

REPORT ON

VISIT OF VSP “DR. TAHIRA FATIMA”

FROM PURDUE UNIVERSITY, USA



Submitted By:

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Schedule of the Visit		
17th November, 2017		(Arrival at Lahore)
18th-19th November, 2017		(Weekend)
19th November, 2017		
07:00 PM	Arrival from Lahore	Camp Office Guest House
20th November, 2017		
09:00-10:00	Meeting with Vice Chancellor and Chairmen of the Departments	VC Office
10:00-11:00	Meeting with faculty on tea with light discussion on Cultural Differences and Work Environment	Committee Room
02:30-04:00	Seminar on “Biosafety Biosecurity”	MRI, Multan
21st November, 2017		
10:40-12:00	Seminar for Faculty and Post Graduate Students of the Department of FS&T regarding “Polyamines as ubiquitous Bio-Molecules in Nutrition, Health and Disease) and Aging Process”	Committee Room
01:30-03:30	Meeting with Dr. Asif Raza and Dr. Arsalan regarding workshop planning	
22nd November, 2017		
Talk preparation & participation in “International Conference on Cotton Breeding & Biotechnology”		
10:00-12:00	Farmer’s Convention	MNS-UAM Lawns
01:00-03:00	Entrepreneur’s Meeting	MNS-UAM Lawns
23rd November, 2017		
10:00 AM	Co-Chair for the 1 st session in Conference	
12:10 PM	Talk Entitled “Biosafety and Regulation of GM crops”	
03:00 PM	Member of Poster Judgment Committee	
24th November, 2017		
Participation in “International Conference on Cotton Breeding & Biotechnology”		
Judgment, announcement and recommendations for participants		
25th-26th November, 2017		(Weekend)
27th November, 2017		
Time	Event Schedule	Venue
11:00-11:05	Recitation of The Holy Quran	MRI Hall Faculty and Students of FS&T, PBG and Entomology, Plant Pathology, Horticulture
11:05-11:20	Welcome Remarks/Opening Speech (Vice Chancellor)	
11:20-12:15	Lecture by Dr. Asif Raza	
12:15-01:00	Lecture by Dr. Arsalan Ahmad	
01:00-01:45	Lecture on “Food for Medicine” by Dr. Tahira Fatima	
28th November, 2017		(Holiday)

29th November, 2017		
Time	Event Schedule	Venue
Workshop on Aspects of Seed Science and Technology		
10:00-11:30	Lecture on “Improving Seed Quality using Bioengineering and Other Recent Technologies” (Dr. Tahira Fatima)	MRI Hall (Faculty, Post-Grad Students and concerned persons of Bio-Tec, PBG, Plant Pathology, Agronomy Horticulture will attend)
11:30-12:00	Tea/Coffee Break	
12:00-12:45	Lecture on “Seed Certification and Regulation” (Dr. Hammad Nadeem Tahir)	
12:45-01:30	Meeting with PBG staff (Dr. Nadia, Dr. Ummara)	
01:30-02:45	Meeting with FS&T Staff (Dr. Umar Farooq, Dr. Kashif Razzaq, Dr. M. Amin)	
03:00-05:00	Meeting with Staff for “Seed Development”	Committee Room
30th November, 2017		
10:00 AM	Meeting with Vice Chancellor	Chamber of VC

Genetically Modified Crops: Bio safety and Regulation

Dr. Tahira Fatima, Associate professor at Purdue University, USA was guest speaker. Seminar was held at Mango Research Institute (MRI), Multan, Pakistan. The topic of discussion was "Genetically Modified Crops: Bio safety and Regulation". She discussed that farmers should have to produce more food to fulfill demand of fast multiplying world population.

Due to recombinant DNA technology, a large number of modern day GM crops have been created. There are ten major GM crops with single and double genes, are available in the market. These include cotton, corn, soybean and others. She emphasized need of sustainable resistance against biotic and a biotic stress. The example includes development of Indica basmati rice harbouring two insecticidal genes for sustainable resistance against Lepidopteron. Dr. Tahira Fatima engineered designer tomato transformed with Yeast SAM Decarboxylase gene in ripening-specific expression manner. There was significantly enhanced lycopene and essential amino acids level with higher juice quality and longer vine/shelf life in transgenic tomatoes. There was increase in spermine and spermine level with gradual decrease of Pitocin level. The speaker mentioned that there were 110-fold increases in commercialization of GM crops. In Pakistan GM crops were cultivated over 2.9-million-hectare area in 2016 while 10.8 and 2.8-million-hectare area was cultivated with GM crops in India and China respectively. GM crops are more widely grown in developing countries than developed countries.

The second part of talk comprised "Biosafety and Regulation". Dr. Tahira Fatima mentioned that GM crops are grown, exported and used in field trails in more than 70 countries of the world. Farmers growing GM crops are concerned about technology cost, customer acceptance, premium and impact on beneficial insects. Consumers have different consideration in United States and Europe. Most of American consume FDA approved GM food without hesitation while Europeans are reluctant to use GM commodities. The speaker mentioned many reasoning including undesired Gene Flow, Ecological impact, Allergenicity, Unknown future health consequences. On the other hand, a study of 1783 scientific papers on the safety of GM crops published from 2002 to October 2012 concluded that there is no evidence showing the use of GM crops has posed significant hazards to the environment and human. Risk of evolution of insect pest populations immune to the BT toxin and the management schemes to delay that evolution as long as practically possible by employing a non-Bt.

Dr. Tahira mentioned that crop refuge area is also widely accepted and practiced. She emphasized that GM crops should be under regulations and based on sound science. A GM food with minor dietary exposure would require the same regulatory assessment as staple commodity such as GM wheat variety with widespread dietary exposure. Apart from GMO peas with a brazil nut protein, none of GM crop has shown to be toxic. There are different approaches regarding GM crops. In USA depending on its intended use, a product may or may not be reviewed by all three regulatory agencies (FDA, EPA, USDA).

Review based database are created by the US government agencies to determine if a new biotech product needs to be regulated. USDA determined in April 2016 that it will not regulate a mushroom genetically modified with using CRISPR-Cas9, making it the first CRISPR-edited product to receive a green light from the US government. Dr. Tahira

mentioned that Gene editing is another technique to introduce targeted mutations introduced into a plant genome. The transgenic modifications segregate out by simple breeding. Gene editing products will not be subject to the restrictions imposed on genetically modified products, except in some cases where the mutation involves a large sequence insertion into the genome. Versatility and precision of CRISPR/Cas9 promises to be more flexible and more accurate. Various agencies are regulating including Bio Safety Center (NBC), PAK-Environmental Protection Agency, Ministry of Science and Technology and Pakistan Agricultural Research Council. Major Issues regarding use of GM crops in Pakistan include Sale of poor quality seeds, use of uncertified varieties of GM seeds, over use of pesticides due increased immunity in insects.

Dr. Tahira Fatima recommended that the commercialization of GM crops would require a strong regulatory system, trained staff and well- equipped laboratory to deal with present and future issues so that production of GM crops may keep on in Pakistan and whole world. The audience were mainly concerned about GM crops and their effect on human health and environment.



First part:

Higher Polyamines up-regulate Bioactive and Chemo-preventive Molecules in Transgenic Tomato Fruits.

The topic of talk was "Higher polyamines up-regulate bioactive and chemo-preventive molecules in transgenic tomato fruits". Dr. Tahira Fatima, Associate professor at Purdue University, USA was guest speaker. The seminar held at Muhammad Nawaz Shareef university of Agriculture Multan, Pakistan. Post graduate students and faculty were targeted audience. The talk started with the impact of various bio molecules on human health. These beneficial nutrients include poly phenolics, poly amines, Vitamin C, essential amino acid and micronutrients. The nutrients have role in defense against many diseases including Osteoporosis, heart disease, cancer and diabetes. Polyamines are a class of biomolecules derived from positively charged amino acid arginine. These compounds are found in all cell types and have role in various crucial processes including cell division, root formation and defense.

Dr. Tahira Fatima have research on the role of polyamines in regulating various health promoting metabolites and to transform plants with these compounds. In the study two tomato lines 556 and 579 were transformed with a yeast S-adenosyl methionine decarboxylase gene (ySAMdc; Spe2) fused with a ripening-inducible E8 promoter. It specifically increased levels of the polyamines including spermidine and spermine in tomato fruit during ripening. Isogenic parental line (Ohio 8245) was used as a control. There were two growing conditions including Conventional black plastic and Cover Crop-Hairy vetch practices. Metabolome and transcriptome profiles of transgenic plants were compared with controls. Anti-oxidant capacity and Poly phenols levels of transgenic tomato were compared with control plants. The results showed conversion of putrescine into higher polyamines spermidine and spermine was in ripening-specific manner. There was 2 to3 fold increase in lycopene level, 1.67-fold increase FRAP values in transgenic lines. Transgenic tomatoes exhibited longer shelf life and better juice quality than control. Transcriptome analysis revealed that High Spd/Spm tomato fruit exhibit 2,455 and 3,362 differentially expressed genes at breaker and ripe stages, respective to control. Orthologs of 15 phenolic and flavonoid biosynthesis pathway genes were also identified in tomato fruit. Genes involved in isoprenoid pathways expressed at significantly higher levels in high spermidine and spermine lines as compared to the control at all stages. Genes for flavonoid pathway, including CHS, F3H and ANS, also expressed at significantly higher levels in the transgenic lines as compared to the control. RNA sequence analysis and metabolomics study concluded that Spermidine and spermine are linked with 'Anabolic Cell Growth' Processes, Mitochondrial Respiration, Primary Metabolism, Secondary metabolism including carotenoids, polyphenolics, flavonoids.

2nd part:

High Polyamines Tomatoes & Hairy Vetch Cultivation

The second part of talk comprised application of system approaches for crop production and sustainable agriculture system. For example, we should develop soil matter in such that plant can fix their own nitrogen and use less water. we should develop plant diversity to manage pest and weed. There must be practices to improve the use of fertilizers. The speaker mentioned two growing practices one of them conventional black and other with Hairy vetch, which an annual legume (*Vicia villosa*). Hairy vetch is a beneficial cover crop capable of high nitrogen fixing and fits well into different cropping rotations. Level of various health related compound including anti-oxidants and polyphenolics were significantly high in high polyamines lines as compared with control type grown with hairy vetch (HV) cover crop. The speaker concluded that levels of health-promoting metabolites can be greatly increased by engineering higher Spermine and Spermidine in plants. Cultivation in HV cover crop also enhanced levels of polyphenols and showed synergism with polyamines.

Dr. Tahira Fatima concluded that these results provide a path for higher polyamines as median to develop crops with strong human health benefit. The audience showed great interest in Hairy vetch cover crop practices for metabolites level and its role in nitrogen fixation.





Food for Medicine: Functional Foods and Natural Health Products

Dr. Tahira Fatima, Associate professor from Purdue University, USA was guest speaker. The seminar was held at Muhammad Nawaz Shareef university of Agriculture Multan, Pakistan. All post graduate students and faculty were invited to attend seminar.

Dr. Tahira started her presentation by briefing the need of consumers that they are seeking for food ingredients that might provide them nutritional benefits and disease preventions. This is why food scientists are now working for improved food products. She highlighted the importance of convincing the users to adopt the improved products which can be done by researchers. She gave the concept of FFNHP (Functional Foods and Natural Health Products) that were requirement of a healthy user. She highlighted the industrial overview that more than 750 Canadian companies are specialized in FFNHP generating more than \$11 Billion in 2011 revenue. Then she further moved on to the Sea Buckthorn which he highlighted in common language as Siberian Pineapple, Sea berry, Sand thorn and swallow thorn etc. The most common specie was stated here too as Hippophae hippo rhomboids and more than 90% is present in China, Magnolia, Russia and Northern Europe. She explained that Sea Buckthorn can be used for multiple purposes including: Medicinal; as Anti-inflammatory, anti-microbial, pain relief and ulcer etc., Nutritional; as Berry Juice, it is rich in protein, Vitamin C & D and organic acids etc., and also for cosmetics purposes as it has good effect on skin. She planned a research to Identify and quantify phytochemicals in Canadian grown sea buckthorn cultivars and Identify and study important metabolic pathways and genes involved in the production of useful phytochemicals. She used GC-MS to determine fatty acid composition of total lipids, HPLC-UV for Phenolic acids and flavonoids level and NMR spectroscopy to determine level of Ascorbate, tocopherol, Sugars, Organic acids & Amino acids. Fatty acid compositions do not vary within subspecies or the growing environment is a major factor controlling fatty acid composition. At the end, it was suggested that it is the need to understand its importance and transfer the knowledge to other researchers also to start a plan for use of this valuable product.



IMPROVING SEED QUALITY USING BIOENGINEERING AND OTHER RECENT TECHNOLOGIES

The seminar was held at Muhammad Nawaz Shareef university of Agriculture Multan, Pakistan. All post graduate students and faculty were invited Dr. Tahira Fatima, Associate professor from Purdue University, USA was guest speaker. She discussed the topic "Improving seed quality using bioengineering and other recent technologies". Dr. Tahira started her talk with importance of seeds. She demonstrated that seed are source of food and feed and delivery system of genetic information. Seed quality is crucial determining factor of yield and quality of crop production. Good quality seed is superior to other standard seed in genetic and physiological purity and is free from seed borne diseases and disorders. The quality of the seeds is determined by the interaction of a number of genetic and environmental factors and climatic changes significantly affect seed characteristics. Plant breeding is the essential platform for sustainable agriculture. Innovation is the key. Through innovation we can adapt to climate change. The first genetically modified (GM) crop developed through the use of transgenic methods and approved for cultivation was the 'Flavr Savr' tomato in 1994 in the United States. The major commercially grown GM crops have the traits of herbicide and insect resistance, better resistance to drought environment. Modified nutritional profiles such as improved amino acid composition of maize, improved fatty acid composition of maize and soybean, and modified starch in maize and potato.

The global seed market is expected to witness a CAGR of 7.1% during 2017-2022 (the forecast period). The market, estimated at USD 56020 million as of 2017, is projected to reach a value of USD 78764.1 million by 2022. A number of crops including corn, soya bean, cotton, alfalfa, Sugar Beets, zucchini, papaya, potato, apple (Oilseeds, Cereals & Grains, and Fruit & Vegetables). Beneficial trait which are being introduced into plants are herbicide tolerance, insect tolerance. She stated that Sales Channel: include direct sales, E-retailers and other retail outlets. The main region were North America, Latin America, Europe, Asia, Japan, Middle East and Africa. Requirements good seed industry are availability of Germ plasm or parent lines, seed production, seed processing, seed storage and seed distribution. Targeted mutations are introduced into a plant genome. The transgenic modifications segregate out by simple breeding. She explained that gene editing products will not be subject to the restrictions imposed on genetically modified seed crops. No off-target mutations were identified in the CRISPR-Cas9 lines, indicating that the mutations induced were highly specific. Versatility and precision of CRISPR/Cas9 promises to be more flexible and more accurate. Sale of poor quality Bt. cotton seeds in the open market for quite some time. The use of uncertified varieties of GM seeds increase input costs for farmers. The low levels of pest resistance in these seeds have increased insects' immunity which necessitates over use of pesticides. The commercialization of GM seed crops would require a strong regulatory system, trained staff and well- equipped laboratory to deal with present and future issues. GM and Gene editing technologies are going to play main roles in solving issues related to seed production, processing, storage and quality. There is need to integrate seed crops with precision agriculture in a sustainable environment.

All faculty members of seed science and plant breeding department took interest in the seminar and discussed the issues related to seed industry in Pakistan.

