no maturation drying at the final phase of development, tolerate very little post-shedding desiccation and are often chilling-sensitive (eg. seeds of mango, cocoa, coconut etc.) were grouped as recalcitrant. Plants that produce recalcitrant seeds, usually occur in habitats conducive for relatively rapid, if not immediate, seedling establishment (Roberts and King, 1980). In such environments, there is little selective advantage for maturation drying. Many of the extant species of tropical and sub-tropical distribution, have seeds that are apparently recalcitrant (Berjak, 1969). Later, in 1990, Ellis and co-workers discovered an intermediate class of seed that can tolerate limited desiccation but are chilling sensitive (eg. citrus, papaya and coffee). The major unresolved issue in conserving recalcitrant seeds is that no successful universal storage regime has been

established. Unlike orthodox seeds, the recalcitrant seeds remain metabolically active at harvest, leading to various metabolism induced damages. The high degree of free radical production owing to the ongoing metabolic activity, add up to the rapid loss of viability in these seeds.

Several approaches at prolonging seed longevity in recalcitrant species have been attempted. The rate at which the seeds are dried is found to have profound influence on the rate of viability loss. Storage studies in *Shorea robusta* revealed that rapid drying of the seeds to their critical moisture content is more advantageous than the slow drying approach. This was because the duration of seed remaining in the aqueous based metabolism phase is reduced (Boby *et al*., 2004).

Seeds of *Hydrocaris dubia* registered a high germination (60 %) after 180 days storage under moist and imbibed condition (Zhao *et al.,* 2017*).* Apart from attempts to conserve recalcitrant seeds through moist and imbibed storage, partial dehydration and rapid cooling, and cryopreservation, the conventional *in-situ* conservation of recalcitrant species is also widely resorted to world over.

Considerable variation exists among recalcitrant seeds with respect to their response to storage conditions. Hence, storage protocols will have to be elucidated on a species by species basis. This will help develop more precise storage technologies specific to each species and thereby, help conserve the seeds for future.

References

Berjak, P., Jill. M., Farrant, B., and Pammenter, N.W. 1969. The basis of recalcitrant seed behaviour. In: Taylorson R.B. (ed.), *Recent Advances in the Development and Germination of Seeds.* Plenum Press, New York, pp. 89-108.

Boby, V., George, V.W., and Naithani, S.C. 2004. Effect of differential rates of drying on viability and storability in recalcitrant Sal (*Shorea robusta* C.F. Gaertn) seeds. *Seed Technol.* 26(1): 51-64.

Roberts, E.H. and King, M.W. 1980. The characteristics of recalcitrant seeds. In: Chin, H.F. and Roberts, E.H. (eds), *Recalcitrant Crop Seeds*, Tropical Press, Kuala Lumpur, 89p.

Zhao, S., Huang, W., Jiang, H., Sun, J., Yin, L., and Li, W. 2017. *Hydrocharis dubia* seeds maintain high seed vigor in ambient wet storage condition through scavenging hydrogen peroxide by antioxidant systems. *Aquat. Bot.* 143: 18-24.

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE, VELLANIKKARA
Department of Seed Science and Technology

SST 591: Masters' Seminar

Name	**:** Adersh S.	**Venue :**	Seminar hall
Admission No.	**:** 2016-11-060	**Date :**	05/01/2018
Major advisor	**:** Dr. Dijee Bastian	**Time :**	10.45 a.m.

Automated computer imaging system- a boon to seed industry

Abstract

The use of high quality seed is the pre-requisite to sustaining high yield in crop production. The primary bases for defining seed quality are purity, germination and freedom from diseases. Seed quality assessment and distinguishing variety on the basis of classical approach is highly difficult as it is time-consuming, labour-intensive and expensive. With the advance of technology and engineering, scholars have focused their attention on developing rapid, accurate and non-destructive techniques for seed classification and identification.

Automated Computer Imaging System (ACIS) includes X-ray imaging, Machine Vision Technology (MVT), Near Infrared Spectroscopy (NIRS), and Hyperspectral Imaging System (HIS). Advancement in computer technology leads to the use of these potential non-destructive techniques in the domain of food and seed processing like grading, sorting, and quality inspection.

X-ray imaging is one of the most prominent medical diagnostic techniques. X-ray image is a transmittance projection of the material coming across the X-ray path. In recent years, X-ray based systems (soft X-rays) have increasingly been used effectively as a research tool for the detection of internal defects in agricultural products. In seed industries, it is mainly used for seed analysis and sorting. Narvankar *et al.* (2009) used X-rays to detect fungal infection in wheat and achieved 92.2 to 98.9 per cent classification accuracy.

Machine vision technology is a computerized tool for image analysis. It refers to the acquisition of data (shape, size, etc.) via a video camera or similar system and the subsequent

computer analysis of these data following suitable processing (Dell'Aquila, 2004). It evaluates image features such as colour, size, shape, and surface texture of seeds for seed grading, variety classification and quality monitoring (Draper and Travis, 1984).

Near infrared spectroscopy and hyperspectral imaging are the other potential non-destructive techniques for seed quality assessment and classification. In NIRS, seed is irradiated with near infrared radiation, and the reflected or transmitted radiation is measured. The NIRS technique works on the principle that unique chemical composition causes molecules to absorb light in the near infrared region and vibrate at unique frequencies. The most attractive merit of NIRS is that it is a non-destructive approach to determine the chemical composition of seeds. Hyperspectral imaging integrates MVT and NIRS into a single system. This technique obtains both image and spectral information, thereby overcoming the limitations of MVT and NIRS (Ferrari *et al*., 2015).

Automated computer imaging system with its ability to handle visual data, is an important technology that will find many applications in modern varietal identification and seed certification. The unique features of each technique have a wide-ranging application in seed industry.

References

Dell'Aquila, A. 2004. Application of a computer-aided image analysis system to evaluate seed germination under different environmental conditions. *Ital. J. Agron*. 8: 51-62.

Draper, S. R., and Travis, A. J. 1984. Preliminary observations with a computer based system for analysis of the shape of seeds and vegetative structures. *J. Nat. Inst. Agric. Bot*. 16: 387-395.

Ferrari, C., Foca, G., Calvini, R., and Ulrici, A. 2015. Fast exploration and classification of large hyperspectral image datasets for early bruise detection on apples. *Chemometrics Intell. Lab. Syst.* 146: 108-119.

Narvankar, D. S., Singh, C. B., Jayas, D. S., and White, N. D. G. 2009. Assessment of soft X-ray imaging for detection of fungal infection in wheat. *Biosyst. Eng.* 103: 49-56.

.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Seed Science and Technology

SST 591: Masters' Seminar

Name	:	Reshma P.K.	Venue	:	Seminar hall
Admission No.	:	2016-11-083	Date	:	06/01/2018
Major Advisor	:	Dr. Dijee Bastian	Time	:	10.00 a.m.

Plasma treatment and seed quality

Abstract

Global food shortage is likely to escalate as a result of increase in population and urbanization. As it is difficult to increase the area under cultivation, the only way to address food shortage is by increasing the productivity. Use of quality seed alone is known to increase yield by 20 per cent. Several seed treatment methods are used to enhance the quality of seeds. One such innovative technology used recently is plasma treatment. Plasma treatment is a physio-chemical method which has the potential to improve germination and crop yield (Sehrawat *et al*., 2017).

The term 'plasma' was first coined by chemist Irving Langmuir in 1920 and it is a Greek word meaning 'moldable substance'. Plasma is the fourth state of matter. It is an ionized gas consisting of approximately equal number of positively and negatively charged electrons. It is the most abundant state of matter in the universe. More than 99.9 per cent mass of the solar system is in plasma state. Unlike the other three states of matter *viz*., solid, liquid and gas, plasma does not exist freely on the earth and can only be artificially generated by subjecting neutral gas to a strong electromagnetic field.

Devices such as Dielectric Barrier Discharge (DBD), Planar Rotating Electrode (PRE), Downstream Microwave Plasma (DMP), Hollow cathode discharge, Glidarc and Plasma torches are used to generate plasma. Among these, DBD is most commonly used for seed treatment.The source, intensity and duration of exposure of plasma determine the effectiveness of the treatment.

Several workers have reported positive effects of plasma treatment on seed characters like germination, vigour, enzyme activity, seed health, and storability. Mitra *et al*. (2013) reported enhanced germination and seedling growth in plasma treated chickpea seeds. Significantly higher dehydrogenase enzyme activity was observed in maize embryos isolated from the seeds treated

with plasma for 60 seconds (Henselova *et al*., 2012). The exposure of winter wheat to plasma for 10 seconds reduced the frequency of fungal incidence (Kordas *et al*., 2015).

Sehrawat *et al*. (2017) reported that plasma treated seeds retained higher germination up to 9 months after storage over control in okra.

Plasma treatment has been found to increase the yield, productivity and stress tolerance in many crops. Jiang *et al.* (2014) observed that plasma treatment increased the yield in wheat. Plasma treatment improved drought tolerance by improving antioxidant enzyme activities in oilseed rape (Li *et al*., 2015).

In India, plasma technology facilities have been established at Facilitation Centre for Industrial Plasma Technologies (FCIPTC), Institute for Plasma Research, Gandhinagar. The field of plasma technology is ecologically safe, cheap and highly effective for seed treatment. Apart from its application in seed industry, plasma technology plays vital role in several other industries like food, medicine, textile and automobiles. Further understanding of the principle of plasma-biological interactions will help fine tune the application of this technology in field of seed quality enhancement.

References

Henselova, M., Slovakova, L., Martinka, M., and Zahoranova, A. 2012. Growth, anatomy and enzyme activity changes in maize roots induced by treatment of seeds with low temperature plasma. *Biologia* 67(3): 490- 497.

Jiang, J., He, X., Li, L., Li, J., Shao, H., Xu, Q., Ye, R., and Dong Y. 2014. Effect of cold plasma treatment on seed germination and growth of wheat. *Plasma Sci. Technol*. 16(1): 54-58.

Kordas, L., Pusz, W., Czapka, T., and Kacprzyk, R. 2015. The effect of low temperature plasma on fungus colonization of winter wheat grain and seed quality. *Pol. J. Environ. Stud*. 24(1): 433- 438.

Li, L., Li, J., Shen, M., Zhang. C., and Dong Y. 2015. Cold plasma treatment enhances oilseed rape seed germination under drought stress. *Sci. Rep*. 6(10): 4-8.

Mitra, A., Fang Li, Y., Klampfl, T. G., Shimizu, T., Jeon, J., Morfill, G. E., and Zimmermann, J. L 2013. Inactivation of surface borne microorganisms and increased germination of seeds specimen by cold atmospheric plasma. *Food Bioprocess Technol*. 7: 645-653.

Sehrawat, R., Thakur, A.K., Vikram, A., Vaid, A., and Rane, R. 2017. Effect of cold plasma treatment on physiological quality of okra seed. *J. Hill Agric*. 8(1): 66-71.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE,VELLANIKKARA

Department of Seed Science and Technology

SST 591: Masters Seminar

Name **:**Bennett Thomas K **Venue:** Seminar Hall

Admission No.: 2016- 11- 125 **Date :** 03/11/2017

Major Advisor: Dr. Rose Mary Francies **Time:** 10.30 a.m.

Biophysical stimuli : Insights on germination and seedling growth

Abstract

Plant responses to stimulation have captured the imagination of biologists since Robert Hooke first discovered the touch-induced folding of leaves of the 'humble plant', *Mimosa pudica* as early as1665.

Biophysics or biological physics is an interdisciplinary science that applies the approaches and methods of physics to study changes in the biological systems (Pearson,1892). A stimulus is a result of change in an energy source or force, such as light, sound or heat. A plant can perceive changes in internal mechanical forces like turgor pressure (state of hydration within a cell) and gravitropic signals (gravi-perception) and external stimuli like light, temperature, heat, mechanical loading by wind, snow, rainfall, touch, *etc*

Unlike the mechanical stimuli, stimulation of plant system caused by physical factors such as ultraviolet (UV rays), gamma rays, ultrasound, ionized radiation, laser light, electromagnetic waves and magnetic stimulation, affects the dielectric characteristics of bio-membranes of plant cell. The physical stimuli increase the energy account of the cell by initializing internal transformation of energy into electrical energy, thereby increasing the electro-potential of the cell membrane. Stimulation of plant system by thesephysical factors enables plants to vegetate at a higher energy level (Vasilevski, 2003). Thus, biophysical stimulation of the seeds, increases their energy balance and thereby intensifies the intra-cell and inter-cell exchange of materials resulting in activation of the growth and yield processes.

Iqbal (2016) found that pre-sowing magnetic field stimulation of bitter gourd seed resulted in higher germination, shoot and root growth and higher growth rate. Response of plants to magnetic stimulation with varying intensity and duration of magnetic field exposure has also been reported.

Germination and seedling growth were found to be positively influenced by pre-sowing exposure to electric field in maize (Gatjens*et al.,* 2017) and other crops. Similarly, germination and seedling growth were found to be stimulated by gamma irradiation, laser radiations, ultrasound waves*etc*, in crops like okra and tomato (Norfadzrin *et al*., 2007).

To sum up, the response in seed germination and its growth due to biophysical stimuli vary the dosage, exposure time and the crop grown. Enhanced germination and seedling growth on exposure to biophysical stimuli have been attributed to accelerated metabolism in plant system, improved ion movement across plasma membrane, increased biosynthesis of chlorophyll and carotenes, increased water uptake rate, changes of hormone concentrations, stimulation of enzyme functions and biochemical reactions.

Elucidating the best stimuli to enhance seed germination and growth can be laborious and time consuming. Such discovery can, however prove advantageous in eliciting subtle or obvious responses in germination, crop growth and yield. Further research is needed to refine this technology before promoting it on a large scale.

References

Gatjens, B. O., Diaz, C., Hernandez, V. L., Chavarria, R. P., and Martinez, A. E. 2017. Effect of electric current applied in soaking conditions on germination of maize seeds. *J. Agric. Vet. Sci.* 10(4): 11-18

Iqbal, M., Haq, Z., Malik, A., Ayoub, C.M., Jamil, Y., and Nisar, J. 2016. Pre-sowing seed magnetic field stimulation: a good option to enhance bitter gourd germination, seedling growth and yield characteristics. *Biocatalysis. Agric. Biotechnol*. 5:30-37.

Norfazdrin, F., Rahman, S., and Dwiki, L. 2007. A preliminary study on gamma radiosensitivity of tomato (*Lycopericonesculentum*) and okra (*Abelmoschusesculentus*). *Int. J. Agric. Res*. 2:620-625.

Pearson, K. 1892. Mordern physical ideas. *The grammer of science*. Dover publishers, USA, 416p.

Vasilevski, G. 2003. Perspectives of the application of biophysical methods in sustainable agriculture. *Bulg. J. Plant Physiol*. 4:179-186

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Soil Science and Agricultural Chemistry

SOILS 591: MASTERS' SEMINAR

Name: Nisha Paul Venue: Seminar Hall

Admission No : 2016-11-010 Date : 07/12/2017

Major Advisor:Dr. K. M. Durga Devi Time : 9.15a.m

Novel fertilizers for enhanced nutrient uptake

Abstract

Fertilizer is a vital input for the sustainable development of crop production and the rational fertilizer application is an efficient and important measure for increasing crop production. There is an urgent need for advancement of fertilizer technology to develop newer products that will resolve poor use efficiency and environmental issues.

Enhanced Efficiency Fertilizers (EEFs) are a group of fertilizers that reduce the risk of nutrient loss to the environment and subsequently increase fertilizer use efficiency. These include slow release fertilizers, controlled release fertilizers, and stabilized fertilizers. Several studies indicated that the technologies utilized by EEFs are more effective in optimizing plant nutrient uptake when compared to non-EEF sources.Field trials showed that EEFs increased the rice yield in the range of 10-55 per cent over control and up to 17 per cent over conventional micronutrient fertilizers (Bandyopadhyay*et al*., 2014). Randall and Vetsch (2002) showed the effect of coated diammonium phosphate fertilizer in increasing yield of corn significantly.

The term 'Smart fertilizer'is coined for a group of compounds based on polymeric phosphate structures where the polyphosphate chain acts as a template and release nutrients on demand by the crop. Smart fertilizers have been developed for all the micronutrients, *viz*., zinc, iron, manganese, copper, boron and molybdenum. The molecules can be synthesized for single nutrient as well as multinutrients in any desired ratio. Unlike in products like chelates or coatings, there is no residual material build up in the soil.It increases the efficiency, reduces soil

toxicity, minimizes the negative effects associated with over dosage and also reduces the frequency of application.According to Ghosh (2015), field response of rice to smart zinc application (at 0.50 kg Zn ha^{-1}) was to the extent of 7.0 t ha^{-1}, whereas for zinc sulphate (at 5.0 kg Zn ha^{-1}) was 5.0 t ha^{-1}.

Nanomaterials loaded with plant nutrient(s), aimed at increasing plant-uptake efficiency of the nutrient(s) and/ or reducing the adverse impacts of fertilizer application are referred as nanofertilizers. Nitrogen use efficiency of conventional fertilizer and organobentonite modified nano fertilizer were studied by Subramanian and Rahale (2000). Conventional fertilizer recorded 30 per cent nitrogen use efficiency, whereas 80 per cent was observed in nanofertilizer.

Nano clay polymer composites (NCPCs), as emerging nanotechnology products have wide application in the field of fertilizers. Roy *et al*. (2015) reported that natural source of phosphorus in combination with organic acid loaded NCPC and phosphorus solubilizing bacteria is as effective as that of conventional water soluble P fertilizer and it can be used as an alternative for commercial fertilizer.

References

Bandyopadhyay, S., Ghosh, K., and Varadachari, C. 2014.Multinutrient slow release fertilizer of zinc, iron, manganese, and copper.*Int. J. Chem.Eng*. 45(4): 1447-1453.

Ghosh, K. 2015. New concepts in fertilizer development.*J. Indian Soc. Soil Sci*. 63(3): 53-58.

Randall, G. W. andVetsch, L.F.2002.Corn production affected by nitrogen application timing and tillage.*Agron. J*. 63:119–123.

Roy, T., Biswas, D. R., Datta, S. C.,Dwivedi, B. S., Bandyopadhyay, K. K., Sarkar, A., Agarwal, B. K., and Shahi, D. K. 2015. Solubilization of Purulia rock phosphate through organic acid loaded nano clay polymer composite and phosphate solubilizing bacteria and its effectiveness as P-fertilizer to wheat.*J. Indian Soc. Soil Sci*. 63(3): 327-338.

Subramanian, K. S. and Rahale, S. C. 2000.Nano fertilizer formulations for balanced fertilization of crops.*Int.J. Soil Sci.*45(3):21-25.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Soils 591: Masters' Seminar

Name :Shaniba M.	Venue: Seminar hall
Admission no: 2016-11-011	Date: 15/12/2017
Major advisor: Dr. Beena V.I.	Time : 10.00 a.m.

Bio-intervention of silicate minerals – an alternative source of potassium

Abstract

Potassium (K) ranks third among the essential plant nutrients. K exists in soil in different forms. Based on the availability to plant,soil K is categorized into four groups: water-soluble (solution-K), exchangeable, non-exchangeable, and mineral K. The major portion of the total soil K exists in the mineral fraction(92–98 per cent), which is not available to the plant.Bio-intervention of silicate minerals has been found to improve plant K availability by solubilizing mineral K.The K-supplying power of soil depends on the content and nature of K-bearing minerals and the rate at which structural and fixed-K become available to plants.

Application of silicate minerals as such is not effective as application of commercial K fertilizers. Some interventions are needed to speed up the K release rate. Inoculation of Potassium Solubilizing Bacteria (KSB) withK-feldspar powder could be a promising alternative to commercial K fertilizer and may help to maintain the availability of soil nutrients (Zhang and Kong, 2014). Mechanisms of K mobilization from silicate minerals are dissolution by organic acids, metal-complexing ligands and formation of biofilms.

Setiawati and Mutmainnah (2016) isolated potassium solubilizers from sugarcane plantations andfound that all isolates produced organic acids like citric, ferulic and coumaric acids and were capable of solubilizing K from insoluble K bearing minerals source. Anjanadevi *et al*. (2015) isolated 36 rock inhabiting potassium solubilizing bacteria from Kerala, and found that K solubilizing efficiency increased with decrease in pH, increase in viscosity and viable cell

count. Based on the level of K solubilization, two potent isolates were selected and identified as *Bacillus subtilis* and *Bacillus megaterium.*

Application of mica inoculated with bacteria (*Bacillus mucilaginosus*) significantly enhanced biomass yield, K uptake and per cent K recoveries by sudan grass than uninoculated one (Basak and Biswas, 2008). Fatima *et al*. (2014) also found that the application of KSB in maize has a significant effect on biomass yield and K uptake due to higher solubilization of K.

An advancement of knowledge in this field will contribute to a better understanding of natural process of soil K fertility and will help to develop a new approach to utilize natural mineral resources for sustainable and eco-friendly agricultural practice.

References

Anjanadevi, I. P., John, N. S., John, K. S., Jeeva, M. L., and Misra, R.J.2015. Rock inhabiting potassium solubilizing bacteria from Kerala, India: characterization and possibility in chemical K fertilizer substitution. *J. Basic Microbiol*. 56: 67-77.

Basak, B.B. and Biswas, D.R. 2008. Influence of potassium solubilizing microorganism (*Bacillus mucilaginosus*) and waste mica on potassium uptake dynamics by sudan grass (*Sorghum vulgare*Pers.) grown under two Alfisols. *Plant Soil* 317:235–255.

Fatima,S., Akram,A., Arshad,M., Chaudhari, S.K., Amjad,M.S., and Qureshi, H.2014.Effect of biological potassium fertilization (BPF) on the availability of phosphorus and potassium to maize (*Zea Mays* L.) under controlled conditions. *Inter. J. Biosci.* 5: 25-36.

Setiawati, T. C. and Mutmainnah, L. 2016. Solubilization of potassium containing mineral by microorganisms from sugarcane rhizosphere. *Agri. Agri. Sci. Procedia* 9:108 – 117.

Zhang.C. and Kong, F. 2014.Isolation and identification of potassium-solubilizing bacteria from tobaccorhizospheric soil and their effect on tobacco plants. *Applied Soil Ecol.* 82: 18- 25.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Soils 591: Masters' Seminar

Name: Sophia Baby **Venue: Seminar Hall**

Admission No: 2016-11-041 **Date: 03/11/2017**

Major Advisor:Dr. Betty Bastin **Time: 9.45am**

Biological soil crust: a multifunctional principle in terrestrial ecosystems

Abstract

Drylands include arid, semiarid and dry sub humid ecosystems which constitute approximately 41 per cent of earth's terrestrial surface. The vegetation cover in such areas is often sparse or absent. They are covered by a community of highly specialized organisms called biological soil crusts (BSCs).Biological soil crust is a complex mosaic of cyanobacteria, green algae, fungi, lichens, mosses, bacteria and other organisms. They are also known as micro floral, biogenic and cryptobiotic soil crusts or biocrusts. They constitute a specialized biotic community that exerts a strong influence on key ecosystem processes.

Biological soil crusts play key roles in global carbon (C) cycles, in terms of both C uptake and its release back into the atmosphere (Elbert *et al*., 2012).The extracellular polymers secreted by crustal organisms also contribute to soil carbon. There is an increase of 300 percent in the content of soil polysaccharides and total carbon in biologically crusted soilthan crust free soil(Rogers and Burns, 1994). Cyanobacteria and cyanolichens present in the crusts are vital sources of fixed nitrogen in the desert soils. DeFalco (1995) reported that the presence of biocrusts increases the surrounding content of soil N up to 200 percent. It also increases the potentially available P content of the soil by solubilization and nutrient rich dust trapping. Proportions of labile and moderately labile organic P are higher in BSC than in crust free soil at the expense of residual P indicating weathering of Fe/Al species by crustal organisms (Baumann *et al*., 2017).Biologically crusted soil surfaces significantly alter the uptake of bioessential elements by associated vascular plants.This has positive effect on their establishment and

growth. Increase in N content increases the decomposition rates enhancing the flow of other essential nutrients to plants.

Crustal organisms have a pronounced effect on *albedo* and soil temperature. They decrease *albedo* by absorbing more solar radiation. They have the ability to swell many times when wetted. This helps to reduce water and wind erosion. The formation of crust cover on the soil surface also protects the soil from wind and water transportation (Belnap and Gardener, 1993).

Biocrusts can be destructed by natural and anthropogenic disturbances. Grazing, fire accidents, annual plant invasion, recreational activities and burial destroy them. Crust disruption often destabilizes the underlying soil making it vulnerable to wind and water erosion.

Thus biological soil crusts play a major role in soil fertility, hydrological cycle andsoil stability which are critical to ecosystem sustainability. There is a need to carry out more research in biological soil crusts and conserve them to check the process of desertification.

References

Baumann, K., Glaser, K., Mutz J., Karsten, U., MacLennan, A., Hu, Y., Michalik, D., Kruse, J., Eckhardt, K., Schall, P., and Leinweber, P.2017. Biological soil crusts of temperate forests: their role in P cycling. *Soil Biol. and Biochem.*109: 156-166.

Belnap, J. and Gardner, J.S. 1993. Soil microstructure in soils of the Colorado Plateau: the role of the cyanobacterium*Microcoleusvaginatus*. *Great Basin Nat.*53: 40-47.

DeFalco, L.A. 1995. *Influence of Cryptobiotic Crusts on Winter Annuals and Foraging Movements of the Desert Tortoise*.Thesis.Department of Biology, Colorado State University, Fort Collins, CO, USA.48p.

Elbert, W., Weber, B., Burrows, S., Steinkamp, J., Büdel, B., Andreae, M.O., and Poschl, U. 2012. Contribution of cryptogamic covers to the global cycles of carbon and nitrogen.*Nat. Geosci*. 5: 459-462.

Rogers, S.L. and Burns, R.G. 1994. Changes in aggregate stability, nutrient status, indigenous microbial populations, and seedling emergence, following inoculation of soil with *Nostocmuscorum.Biol. and Fertil. Soils*.18: 209 -215.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Soils 591: Masters' Seminar

Name	: Diya P.V.	Venue	: Seminar hall
Admission no	: 2016-11-066	Date	: 16/12/2017
Major advisor	: Dr. A. K. Sreelatha	Time	: 9.15 a.m.

Land configuration for the management of waterlogged-saline soil

Abstract

Waterlogging and soil salinity are serious environmental problems adversely affecting crop yield, soil health and socio economic conditions of farming community. Water logging affects plant growth by reducing soil aeration around the root zone where as salinization affects the crop by increasing osmotic potential of the soil solution. Damage to plant growth and yield is more serious when these processes occur simultaneously. In general, these soils can be classified into coastal saline waterlogged soils and inland saline waterlogged soils. Poor crop productivity and poor agricultural diversification are witnessed in areas where waterlogged saline conditions exist as predominant problem. Farmers struggle in utilizing these lands for crop production.

Management of degraded land and water resources on sustainable basis offers an opportunity for horizontal expansion of agricultural area in the country. Land configuration techniques are one of the innovative technologies in managing salt affected waterlogged lands. Land shaping or configuration is the articulation of land arrangement so as to overcome certain hydrologic problems in agricultural area for potential crop cultivation. Major land configuration techniques include, raised bed and sunken bed technology, ridges and furrows, broad bed furrows, pond based integrated farming system, three tier land farming system, paddy cum fish culture *etc*.

Velmurugan *et al.* (2016) found that in an island ecosystem as in Andaman and Nicobar, permanent raised bed and furrow system with 4m wide bed and 1m height could withstand the waterlogging and avoid the entry of significant amount of salts into the furrows. The raised beds also avoid the submergence during wet season. Over the years, significant reduction in the concentration of soluble salts in the raised beds was recorded.

According to the study conducted by Tomar *et al.* (1996), performance of soybean improved significantly when planted in raised and sunken beds instead of using the normal flat planting in deep vertisols of Madhya Pradesh during rainy season and thereby helped in reducing *Kharif* fallowing.

Adoption of raised and sunken bed in alkali vertisols under waterlogged condition, reduced exchangeable sodium percentage by more than 60 percent over a period of 4-5 years. Cost benefit was computed on the basis of investment and returns of first three years. The computation indicated some loss during first year due to high investment on gypsum but over a period of 3 years, it proved to be economically beneficial (AICRP, 2003).Height of raised bed should be in a range of 1.0 to 2.0 m under waterlogged sodic conditions. Depth and width of sunken bed depends on its intended use (Verma*et al.*, 2016). In a study on rainwater management in Sundarbans delta, West Bengal, Ambast *et al.,* (1998) suggested to convert 20 per cent of the farm area into an on farm reservoir to harvest excess rain water. In Andaman, ridges and furrows of 1.0-1.5 m width and height of up to 0.5 m were constructed in low lying paddy land and ridges were used for planting coconut, arecanut and banana (Ambast *et al.*, 2011).

These land shaping techniques help to improve drainage facility, salinity reduction, increase water use efficiency, rain water harvesting and improve the agricultural diversification to sustain agricultural production thereby ensuring livelihood security for the local population.

References

AICRP, 2003. Annual report, AICRP on salt affected soils and use of saline water in agriculture, Indore, 112p.

Ambast, S. K., Ravisankar, N., and Velmurugan, A. 2011.Land shaping for crop diversification and enhancing productivity in degraded lands of Andaman and Nicobar Islands. *J. Soil Salin. Water Qual*. 3(2): 83-87.

Ambast, S. K., Sen, H. S and Tyagi, N. K. 1998. Rainwater management for multiple cropping in Sundarbans delta (W.B.). Bulletin No 2/98, Regional Research Station, Central Soil Salinity Research Institute, Canning Town, India, 69p.

Tomar, S. S., Tembe, G. P., Sharma, S. K. and Tomar, V. S. 1996. Studies on some land management practices for increasing agricultural production in Vertisols of Central India. *Agric. Water Manag*. 30: 91-106

Velmurugan, A., Swarnam, T. P., Ambast, S. K. and Kumar, N. 2016.Managing waterlogging and soil salinity with a permanent raised bed and furrow system in coastal lowlands of humid tropics.*Agric. Water Manag.*168: 56-67

Verma, C. L., Singh, Y. P., Damodaran, T., Singh, A. K. and Mishra, V. K. 2016. Developing design guidelines for calculation of width and height of raised bed and depth of sunken bed system in waterlogged sodic soil. *J. Soil Salin. Water Qual*. 8(1): 59-66.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

DEPARTMENT OF OLERICULTURE

VSC 591: Masters' Seminar

Name : Remzeena A. **Venue :** Seminar hall

Admission number: 2016-12-001 **Date :** 23/11/2017

Major advisor : Dr. P. Anitha **Time :** 09.15 a.m.

Pollination management in vegetable crops

Abstract

According to NSSO (2011), the per capita consumption of cereals has declined while that of horticultural crops like vegetables has increased. So, there is a projected demand - supply gap of 32 million tonnes of vegetables in the market by 2030. Hence, new strategies have to be adopted to boost the production of vegetables. In this context, pollination management has immense potential in augmenting vegetable production.

All crop management practices may not yield desired results unless there is an effective pollination management strategy. Hence, pollination management may also be considered as a crop management practice. It is the sum total of all horticultural practices, which enhanced pollination of a crop to improve quality and yield by management of pollinators, pollenizers and pollination conditions (Paroda, 2004).

Pollinator management enhances yield and quality of vegetables. Seventy per cent of vegetable crops are pollinated by honeybees. Honey bee pollination significantly increased fruit and seed yield in pumpkin (Walters and Taylor, 2006); organoleptic and nutritional quality of muskmelon (Huang *et al*., 2017); and fruit length and diameter in cucumber (Bui *etal*., 2017).

In protected cultivation of vegetables, farmers are faced with the problem of lack of natural pollinators with the consequence of poor fruit set even in self-pollinated crops like tomato. Bumble bee pollination resulted in high fruit weight of tomatoes grown in greenhouses (Attal*et al*., 2003). They can also be used as a suitable alternative for honey bees for pollination of muskmelon in greenhouses (Dasgan*et al*., 1999). Supplementary pollination techniques such as vibration pollination, hand pollination and pollination sprays are effective and widely used to improve fruit set of vegetables grown in protected structures (Abad and Monterio, 1989).

Pollenizer is a plant that serves as a source of pollen. In vegetables seedless watermelon and gynoecious cucumber hybrids depend on pollenizers for successful fruit set. Pollenizer management in terms of number of pollenizers and distance from the main crop is important. Distance and ratio between triploid plants and pollenizer influences the fruit yield in seedless watermelon (Nesmith and Duval, 2001).

References

Abad, M. and Monterio, A.A. 1989.The use of auxins for production of greenhouse tomatoes in mild-winter conditions.*Sci. Hortic*. 38(3-4): 167-192.

Attal, Y.Z., Kasrawi, M.A., and Nazer, I.K. 2003. Influence of pollination technique on greenhouse tomato production. *Agric. Marine Sci*. 8(1): 21 -26.

Bui, M., Singh, H.K., Waluniba, A., and Alemla, M. 2017.Qualitative enhancement of cucumber with bee (*Apiscerana*) pollination at Nagaland.*Indian J. Entomol*. 79(2): 160-162.

Dasgan, H.Y., Ozdogan, A.O., Abak, K. and Kaftanoglu, O. 1999.Effect of bumble bee and honey bee pollination on the yield and fruit characteristics of melon grown in greenhouses.*ActaHortic*.492: 159- 162.

Huang, Y., Li, W., Zhao,L., Shen, T., Sun, J., Chen, H., Kong, Q., Nawaz, M.A., and Bie, Z. 2017. Melon fruit sugar and amino acid contents are affected by fruit setting method under protected cultivation. *Sci. Hortic*.214: 288- 294.

NSSO [National Sample Survey Organization] 2011.*Consumer Expenditure Survey*.Government of India, New Delhi. 110p.

Nesmith, D.S. and Duval, J.R. 2001. Fruit set of triploid watermelons as a function of distance from a diploid pollenizer. *Hortic. Sci*. 36(1): 60-61.

Paroda, R.S. 2004. *Fruit Crops Pollination*.Kalyani Publishers, Ludhiana, 405p.

Walters, S.A. and Taylor, B.H. 2006.Effects of honey bee pollination on pumpkin fruit and seed yield.*Hortic. Sci*. 41(2): 370 – 373.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

DEPARTMENT OF OLERICULTURE

VSC 591: Masters' Seminar

Name	:Aruna S.	Venue	: Seminar hall
Admission No.	: 2016-12-002	Date	: 06/01/2018
Major advisor	: Dr. P. Indira	Time	:9.15 a.m.

Recent trends in the genetic improvement of onion

Abstract

Onion is the third most important crop of the world after potato and tomato. India ranks second in global onion production after China with an annual production of 20 million tonnes. However, India's onion productivity is one of the lowest (15.86 t ha^{-1}). To cater the requirement of ever increasing population, productivity needs to be increased.

Commonly used methods of breeding in onion are, introduction, mass selection, selfing followed by massing, recurrent selection, backcross breeding, and heterosis breeding (Pradeepkumar*et al*., 2013). Biennial habit and high degree of natural cross pollination make this crop unattractive for plant breeders. The recent trends in the genetic improvement of onion include production of double haploids, adoptability breeding for non- traditional areas, production and characterization of non pungent onion, application of molecular markers, and breeding for low input farming.

Being a cross pollinated crop, onion suffers from severe inbreeding depression on self pollination. Double haploid lines have been used to accelerate inbred line development. Anandhan *et al.* (2014) claimed a significant variation in gynogenic potential among Indian short day onion varieties. Onion is not suitable for cultivation in humid tropics. However, with the advent of tropical varieties as well as adaptation of traditional varieties to climate change, the cultivation of cool season vegetables during winter season is gradually picking up in the plains also (Menon *et al*., 2016).

Pungency in onion has been correlated with the production of lachrymatory factor, which is produced through the successive enzymatic reactions that occur upon tissue

disruption. Kato *et al.* (2016) reported the production and characterization of tear less or non pungent onion through mutagenesis.

Recognizing the potential of molecular markers, they are being widely used for diversity analysis and varietal identification, colour improvement, characterization of other quality traits, isolation of male sterile lines and genetic mapping in onion. Malik *et al.* (2017) reported the use of PCR based molecular marker (cob marker) for the isolation of male sterile and maintainer lines in onion.

A massive amount of fertilizers is needed to grow onion because of their poorly developed root system. For organic or low input agriculture plants need to be good nutrient scavengers. According to Melo (2003), variation in the root traits of onion is limited and root traits of *Allium fistulosum* can be exploited for improvement of this character.

References

Anandhan, S., Chavan, A., Gopal, J., Mote, S. R., Shelke, P. V., and Lawande, K. E. 2014. Variation in gynogenic potential for haploid induction in Indian short-day onions.*Indian. J. Genet*. 74(4): 526-528.

Kato, M., Masamura, N., Shono, J., Okamoto, D., and Imai, S. 2016. Production and characterization of tearless and non-pungent onion.*Sci. Rep.* 6: 23770-23779.Available: htpp://www.nature.com/scientificreports [15 Dec. 2017].

Malik, G., Dhatt, A. S., and Malik, A. A. 2017.Isolation male sterile and maintainer lines from North- Indian onion (*Allium cepa* L.) populations with the aid of PCR-based molecular marker.*Vegetos* 30(2): 94-99.

Melo, P. E. 2003. The root system of onion and *Alliumfistulosum* in the context of organic farming: a breeding approach. Ph. D(Ag) thesis. Wageningn University and Research Center, The Netherlands, 136p.

Menon, J. S., Prameela, P., Mohan, L. K., and Karippai, R. S. 2016.Performance evaluation of onion (*Allium cepa* L.) varieties in tropical plains of Thrissur.*J. Trop. Agric*.54 (1): 66-70.

Pradeepkumar, T., Sadhankumar, P. G., and Prasanna, K. P. 2013.*Vegetable Breeding-Theory and Practice.* Stadium Press (India) Pvt. Ltd, New Delhi. 499p.

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE, VELLANIKKARA
DEPARTMENT OF OLERICULTURE
VSC. 591 Master's Seminar

Name : Shilpashree N. **Venue: Seminar Hall**
Admission No. : 2016-12-021 **Date : 30-11-2017**
Major Advisor: Dr. Nirmala Devi S. **Time : 10:00 am**

Breeding for nutritional quality improvement in vegetable crops

Abstract

Vegetables are considered essential for well-balanced diets since they supply vitamins, minerals, dietary fibre and phytochemicals. Each vegetable group contains a unique combination and amount of these phytonutraceuticals, which distinguishes them from other groups and vegetables within their own group (Dias, 2012). Antioxidants present in vegetables reduce the risk of chronic diseases by scavenging free radical and detoxification of carcinogens. In the daily diet, they are strongly associated with improvement of gastrointestinal health, good vision and reduced risk of heart disease, diabetes and some forms of cancer.

Improving nutritional quality has recently become one of the major objectives in vegetable breeding due to the increasing awareness on benefits of neutraceutical compounds to human nutrition and health.At present, the consumers are more aware of health benefits due to nutraceuticals present in vegetable crops and hence, vegetable breeding programmes are oriented towards nutritional quality also. The success depends on enhanced nutritional content and its bioavailability.Quality refers to the suitability or fitness of an economic plant produce in relation to its end use and is classified as organoleptic, nutritional, biological and other quality traits. It is a complex character influenced by both genetical and environmental factors. Conventional and non-conventional breeding methods are employed for improvement of quality traits in vegetable crops. The choice of breeding method would be largely guided by the nature of gene action, relative magnitude of additive genetic variance, dominance variance and epistasis in a breeding population.Dey*et.al* (2006) screened bitter gourd accessions for ascorbic acid and carotenoid content and reported that DBTG-8 is highly promising for highnutritional qualities and fruit yield. Zewdie *et.al* (2000) studied the capsaicinoid inheritance in an interspecific hybrid of *Capsicum annuum* and *C.chinense*. They reported that due to significant additive gene action effects, improvement

through repeated backcrossing and selection of desirable recombinants from segregating population could be an effective way to increase the capsaicinoid content chilli.Hazra*et.al* (2012) reported that in tomato fruit carotenoid content and colour can be enhanced by different mutant genes *viz.,* high pigment (*hp*), old gold crimson (og^c) and anthocyanin (*Aft*) in Alisa Craig. The og^cgenotype increased the lycopene and beta carotene content in the fruits followed by the genotype with *hp* and *Aft.* Alisa Craig$og^c$and two mutant x non-mutant hybrids Alisa Craig og^cx Patharkutchi and Alisa Craig og^c x BCT 53 were superior over its parents for quality traits.The old gold crimson (og^c) and anthocyanin fruit (*Aft*) mutant could effectively be employed in breeding tomato hybrids for improved fruit quality.

Effect of ploidy number (2x, 3x and 4x) on TSS and Glutathione content in six polyploidy families of watermelon was studied byDavis *et al*., 2013. They reported that TSS was higher in autotetraploid than autotriploid and diploid fruit in all families (10.5%, 10.2% and 9.5% TSS respectively). Similarly, the mean GSH content was higher in autotriploid than in the diploid and autotetraploid fruits. It shows that selection of parents is very important to produce triploids with high TSS.Chakraborty*et. al.* (2000) attempted to introduce nonallergenic seed albumin gene from *Amaranthus hypochondriacus* to potato and based on AmA1 expression level, showed an increase in all essential amino acids in pSB8 and pSB8G transgenic lines compared to wild-type A16 genotype.

References

Chakraborty, S., Chakraborty, N., and Datta, A. 2000.Increased nutritive value of transgenic potato by expressing a nonallergenic seed albumin gene from *Amaranthus hypochondriacus*.*Proc. Natl. Acad. Sci.* USA, 97(7): 3724–3729.

Cuevas H. E., Song, H., Staub J. E., and Simon P. W. 2010. Inheritance of beta-carotene-associated flesh colour in cucumber (*Cucumissativus* L.) fruit. *Euphytica.*171: 301.

Davis, A. R., Webber, C. L., Liu, W., Perkins-Veazie, P., Levi, A., and King, S. 2013. Watermelon Quality Traits as Affected by Ploidy. *Hortsci.* 48(9): 1113–1118.

Dey, S. S., Behera, T. K., and Kaur, C. 2006.Genetic Variability in Ascorbic Acid andCarotenoids Content in Indian Bitter Gourd *(Momordica charantia* L.*)*Germplasm. Cucurbit Genetics Cooperative Report 28-29. Maryland, USA. 192p.

Dias, J. S. 2012. Nutritional quality and health benefits of vegetables: A Review. *Food Nutrition Sci.* 3(10): 1354-1374.

Hazra, P., Akhtar, S. H., Karak, C., Biswas, P., Atanassova, B., and Balacheva, E. 2012.Effect of mutant genes on the content of the nutritive quality related compounds in tomato (*Solanum lycopersicum* L.) fruits. *Acta Hortic.960.1*:311-318.

ZewdieY., and Bosland P. W. 2000. Capsaicinoid Inheritance in an Interspecific Hybridization of *Capsicumannuum* x *C.chinense*. *J. Amer. Soc. Hort. Sci.* 125(4):448–453.

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE, VELLANIKKARA
Department of Plantation Crops and Spices
PSMA 591: Masters' Seminar

Name : Shibana S. N.
Admission number: 2016-12-003
Major advisor : Dr. Jalaja S. Menon

Venue : Seminar hall
Date : 21/12/2017
Time : 11.30 a.m.

Adulterants in spices

Abstract

Spices are low volume high value crops which are accepted worldwide as agricultural commodities. India, with its varied agro-climatic regions, supports the cultivation of around 63 different spices and is a major spice exporting country. But recent data show that spices exported from India has the highest number of refusals among agricultural commodities in international trade. Nearly fifty per cent shipments of spices and flavours from India were refused by Food and Drug Administration (FDA) during a period of eight years from 2005 (Bovay, 2016). Adulteration is one of the important reasons for these refusals.

Adulterant means any material which is or could be employed for making the food unsafe or sub-standard or mis-branded or containing extraneous matter. It may be synthetic chemicals, earthy materials or the products of plant origin. Black pepper, one of the major spices, is adulterated with many low cost and easily available materials, among which papaya seed is the most commonly used one. Adulteration alters the saponification value, iodine value and piperine content of black pepper oleoresin (Madan *et al*., 1996).

In cardamom, an important commodity of international trade, the capsules, seeds and even seed powder are found to be adulterated. Capsules are adulterated with orange seeds, unroasted coffee berries, small pebbles and talc coated exhausted cardamom capsules. The seeds are adulterated with the seeds from wild species of cardamom (*Ammomum aromaticum, A. subulatum* and *A. cardamomum)* and seed powder is often adulterated with the powder from cardamom hulls. In chilli powder adulteration with artificial colours, synthetic pungent compounds, brick powder and even plant based materials are common (Dhanya and Sasikumar, 2010).

Turmeric powder is often adulterated with starch of maize, wheat, rice and tapioca, metanil yellow, lead chromate and powder from the wild species of turmeric (*Curcuma zedoaria*

and *C. malabarica).* Chemical fingerprints of curcuminoids or essential oils of each species serve as identification markers to detect the adulterants in turmeric (Li *et al*., 2011). In case of cinnamon (*Cinnamomum zeylanicum*), common adulterant used is cassia (*Cinnamomum cassia*). Adulteration of cinnamon inner bark oil with leaf oil can be recognized by an elevated concentration of eugenol.

To harmonize the quality of spices, product-specific standards have been established. In India, the standards by FSSAI, BIS and AGMARK are adopted. According to the standards the products should be free from the adulterants or colourants. The analytical techniques to detect the adulterants include, physical, chemical and molecular methods. Physical methods consist of macroscopic and microscopic evaluation and difference in physical parameters of spice and its adulterants. Colour tests, chromatography, spectroscopy and E-nose technique are the important chemical methods. Molecular techniques like RAPD profiling and DNA barcoding are used to detect the plant based adulterants in spices like cinnamon, black pepper, turmeric and nutmeg (Swetha *et al*., 2017).

Quality of spices is a major concern at present both in export and domestic trade. In order to maintain public health and to increase national economy through trade, new detection techniques of adulterants are to be exploited.

References:

Bovay, J. 2016. *FDA Refusals of Imported Food Products by Country and Category, 2005–2013*. Economic Information Bulletin No. 151, U.S. Department of Agriculture, Economic Research Service, 20p.

Dhanya, K. and Sasikumar, B. 2010. Molecular marker based adulteration detection in traded food and agricultural commodities of plant origin with special reference to spices. *Curr. Trends Biotechnol. Pharmacy* 4 (1): 454-489.

Li, S., Yuan, W., Deng, G., Wang, P., Yang, P., and Aggarwal, B. B. 2011. Chemical composition and product quality control of turmeric (*Curcuma longa* L.). *Pharma. Crops* 2: 28-54.

Madan, M. M., Singhal, R. S., and Kulkarni, P. R. 1996. An approach into the detection of authenticity of black pepper *(Piper nigrum* L.) oleoresin. *J. Spices Aromat. Crops* 5 (1): 64-67.

Swetha, V. P., Parvathy, V. A., Sheeja, T. E., and Sasikumar, B. 2017. Authentication of *Myristica fragrans* Houtt. using DNA barcoding. *Food Control* 73: 1010-1015.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Plantation Crops and Spices

PSMA 591: MASTERS' SEMINAR

Name : Anila Peter **Venue: Seminar Hall**

Admission No : 2016-12-006 **Date : 21/12/2017**

Major Advisor:Dr. K. Krishnakumary **Time : 11.45am**

Herbal spices as healers

Abstract

Herbal spices play a pivotal role in day-to-day life of mankind flavouring agents in foods, beverages and also in pharmaceutical industry. Scientific research indicates that spices are loaded with unique health enhancing compounds, which contains more than that of fruits and vegetables. Studies of dietary patterns around the world confirm that spice consuming populations have the lowest incidence of life threatening illness like diabetes, cancer and heart disease.

According to Shylaja and Peter (2004), herbal spices are classified based on botanical families, duration of crop and growth habit.The healing power of herbal spices isattributed to their antioxidant, anti-microbial, anti-inflammatory, anti-tumorigenic and anti-mutagenic and apoptotic activities. Lamiaceae family is the richest source of antioxidants and among herbal spices, rosemary exhibits highest antioxidant activity (Luminita, 2015).

Cardiovascular diseases are caused by a great number of factors such as high cholesterol, hypertension and increased platelet aggregation. Herbal spices have inhibitory effect on human platelet aggregation (Okazaki *et al*.,1998). According to Arulselvan and Subramanian (2007) curry leaf possesses hypoglycemic effect, which can cause decreased blood glucose level and increased plasma insulin level.

A number of *in vitro* and *in vivo* models indicated the potential of herbal spices in chemoprevention of cancer. Rosemary extract showed highest inhibition of cell proliferation on cervical epithelial carcinoma cell line (Berrington and Lall, 2012).

Aromatherapy is one of the complementary therapies which use essential oils as the major therapeutic agents to treat several diseases. Essential or volatile oil from herbal spices are widely used in aromatherapy to get relief from depression, anxiety, insomnia, muscular pain, memory loss and skin ailments.

Herbal spices are considered as potential healer of variety of diseases and can be exploited for development of future drugs. Because of easiness in cultivation, cost effectiveness and response to organic management practices, herbal spices are preferred both in rural and urban living. These herbs will serve as a better alternative medicine in the future, as the cost and negative effects of modern drugs are increasing.

References

Arulselvan, P. and Subramanian, S. P. 2007. Beneficial effects of *Murrayakoenigii* leaves on antioxidant defense system and ultra-structural changes of pancreatic beta cells in experimental diabetes in rats. *Chem. Biol. Interact*. 165: 155-164.

Berrington, D. and Lall, N.2012. Anticancer activity of certain herbs and spices on the cervical epithelial carcinoma cell line. *Asian Pac. J. Cancer Prev*. 16: 346-352.

Luminita, P. 2015. Comparative evaluation of antioxidant capacity of herbal plants by different methods. *J. Hortic. For. Biotechnol*. 19(4): 9-12.

Okazaki, K., Nakayama, S., Kawazoe, K., and Takaishi, Y. 1998. Anti-aggregant effects on human platelets of culinary herbs. *Phytother. Res*. 12(8): 603-605.

Shylaja, M.R. and Peter, K.V. 2004. The functional role of herbal spices. In: K.V. Peter. (ed.), *Handbook of herbs and spices*. Woodhead publishing, England, pp.26-38.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Plantation Crops and Spices

PSMA 591: MASTERS' SEMINAR

Name : Sreelekshmi S.	**Venue: Seminar Hall**
Admission No : 2016-12-007	**Date : 15/12/2017**
Major Advisor:Dr. B. Suma	**Time : 9:15 am**

Flavour chemistry of cocoa and cocoa products

Abstract

Cocoa –'The food of God' has been considered as a divine drink from time immemorial. It is the only source of chocolate and is consumed for sensory pleasure and energy. The value and quality of cocoa is related to its unique and complex flavour. The characteristic flavour of beans is due to a very rich volatile fraction composed of a mixture of hundreds of compounds like carboxylic acids, aldehydes, ketones, esters and pyrazines (Magi *et al.,* 2012).Currently more than 600 flavour compounds have been identified from cocoa beans and products.

Flavour development in cocoa is influenced by both pre-harvest and post-harvest factors. The pre-harvest factors mainly include genotype and origin. Based on genotype the commercially exploited varieties are Criollo, Forestero and Trinitario. They differ in their morphological features of fruit, geographic origin and flavour (Ziegleder, 2009).The specific flavour of cocoa is also influenced by postharvest processing of beans like fermentation, drying and roasting. The formation of flavour precursors, reduction in bitterness and astringency as well as development of colour are initiated during fermentation (Afoakwa *et al*.,2008).During drying, phenol oxidase catalyses the transformation of polyphenols to quinones. This undergoes condensation with amino acid leading to brown polymers which imparts colour and flavour to beans (Ziegleder, 2009). Roasting, a crucial step in cocoa processing, involves development of typicalroasty and chocolate flavour through Maillard reaction.

Flavour profiling is a method of judging the flavour of foods by examination of a list of separate factors through which theflavour can be analysed.The profiling can be done in cocoa by sensory evaluation.

The three primary products obtained after cocoa processing are nib, cocoa mass and cocoa butter. Among cocoa products, chocolate has pleasant, stimulant and euphorizing effects. The different types of chocolate like dark, milk and white are unique in preparation and flavour. In addition to widely enjoyed flavour, cocoa also has notable health benefits. High level of flavonoids in cocoa attributes to its cardiovascular health benefits. It also shows promising antioxidant, neuroprotective and chemo-preventive potentials (Andujar*et al*, 2012).

Eventhough a lot of research has been done on the flavour components of cocoa, its role in flavour formation, sensory properties and sources, and mechanisms of action are not fully understood. So more study has to be done on compositional and sensory perspective.

References

Afoakwa, E. O., Paterson, A., Fowler, M., and Ryan, A. 2008. Flavour formation and character incocoa and chocolate: a critical review. *Crit. Rev. Food Sci. Nutr.* 48: 840-857.

Andujar, I., Recio, M. C., Giner, R. M., and Rios, J. L. 2012. Cocoa polyphenols and their potential benefits for human health.*Oxid. Med.Cell. Longev*.2012: 23.

Magi, E., Bono, L., and Di Carro, M. 2012. Characterization of cocoa liquors by GC-MS and LC-MS/MS: Focus on alkylpyrazines and flavanols. *J. Mass Spectrometry* 47: 1191-1197.

Ziegleder, G. 2009. Flavour development in cocoa and chocolate. In: *Industrial Chocolate Manufacture and Use*. Blackwell Publishing, West Sussex, UK, pp.169–191

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE, VELLANIKKARA
Department of Plantation crops and Spices
PSMA-591 Masters' Seminar

Name : Dharini Chittaragi

Admission No. : 2016-12-027

Major Advisor :Dr.Jalaja S. Menon

Venue: Seminar Hall

Date : 22-12-2017

Time : 10.45 a.m.

Bio-colours from Spices

Abstract

Colour is an important aspect influencing every moment of our life. It may be the clothes we wear, furnishings of our home, religious ceremonies and even the food we relish. Colour is a molecule that absorbs certain wavelengths of visible light and transmits or reflects others. It is added to food in order to replace the colour lost during processing and to minimize the batch variations. There are four different types of colours *viz*., natural colours, nature identical colours, synthetic colours and inorganic colours (Downham and Collins, 2000).

The worldwide demand for natural colours is of great interest due to the awareness of their therapeutic properties. Bio-colour is a dye or pigment of biological origin (plants, insects, animals or microbes) that imparts colour when applied to food, drug, textiles or cosmetics (Pattnaik*et al*., 1997). Bio-colours are classified into five groups*viz*., anthocyanin, betalain, carotenoid, chlorophyll and caramel. Anthocyanins, a group of water soluble pigments, impart red to blue colours (250-650nm). Betalains yield betacyanin (red) and betaxanthin (yellow) pigments. Carotenoid groups are responsible for the yellow and orange pigments (250-650nm). Chlorophylls are found in two forms: chlorophyll a (blue - green) and b (yellow- green). Caramel is obtained by heating carbohydrates, which imparts brown colour (Sharma, 2014).

Spices are generally used for seasoning and flavouring. Some spices can also be used as biocolourants. The common spices used as colourants are turmeric (curcumin), paprika (capsanthin), saffron (crocin), tamarind (leucoanthocyanidine) and kokum (anthocyanin) (Mayavel*et al*., 2012).

Maceration method of extraction yielded high curcumin from turmeric (*Curcuma longa* L.) as compared to other methods (Kadu *et al*., 2015). The red pigment and absorbance ratio in chilli (*Capsicum annuum*) were found to decrease with decrease in moisture content as the capsanthin is heat sensitive (Basavaraj*et al.*, 2008).

In saffron (*Crocus sativus*) apart from the stigma, floral waste can also be used as natural dye. The dye extracted by using the floral waste showed high colour strength value (1.98) at acidic pH (Raja *et al*., 2012). In red tamarind (*Tamarindusindica* L.), the colour was maximum at 90 days after fruiting and this red colour can be used as a food colourant (Mayavel*et al*., 2012). The red colour of Kokum (*Garciniaindica*) can also be used as a dye in textiles (Vasundhara*et al*., 2016). Use of colour is regulated by laws, such as U.S. Food and Drug Act (1906) and Food Drug and Cosmetic Act (1938). Food and Drug Administration prohibits the use of poisionous colours in food industry worldwide (FDA, 1960).

Bio-colours have wide applications in pharmaceuticals, dairy, textiles, fisheries, food and confectioneries and in the printing industries. Although bio-colourants have potential benefits, the tedious extraction procedures, low colour value and instability during processing hinder their popularity. More detailed studies on the production and stability of bio-colours are necessary for their promotion in various sectors.

References

Basavaraj,M., Kumar, P. G. P., Sathyanarayanareddy, B., and Jagadeesha, R.C. 2008. Effect of drying on colour degradation and rheology in red chilli cv. BYADAGI.*Asian J. Hort.* 3(2): 253-255.

Downham, A. and Collins, P. 2000. Colouring our foods in the last and next millennium.*Int. J. Food Sci. Technol.* 35: 5-22.

FDA [Food and Drug Administration]. 1960. Colour additive ammendment. [on-line]. Available: https://www.fda.gov/default.htm. [16 Dec.2017].

Kadu, P., Waghmare, P. and Patingrao, D. 2015. Extraction, isolation, purification and identification of curcumin.*Eur. J. Biomed.Pharma. Sci.* 2(3): 108-123.

Mayavel, A., Singh, G. B., Durai, A., and Murugeasan, S. 2012. Evaluation of colour and stability of anthocyanin in red tamarind (*Tamarindusindica* L.).*Int. J. Adv. Life Sci.* 5(2): 137-144.

Pattnaik, P., Roy, U. and Jain P. 1997. Biocolours: New generation additives for food. *Indian Food Ind.* 16(5): 21-32.

Raja, S. M., Pareek, P. K., Shakyawar, D. B., Sarfaraz, A. W., Nehvi, F. A.,andAsif, H. 2012. Extraction of natural dye from saffron flower waste and its application on pashmina fabric.*Adv. Appl. Sci. Res*. 3 (1): 156-161.

Sharma, D. 2014. Understanding biocolour- A Review.*Int. J. Sci. Technol. Res*. 3(1): 294-299.

Vasundhara, M., Radhika, B., Thara, B.S., Priyanka, R., and Jayaram, A. 2016.Organic colours for ayurvastra from kokum fruits and rinds.*J. Med. Plants Stud.* 4(6): 104-107.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Fruit Science

FSC 591: Master's Seminar

Name	: Dhanyasree K.	Venue	: Seminar hall
Admission No	: 2016-12-008	Date	: 23/11/2017
Major advisor	: Dr. A. Sobhana	Time	: 10.45 a. m.

Rootstocks in fruit production: Making better the best

Abstract

The current changes in the fruit production scenario have challenged the quality and quantity of fruits required for the vast population. Easiest and effective way of mitigating this behaviour is the proper scion selection. Eventhough better scions could only give promising yield, the present problems of stress and low quality can be tackled by using an effective rootstock to make "better scion the best".

Generally, rootstocks can be classified into two types, seedling rootstocks and clonal rootstocks. Every rootstock to be utilized in propagation should possesscertain characteristics like high degree of compatibility with scion, well adaption to agro- climatic condition, resistance to diseases and pest, tolerance to adverse soil conditions and positive influence on growth(Hartmann *et al.*, 2002).In fruit crops, rootstocks are multiplied by both sexual and asexual methods, *viz.*,zygotic or polyembryonic seeds, stooling, cutting, and micropropagation.

The effect of rootstock on scion can be through, Stress management, canopy management and yield and quality improvement.

Certain rootstocks have ability to survive and perform better under adverse soil conditions and incidence of pests and diseases. Pandey*et al.* (2014) reported that the Olour variety of mango has high salt tolerant capacity as it impedes the uptake of chlorine ions.Tristeza virus is a devastating problem in citrus cultivation. The plants obtained by grafting sour orange on rough lemon were found to be free of citrus tristeza virus(CTV) (Abbas *et al.*,2008).

Canopy management of fruit trees refers to development and maintenance of tree structure in relation to their size and shape for maximum productivity and quality. It has been reported that the varieties Muvandan and Bappakai imparted vigour and Vellaikulamban imparted dwarfiness in Alphonso variety of mango (Reddy *et al*., 2003).

Rootstocks have a positive influence on the yield and quality of fruits.Gill *et al*. (2014) reported that the guava cultivars Sardar and Allahabad Safeda produce more number of fruits per tree when grafted on Portugal rootstock. Paulson rootstock of grape yielded high ascorbic acid content, which further resulted in better shelf life of fruits when Flame Seedless was used as the scion (Loay and Khateeb, 2017).

Righteous qualities of rootstock will pave way for increased production of fruit with improved quality and will re-write the progression of fruit orchard establishment and management.

References

Abbas, M., Khan, M. M., Fatima, B., Iftikhar, Y., Mughal, S. M.,Jaskani, M. J., Khan, I. A., and Abbas, H. 2008. Elimination of citrus Tristezaclosterovirus(CTV) and production of certified citrus plants through shoot-tip micrografting.*Pak. J. Bot.*40(3): 1301-1312.

Gill, M. S., Chahil, D. S., and Singh, N. 2014.Effect of different rootstocks on stionic relationship, tree growth and yield of guava (*Psidiumguajava* L.).*Progressive Hortic.*46(1): 34-38.

Hartmann, H. T., Kester, D. E., Davies, F.T., and Geneve, R. L. 2002.*Plant Propagation Principles and Practices* (6 thed.).Prentice Hall of India, New Delhi, 333p.

Loay, A. A. and Khateeb, E. Y.T. 2017. Evaluation the effect of rootstocks on postharvest berries quality of 'Flame Seedless' grapes.*Sci.Hortic.*220: 299-302.

Pandey, P., Singh, A. K., Dubey, A. K., and Awasth, O. P. 2014.Effect of salinity stress on growth and nutrient uptake in polyembryonic mango rootstocks.*Indian J. Hortic*. 71(1): 28-34.

Reddy, Y. T. N., Kurian, M. R., Ramachander, P. R., Singh, N., and Kohli, R. R. 2003. Long-term effects of rootstocks on growth and fruit yielding patterns of Alphonso mango. *Sci.Hortic.*77: 95-108.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Floriculture and Landscaping

FLA 591: Masters' Seminar

Name	: Priya Philip	Venue	: Seminar hall
Admission No.	: 2016-12-009	Date	: 17/11/2017
Major advisor	: Dr. Mini Sankar	Time	: 9.15 a.m

VALUE ADDITION IN ROSE: THE BLOOMING POTENTIAL

Abstract

Rose (*Rosa sp.*) is one of nature's beautiful creations and is universally acclaimed as ''queen of flowers''. No other flower can be a better symbol of love, innocence and adoration. There are about 150 species and 18000 cultivars with exquisite shape, colour and fragrance in this genus. Apart from the 'glam' factor several nutritional, pharmacological and other beneficial properties of rose have been identified, providing opportunities for potential value addition in different fields.

Since ancient times roses were used in culinary preparations like sauces, salads and desserts in various countries. Rose petals are rich in carbohydrates, proteins, polyphenols, essential fatty acids and vitamins. Anthocyanins, identified as the major pigment present in rose petals, can be used as a natural colourant in food items. Rose hips, the fleshy fruits of rose, have been discovered to be rich in essential fatty acids, vitamin C, vitamin A, vitamin E and minerals. The nutritional benefits of petals and hips can be exploited for the preparation of several value-added products like jam, jelly, syrup and squash. Kumar *et al.* (2017) standardized a process to produce natural rose syrup using fresh rose petals and sugar. The product was rich in polyphenols, antioxidants, anthocyanins and scored a high overall acceptability among consumers.

Various phytochemicals present in petals and hips were found to have several pharmacological properties like anti-cancerous, anti-HIV, anti-migraine and anti-diabetic.Gehricke *et al.* (2016) reported that rose hip oil loaded with Indole-3-carbinol had two times more anti- tumour effect than the conventional formulations.

Nature therapy is a kind of horticultural therapy aimed at achieving preventive medical effects through exposure to natural stimuli. Ikei *et al* .(2014) reported that viewing of fresh pink roses by office workers for a brief period of time significantly increased parasympathetic nervous activity which in turn resulted in significantly more comfortable state compared to control. The essential oil of rose which contains volatile organic compounds is used in aromatherapy for the management of psychiatric disorders.

Rose flowers are rich in phytochemicals which have potential antibacterial, antifungal and insecticidal properties. Antifungal activity of rose petal extracts against *Penicilliumnotatum* was reported by Zhang *et al*. (2011) and the compound responsible for the property was identified as γ-sitosterol. These types of compounds can be used for designing eco-friendly antifungal formulations.

Roses are included in cosmetics for their ability to rejuvenate and replenish skin. Rose water, essential oil, concrete and absolute are the main products obtained from roses which act as base material for the preparation of cosmetics. Kim *et al*. (2014) tested the efficacy of a shampoo containing extracts of *R. centifolia* petals and found to be as effective in treatment of dandruff as that of shampoos available in the market.

Value addition in the form of floral crafts can increase the consumer appeal and economic value of floricultural commodities. Nowadays floral crafts are widely used in special occasions. Farmers can set up small enterprises using different value-added products of rose flowers like bouquets, garlands, flower arrangements in containers and dry flower making.

Value added products open up new markets, offer new returns and is the ultimate way to rescue flowers from huge post-harvest losses. The enormous chances of rose can be effectively exploited so as to enhance grower's business and to offer them a steady income even during off season.

References

Gehricke, M., Guiliani, L., Ferreira, L., Barbieri, A. V., Sari, H., Silveira, E., Azambuja, J., Noguera, C., Braganhole, E., and Cruz, L. 2016.Enhanced photo stability, radical scavenging and anti-tumour activity of Indole-3-carbinol loaded rose hip oil nano capsules. *Materials Sci. Eng.*74: 279-286.

Ikei, H., Komatsu, M., Song, C., Himoro, E., and Miyazaki, Y. 2014. The physiological effects of viewing rose flowers in office workers. *J. Physiol. Anthropol*. 33(6): 38-43.

Kim, Y. R., Kim, J. H., Shin, H. J., Choe, Y. B., Ahn, K. J., and Lee, Y. W. 2014. Clinical evaluation of a new formula shampoo for scalp seborreic dermatitis containing extract of *Rosa centifolia* petals and epigallocatechingallate: a randomized, double – blind controlled study. *Ann. Dermatol*. 26(6): 733-738.

Kumar, A., Kaur, A., Gill, K., and Aggarwal, P. 2017. Development and economics of artificial additives - free rose syrup from desi rose. *Indian J. Econ. Dev*. 13(2): 536- 539.

Zhang, W., Rahman, F. H., and Saleh, M. A. 2011.Natural resistance of rose petals to microbial attack.*J. Environ. Sci.Health*46: 381-393.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE,VELLANIKKARA

DEPARTMENT OF FLORICULTURE AND LANDSCAPING

FLA591: Masters' Seminar

Name :AthiraBaburaj | Venue: Seminar hall

Admission No.:2016-12-013 | Date :16/11/2017

Major advisor :Dr. Sreelatha U. | Time :10.00.a.m.

Floral waste management

Abstract

Environmental degradation is a major threat confronting the world. The primary cause of environmental degradation could be attributed to the rapid growth of population, over utilization of environmental resources which adversely affect the natural resources and environment. India is on the brink of massive waste disposal crisis ,lot of studies are being taken up to solve the problem of waste management. Despite various notions about the utilization of this waste materials, they are being utilized for the production of value added products as well as for bio energy generation . According to Kimenju and Groote(2008)waste is considered as discarded tangible products of human activities that are regarded as unwanted and useless. Flower waste is a portion of biodegradable waste. Every year 8-10 lakh tonnes of flower waste is being dumped in Indian rivers. Flowers come as waste from markets,gardens,temples,churches and various cultural ceremonies.

Waste management is the process of collection, separation and final disposal of waste in a sustainable manner. Various types of waste utilization methods can be employed for utilization of floral waste.Composting is a sustainable method of waste disposal. It acts as a remunerative source of organic manure.The pot culture studies of *Rosa damscena* using vermicompost prepared from the flower waste showed good growth enhancement in terms of plant height and number of flowers/plant (Gaurav and Pathade,2011).Biogas which is a renewable source of natural gas has been adopted as one of the best alternative for fossil fuel. Ranjita*et al.*,2014 reported that flower waste showed higher biogas yield (16.69g/kg) and shorter degradation

period (4days) when compared to that of vegetable waste which yielded a low proportion of biogas (9.089g/kg) in a longer duration (6 days).

Other value added products from floral waste are essential oil, Natural dye, cosmetic cream, liquid hand wash, poultry feed, bio ethanol, biochar, herbal incense sticks and hand made papers. Rose flowers collected from the temple waste were used to extract essential oil by steam distillation method (Perumal*et al*.,2012). Marigold flower waste was successfully utilized for the production of cosmetic products like creams and hand wash.

The leutin present in marigold flower waste helps in enhancing the egg yolk colour. According to Jyothi (2008) the dye extracted from *Tageteserecta* flower waste showed good dye strength (1.17) light fastness and wash fastness. A large quantity of incense stick made using synthetic colours is burnt in worship places and during religious functions and this contributes to air pollution to some extent. This problem can be solved by making herbal incense sticks using waste flowers.Handmade papers made from flower waste has not only the advantage of being wood free but also that it is free from all chemicals and leaves no harmful by-products during manufacturing.

Floral waste management and utilisation of this waste for bio-energy and value added products contributes to a cleaner, healthier environment and creates livelihood for many people.

References

Gaurav**,** M.V. and Pathade, G.R. 2011.Production of vermicompost from temple waste (Nirmalya): A case study.*Univers. J. Environ. Res. Tech*. 1(2): 182-192.

Jothi, D.2008.Extraction of natural dyes from african marigold flower(*Tageteserecta*L.) for textile coloration.*AUTEXRes.J*. 8: 49-53.

Kimenju, S.C. and De Groote,H. 2008.Consumer willingness to pay for genetically modified food in Kenya.*Agric. Econ.* 28(8): 35-46.

Perumal, K., Moorthy, T.A., and Savita, J.S. 2012.Characterization of essential oil from offered temple flowers *Rosa damascena* Mill. *Asian J. Exp. Biology. Sci*. 3(2): 330-334.

Ranjitha, J., Vijayalakshmi, S., Vijaya, K.P. and Ralph, N.P.2014. Production of bio-gas from flowers and vegetable waste using anaerobic digestion.*Int. J. Res. Eng. Tech*. 3(8):279-283.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE,VELLANIKKARA

DEPARTMENT OF FRUIT SCIENCE

FSC591: Masters' Seminar

Name :Lakshmi K.S. Venue :Seminar hall

Admission No.: 2016-12-013 Date :24/11/2017

Major advisor : Dr. JyothiBhaskar Time:09.15 a.m.

Flowering and fruiting cycle management in fruit crops

Abstract

India is the second largest producer of fruits in the world after China, having an annual production of 68.46 million tonnes from an area of 6.10 million hectares (NHB, 2015). However in productivity (11.2 MT/ha), India stands at the eighth position (FAOSTAT, 2015). One of the main reasons for low productivity is the unscientific management of the orchards. For scientific management of the orchards, knowledge regarding the flowering and fruiting cycle of fruit crops is very essential.

The differentiation of vegetative primordia to reproductive primordia (floral transition) is the first step during the reproductive phase which determines the blossom intensity and yield capacity. The mechanisms regulating floral transition is more complex in perennial fruit crops, as they are constantly exposed to environmental cues and can be well elucidated by flowering model systems. The model explains different floral initiation pathways *viz*., long day, autonomous, vernalization and GA pathways (Coen and Meyerowitz, 1991).

The main aim of flowering and fruiting cycle management is to get uniform and early flowering, ultimately leading to high yield and quality, which is possible through cultural and chemical methods. The cultural methods such as pruning, bending, girdling, withholding irrigation, rejuvenation and bahar treatment are followed in fruit crops. Current trend is to adopt high density planting or meadow orcharding in fruit crops which leads to high yield and quality fruit production.

Nowadays plant growth regulators and chemicals are widely used for inducing flowering and improving fruit set and quality of many fruit crops which include paclobutrazol, ethrel, gibberellins and naphthalene acetic acid.

Drenching the soil basin with paclobutrazol reduced the days taken for flowering in mango (Singh and Ranganath, 2006). Application of plant growth regulators is being done commercially in pineapple and mango orchards for flower induction (KAU, 2016). Summer pruning in guava reported highest yield and quality fruits in winter season crop compared to rainy season crop which in turn induced the off season fruit production (Prakash *et al*.,2012). Samant*et al*. (2016) reported thatbranch bending in guava resulted in higher yield and quality than shoot pruning.

Since the efficiency of flowering and fruiting cycle management varies with climatic conditions and fruit crops under cultivation, the technique are to be standardized for each crop under different agro-climatic conditions before they are exploited commercially.

References

Coen, E.S. and Meyerowitz, E.M. 1991. The war of the whorls: genetic interactions controlling flower development. *Nature* 353: 31-37.

FAOSTAT [FAO Statistical Databases]2015.Food and Agriculture Organization. Available:https://databases.library.wisc.edu/browse/statistics [20 Nov. 2017].

KAU[Kerala Agricultural University] 2016.*Package of Practices Recommendations: Crops* (15th Ed.). Kerala Agricultural University, Thrissur, 392p.

NHB[National Horticultural Board] 2015.Indian horticulture data base. Available: http://nhb.gov.in/PDFViwer.aspx?enc=3ZOO8K5CzcdC/Yq6HcdIxC0U1kZZenFuNVXacDLxz28= [20 Nov. 2017].

Prakash, S., Kumar, V., Saroj, P.L., and Sirohi, S.C. 2012.Response of yield and quality of winter guava to severity of summer pruning.*Indian J. Hort*. 69(2): 173-176.

Samant, D., Kishore, K., and Singh, H.S. 2016.Branch bending for crop regulation in guava under hot and humid climate of eastern India.*J. Indian Soc. Coastal Agric. Res.* 34(1): 92-96.

Singh, D.B. and Ranganath, H.R. 2006.Induction of regular and early fruiting in mango by paclobutrazol under tropical humid climate.*Indian J. Hort*. 63: 248-250.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE VELLANIKKARA

Department of fruit science

FSC 591: Master's seminar

Name	: Amal Premachandran.	Venue : Seminar hall
Admission No.	: 2016- 12- 025	Date : 16/11/2017
Major Advisor	: Dr. Sajan Kurien.	Time : 10. 00 AM

Less is better: Strategies and prospects of seedless fruits

Abstract

Seedlessness is appreciated by consumers both for fresh consumption (e.g., grape, citrus, and banana) as well as in conserved or processed form. Evidence that seedless forms of *Vitis vinifera* grapes have been prized for many centuries asdried fruit is provided by Greek philosophers such as Hippocrates, Platon and in the writings of ancient Egypt of 3000 BC.

In most plants, early fruit development can be divided into three phases. Phase I: Ovary development, Fertilization, and Fruit Set, Phase II: Cell division, Seed formation, and Early embryo development and Phase III: Cell expansion and Embryo maturation. A different scenario of chemical and genetical manipulation is occurring in seedless fruits were hormonal and signal transduction alteration mainly is case growth regulators gibberellins, cytokinin and synthetic auxin, and parthenocarpic gene(George *et al*., 1984). These hormonal changes mimic the normal fruit development and result into fruit without seed. One of the classical case of seedless is the parthenocarpy, majorly 3 types of parthenocarpy exist they are vegetative parthenocarpy, stimulative parthenocarpy and stenospermocarpy.

Seedlessness in could be due to many reasons include certain environmental conditions, such as low or high temperatures, chemical treatments, chromosomal aberrations leading controlling meiosis and certain minor factors like self-incompatibility and age. There are many techniques for induction of seedlessness in fruits some of the major and relevant techniques are growth regulator application, ploidy breeding, mutation breeding, endosperm culture, biotechnological and transgenic approaches.Growth regulator such as gibberellins, cytokinin and auxin are having profound effect, in that gibberellins is found to be more successful and widely used. Increase in concentration of the gibberellins application to the grape flower has resulted in increase in production of seedless fruit (Dass and Randhawa, 1968). Gibberellin application to the facultative parthenocarpy citrus cultivar resulted in seedless fruit. Moreover, it has increased the ovary weight and fruit set (Mesejo *et al.,* 2016). Cytokinin has shown to abort seed in the fruits of family Rosaceae and increase the fruit set (Zhang *et al*., 2008).Ploidy manipulation is found to another effective technique in fruits like citrus and grape. In these crops tetraploid when

crossed with diploid cultivars resulted in triploids and further it has been rescued through embryo rescue technique (Alezae *et al*.,2012). Mutation have also shown to be successful technique and resulted in considerable reduction of seeds in the citrus (Goldenberg *et al.,*2014). Biotechnological and transgenic approaches are picking up the momentum in this field somatic hybridization, suicidal gene incorporation and manipulating hormone which regulate the fruit set is a promising technique.

Seedless fruit have many advantage over seeded, possibility of year-round production without the worry of pollen is profound. Moreover, it has gustatory and fruit quality advantage. Biochemical analysis also revealed that clear cut superiority of seedless fruit over seeded(Bermejo *et al.,* 2011;Hamza *etal*., 2016).Further consumer preference and needs of processing industry also revels the significance of seedless fruits. Limitation including small and malformed fruit and stability of gene expressing could be effectively handled by emerging technologies.

References

Aleza,P., Juárez, J., Hernández, M., Ollitrault, P and Navarro, L. 2012. Implementation of extensive citrus triploid breeding programs based on 4x×2x sexual hybridizations. *Tree Genet. & Genomes*. 8:1293–1306.

Bermejo, A., Pardo, J and Cano, A. 2011. Influence of Gamma Irradiation on Seedless Citrus Production: Pollen Germination and Fruit Quality. *Food and Nutr. Sci.* 2: 169-180.

Dass, H. C and Randhawa, G. S. 1968. Effect of gibberline on seeded *Vitis vinifera* with special reference to induction of seedelessness. *Vitis*. 7: 10-21.

George, W., Scott, J and Spllttstoesser, W. 1984**.** Parthenocarpy in tomato. *Hort. Rev*. 6: 65-84.

Goldenberg, L., Yaniv, Y., Porat, R and Carmi, N. 2014. Effects of gamma-irradiation mutagenesis for induction of seedlessness, on the quality of Mandarin fruit. *Food and Nutr. Sci.*5: 943-952.

Hamza, H., Mrabet, A and Araujo, A. J. 2016. Date palm parthenocarpic fruits (*Phoenix dactylifera* L.) cv. Deglet Nour: chemical characterization, functional properties and antioxidant capacity in comparison with seeded fruits. *Scientia Horticulturae*. 211: 352–357.

Mesejo, C., Yuste, R., Reig, C., Fuentes, A. M., Iglesias, D. J., Fambuenab, N. M., Bermejoc, A., Germanàb, M. A., Milloc, E. P and Agustía, M. 2016. Gibberellin reactivates and maintains ovary-wall cell division causingfruit set in parthenocarpic Citrus species. *Plant Sci*. 247: 13–24.

Zhang, C., Lee, U and Tanabe, K. 2008. Hormonal regulation of fruit set, parthenogenesis induction and fruit expansion in Japanese pear. *Plant Growth Regul*. 55: 231–240

KERALA AGRICULTURE UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Fruit Science

FSC 591: Master's Seminar

Name : Mohammed Murthala C. N. Venue: Seminar hall

Admission No.: 2016-12-026 Date : 05/01/2018

Major Advisor : Dr.K. AjithKumar Time : 10.00 AM

Role of Volatile Organic Compounds (VOCs) in fruit crops

Abstract

Volatile compounds act as a language that plants use for their communication and interaction with the surrounding environment. A total of 1700 volatile compounds have been isolated from more than 90 plant families. These volatiles, released from leaves, flowers, and fruits into the atmosphere and from roots into the soil, defend plants against herbivores and pathogens or provide a reproductive advantage by attracting pollinators and seed dispersers. Plant volatiles constitute about one per cent of plant secondary metabolites and are mainly represented by terpenoids, phenylpropanoids/benzenoids, fatty acid derivatives, and amino acid derivatives.

Due to the complex nature of the volatile profiles, volatile composition is continuously changing in fresh fruits. Many factors affect volatile composition including the genetic makeup of the fruit, its maturity, environmental conditions during production, postharvest handling, and storage.

The biosynthetic pathways lead to the emission of plant Volatile Organic Compounds (VOCs). The precursors for plant VOCs originate from primary metabolism. The three major biosynthetic pathways areshikimic acid, mevalonic acid andMethyl Erythritol Phosphate (MEP) pathways (Dudavera *et al*., 2013).

In general, the measurement of plant VOC emissions consist of three steps- collection of plant-emitted VOCs,separation of the plant-emitted VOC-blend and quantification of the separate VOCs (Jansen *et al*., 2011). Various types of detectors are available on the market to identify and quantify plant emitted VOCs. The most popular detectors in use are the Flame

Ionization Detector (FID) and the Mass Spectrometer (MS). Electronicnoses (E-noses) are also widely used to detect plant-emitted VOCs in air.

Functions are attraction of pollinators (Pichersky and Gershenzon, 2002) and dispersers of seed, above ground defense against herbivores, protection against pathogens(Song and Ryu, 2013)and plant toplant signaling (Cellini *et al*., 2015). In addition, they protect plants against abiotic stresses such as high light, temperature and oxidative stress(Vieira *et al.,* 2016)and VOCs can be exploited for marker assisted selection.

Studies have been conducted to know the influence of VOCs in abiotic and biotic stress defense mechanism. Both individual and blended VOCs are important in plant communication (Ueda *et al*., 2012). Thelimitations of VOC mediated plant communication are the rapid evaporation rate of VOCs andnarrow rangecommunication.

References

Cellini, A., Biondi, E., Buriani, G., Farneti, B., Braschi, I., Savioli, S., and Spinelli, F. 2015. Characterization of volatile organic compounds emitted by kiwifruit plants infected with *Pseudomonas syringe*pv. *actinidiae* and their effects on host defences. *Trees* 30:795-806.

Dudavera, N., Klempien, A., Muhlemann, J. K., and Kaplan, I. 2013. Biosynthesis, function and metabolic engineering of plant volatile organic compounds.*New Phytologist* 198: 16-32.

Jansen, R. M. C., Wildt, J., Kappers, J. W., Bouwmeester, H. J., Hofstee, J. W., and Henten, E. J. 2011. Detection of diseased plants by analysis of volatile organic compound emission.*Annu. Rev. Phytopathol*. 49: 157-174.

Pichersky, E. and Gershenzon, J. 2002. The formation and function of plant volatiles: perfumes for pollinator attraction and defense. *Curr.OpinionPlant Biol.* 5: 237-243.

Song, G. C. and Ryu, C. M. 2013. Two volatile organic compounds trigger plant self-defense against a bacterial pathogen and a sucking insect in cucumber under open field conditions. *Int. J. Mol. Sci.* 14: 9803-9819.

Ueda, H., Kikuta, Y., and Matsuda, K. 2012. Plant communication mediated by individual or blended VOCs. *Plant Signaling Behav.* 7: 222-226.

Vieira, D. S., Emiliani, G., Michelozzi, M., Centritto, M., and Maserti, B. 2016.Polyploidization alters constitutive content of Volatile Organic Compounds (VOC) and improves membrane stability under water deficit in Volkamer lemon (*Citrus limonia*) leaves. *Environ. Exp. Bot.* 126: 1-9.

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE,VELLANIKKARA
DEPARTMENT OF POST HARVEST TECHNOLOGY
PRT 591: Masters' Seminar

Name : Archana Unnikrishnan **Venue : Seminar hall**
Admission No.: 2016-11-005 **Date : 06/01/2018**
Major advisor : Dr. Saji Gomez **Time :11.30 a.m.**

Taste the diversity of fruit wines

Abstract

India is the second largest producer of fruits in the world. Due to improper post- harvest handling and inadequate processing facilities, nearly 25 to 30 per cent of horticultural production goes waste. The fruit and vegetable preservation industry in India utilizes less than 2 per cent of the total fruits produced.

Alcoholic fermentation is considered as one of the best methods of preservation. Wine is one of the oldest, fermented, traditional, convenient alcoholic beverages of the mankind (Das *et al.,* 2012). Fruit wines are made from fruits other than grapes and are often named after the fruits as in mango wine, pineapple wine. Wines are classified into different types depending upon the various attributes such as colour, alcohol content, use, presence or absence of carbon dioxide, and sugar content.

Many tropical and subtropical fruits yield good amounts of juice on extraction. Reddy and Reddy (2009) studied production, optimization and characterization of wine from ten mango varieties (*Mangifera indica*Linn.) and concluded that Banganapalli, Totapuri and Alphonso were the most suitable cultivars for mango wine production on the basis of physio-chemical properties and sensory characteristics. Banana fruits yield high amount of wine when fermented with baker's yeast and tannin content in the wine was found to increase from 0.009mg $100ml^{-1}$ to 0.022mg $100ml^{-1}$ during storage (Saritha, 2011). The fermentation of jackfruit was very fast and 12-14 per cent alcohol content was achieved in two weeks, which rose up to 19 per cent on 21^{st} day (Nirmal *et al*., 2013).

Most of the minor fruits are rich in vitamins, antioxidants, organic acids, and phenolics and thus suitable for wine making. Prem*et al*. (2016) studied the overall acceptability of wine prepared from three minor fruits namely bilimbi, goose berry, and Java apple and concluded that

the overall acceptability was very high for goose berry followed by bilimbi and Java apple.Fruit wine made from Cricket ball variety of sapota was found to be superiortoKalipatti variety and itsover all acceptability was higher at a pH level of 3.5 and at 6% inoculum level of fermenting yeast (Sreenivasulu, 2004). Jamun is a fruit which is universally accepted for its medicinal property and is rich in anthocyanin. Choudhary and Ray, (2007) reported that the jamun wine contained high concentration anthocyanin and tannin (60± 4.5 and 1.40 ± 0.75mg 100 ml^{-1})respectively than grape wine. Phenol content of sweet lovi- lovi wine increased during storage which witnessed 0.22mg 100 ml^{-1} initially and 0.33mg $100ml^{-1}$ three months after storage (Sebastian, 2017).

Fermentation is a viable and easy method of food preservation and every fruit has good fermentation capability. This should be exploited in order to increase the shelf life of fruits by reducing the post harvest losses.

References

Chowdhary, P. and Ray, R. C. 2007.Fermentation of jamun (*Syzigiumcumini*L.) fruits to form red wine. *ASEAN Food J.* 14 (1): 15-23.

Das, A., Rayachaudhari, U., and Chakraborty, R. 2012. Cereal based functional food of Indian subcontinent. A review.*J. Food Sci. Tech.* 49(6): 665- 672.

Nirmal, S., Sonam, P. B., and Danesh, A. 2013.Process optimization for fermentation of wine from jackfruit(*Artocarpusheterophyllus Lam.*).*J. Food Process. Tech.* 4: 2- 8.

Prem, J. V., Jiby, J. M., Sajeshkumar, N. K., Ajesh, C. K., and Benchamin, A. 2016.Wine production from various underutilized and neglected fruits in Kerala.. *J. Biotech.* 5(2): 1-14.

Reddy, W. and Reddy, A. 2009.Effects of different inoculation strategies of *Saccharomyces cerevisiae* and *Williopsissaturnus* on chemical components of mango wine.*J. Food Sci. Tech.* 47: 85- 92.

Saritha, E. V. 2011. Process standardization for banana wine.MSc(Ag) thesis, Kerala Agricultural University, Thrissur, 90pp.

Sebastian, K. 2017. Post harvest characterisation and value addition of sweet lovi-lovi (*Flacourtia*spp.). MSc(Ag) thesis, Kerala Agricultural University, Thrissur, 95pp.

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKKARA

Department of Processing Technology

PRT 591: Master's Seminar

Name	: Geethu M.	Venue	: Seminar hall
Admission No.	: 2016-12-014	Date	: 14/12/2017
Major Advisor	: Dr. K. B. Sheela	Time	: 10.00 AM

Smart packaging for quality and safety

Abstract

Packaging is one of the main processes to preserve the quality of food products during transportation and storage helping in efficient marketing and distribution by reducing food spoilage. The basic functions of packaging are containment, protection, convenience and communication.

Active packaging is the system of packaging in which subsidiary constituents have been deliberately included in the packaging material or the package headspace to enhance the performance of the package system (Robertson, 2012).Intelligent packaging or smart packaging is the system that monitors the condition of packaged foods to give information about the quality during transport and storage (Ahvenainen, 2003). It can be used to check the effectiveness of active packaging systems (Kerry *et al*., 2006). The three important technologies used for smart packaging are indicators, data carriers and sensors.

Indicators indicate the presence, absence or concentration of another substance or degree of reaction between two or more substances by characteristic changes (Kerry *et al*., 2006).Mainly three categories of indicators are used viz. temperature indicators, freshness indicators and gas indicators. Temperature indicators respond with visual changes by the melting of a solvent at temperature higher than critical temperature (Lorite *et al.,* 2017).

Data carriers provide information on automation, traceability, theft prevention or counterfeit protection rather than quality status of the food. Barcode labels and RFID tags are the

important data carrier devices. By connecting the critical temperature indicator to a RFID tag, the visible response is converted to a remotely readable signal which can be applied to monitor and trace the supply chain (Lorite *et al.,* 2017).

A sensor is used to detect, locate or quantify energy or matter, by giving a signal to the device which responds (Kress-Rogers, 1998). Biosensors and gas sensors are important sensors available in food industry. Active and smart biodegradable packaging material has been developed. Thermo-plastic starch films (TPS) with tea extract (TPS-T) showed significant antioxidant property and with basil extract (TPS-B) showed colour change at different pH. Both films have fast degradation and excellent thermal properties (Medina-Jaramillo, 2017).

Adoption of novel and advanced packaging technologies in food industry is useful not only to extend the shelf life and improve quality, but also to provide information about the product safety. Research works on smart packaging technologies going on in and around the world helps to ensure food and nutritional security.

References

Ahvenainen, R. 2003. Active and intelligent packaging: an introduction. In: Ahvenainen, R. (ed.), *Novel Food Packaging Techniques*. Woodhead Publishing, Cambridge, UK, pp. 5-21.

Kerry, J. P., O`Grady, M. N., and Hogan, S. A. 2006. Past, current and potential utilization of active and intelligent packaging systems for meat and muscle-based products: a review. *Meat Sci*. 74: 113-130.

Kress-Rogers, E. 1998.Terms in instrumentation and sensors technology. In: Kress-Rodgers, E. (ed.), *Instrumentation and Sensors for the FoodIndustry.*Woodhead Publishing, Cambridge, UK, pp. 673-691.

Lorite, G. S., Selkala, T., Sipola, T., Palenzuela, J., Jubete, E., Vinuales, A., Cabanero, G., Grande, H. J., Tuominen, J., Uusitalo, S., Hakalahti, L., Kordas, K., and Toth, G. 2017. Novel, smart and RFID assisted critical temperature indicator for supply chain monitoring. *J. Food Eng.* 193: 20-28.

Medina-Jaramillo, C., Ochoa-Yepes, O., Bernal, C., and Fama, L. 2017. Active and smart biodegradable packaging based on starch and natural extracts. *Carbohydr.Polym.* 176: 187-194.

Robertson, G. L. 2012. *Food Packaging: Principles and Practice* (3rd Ed.). Taylor and Francis, New York, 686p.

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE, VELLANIKKARA
DEPARTMENT OF COMMUNITY SCIENCE
FN 591: Master's Seminar

Name	: Amitha Elias	Venue	: Seminar hall
Admission No.	: 2016-16-003	Date	: 30/11/2017
Major advisor	: Dr. Aneena E.R.	Time	: 11.30 a.m.

Food based strategies for polycystic ovary syndrome (PCOS)

Abstract

Women face many health related challenges throughout her life. Polycystic Ovary Syndrome (PCOS) is the most common endocrine disorder among women today. It is characterised by chronic anovulatory dysfunction and hyperandrogenism with a significant psychological burden throughout the life. Sedentary life style coupled with unhealthy eating habits has turned it as a life style disease.

PCOS is defined as a hormonal disorder characterised by the presence of atleast one polycystic ovary accompanied by ovulatory dysfunction and excessive secretion of androgen (Vijaya *et al.,* 2009). PCOS is a leading cause of infertility among women (Snehalatha *et al*., 2013) and was prevalent in 116 million women (3.4%) worldwide in 2012 (WHO, 2016). Hyperandrogenism is a characteristic feature of PCOS and is detected in 60 – 80 per cent of PCOS patients. Insulin resistant PCOS and non insulin resistance PCOS are the major types of PCOS. The risk factors of PCOS are sedentary life style, obesity, stress, endocrine disorders, family history and dietary habits. Dandruff, male pattern baldness, excessive facial hair growth, masculine features, dark patches, acne, weight gain are the physical implications of PCOS. There are many consequences like, infertility, complications in pregnancy, miscarriage, gestational diabetes, pregnancy induced hypertensive disorder and increased endometrial hyperplasia. Obesity, weight gain, insulin resistance, hyperglycemia, cardio vascular diseases and metabolic syndrome are the major metabolic implications of PCOS.

The strategies for management of PCOS involve dietary management, exercise and stress management. Weight management is the prime important objective of diet management in PCOS. Low carbohydrate, low cholesterol, high fibre, low saturated fat diet is suggested for PCOD patients (Nair *et al*., 2015). Restriction of high glycemic foods and a high intake of whole grains, fibre rich vegetables, fruits and green leafy vegetables is also suggested (Farshi *et al.,* 2007). Antioxidant rich foods have greater role in PCOS to reduce oxidative stress. High vitamins and minerals supplementation is recommended to boost immunity among PCOS patients.

Polycystic Ovary Syndrome **(**PCOS) is a multifaceted disease which is closely linked with diabetes and obesity. Strategies to reduce body weight and to improve insulin resistance have to be adopted from the early stage of detection. Dietary management, exercise and life style modifications can effectively manage PCOS among women.

References

Farshchi, H., Rane, A., Love, A., and Kennedy, R. 2007. Diet and nutrition in polycystic ovary syndrome (PCOS): Pointer for nutritional management. *J. Obstet. and Gynecol.* 27(8): 762-773

Nair, M., Pappachan, P., Balakrishnan, S., Leena, M., George, B., and Russell, P. 2011. Menstrual irregularity and Polycystic Ovarian Syndrome (PCOS) among adolescent girls- a 2 year follow-up study. *Indian J Pediatrics*. 79(4): 69-73.

Snehalatha, C., Viswanathan V., and Ramachandran, A. 2003. Cut-off value for normal anthropometric variables in Asian Indian adults. *Indian J. Diabetes*. 35:1380–1384p.

Vijaya, K.D. and Bharatwaj, R.S. 2012. Prevalence and undetected burden of Polycystic Ovarian Syndrome (PCOS) among female medical undergraduate students in south India - A prospective study in Pondicherry. *Glob. J. Res. Anal.*, 3(1): 63-64.

WHO [World Health Organization], 2013. Food Science and Nutrition for Women, (14^{th} Ed.). World Health Organisation, Geneva, 306p.

KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE, VELLANIKKARA
DEPARTMENT OF COMMUNITY SCIENCE
FN 591: Masters' Seminar

Name	**: RammyaMolu K.**	**Venue**	**: Seminar Hall**
Admission No.	**: 2016-16-002**	**Date**	**: 21/12/2017**
Major advisor	**: Dr. Aneena E. R.**	**Time**	**: 09.15 a.m.**

Modified starches and their applications

Abstract

Starch is the principal food reserve polysaccharide of the plant kingdom. It occurs in cereal grains, pulses, tubers, bulbs and fruits in varying amounts. It is one of the most abundant carbohydrate in nature and these starchy substances constitute the major part of diet for human as well as for many other animals. Starch consists of two types of molecules namely, amylose and amylopectin. Amylose is a linear chain molecule and amylopectin contains both linear and branched chain molecules. It is not only the primary source of food for the humans, but can also be regarded as renewable resource that can be utilized in industrial and therapeutic food applications.

Singh *et al*. (2010) reported that unprocessed native starches are structurally weak and functionally restricted for applications in pharmaceutical, food and non-food technologies. Modifications are necessary to improve qualities which add a range of functionality. Several quality attributes of starches can be greatly improved and some characteristics like paste viscosity, gel strength and paste stability can be tailored by starch modification. When starch is modified, the molecules are chemically or physically engineered into a new structure that gives the desired property. Modified starches are typically used in food industries around the globe.

One or more of the original characteristics of food starches altered by various treatments in accordance with good manufacturing practice, are referred to as modified starches. Modification can be chemical, physical and enzymatic. Chemically modified starches include cross linked starch, oxidized starch and acid hydrolysed starch. Physically modified starches include pregelatinised starch, thermally modified starch and also starches modified by means of ultra-high pressure, microwaves and ultrasound. Enzyme modification can be done by hydrolysis using enzymes like α-amylase and cyclodextrin glycosyl transferase [CGTase] (Neelam *et al*., 2012).

Resistant starches are a typical example for physically modified starch. These are the starch and products of starch digestion that are not absorbed in the small intestine of healthy individuals. Resistant starches have wide application in therapeutic and food industry (Baby, 2014). Resistant starches are abundant dietary sources of non-digestible carbohydrate and are produced by thermal modification of starch. Instant starches or pregelatinised starches are prepared by cooking the slurry, roll drying or spray drying or by extrusion process (Singh *et al*., 2010). Instant starches are widely used in instant food mixes, soup mixes, textiles and paper industry.

Oxidized starches are obtained by reaction with sodium hypochlorite or peroxide. These are mainly used as surface sizing agent, coating agent, flavour encapsulating agent, etc. Acid hydrolysed starches are also known as thin boiled starch. Fragmentation of granules, low paste viscosity, high gelatinisation temperature are the characters of acid hydrolysed starch. It is used in food and pharmaceutical industries. Maltodextrin is a starch derivative, produced from various starch sources like cassava and corn starch by enzymatic hydrolysis with α-amylase. It is widely used as fat replacer, anticaking agent and bulking agent in food industry. Cyclodextrins are oligosaccharides produced by enzyme hydrolysis using CGTase (Singh *et al*., 2002). They are flavour protecting agent and also in processed foods to mask off odours (Valle, 2003).

Several studies with various modified starches gave negative results to toxicities including carcinogenesis and hence it is generally recognised as safe for human consumption. Starch has a major role in the food industry not only for its nutritional value, but also for its broad spectrum of functional applications.

References

Baby, L. 2014.Optimisation and utilisation of resistant starch for value addition in rice products. Ph.D. (H.Sc.) thesis, Kerala Agricultural University, Thrissur, 160p.

Neelam, K., Vijay, S., and Lalit, S. 2012. Various techniques for the modification of starch and the applications of its derivatives. *Int. Res. J. Pharmacy*, 3(5): 25- 31.

Singh, M., Sharma, R., and Banerjee, U.C. 2002. Biotechnological applications of cyclodextrins. *Biotechnol. Adv*. 20: 341-359.

Singh, V. A., Nath, K. L., and Singh, A. 2010. Pharmaceutical, food and non- food applications of modified starches: A critical review. *Electr. J. Environ. Agric. Food Chem*. 9(7): 1214-1221.

Valle, E. M. 2003.Cyclodextrins and their uses: A review. *Process Biochem*. 39:1033-1046.