10 YEARS OF EXCELLENCE 2006-2016

FACULTY DEVELOPMENT

TECHNOLOGY TRANSFER

PRODUCT COMMERCIALIZATION

RESEARCH & DEVELOPMENT

Vision

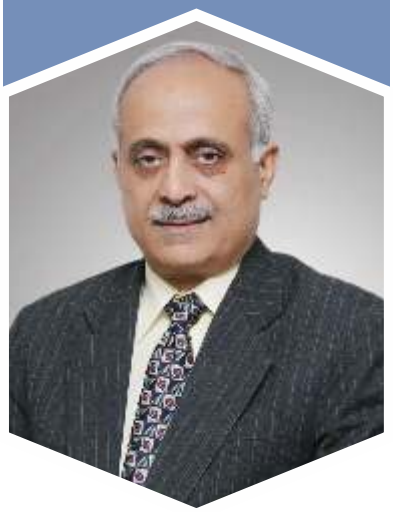
To assist the agriculture sector in becoming competitive, profitable and sustainable through innovation and commercialization.

Mission

- To support UAF faculty and the national scientific community working for the cause of agricultural and rural development.
- To promote competitiveness in agriculture through competitive/ commissioned Research & Development initiatives.
- To explore ways and means for strengthening of Endowment Fund for Research & Development.

from the

CHAIRMAN



Agriculture has special significance for the economy of Pakistan as it contributes about 23% to GDP, provides employment to nearly half of the total labor force and approximately 70% population is directly or indirectly dependent on this sector. We face the challenge of ever-increasing population which compels for food imports in spite of the good fertile soils and the largest surface irrigation system of the world.

Historically, UAF is engaged in teaching and research in agriculture and related sciences since 1906. Limited international activities through PL-480, ISMR, MART, JICA, BOSTID, Asia Linkages Program, Faisalabad Bangor Link Program and UNDP have been coordinated. All these programs were very successful in terms of scientific achievements and establishment of research and teaching laboratories.

For global food security Unified Agricultural Research System (UARS) comprising of education, research and extension should be the strategy of near future. The objectives of Endowment Fund are close to those of UARS. Endowment Fund sponsored by the US Department of Agriculture (USDA) provided an opportunity to revitalize the university's agenda for agricultural development. The community engagement and outreach program of UAF is the successful model which needs to be scaled up and institutionalized.

Besides the research partnership and linkages with the US scientists, the Endowment Fund Program has a built-in provision to extend Pakistan's agricultural research partnership with other national or international research systems. Partnership and continuing involvement of US Government with Pakistan in the agriculture development is commendable. I hope mutual confidence, interests and collaborations between USA and UAF will grow further in the future.

I would like to acknowledge the role of faculty members, research scientists, heads of research & field organizations whose participation and interest made it possible for conceiving and execution of innovative programs.

I appreciate Endowment Fund's staff for compiling this 10-years report and presenting the achievements in a commendable manner.

PROF. DR. IQRAR AHMAD KHAN
Chairman BoD/Vice Chancellor

Executive

SUMMARY

The Endowment Fund was established in 2006 at the University of Agriculture, Faisalabad with the assistance of USDA under "Food for Progress" agreement with an amount of Rs. 650.00 million through the Government of Pakistan and Higher Education Commission, Pakistan.

The principal amount was invested in banks and the profit generated was allocated for different activities approved by the Board of Directors. Endowment Fund supports the whole value chain of Agriculture including human resource development, sponsoring Research & Development, dissemination of knowledge intensive technologies and promoting University Industry linkages for commercialization of research output.

During the period 2006-2016 Endowment Fund Secretariat (EFS) granted 135 projects with an expenditure of Rs. 358.00 million, 132 travel grants and 179 seminars/workshops with total investment of Rs. 62.00 million. Endowment Fund has provided technical assistance to all segments of the rural community through Faculty Outreach Program started in 2011 with the focus on skill development and gender mainstreaming. Up till now, ninety such events have been conducted by UAF faculty at the door step of farmers with an expenditure of Rs. 8.0 million. In addition to this, Endowment Fund has supported the University in developing physical infrastructure like Business Incubation Centre, Farm Market, Bio-Safety Lab, Exhibition Centre, FM Radio and Integrated Farming Model. Some of the major technology transfer projects sponsored by EFS include 22 projects in Crop Production, 10 in Plant Protection, 09 in Horticultural Fruits Production, 04 in Horticultural Germs Plasm Collection, 04 in Vegetable Production, 03 in Agro Forestry, 07 in Animal Production, 08 in Animal Health, 04 in Integrated Model Farming, 04 in Agri. Mechanization, 07 in Water Resource Management, 02 in Waste Water Treatment, 03 in Alternative Energy Program, 04 in Use of ICT in Agriculture, 03 in Exhibition & Showcasing, 03 in Diagnostic Services and 02 in Conservation of Agricultural Heritage.

Endowment Fund has succeeded in bringing Universities, research organizations and field departments closer together for collaborative efforts for agriculture development. These peer organizations were made partner in the execution of most of the activities, like arranging exhibitions, farmers' field days and consultative workshops. EFS aspires to revitalize its program in alignment with the UAF vision 2030 and to fulfil the international obligations of our country in achieving the Sustainable Development Goals.

Executive

DIRECTORS

Dr. Zahir Ahmad Zahir
Professor
Institute of Soil & Environmental Sciences, UAF

2014 - to date

Dr. Tahir Zahoor
Professor
National Institute of Food Science
& Technology, UAF

2011-2014

Dr. Zafar Iqbal Randhawa
Professor
Department of Parasitology, UAF

2009-2011

Dr. Abdul Ghafoor
Professor
Institute of Soil & Environmental Sciences, UAF

2006-2009

BOARD OF DIRECTORS

Vice Chancellor, UAF (Chairman BoD)

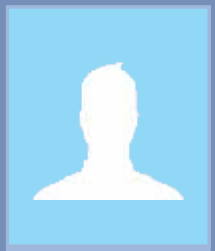
Prof. Dr. Iqrar Ahmad Khan
2008-to date

Prof. Dr. Bashir Ahmad
2006-2008

Vice Chancellor, Agriculture University Peshawar, KPK

Prof. Dr. Zahoor A. Swati
2013-to date

Prof. Dr. Khan Bahadar Marwat
2010-2013



Prof. Dr. Said Khan Khalil
2006-2010

Eminent Scientists

Dr. M.E. Tusneem
Honorary Chairman,, NAEAC/HEC
from July, 2016…..

Dr. Noor-ul-Islam
CEO, PARB, Lahore
2009-2016

Dr. Kausar A. Malik
Former Member, Planning Commission, ISD
2006-2009

Eminent Scientists

Dr. M. Anjum Buttar
DG Agri. (Ext. & Adoptive Research, LHR
from July, 2016…..

Mr. Natiq Hussain
Planning & Eval. Cell Agri. Dept., LHR
2009-2016

Prof. (Rtd.) Dr. Bakhat Baidar Khan
Faculty of Animal Husbandry, UAF
2007-2008

Progressive Farmer

Mr. Faisal Hassan
from July, 2016…….

Mr. Afaq Ahmad Tiwana
2006-2016

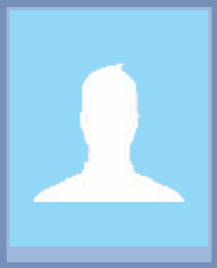
Executive Director, ALP (PARC), Islamabad

Dr. Ahmad B. Mahar
2012-to date

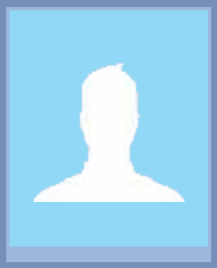
Dr. Shahida Jameel
2006-2012

Registrar, UAF

Ch. Muhammad Hussain
2006-to date



USDA Agri. Attache
in Pakistan



Agri. Specialist, USDA,
US Embassy in Pakistan

Treasurer, UAF

Mr. Umar Saeed
2013-to date

Mr. Abdul Ghafoor Khan
2008-2013

Dr. Shahid Afzal Gill
2007-2008

Mr. Azhar Latif
2006-2007

10 YEARS OF EXCELLENCE
2006-2016

CONTENTS

Description	Page
Introduction	10
TECHNOLOGY TRANSFER	12
Crop Production	14
Plant Protection	31
Horticultural Fruits Production	37
Horticultural Germs Plasm Collection	45
Vegetable Production	49
Agro Forestry	53
Animal Production	56
Animal Health	61
Integrated Model Farming	70
Agriculture Mechanization	77
Policy Papers/Evaluation Studies	79
Water Resource Management	80
Waste Water Treatment	85
Alternate Energy Program	86
Use of ICT in Agriculture	88
Exhibitions & Showcasing	91
Diagnostic Services	95
Conservation of Agricultural Heritage	96

Description	Page
FACULTY DEVELOPMENT	98
Short Trainings Abroad	100
Short Trainings Inland	104
Travel Grants Abroad to Present papers	105
Travel Grants for Short Visits	115
Seminars/Workshops/Conferences/Trainings	120
Significant Events	139
List of Foreigners sponsored by EFS	159
PRODUCT COMMERCIALIZATION	177
Exhibition Centre	179
Farm Market	181
Projects	181
RESEARCH & DEVELOPMENT	182
Establishment of BSL-3 Lab.	185
List of Ongoing Projects	186
University Outreach Program	187
Outreach Projects	188
Significant Projects	189
List of Outreach Activities	190
Glimpses of Some Events	200

INTRODUCTION

Establishment of Endowment Fund at UAF

The Government of Pakistan and United States of America signed a US$ 12.4 million Food for Progress Agreement on September 15, 2003. Under this Agreement, the Syndicate under Section 25(2)(i) of the University of Agriculture Faisalabad Act, 1973 approved to establish Endowment Fund at UAF. The Ministry of Finance transferred Rs. 650.00 million to UAF in 2006. The principal amount is invested in scheduled banks approved by Board of Directors. The income generated is allocated for different activities in line with the Pakistan's long term goals for the agriculture sector which focus on food security, poverty alleviation and promoting broad based equitable and sustainable agriculture. The Endowment Fund is an independent entity and possess all of the powers necessary to carry out its following objectives:

a) To support UAF programs for advanced training in biotechnology, agricultural sciences research, technology transfer and product commercialization.
b) To strengthen faculty and support R&D activities of UAF.
c) To support similar programs with other institutions of higher learning, private sector, not-for profit organizations, and domestic and international organizations.
d) To encourage increased cooperation among scientists conducting agriculture-related research at universities in Pakistan and the United States of America.

Management of the Fund

The Board of Directors (BoD) is the governing body of this Fund and is responsible for Fund's program, its financial and managerial policies. Following is the composition of Board:

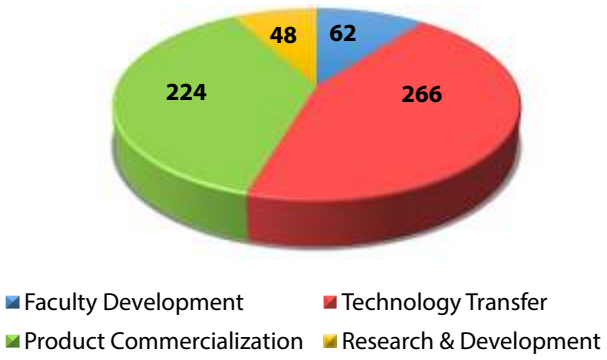
▪ Vice Chancellor, UAF (Chairman)	Ex-off
▪ Vice Chancellor, Agriculture University Peshawar, KPK	Ex-off
▪ USDA Agri. Attache' in Pakistan or his nominee	Ex-off
▪ Agri. Specialist, USDA, US Embassy in Pakistan	Ex-off
▪ Eminent Scientists (Two)	For 3-years
▪ Progressive Farmer (One)	For 3-years
▪ Executive Director, ALP (PARC), Islamabad	Ex-off
▪ Registrar, UAF	Ex-off
▪ Treasurer, UAF	EX-off
▪ Executive Director, EFS, Member/Secretary	Ex-off

Components:

Endowment Fund, University of Agriculture, Faisalabad comprises of four components as under:

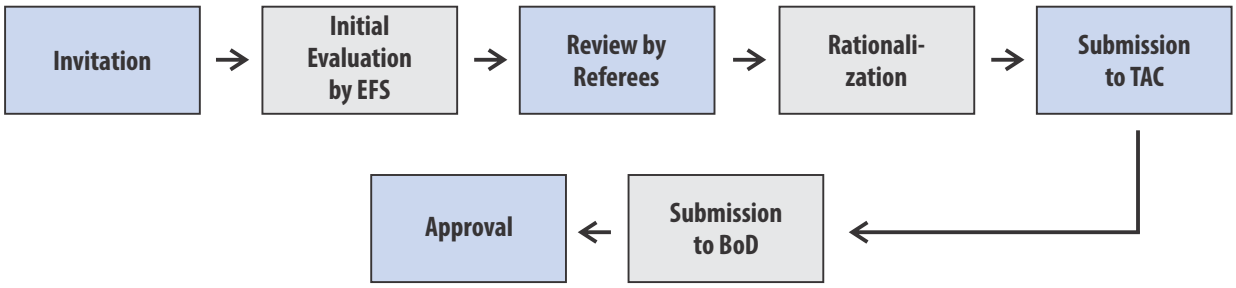
Faculty Development
Technology Transfer
Research & Development
Product Commercialization

EFS Expenditure 2006 to 2016 (Rs. in million)



Project Award Process

- Solicitation of proposals through national dailies
- Review of proposals by two experts
- Submission of proposals to TAC along with recommendations of reviewers for evaluations
- The recommendations of TAC are submitted to the BoD for final approval and allocation of budget
- Implementation Agreement between the executor and the Endowment Fund
- Issuance of Administrative approval of projects
- Monitoring, review and evaluation of projects is coordinated by the Endowment Fund Secretariat, UAF
- Annual & half yearly reports are submitted by the PIs and reviewed by two experts
- Funding of projects are withheld that do not show adequate progress
- Annual Review Workshop



TOTAL PROJECTS AWARDED BY EFS UP TO 2016

(Rs. In Million)

Projects	TT		RD		PC		Total	
	No.	Rs.	No.	Rs.	No.	Rs.	No.	Rs.
Total	113	336	20	19	2	3	135	358
Completed	94	298	14	12	1	1	109	311
Ongoing	19	38	6	7	1	2	26	47

TECHNOLOGY TRANSFER

2006 - 2016 10 YEARS OF EXCELLENCE

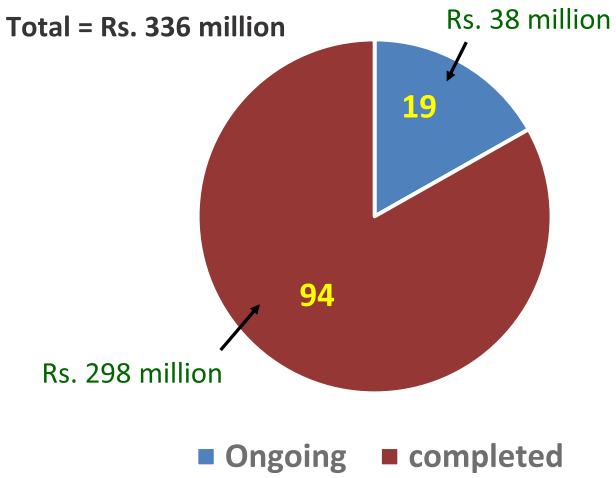
TECHNOLOGY TRANSFER

Agricultural technology has a key role to play for sustainable development. Access to capital intensive technologies is unevenly spread, especially across developing countries, and capacity for knowledge-intensive technologies needs to be augmented.

Less capital-intensive technologies require investment in human and social capital because they are more knowledge-intensive. Needed capacity-building includes improving resilience at the household level.

According to FAO, one of the major constraints to realizing the potential for increased productivity in Pakistan is the woeful lack of a mechanism to transfer existing technology from government research institutions to farmers.

This component provides an opportunity for the scientists to get financial support for transfer of technologies to the stakeholders. Endowment Fund Secretariat accepts proposals for technology transfer from all public entities which demonstrate needed research and development capabilities and financial responsibilities. The portfolio under this component consists of outreach projects, demonstration on campus, organizing Farmers' Fairs/Exhibitions and Horse & Cattle Show.



The technologies disseminated through these projects relate to Animal Nutrition Strategies, Livestock Management through IT, Animal Disease Control, Water Use Strategies, Drip Irrigation, Policy Studies, Fruit Germplasm Collection, Soil Reclamation Strategies, Propagation of Floriculture, Reverse Engineering, Citrus Diagnostic Services and Nursery, Food Quality, Silk Production, Precision Agriculture, Seed Production Technologies, Cyber Extension, FM Radio, Integrated Farming, Gender Empowerment and use of ICT in Agriculture. List of the projects funded by EFS under this component is given in next pages;

Crop Production

Sr.#	Title of the Project/Location	Name of the PI
1	Demonstration of Technologies Developed by the Department of Agronomy in the University of Agriculture, Faisalabad	Dr. Zahid Atta Department of Agronomy, UAF
2	Demonstration of Elite Breeding Lines of Different Crops at U-Road in the Main Campus, University of Agriculture, Faisalabad	Prof. Dr. Faqir M. Azhar Department of Plant Breeding and Genetics, UAF
3	Enhancing Crop Productivity on Salt-affected Soils through Combined use of Soil Applied Gypsum and Pre-sowing Seed Treatment	Dr. Saif Ullah Institute of Soil & Environmental Sciences, UAF
4	Demonstration of Seed Priming for Enhancing Cereal Yields under Normal Conditions	Prof. Dr Shahzad M. A. Basra Department Crop Physiology, UAF
5	Salt Affected Soils - Technologies Associated with their Management	Mr. Muhammad Sarfraz Soil Salinity Research Institute, Pindi Bhattian
6	Use of low quality Water in Conjunction with Amendments During Reclamation of Salt-Affected Soils by Growing Wheat and Sesbania Crops	Dr. Ghulam Murtaza Institute of Soil & Environmental Sciences, UAF
7	Demonstration and Transfer of Entomological Technologies as Income Generating Source for Small Farmers	Prof. Dr. M. Ashfaq (T.I.) Department of Agri. Entomology, UAF
8	Relay Cropping of Sesbania in the Wheat for Residues Management and Improving Soil Health	Prof. Dr. Ehsanullah Department of Agronomy, UAF
9	Synthesis of Available Fertilizer Trials Data for Site-Specific Recommendations and Diagnostic Survey for Low Adoption of Fertilizer Use Technology	Dr. Muhammad Rashid Ex-Director General Agri. (Research) Punjab/Subject Specialist, Institute of Soil & Environmental Sciences, UAF

10	Facilitation of the Demonstration of Different Technologies under UAF-Technology Park Projects at Postgraduate Agricultural Research Station (PARS), University of Agriculture, Faisalabad	Mr. Amir Saeed Rana Superintendent PARS, Directorate of Farms, UAF
11	Demonstration of Production Technology of Quinoa (*Chenopodium quinoa* Willd.) as a New Climate Proof Grain Crop	Prof. Dr. Shahzad M. Ahmed Basra, Department of Crop Physiology, UAF
12	Demonstration of Technology of Silymarin Extraction from Milk Thistle	Prof. Dr. Khalil-ur-Rehman Department of Chemistry & Biochemistry, UAF
13	Introducing Farmers with UAF-11: A Brassica Oilseed Elite Line of the University of Agriculture, Faisalabad	Prof. Dr. Hafeez Ahmad Sadaqat Department of Plant Breeding & Genetics, UAF
14	Dissemination of Seed Production Technology of Alfalfa	Mr. Qamar Shakil Fodder Research Sub-Station, AARI, Faisalabad
15	Direct Seeding of Rice, New Option in Rice-wheat Cropping System in Central Punjab	Dr. Nadeem Akbar Department of Agronomy, UAF
16	Removing Early Fruiting Branches (REFB) at Higher N Dose Improves Growth and Yield of Bt Cotton by Altering its Senescence and Cry1Ac Expression Pattern	Dr. M. Farrukh Saleem Department of Agronomy, UAF
17	Strengthening Informal Seed Supply System at Two Locations in Potohar Trough Participatory Technology Transfer	Dr. Abdul Razzaq PMAS-Arid Agriculture University Rawalpindi
18	Technology Transfer to Potato Growers in Relation to Pathogen Free Seed Potato, Management of Diseases and Adoption of Improved Agrotechniquies	Dr. Ishfaq Ahmad Hafiz PMAS-Arid Agriculture University Rawalpindi
19	Improving Water use Efficiency in Cereals through ACC-deaminase Biotechnology	Prof. Dr. M. Arshad (T.I.) Institute of Soil & Environmental Sciences, UAF
20	Demonstration of Multi-Nutrients Foliar Feeding technology for Sustainable Crop Production	Dr. Muhammad Yaseen Institute of Soil & Environmental Sciences, UAF

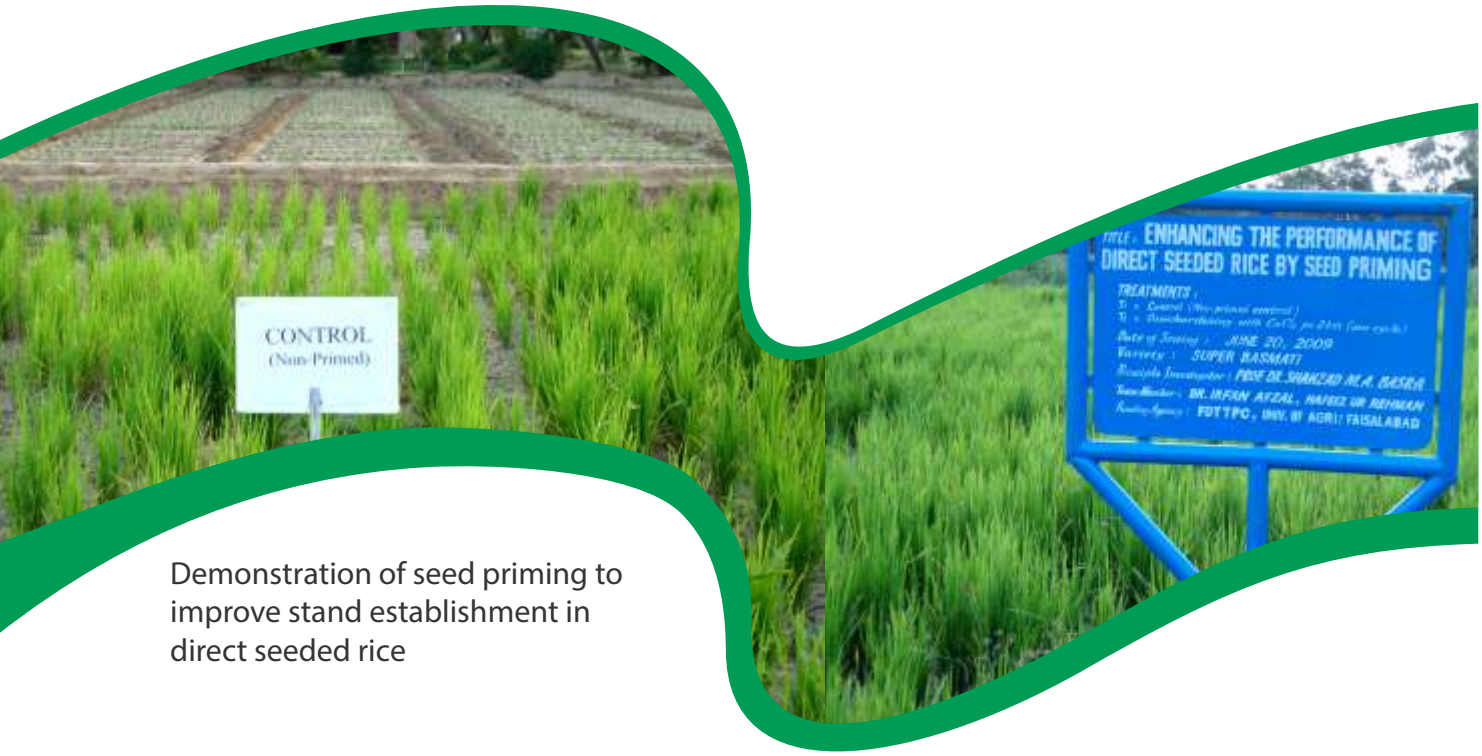
21	Technology Transfer for Using Tube well Water on Salt-Affected Soils for Crop Production	Dr. Ghulam Murtaza Institute of Soil & Environmental Science, UAF

Seed Priming Techniques

Seed priming techniques have received greater attention in recent years and are widely used to enhance the cereals performance by improving crop stand and yield. Many seed priming techniques developed have been tested and appraised under field conditions to improve crop stand and yield performance in cereals.

After two seasonal demonstration trials in direct seeded rice, among various seed priming techniques employed, osmopriming with $CaCl_2$ has pronounced effect on crop stand and yield performance in wheat, maize and rice under normal as well delayed planting conditions and can be successfully employed at farmer's field. In addition, hormonal priming with salicylic acid (SA) has also potential to ameliorate the adverse effects in wheat and maize when planted under late sown conditions.

Demonstration of seed priming to improve the wheat performance under normal condition



Demonstration of seed priming to improve stand establishment in direct seeded rice

Salt Affected Soils - Technologies Associated with their Management

Plant nutritionists are always in search of substitutes or combinations of mineral fertilizers with the organic sources that enhance the efficiency of mineral fertilizers or to compensate / supplement the mineral fertilizers. The Punjab soils are generally and particularly the region of moderately salt affected extremely poor in organic matter status which has appeared to be the main cause of yield reduction. The combined application of composts and mineral fertilizer has proved to be effective, environment friendly and provides sound nutrient management strategy to enhance crop productivity. Soil phosphorus based estimation of fertilizer requirement is considered an economically and environmentally efficient method to maintain the appropriate P level in the soil. Results of three year experiments suggested that combined application of compost with mineral fertilizer i.e. site specific use of mineral fertilizer with compost in 80:20 ratio and integrated use of chemical fertilizers with compost in 80:20 ratio enhanced paddy / grain yield and improved the fertility status of the soil.

Due to the diminishing resources of canal water, farmers are bound to use tube wells either their water are fit or unfit. Poor quality water or brackish water can be used for crop production on a variety of soils using chemical amendments like the use of gypsum and organic sources like compost, FYM, press mud and poultry manure etc. Results of three year experiments suggested that canal water in combination with gypsum application on the basis of soil GR proved better followed by brackish water with gypsum application on the basis of GR of soil and water on RSC basis. Canal water usage with gypsum application at 100% GR of soil proved better than the brackish water plus 100% GR of soil and water on RSC basis and improved the crop yields followed by brackish water plus gypsum at100 GR of soil and irrigation water on the basis of RSC at all the three experimental sites.

Relay Cropping of Sesbania in the Wheat

Recycling of crop residues has the advantage of converting surplus farm waste into useful products for meeting the nutrients prerequisite of field crops. Varying categories of farmers like small, medium and large were selected along the main road side in Gujranwala and Hafizabad districts of Punjab. Total sites for the demonstration plots were 8 in both above mentioned districts. The area of each demonstration plot was more than 3 acres during first year of project conducted. The results were promising, extra-ordinary and fruitful.

Consequently, the farmers practiced this technology on large scales. Jantar was grown on an area of 70 acres in Majju chak (Gujranwala), 85 acres at Ali Pur Chattha (Gujranwala), 15 acres at Haiger (Gujranwala), 15 acres at Tali Goraya (Hafizabad). The crop residues are precious resource and needs to be managed as an integral component of the system for improving soil health, and sustaining natural ecosystem as well as improving soil productivity.

Fertilizer Prediction Models

Soil Fertility of every field is variable; the requirement of nutrients, therefore, will vary. The general fertilizer recommendations will not, therefore, meet the site specific requirement. To determine the N and P requirement for desired yield of crops, fertilizer prediction models have been developed and uploaded on the website: www.fertilizeruaf.pk . Through these models, every farmer can determine the requirement of N and P for every field by selecting his district and crop. He has to enter organic matter and available phosphorus as indicated in the laboratory report and desired yield. N and P requirement are displayed in kgs for one acre. The calculations in bags are also available. The management factors, list of varieties and production plan are also available for the complete guidance of the user. The fertilizer prediction models for wheat, rice, cotton, maize sugarcane, potato, tomato, carrot, cabbage, garlic and sunflower are available on the web.

UAF-Technology Park at Postgraduate Agricultural Research Station (PARS), UAF

Establishment, Demonstration & Visitation of agri technologies at PARS. A large number farmers, students and visitors were given training at these facilities.

Herbal Plant: Milk Thistle

Milk thistle (*Silybum marianum*) is an important medicinal plant which is a source of silymarin, a hepatoprotective flavonoid. In Pakistan most of it is imported from India and China. The interest of this study was to introduce milk thistle as alternative crop among the farmers and provide an indigenous and cheaper source of silymarin to manage liver disorders.

To see the growth potential of milk thistle in various zones, the field experiments were conducted at UAF, PARS, Farooqabad, AARI, Chakwal and Karoor.

The silymarin was extracted from seeds of milk thistle by applying various techniques and varying different solvents. Extraction with soxhlet and microwave assisted proved better as compared to the other regarding % yield of silymarin. Methanol was solvent of choice for maximum extraction of silymarin. Furthermore, the efforts made for the preparation of nanoparticle and suspension of silymarin is no doubt another attraction for herbal pharmaceutical industries.

UAF-11: A Brassica Oilseed Elite Line of the UAF

The scientific endeavors of the oilseeds research team of the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad has resulted in the development of oilseed type UAF-11 that addresses the issues related with oilseeds deficit in the country in an excellent way. This is of short stature, early maturing and has higher seed oil contents than all the present day varieties of Brassica oilseeds. It is envisaged that it would enhance the production by increasing the seed yield per acre as well as oil yield per acre since it has around 49% seed oil contents. Therefore, it has the potential to grab a room in the cropping pattern of different zones in Pakistan.

The seed was gifted to the farmers, visiting University of Agriculture, Faisalabad during Rabi Mela and other events. Farmers in thousands obtained seed of UAF-11 from the University directly from research team, Directorate of Farms and from other farmers of their locality. Demonstrational/ observational plots of UAF-11 were sown at farmers' fields and Govt. farms in all Punjab and the seed was submitted to Federal Seed Certification & Research Development for Distinctiveness, Uniformity and Stability evaluation.

The line was introduced to the farmers in all agro-ecological zones of Punjab by outreach activities. The seed was also given to the farmers in other provinces of Pakistan and also to scientists of other countries like China and India visiting UAF.

Seed Production Technology of Alfalfa Crop

Good quality and high seed yield of alfalfa is prerequisites to attain a high fodder yield for forage and hay production. Pakistan has imported 579 metric tons of alfalfa seed amounting to Rs. 86.55 million during the previous years. It was largely considered by the farmers that alfalfa seed production is not profitable due to various constraints. As alfalfa seed production largely depends upon climatic conditions i.e. humidity and temperature etc. Therefore, it is necessary to locate the important pockets for its seed production throughout the Punjab. Also it is imperative to disseminate its production technology among the farmers of the known pockets/regions for its production.

More emphasis was given on the selection of soil and plantation of alfalfa crop in isolation for seed multiplication. Farmers were told that sandy loam to clayey loam soil is prerequisite for alfalfa seed production. Heavy soil with efficient drainage system is also suitable for its plantation. Fungicide was used to treat the seed to avoid fungus attack before sowing. Water soaked seed was sown at row distance of 30 cm by seed -drill or kaira at sufficient soil moisture. To obtain good germination, pre-sowing irrigation was applied. The crop required very frequent irrigations during its early growth period at an interval of about one week but once the plants were established, subsequent irrigations were provided at an interval of 15–20 days during winter and 10–12 days during spring and summer seasons. Optimum germination temperature ranges between 65°F and 77°F. Farmers should ensure optimum seed to soil contact, plant seed not deeper than ½ inch, provision of adequate level of nutrients and minimize risk of soil crusting in order to attain maximum plant population. The farmers were advised to control weeds during the first 60 days to prevent seed loss. New planting should not be harvested until sufficient carbohydrates have been stored in the roots to support rapid regrowth. Depending on growing conditions, this generally occurs around 60 days after emergence.

Recently, a seed drill for alfalfa has been designed by Fodder Research Station Ayub Agriculture Research, institute Faisalabad and is in practice on commercial farming community. Dodder is an unique weed, and is particularly problematic in alfalfa seed production fields in Pakistan. Alfalfa crop for fodder should not be sprayed with insecticide in order to avoid any damage to the livestock. At seed formation stage, alfalfa crop is often heavily attacked by army worm insect due to high humidity in the air. To control this attack insecticide/granules insecticide should be sprayed/ scattered in the field. Systemic insecticides is used that absorbed through roots of the plants by dissolving with water. In this way the crop is protected from insects attack till seed ripening. Common insects that damage the alfalfa crop are alfalfa wevile, aphids, clover leaf weevil, grass hopper, army worm, etc. Delaying harvesting beyond 60 days generally does not improve re-growth and may drastically reduce forage yield. The farmer were demonstrated when and how the alfalfa crop must be left for seed multiplication. The last cut of the crop is done up to 30th March and not later than 10th of April in order to ensure good seed setting. After last cut before the crop was left for seed, it was irrigated for maximum sprouting. Once the majority of the seed is mature, it is cut manually and layed in windrows on the stubble to air dry in the field. Any green seed that remains on the plant will continue to ripen (mature) in the windrow. Windrows are ready for threshing when the moisture content of the plant is from 12 to 18 percent. Alfalfa seed is threshed by wheat thresher or manually. Farmers were demonstrated that alfalfa seed must be stored in jute bags after proper cleaning of seed, so that air and light can pass through it.

Direct Seeding of Rice, a New Option in Rice- Wheat Cropping System in Central Punjab

It is estimated that 3000-5000 liter of water is being used to produce one kg of Basmati rice. So the over dependence on Basmati rice as compared to non-Basmati is posing a serious threat to meet the challenge of production demand. Due to continued dry spell over the past several years both surface and ground water resources are depleting. The rising scarcity of water and labor are the major drivers of the shift from transplanting of rice to direct seeding because of increased demand of both in non-agriculture sectors associated with rapid economic growth in many Asian Counties. In the United States, Malaysia, and Sri Lanka, more than 90% of the rice has been direct seeded for the past few decades.

Information regarding direct seeding of rice were disseminated to promote its adoption in Rice-Wheat cropping system. Technical knowledge was communicated directly to farmers through different programmes of field visits, farmer days, farmer-to-farmer exchange and distribution of pamphlets. It was all done at the time of harvesting of rice crop when late monsoon would otherwise delay transplanting. Direct seeded rice (DSR) reduced the use of irrigation water, reduced labour costs. Wet seeding has also an advantage in irrigated rice allowing timely crop establishment with decreased costs.

Weed management options for direct-seeded rice were disseminated to farmers. It was demonstrated that DSR has the ability to produce similar yield as that of transplanted rice with additional benefit of cost-saving technology that saved water and labour efforts. Farmers had observed a shift in weed population and the emergence of new problematic weeds. Farmers were educated about weeds and control strategies such as mechanical and chemical methods to manage specific weeds. Farmers took keen interest in this new technology of direct rice seeding through drill method and were greatly motivated to adopt this technology.

Kissan Seed Bank in Chakwal

Twenty farmers were selected at Gujar Khan and 20 at Mulhal Mughlan, Chakwal for seed technology transfer. During farmers' meetings (held at both locations) team members told the farmers about the importance of producing and using good healthy seed. They showed their interest to be seed producing farmers under the supervision of project team. The selected farmers were advised to sow at least one plot as a seed plot to be supervised by the project team. For demonstration plots land was got prepared and sowing of crop was done. Skill imparting programs and participatory technology transfer activities were conducted simultaneously at both locations for production of quality wheat seed. Consequently farmers produced seed of different wheat cultivars under supervision of project team. Seed produced by the farmers was tested for minimum standards set by FSC&RD and the seed qualifying the minimum standard was approved for storage till next sowing season. Next step was to establish Kisan Seed Bank for storage of seed produced by the farmers at both locations. Farmers' associations at both locations cooperated for this purpose. First Kisan Seed bank was inaugurated at Nara Mughlan (Tehsil Chakwal). Necessary training to the farmers for seed care in storage and chemical treatment to avoid attack of insects/ diseases while maintaining the good quality of seed is being imparted to the farmers. Final testing for analytical purity, varietal purity, germination percentage and viability was done. Seed found within the permissible limits as describe by FCS&RD was packed in 50 kg bags with printed logos of the university and the respective association.

Biotechnology for Improving Water Use Efficiency

Effective bio-fertilizer from ACC-deaminase bacteria has been developed for the efficient utilization of water and increasing growth and yield of wheat and maize under limited water supply.

Positive influence of ACC-deaminase on wheat

Inoculated Organic fertilizer (Biofertilizer)

Water scarcity in agriculture sector is becoming very serious problem in hampering the crop yields. One of the several strategies to reduce the pressure on scarce water resources could be to increase the efficiency of water use in agriculture. One strategy to overcome the limitation of plant growth by soil drying could be to promote root growth to allow water uptake from greater soil volume. Ethylene is a plant hormone that is involved in the regulation of many plant physiological responses especially under stress conditions. Water stress has been extensively associated with elevated release of endogenous ethylene by the plant which results in root growth inhibition dramatically. It is highly likely that sensitivity of plants to water stress might be due to a sharp surge in ethylene production. It implies that the regulation of ethylene under water stress conditions can eliminate the inhibitory effects of water stress on plant growth. 1- Aminocyclopropane-1- carboxylic acid (ACC) is the immediate precursor of ethylene in higher plants. Fortunately, there are certain plant growth promoting

rhizob acteria (PGPR) which contain a unique enzyme, ACC-deaminase that hydrolyses ACC and decreases ethylene in inoculated plant roots. It is well established fact that inoculation of seed/plant with these PGPR increases growth of inoculated plants. More root growth can result in better water use efficiency through exploiting greater soil volume.

Results revealed that seed inoculation or inoculated compost (biofertilizer) caused significant increases in growth and yield parameters of wheat, sorghum and maize over respective uninoculated NPK control under variable number of irrigations.

Foliar Spray for Improving Crop Production

Multinutrient foliar spray was prepared using various nutrient sources like, N, K_2O, Zn, Fe, B, Mn, Cu, etc. Demonstration trials on wheat crop were conducted at tehsil Toba Tek Singh. The results revealed 21-27 %, 13-27 % and 17-30% increase in number of tillers m^{-2}, straw and grain yields, respectively in sprayed plots compared to control.

Fertilization strategies can influence germination, tillering, flowering, grain formation, fruit set, fruit size and the amount of vegetative growth and other plant characteristics. Foliar feeding has been used as a means of supplying supplemental doses of minor and major nutrients, plant hormones, stimulants and other beneficial substances. Foliar fertilization can be from 10 to 20 times as efficient as soil application. However, this efficiency is not always achieved in actual practice due to weather extremes, application of the wrong spray mix, or of the right mix at wrong time. Foliar fertilizations are often timed to coincide with specific vegetative or fruiting stages of growth, and the fertilizer formula is adjusted accordingly.

Pathogen Free Seed Potato-Pothowar Region

Potato is the most important crop of the world. This crop also has capability to give more production in limited time and can be successfully grown from sea level to nine thousand feet height. It ranks third among field crops after wheat and rice.

Potato is a good source of carbohydrates, vitamins, minerals and proteins. Moreover, the main advantage is that it is very low in fats. If we compare the increasing population with their increasing demand of food then it may be concluded that situation will become worse and it will be difficult to cope with the situation, so present scenario of potato potential in Pakistan and its contribution to fulfill the dietary requirements, is opening a new aspect to fulfill the future food demands of increasing population.

The main and serious problem of low yield is fungal and viral diseases. This project was designed to provide disease free seed potato and to disseminate improved cultural practices to the growers and farmers. Surveys were done to know the problems of the farmers of the selected areas of the Pothowar regions. After knowing the constraints of the regions, growers were trained according to their relevant impediments, so that they can improve their yield and fulfill the future demand of the country.

Technology for Using Low Quality Tubewell Water

Continuous use of such low quality ground water without appropriate management practices or amendments could make the soils saline/sodic. By now, about 3.5 mha soils have developed surface salinity/sodicity due to the use of poor quality irrigation waters. Farmers in arid and semi-arid regions are forced to exploit low quality ground water, which needs addition of a Ca-source. Otherwise such waters could result in deterioration of soil health and economic yield as well as produce quality.

It is concluded that saline- sodic water with EC and SAR higher than the critical levels of 1 and 10 dS m-1, respectively could successfully be used to reclaim saline- sodic (sandy loam) soils following rice-wheat and sorghum-barseem crop rotations.

Plant Protection

Sr.#	Title of the Project/Location	Name of the PI
1	Distribution and Management of Root-Knot Nematodes (Meloidogyne spp.)	Dr. Tariq Mukhtar Department of Plant Pathology, PMAS, Arid Agriculture University, Rawalpindi
2	Survey and Management of Mite Pests of Stored Grains in Tehsil Toba Tek Singh	Dr. M. Hamid Bashir Department of Entomology, UAF
3	Transfer of Pheromone Control Techniques for the Control of Fruit Fly to the Farmers of District Lasbela, Balochistan, Pakistan	Prof. Dr. Abdul Hameed Bajoi Vice Chancellor, Lasbela University of Agriculture, Water and Marine Sciences, Uthal Balochistan
4	Demonstration of Plant Pathological technologies at U-Road on the Main Campus, UAF	Dr. Nazir Javed Department of Plant Pathology, UAF.
5	Demonstration of Innovative Technology of the Department at the Main Campus, UAF	Prof. Dr. Rashid A. Khan Department of Forestry & Range Management, UAF
6	Demonstration and Training of Integrated Pest Management Techniques for the Control of Fruit Flies at Farm Field Level	Dr. Muhammad Ahsan Khan Department of Entomology, UAF
7	Demonstration and Control of Mango Mealy Bug (Drosicha stebbingi Green) at the University of Agriculture Faisalabad Using Funnel Type Slippery Trap (an innovative technology)	Prof. Dr. Rashid A. Khan Department of Forestry & Range Management, UAF
9	Demonstration of Light Equipped Power Insect Killer (LEPIK Technology) for mechanical insect pest control in croplands	Prof. Dr. Rashid A. Khan Department of Forestry & Range Management, UAF
10	Rhizobaterial Formulations Application Technology for the Control of Major Pathogenic Root Infecting Fungi in Chickpea for Sustainable Crop Production	Dr. Muhammad Inam-ul-Haq PMAS-Arid Agriculture University, Rawalpindi

Training of Farmers in Pothowar Region

Among Phyto-nematodes, root knot nematodes (Meloidogyne spp.), being ubiquitous, infecting a wide host range and causing colossal yield losses are the most important pathogens curtailing world agricultural productivity. Root-knot nematodes are serious constraints to the production of vegetables in Pakistan.

Several management strategies like cultural practices, resistant hosts, biological control agents, physical factors and chemical means can be adopted for the control of nematodes. The project focused on the integration of root-knot management strategies and to create awareness and identification of these nematodes in the fields and about different management strategies through training.

Addressing the Grain Storage Issues

The direct damage of mites to stored grains is through contamination and penetration into seeds which consequently lower the vitality and germination capability of the seeds. They damage the embryo after penetrating into seeds and thus lowering the germination capability of seeds. They eat away the grains and sometimes the whole contents of the seed. The indirect damage is through raising the moisture contents of stored grains and generating much heat which subsequently favours the growth of bacteria and fungi that would deteriorate the quality of produce i.e. fusty smell and bitter taste. Different measures to protect grain from mite infestation embody prophylactic, hygienic and destructive measures. Under prophylactic measures low temperature, low humidity, sufficient ventilation and low rate of micro-biological processes and proper cleaning during threshing are taken into account. Hygienic measures include drying, turning and cleaning of grains. The destructive measures include fumigation of grain and storage buildings.

Lasbela: Outreach Beyond the Provincial Limits

Fruit fly is the main cause of reduced production of the fruits and vegetables in Lasbela district. The trainings were arranged with collaboration of Agriculture Extension Department and NRSP at farmer fields of Uthal, Bela and Wider. The Fruit orchards specially Guava, Chickoo, Jujube and cucurbits were selected for installation of Traps.

Fruit flies attracted on Pheromone trap showing Population of fruit fly in the area and Efficacy of Traps

Demonstration and Installation of Pheromone Traps in an orchard of Guava at Winder

Fruit Flies Control in Guava Orchards in Sheikhupura

Fruit flies are the major pest of most of the fruit crops and a great threat to world horticulture industry because of their greatest economic impacts in fruit production. Most of the fruit flies are causing both direct damage and indirect damage to horticultural fruits and vegetables because of quarantine restrictions in export markets and has become an important quarantine insect pest because of their severe damage, high fecundity rate and wide host range. Fruit flies damage fruits by puncturing and laying eggs under the soft skin in both mature and green fruits. The eggs hatch and larvae feed inside the fruit causing the fruits to rot resulting in unmarketable fruits. Farmers use only insecticides for control of fruit flies, which are toxic to both human and environment. Insecticides have residual effect on fruit which are dangerous for human. Project team trained the orchard growers to control fruit flies through integrated approach like cultural control, pheromone traps, bait application and chemical control etc.

Training of Chickpea Growers in Attock, Hassan Abdal, Fateh Jang & Pindighep

Chickpea is the main crop of Pothowar region of Pakistan affected by number of root infecting pathogens and causing huge yield losses. For the control of soil-borne pathogens, uses of chemical pesticides are a routine practice. Since pesticides are costly and cause environmental hazards and biocontrol with fungal antagonists have shown little success, use of beneficial bacteria in the control of soil borne pathogen offers an alternate method of control.

Horticultural Fruits Production

Sr.#	Title of the Project/Location	Name of the PI
1	Transfer of Viticulture Technology to the Farmers of Pothwar Region	Prof. Dr. Nadeem Akhtar Abbasi PMAS-Arid Agriculture University, Rawalpindi
2	Controlled Atmosphere Technology For Storage and Export of Horticultural Crops	Prof. Dr Aman Ullah Malik Institute of Horticultural Sciences, UAF
3	Establishment of a Model Fruit Plant Nursery for Demonstration of Container Grown Plant Production in Citrus and Guava	Dr. Muhammad Usman Institute of Horticultural Sciences, UAF
4	Technology Transfer to Citrus Growers in Relation to Changing Cultivars in Existing Citrus Orchards Through Top Working	Dr. Muhammad Jafar Jaskani Institute of Horticultural Sciences, UAF
5	Demonstration of *in vitro* Clonal Propagation System in Elite Guava Cultivars	Dr. Muhammad Usman Institute of Horticultural Sciences, UAF
6	Meadow Orcharding System in Guava (*Psidium guajava L.*)	Dr. Rashad Waseem Khan Qadri Institute of Horticultural Sciences, UAF
7	Multiplication and High Density Plantation of Fig Fruit Plants in Saline Soil (Paroka 2)	Dr. Saeed Ahmad Institute of Horticultural Sciences, UAF
8	Technology Transfer of Value Addition in Floriculture to Farmers	Prof. (Rtd.) Dr. M. Aslam Khan Institute of Horticultural Sciences, UAF
9	Establishment of Community Oriented Modern Fruit Plants Nursery System at UAF Sub-Campus Burewala	Dr. M. Fakhar-ud-Din Razi UAF Sub-Campus, Burewala

Controlled Atmosphere Technology For Storage and Export of Horticultural Crops

Fresh fruits and vegetable are highly perishable commodities being susceptible to rapid decay and deterioration at postharvest stage. Being living entity these are continuously undergoing various physical, physiological and biochemical changes even after harvest. From consumer's perspective these undesirable changes need to be minimized, although cannot be stopped. One of the main interventions in reducing postharvest losses of fruits and vegetables and maintaining freshness/quality is their storage under proper conditions/environment. In Pakistan, traditionally, cold storages have been used for storage of fresh commodities and the technology employed is by keeping produce at low temperature and high humidity. This technology gives limited success in increasing storage and shelf life of fresh produce. A more advanced technology is Controlled atmosphere (CA) storage, which involves precise control of gaseous composition around commodity to reduce the rate of respiration and ethylene production, besides low temperature and high humidity control. The high cost of air freight (e.g., Karachi to Europe: By air Avg. Rs. 120/kg compared to Rs. 20/kg by sea) limits the potential export volumes of mangoes to distant markets.

Modified Atmosphere demo on mango cv. Sindhri showed that this variety has potential of 3-4 weeks of storage/shipping followed by handling, ripening and marketing provided careful harvesting and postharvest handling and management is ensured.

Container Grown Nursery in Citrus and Guava

Development of containerized nurseries could be helpful in minimizing soil borne disease spread in both crops particularly guava and could be helpful in checking spread of Guava decline. During this project, a massive campaign was launched to enhance awareness in progressive growers and nurserymen to tell significance of containerized nursery development and potting media sterilization. Nurserymen were trained under different training courses (ASLP, BISP) from different parts of Punjab. The technology was demonstrated in different exhibitions on campus and citrus growers' conference held by ASLP citrus chapter. Collaborations were established with private entrepreneurs like MAK Nursery, Sadiqabad to establish commercial containerized fruit plant nursery. Progressive growers and industrialists groups like JK Farms, Punjab and Olympia group, Sindh are interested in establishing certified nurseries using environment friendly steam sterilization technology.

Human resource development through different training courses like ASLP Citrus nursery growers training and training of nurserymen under Benazir Income Support Program (BISP).

Developed a webpage for technology demonstration and sharing knowledge and expertise in Citrus and Guava nursery production.

Viticulture Technology to the Farmers-Pothwar Region

Grapevine is a major fruit crop worldwide since it is cultivated in all continents on an area of more than eight million hectares. Baluchistan is considered as the most important province with respect to the table grapes production. Pakistan is producing 72.35 thousand tons of table grapes annually, with an annual yield of 7.24 t/ha against the yield of advanced countries like USA of 16.84 tons/ hec. (FAO, 2011).

Currently in the Pothwar region the grapes are gaining momentum with an area of more than 600 acres under cultivation.

However, adoption of viticulture amongst farmers is slow due to lack of awareness about its production technology and high initial cost. Table grapes have unique production technology as compared to other traditional fruit crops of Pothwar. The plants make vine and need support system that is trellis. Their training and pruning for commercial production is also highly technical as per fruit bearing habits of the cultivars. Similarly as being new crop, farmers are not aware about the irrigation requirements, nutritional and pest management. Overall techniques for canopy and floor management of table grapes in Pothwar are totally new to the farmers and the initial cost is also quite high.

Realizing the importance of the issue, this project was designed in order to resolve these problems by providing latest production technology to the farmers i.e. suitability of varities, orchard geometry, Irrigation system, trellising systems, fertigation, Pruning Plant protection strategies.

Top Working: Changing Cultivars in Existing Citrus Orchards

Pakistan's citrus industry is Kinnow mandarin based and this monoculture is a great threat not only to industry but may yield loss to country's economy and human resources. Any disease or disaster to existing Kinnow plantings can collapse the citrus industry. The world citrus industry is diversified and has a wide market window of 6-8 months. Kinnow is late variety and market window is of 3-4 months. Moreover, Kinnow is high seeded cultivar while low seeded strains of Kinnow are highly demanded in international market. Hence varietal diversification is important for the sustainable agro-industry in Pakistan. Establishing new orchards with low seeded Kinnow or diversified cultivars is long term planning and time taking process. This needs thousands of nursery plants which are not available. At the moment top working is the best solution to change varieties in existing orchards which bear fruits earlier than new plantings

The technology is well taken by the growers with introduction of new cultivars especially the low seeded Kinnow. A block of 50 citrus trees is top-worked at Horticultural Fruit Garden Sq. No. 32, UAF, which serves as a technology demonstration site. Further, training and demonstration sessions were arranged at grower's property in Sargodha and Layyah districts.

A brochure on citrus top working has been printed and distributed for better understanding of the technology. Four more orchards with 132 trees are top worked in Vehari and Sargodha. The buders were also trained on the technology in said orchards. A demonstration block is established in Horticultural Fruit Garden Sq. No. 32 with new citrus germplasm of mandarins and oranges. Besides seedless Kinnow, citrus new germplasm like Caffin mandarin, Daisy mandarin and navel oranges are top worked at grower's orchards.

Demonstration of in vitro Clonal Propagation System in Elite Guava Cultivars

Selected strains in guava like Sadabahar Gola and Sadabahar Surahi cultivars offer regular production of fresh fruit up to 7-8 months. No other fruit crop offers such regular production and long harvesting span. This makes guava, third highly produced fruit crop in Punjab, more attractive for the growers to establish new orchards. Guava is also highly nutraceutically rich fruit containing more vitamin C content compared with citrus. It is being commercially propagated through seed since decades in Punjab and selections have been made by the amateur growers mainly in Sherkpura. Seedling based guava industry along with other factors lead to variable production which is merely 8 tons ha^{-1} in Pakistan, three times lower to Brazil. In guava, asexual propagation has been a problem since long time. Seedlessness has been claimed by few growers; however, they have been unable to prove its consistency and could not propagate these strains due to lack of clonal propagation systems. Conventional asexual propagation has limitations like long juvenility, more time and plant material requirement for propagation and season dependency. Micropropagation offers regular and efficient plant multiplication, less plant material requirement for propagation and sanitated plant material production under aseptic environment. Efficient tissue culture system could also help initiating future crop improvement programs in indigenous guava material. Conclusively, future of Guava industry lies in tissue culture grown sanitated guava plants for the nurserymen, growers and other stakeholders. Hence, the project was initiated .

Value Addition in Floriculture to Farmers

This project was aimed to broaden the presence and increase the value of non-traditional high value crops through educating farmers, transfer of technology for essential oil extraction, rose nursery establishment, management, and strategic business planning and collaboration with local industry. Roses are commercially viable and highly profitable non-traditional horticultural crop. A new strain of *Rosa centifolia* is developed which produces profuse flowers throughout the year.

Extensive survey of five districts of Punjab (Faisalabad, Qasoor, Lahore, Sheikhupura, Pakpatan) were made to identify the potential farmers for cultivation of roses for essential oil production. 200 potential farmers were selected and registered from these 4 districts. These farmers were provided with plants for establishment of their own nurseries at their farms. Saplings of the selected strain of rose species and full advisory services were provided to the interested farmers and backup visits were given to them to make the technology paying.

Periurban horticulture includes all practices to grow fruit, vegetables, floricultural and medicinal plants in the vicinity of dwellings. Rose species like Rosa centifolia, Rosa damascena and Rosa Gruss Teplitz were selected to grow in peri-urban area of Faisalabad city.

Optimization of standard conditions for maximum oil yield from *Jasminum sambac* through SCFE was also successfully carried out. Extraction of essential oil of Jasminum sambac by using different extraction techniques like solvent extraction and CO_2 extraction was optimized.

The essential oil from flowers of *Murraya exotica* was extracted thorugh supercritical fluid extraction and analysed by GC and GC–MS, representing 99.8% and 99.2% of the oils, respectively.

4 lacs cuttings and sampling of new rose strain *Rosa centifolia* were provided to farmers and industries. Supercritical Fluid (SCF) CO_2 technique used for oil extraction was demonstrated to farmers who visited the Rosa lab.

Horticultural Germs Plasm Collection

Sr.#	Title of the Project/Location	Name of the PI
1	Collection and Establishment of Germplasm Unit (GPU) of Fruit Plants at Square No. 32, UAF	Dr. Saeed Ahmad Institute of Horticultural Sciences, UAF
2	Establishment of Demonstration Orchard for Transfer of Technology to the Growers at PARS	Dr. Saeed Ahmad Institute of Horticultural Sciences, UAF
3	Demonstration/Dissemination of Promising Ber Cultivars in Marginal Land in Distt. Faisalabad (Punjab)	Dr. Saeed Ahmad Institute of Horticultural Science, UAF
4	Establishment of Date Palm Germplasm Unit	Mr. Summar Abbas Naqvi Institute of Horticultural Sciences, UAF

Collection and Establishment of Germplasm unit (GPU) of Fruit Plants

It was planned to collect and introduce the germplasm at least from within the country and establish the Germplsm Unit (GPU) at the University Campus. Such an effort might lead to evolution of new varieties, techniques to be recommended to growers of the area. Moreover, availability of the gene pool with known characteristics will help scientists to conduct research experiments of current and upcoming issues of horticulture industry like biotic stresses, drought stress, salinity stress and various fatal insect, pests and diseases.

Promising Ber Cultivars in Marginal Land

Peoples of Punjab province are not used to establish ber orchards. Moreover high yielding and attractive cultivars were not available. Different good attractive cultivars have been collected and transplanted in Institute of Horticultural Sciences, University of Agriculture Faisalabad which can be grown in different types of soils successfully. Canopy management was carried out and demonstrated to the growers. Plants height was maintained at 6 and 4 feet. After the proper survey and discussion with farmers at initial stages, four Farmers /growers were convinced to establish a Ber orchard at their farms with Promising Ber Cultivars and to adopt the technology of canopy management. JK Farms Jhumra, Ch. Muhammad Tanveer, Farm, Chak No 25 J. B. Sathoi Wala and Salman Shah Farm, Pansera were selected for the establishment of Ber orchard with promising Ber cultivars. Orchard of Ber in each Farm was established adopting the advanced technology. These cultivars were also transplanted at Paroka 2 in 4 acres during this period and more than five thousand plants of Ber were raised. More than 2000 were grafted and true to type plants were prepared and sold to the farmers. Byproducts such as Jam and Chatni of Ber fruit were prepared and introduced to increase the return of growers and to create self employment.

Establishment of Date Palm Germplasm Unit

Germplasm exchange is currently limited between the different date palm growing regions of Pakistan. Genetic resources conservation is necessary for varietal diversification for sustainable agro-industry to improve livelihood of farmers. Collections are necessary when maintained under field conditions, and should be backed up in repositories for safe-keeping. These issues can be transformed by establishing germplasm unit – a first step toward model nursery system.

Sharing of planting material is limited between the different date palm growing regions of Pakistan. Farmers are bound to one window varietal selection. On the other hand, date palm is being propagated sexually and asexually which are more adopted propagation methods in Pakistan. Propagation through seeds results as chance seedlings. Suckers are the only available best propagation material within for sustainable orchard. Generally, date palm starts to produce suckers at the age of 8-10 years and produce probably 25-40 suckers at the base or top in the whole life span depending on cultivars and cultural practices. Suckers are attached to mother plant for 3-4 years to attain appropriate maturity, size and enough root system so that they can survive independently. After that, it is detached from mother plant and planted in the new place. Aerial suckers almost destroy due to failure in root development.

Germplasm collecting trips were concentrated towards important date palm growing regions of Punjab (Muzafargarh, Dera Ghazi Khan, Multan, Layyah, Bahwalpur, Rahim Yar Khan, Jhang, Shorkot) and Dera Ismail Khan (Panyala and Dhakki). Important date palm accessions depending on their fruit color and taste were marked and further collection was made from visited regions escaping flooded areas. During first year of the project, 99 % survival rates of the suckers were observed.

Different date palm varieties were collected from natural zone of date palm distribution and cultivation i.e. Punjab (Jhang, Shorkot, Muzaffargarh, Lodhran, Bahawalpur, Khanpur and Rahim Yar Khan), KP (Ameer Shah, Daraban, Darazinda, Paniala) and Sindh (Pannu Aqil, Khairpur and Sukkur). In total, 72 different varieties were conserved at PARS-UAF. The collected material comprises of female as well as male plants. Good agronomical practices were adopted for the management. During second year of project 92.79 % survival rates were observed.

Vegetable Production

Sr.#	Title of the Project/Location	Name of the PI
1	Establishment of Mushroom Cultivation Unit for Demonstration and Growth Trials of Wild and Exotic Mushrooms	Prof. Dr. M. Asif Ali Institute of Horticultural Science, UAF
2	Improving Farmers' Profitability and Human Nutrition through Popularization of Carrots	Prof. Dr. Muhammad Amjad Institute of Horticultural Science, UAF
3	Dissemination of Seed Production Technology of Important Vegetable Crops	Dr. Khurram Ziaf Institute of Horticultural Sciences, UAF

Mushroom Cultivation

Demonstration facilities were established to train people. About more than fifteen (15) different species of mushroom from Murree, Nathya Gali, Abbottabad and Islamabad were collected while different strains of ganoderma mushroom from Changa Manga forest. Pure cultures of six button and six oyster mushroom strains were imported from Holland and are being tested in the facility.

Concurrent with growth trials, training sessions, each of one week, were organized. Candidates from regular gardener courses, were also trained in project. These skilled persons are required by progressive farmers to run their farm activities. About 10 persons have been educated about farm activities and can handle responsibilities of a commercial mushroom farm.

Project team has established four model farms in different cities in private sector and a spawn producing laboratory in Faisalabad. Six commercial button mushroom farms and one mushroom spawn lab. have been established.

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