

STATUS OF RESEARCH PROJECTS (1ST Batch 2001-2002)

BACKGROUND

ALP 1st Batch was announced in December, 2000 for inviting the preliminary proposals from the promising Pakistani Agricultural/ Social Scientists for funding out of Agricultural Research Endowment Fund (AREF).

In response 592 preliminary proposals were received from all over the country for funding under ALP 1st batch. Out of these 218 preliminary proposals were short-listed by the Technical Divisions, PARC for developing detailed projects and 374 preliminary proposals, which do not fall under ALP laid down criteria were dropped as detailed below.

<i>Discipline</i>	<i>Recommended</i>	<i>Not Recommended</i>	<i>Total</i>
<i>Animal Sciences</i>	47	67	114
<i>Crops Sciences</i>	122	192	314
<i>Natural Resources</i>	28	97	125
<i>Social Sciences</i>	21	18	39
TOTAL	218	374	592

APPROVAL STATUS

Short listed 218 detailed projects were considered by the Technical Advisory Committee (TAC) meetings and Board of Director (BOD) of ALP finally approved 116 detailed projects for funding under 1st batch as detailed below:

<i>Region</i>	<i>Animal Sciences</i>	<i>Crop Sciences</i>	<i>Natural Resources</i>	<i>Social Sciences</i>	<i>Total</i>
<i>PARC/ NARC</i>	9	27	7	2	45
<i>Punjab</i>	8	9	5	2	24
<i>NWFP</i>	3	8	4	1	16
<i>Sindh</i>	3	4	1	2	10
<i>Balochistan</i>	-	5	2	-	7
<i>AJ & K</i>	-	-	1	-	1
<i>NGO/Others</i>	-	2	-	-	2
<i>Other Federal</i>	1	7	3	-	11
Total	24	62	23	7	116

IMPLEMENTATION STATUS

Out of 116 approved projects 62 projects are on-going, two are in process of agreement, forty three have been completed and five projects of crops sciences has been terminated/dropped due to one or other reasons. Following is the implementation status of ALP 1st Batch:

<i>Projects Status</i>	<i>Animal Sciences</i>	<i>Crops Sciences</i>	<i>Natural Resources</i>	<i>Social Sciences</i>	<i>Total</i>
<i>On-Going</i>	14	35	15	2	66
<i>In process of Agreement</i>	-	2	-	-	2
<i>Completed</i>	8	23	7	5	43
<i>Terminated/ Dropped</i>	2	2	1	-	5
TOTAL	24	62	23	7	116

List showing the title of projects, name of PIs, location & financial status of projects is at Annexure-I

MONITORING & EVALUATION

Monitoring and review of the on-going projects is a regular activity of the ALP Secretariat. ALP Secretariat with the active involvement of concerned Technical & Finance Divisions, PARC has completed on-site review of 66 projects. In addition to that annual/ mid term review in respect of 32 on-going projects also conducted at PARC Headquarters. The recommendations of review teams have been conveyed to concern PIs.

Currently, most of the projects have completed two years of their life span. The annual progress reports of the projects shows that significant task has been completed and the outcomes are very encouraging /cheering. The salient achievements of these projects have been compiled in subsequent chapters of this annual report.

FINANCIAL STATUS

So far an amount of Rs. 168 million has been released against the overall total cost of Rs. 299 million in respects of the approved projects. Till 30th June 2005, overall expenditure of Rs. 143 million has been incurred as reported by the PIs of the projects. Discipline wise details are given below:

(Rs. in million)

<i>Discipline</i>	<i>Total Cost</i>	<i>Releases</i>	<i>Expenditures</i>
<i>Animal Sciences</i>	59	35	32
<i>Crops Sciences</i>	159	86	74
<i>Natural Resources</i>	67	37	30
<i>Social Sciences</i>	14	9	7
<i>TOTAL</i>	299	168	143

A list showing releases, expenditures and duration of each project is Annexed – I.

STATUS OF RESEARCH PROJECTS (2nd Batch 2002-2003)

BACKGROUND

ALP 2nd Batch was announced on 28th July, 2002 for inviting the preliminary proposals from the promising Pakistani Agricultural/Social Scientists for funding out of Agricultural Research Endowment Fund (AREF).

In response 644 preliminary proposals were received for funding under ALP 2nd batch. Out of these 267 preliminary proposals were short-listed by the Technical Divisions, PARC for developing detailed projects and 377 preliminary proposals, which do not fall under ALP laid down criteria were dropped as detailed below:

<i>Discipline</i>	<i>Recommended</i>	<i>Not Recommended</i>	<i>Total</i>
<i>Animal Sciences</i>	59	59	118
<i>Crops Sciences</i>	128	219	347
<i>Natural Resources</i>	49	65	114
<i>Social Sciences</i>	31	34	65
TOTAL	267	377	644

Out of 267 short listed proposals 232 detailed projects were received and 35 PIs had not responded. Incomplete 10 projects were also found among detailed projects which were dropped and only 222 projects were processed further.

APPROVAL STATUS

Detailed projects (222) completed in all respects were processed for appraisal and final approval by TAC & BOD and 135 projects were approved by BOD of ALP so far as detailed below:

<i>Region</i>	<i>Animal Sciences</i>	<i>Crop Sciences</i>	<i>Natural Resources</i>	<i>Social Sciences</i>	<i>Total</i>
<i>PARC/NARC</i>	7	12	6	10	35
<i>Punjab</i>	18	20	7	7	52
<i>NWFP</i>	2	9	8	1	20
<i>Sindh</i>	2	3	-	3	8
<i>Balochistan</i>	1	3	-	1	5
<i>NGO/Others</i>	1	-	-	-	1
<i>Other Federal</i>	1	11	2	-	14
Total	32	58	23	22	135

List showing the title of projects, name of PIs, location & financial status of projects is at Annexure-II

IMPLEMENTATION STATUS:

Out of 135 approved projects, 107 projects are on-going; 22 projects are in process of agreement, six projects, three of Crops Sciences and three of Natural Resource have been dropped due to one or other reasons.

Following is the implementation status of ALP 2nd Batch:

<i>Projects Status</i>	<i>Animal Sciences</i>	<i>Crops Sciences</i>	<i>Natural Resources</i>	<i>Social Sciences</i>	<i>Total</i>
<i>On-Going</i>	23	47	19	18	107
<i>In process of Agreement</i>	9	8	1	4	22
<i>Terminated/ Dropped</i>	-	3	3	-	6
TOTAL	32	58	23	22	135

The progress of the projects which had completed at least their first year of implementation has been included in this progress report.

FINANCIAL STATUS

So far an amount of Rs. 96 million has been released against the overall total cost of Rs. 445 million in respects of approved projects. Till 30th June 2005, overall expenditure of Rs. 64 million has been incurred as reported by the PIs of the projects. Discipline wise details are given below:

<i>Discipline</i>	<i>Total Cost</i>	<i>Releases</i>	<i>Expenditures</i>
<i>Animal Sciences</i>	143	26	16
<i>Crops Sciences</i>	155	33	22
<i>Natural Resources</i>	64	19	14
<i>Social Sciences</i>	83	18	12
TOTAL	445	96	64

(Rs. in million)

A list showing releases, expenditures and duration of each project is Annexed – II

ANIMAL SCIENCES

BACKGROUND

1st Batch:

ALP Secretariat received 114 preliminary proposals relating to animal sciences for funding under the 1st batch. In process of preliminary appraisal 47 proposals were short listed for the invitation of detailed projects and 67 proposals which were not up to the standard were dropped. Finally, 24 projects costing Rs.59 million were approved by the Board of Director (BOD) of ALP for funding to conduct the research in following different disciplines.

2nd Batch:

ALP Secretariat received 118 preliminary proposals relating to animal sciences for funding under the 2nd batch. In process of preliminary appraisal 59 proposals were short listed for the invitation of detailed projects and 59 proposals which were not up to the standard were dropped. Finally, 32 projects costing Rs.143 million were approved so far by the Board of Director (BOD) of ALP for funding to conduct the research in following different disciplines.

There are projects on Animal Health consisting of evaluation of indigenous medicinal plants for veterinary use, development of improved diagnostic techniques for rinder pest and other important viral diseases of livestock, control of parasitic diseases, etiology of *Caprine mycoplasma*, mapping and control of warble fly in Pakistan.

Four projects related to Animal Nutrition are expected to generate new and useful knowledge on nutritional quality of dairy rations, feeding system of lambs, application of balanced feeding at farmer's level and development of milk replacer for calf rearing. Two projects related to Animal Breeding and Genetics will address the important problem like genetic characterization of native cattle breeds and genetic evaluation models for dairy cows and buffaloes.

Genital prolapse is common problem of economic importance faced by our buffalo farmers, which will be investigated for its etiology and control in one of the project is underway.

Bovine somatotropin (bST) hormone is being used in the country to increase milk production of cattle and buffaloes, effect of this recombinant hormone on production and health of buffaloes is, however, not completely known. This important information is expected to be generated under one of the project of Animal Production.

In fisheries there are also projects to generate information on Aquaculture of marine fin fishes, fresh water prawn, American channel cat fish and Tilapia culture. The region wise detail of the on-going projects is summarized as under:

S.No	Region	No. of Projects	
		1 st Batch	2 nd Batch
1	<i>PARC/NARC</i>	9	7
2	<i>PUNJAB</i>	8	18
3	<i>NWFP</i>	3	2
4	<i>SINDH</i>	3	2

5	BALUCHISTAN	-	1
6	NGO/ OTHERS	-	1
7	OTHER FEDERAL	1	1
TOTAL		24	32

IMPLEMENTATION STATUS

1st Batch:

Out of 24 approved projects 14 are on-going and 8 projects have been completed and two projects have been dropped due to one or other reasons.

2nd Batch:

Out of 32 approved projects 23 are on-going and 9 projects are in process of agreement so far.

FINANCIAL STATUS

1st Batch:

So far an amount of Rs.35 million has been released against the overall total cost of Rs.59 million in respect of approved projects. Till 30th June, 2005 overall expenditure of Rs.32 million has been incurred as reported by the PIs of the projects.

2nd Batch:

So far an amount of Rs.26 million has been released against the overall total cost of Rs.143 million in respect of approved projects. Till 30th June, 2005 overall expenditure of Rs.16 million has been incurred as reported by the PIs of the projects.

MONITORING & EVALUATION

ALP Secretariat with the active involvement of concerned Technical & Finance Divisions, PARC has completed on-site review of 16 projects. On the recommendations of external reviewers and other team members 6 projects have been granted extension in the period of execution.

Currently, most of the projects have completed three years of their life span .The annual progress reports of the projects shows that significant task has been completed and the outcomes are very encouraging/cheering. The salient achievements of these projects have been compiled in subsequent chapters of this annual report.

Project Title: *Preliminary studies on the efficiency of locally prepared Staphylococcus Aureus vaccine in the control of Mastitis in dairy buffaloes.*

Principal Investigator: *Dr. Ghulam Muhammad*
Associate Professor & Chairman

Location of Project: *Dept. of Clinical Medicine and Surgery, Faculty of Veterinary Sciences, University of Agriculture, Faisalabad*

<i>Duration:</i>	<i>24(months)</i>	<i>Total Cost (million): 0.754</i>
<i>Start Date:</i>	<i>25/4/2002</i>	<i>Funds Released (Rs): 452000</i>
<i>Project Status:</i>	<i>Completed</i>	<i>Funds Utilized (Rs): 461889</i> <i>(Upto 30th June, 2005)</i>

Objectives:

- To investigate the efficacies of locally prepared Saurerus vaccines in the control of mastitis in dairy buffaloes under experimental and field conditions.
- To determine the cost-effectiveness of mastitis control through vaccination.

Achievements/Progress:

Swelling of the milk-producing organ (udder), technically called mastitis, is economically the most important disease of the dairy animals worldwide. At the very least every fourth cow or buffalo in Pakistan is afflicted with mastitis. The disease is well known to the professionals as well different as farmers for its economic losses. Owing to the deleterious effect on milk quality and public health and oil- concern, the disease would be of even graver concern when WTO Accord domes into force in the year 2005. At present, no mastitis control program is in place in Pakistan. Research studies conducted thus far in Pakistan over several decades have indicated that the bacterium, *S. Staphylococcus aureus* is the most important cause of this disease in dairy buffalo, the mainstay of dairying in Pakistan. Extremely small herd size, ra1npant illiteracy, and generally non-commercial nature of dairy farming militate against the adoption of standard mastitis control measures (e.g., teat dipping, dry period antibiotic therapy) in our country. Against this backdrop, control of *S. aureus* mastitis through vaccination seems a pragmatic alternative/adjunct strategy. In a bid to evaluate control of mastitis through vaccination, 4 different, *S. aureus* mastitis vaccines viz. live attenuated vaccine, plain bacterin, dextran sulphate adjuvanted bacterin, and oil-adjuvanted bacterin) were prepared and evaluated in laboratory setting/laboratory animals, in dry, pregnant non-mastitic buffaloes as well as in lactating buffaloes.

For evaluation in the laboratory setting/animals, all 4 vaccines prepared were evaluated in terms of sterility, safety and side effects. In addition, these vaccines were evaluated by vaccination-challenge method in rabbits. Culturing of the live attenuated vaccine on blood agar plates revealed that it was free of any adventitious microorganism. The three bacterins were found sterile. All vaccines appeared by and large safe and free of any substalltive untoward effect.

Evaluation of the 4 vaccines in the target species i.e., buffalo was undertaken in two phases. Phase-I involved vaccinating 5 pregnant, non-lactating, non-mastitic buffaloes in the last trimester of pregnancy twice with the respective vaccine at day 60 and day 30 precalving. At day 35 after calving the teats of all animals were challenged by immersing in a suspension of live

vaccinal, *S.aureus*. Evaluation parameters included serum and milk whey IHA antibody titers, milk production (L/24 hrs), milk somatic cell count, milk protein and fat percentage and prevalence and incidence of *S. aureus* mastitis till day 120 post calving. The order of efficacy of 4 *S. aureus* vaccines tested on dry pregnant non-mastitic buffaloes in this phase of the study was as follows: dextran sulphate adjuvated bacterin, live attenuated vaccine, oil adjuvated bacterin and plain bacterin.

As a final leg of the project (phase II of evaluation in the target animal i.e. buffalo) two better vaccines (dextran sulphate adjuvated bacterin and live attenuated vaccine) were evaluated under field conditions in 150 lactating buffaloes. Evaluation parameters of the field trial included serum and milk whey antibody titers, milk somatic cell count, severity of clinical episodes, number of colonies of *S. aureus*, prevalence, cumulative incidence, milk yield; vaccine efficacy and cost-benefit analysis of mastitis control through vaccination. Comparing the two vaccinal groups with unvaccinated control revealed that on an average each of the 50 buffaloes vaccinated with live attenuated *S. aureus* vaccine produced 279 liters of additional milk during the 6 months study period. The corresponding value for a buffalo vaccinated with dextran sulphate adjuvated vaccine was 198 liters. Given a farm gate price of Rs. 15/= per liter, additional milk produced by each (buffalo vaccinated with live attenuated *S. aureus* vaccine was valued at Rs. 4185/= and one vaccinated with dextran sulphate adjuvated vaccine at Rs 2970/=). The cost-benefit ratio for an immunological control of mastitis with two shots of live attenuated *S. aureus* vaccine translated into 1: 18.6. The corresponding ratio for the dextran sulphate adjuvated vaccine stood at 1:5.9. In sum, the results of the present study seem poised for devising a fairly effective immunological control of *Staphylococcus aureus* mastitis suited to the conditions of bubaline (buffalo) dairying in Pakistan.

Project Title: *Farming of mud crab (Scylla serrata) in the coastal earthen-ponds.*

Principal Investigator: *Dr. Javed Mustaqim*
Professor

Location of Project: *Center of Excellence in Marine Biology, University of Karachi, Karachi-75270*

Duration: 36(months)

Total Cost (million): 2.386

Start Date: 22/3/2002

Funds Released (Rs): 1984300

Project Status: Completed

Funds Utilized (Rs): 1603870

(Upto 30th June, 2005)

Objectives:

- The main objective of the project is to develop methodology for farming the mud crab in the coastal earthen ponds from seed (juvenile or less than 100 gram in weight) to marketable size (more than 450 gram in weight).
- To study the effect of salinity on growth and survival.

Achievements/Progress:

Three earthen ponds were constructed at Sandspit backwater area. One pond was about 1000 m² and the other two ponds were about 30 m² each. The water depth of the pond was about 1 meter. Each pond was fenced with barbed wire and iron mesh to prevent poaching. Fishing net, having small mesh, was also provided with fence to prevent mud crabs from escaping.

Four crops of mud crabs were harvested. In the first grow-out operation stocking density was 0.2 crab/m², duration was 3 months, mortality rate was 31 % and growth rate was 36.3 gram/month. The second grow-out operation was carried out for a period of 5 months, stocking density was 1.0 crab/ m², mortality rate was 28.5% and the growth rate was 59.4 gram/month. The third grow-out operation was also of 5 months duration, stocking density was 0.4 crab/m², mortality rate was 26.0% and the growth rate was 61.6 gram/month. The last grow-out operation was carried out for a maximum period of 8 months with a stocking density of 1.9 crab/m², mortality rate was 47% and the growth rate was 40 gram/month. The third crop had the highest growth rate and lowest mortality rate.

Effect of low salinity on the growth of mud crab was also studied. For this purpose the two small earthen ponds at Sandspit were used. In one pond salinity was kept low (32 ±4 ppt) and in the other pond it was kept normal (41 ± 3.5 ppt). One hundred crab "seeds" were stocked in each pond and they were allowed to grow for a period of 160 days. The growth rate was 73 gram/month in low salinity and 71 gram/month in nonnal salinity (control). The difference was found insignificant. ($X^2=0.04$)

Meat content of the pond-grown mud crab was also studied and the result was compared with those of wild mud crab. The average meat content in the pond- grown mud crab was found to be 29.3% ± 1.9 (S.D.) whereas it was 30.2% ± 2.6 (S.D.) in the wild mud crab. The difference in meat content between male and female crabs was found insignificant.

Incidence of gill parasitization was also looked into. Two species of stalked barnacles, *Octolasmis cor* and *O. angulata*, were found in the gill chambers of the mud crabs. *Octolasmis cor* was more abundant than *O. angulata*. The distribution pattern was also different. Majority of the *O. cor* was found attached to gill number seven whereas most of the *O. angulata* was found attached to gill number four.

Relationships between carapace breadth and carapace length, crab weight and meat weight, carapace breadth and meat weight, carapace length and meat weight, carapace length and crab weight and carapace breadth and crab weight were also worked out as these information are important tools in the management of crab fisheries.

During present investigation four research papers were presented in the scientific conferences/seminars. The abstract of these papers have been published. Two research papers have been submitted for publication whereas two more research papers are under preparation. Three brochures have also been published: (1) Mud crab, (2) Edible crabs of Pakistan and their fisheries and (3) Farming of mud crab. A training workshop on mud crab is being organized in which participants will be told about various aspects of mud crab biology and the problems and prospects of mud crab farming in Pakistan.

Conclusions:

From the results of four grow-out operation, one can conclude that the best stocking density is about 1 crab/m² and the farming period should be between four to five months. If the stocking density is increased mortality rate also increase. This is mainly due to cannibalism. Similarly when the period of grow-out operation or farming was increased more crabs were found dead or eaten by other crabs (cannibalism). The average weight of the crabs did not exceed 418 grams, although there were many crabs who grew more than 500 grams in weight, which is considered "large" size.

In East and Southeast Asian countries such as Thailand, Philippines etc. the optimum salinity for mud crab farming is around 25 ppt. but results show that the low salinity has no effect on the growth of mud crab. Since the coastal waters of Pakistan are more saline than the East Asian countries mentioned above, the local mud crabs are adapted to such high salinity water and they can be farmed in this salinity.

Project Title: *Polyculture of freshwater prawn, Macrobrachium malcolmsoni with Indian major and Chinese carps at farmers ponds in Pakistan.*

Principal Investigator: *Dr. Rafia Rehana Ghazi*
Director

Location of Project: *VPCI, Southern Zone Agricultural Research Centre (SARC), Karachi.*

Duration: 36(months)

Total Cost (million): 1.984

Start Date: 22/4/2002

Funds Released (Rs): 1797000

Project Status: On-going

Funds Utilized (Rs): 1770899
(Upto 30th June, 2005)

Objectives:

- To study growth and survival of fish and prawns in polyculture system.
- To determine economic feasibility of fish/ prawn polyculture system.

Achievements/Progress:

The project was launched in April, 2002, first growth cycle started during September -October, 2002 and continued upto October- November, 2003.

Second growth cycle was started at two sites one at Dilshad Fish Farm, Chilya, Thatta and other at Ijaz Fish Farm Pir puttho, Thatta.

For this cycle Juvenile Prawns were collected from Indus river near Jamshoro Bridge and near Sajawal Bridge.

A representative sample for data collection were separated and stocked in experimental ponds for acclimatization at the rate of 6000 prawns and 600 composite fish per acre in Polyculture system. While control pond was stocked with 600 fish per acre. During the period stocked fish and prawn were monitored periodically for growth in respect of length and weight. Survival rate of stocked fish and prawn was assessed at the time of harvest. Final growth data revealed successful Polyculture of prawn and fish in Sindh.

Data for water quality was monitored on monthly basis including Dissolved Oxygen, pH, Hardness, Ammonia, Nitrate and Temperature etc.

Regular feeding was made, consisting of CG 30%, rape seed cake in each pond. Ponds were properly fenced to avoid prawn escape and predator entrance. Water level was checked daily by the pond managers and recharged as and when needed. Organic manure was added to keep the water green and for proper plankton growth.

Conclusions:

The second cycle was carried out with complete harmony of experimental design and procedure and it presents more promising results in terms of prawn and fish production and yield in polyculture system as compared to monoculture. Maximum weight of prawns recorded was upto 175 gms.

Project Title: *Studies on Tilapia culture through controlled breeding in saline areas.*

Principal Investigator: *Dr. Iftikhar Ahmed*
Associate Professor

Location of Project: *Fisheries Research Farms, Department of Zoology and Fisheries,
University of Agriculture, Faisalabad.*

Duration: 36(months)

Total Cost (million): 0.898

Start Date: 3/4/2002

Funds Released (Rs): 688100

Project Status: Completed

Funds Utilized (Rs): 688100

(Upto 30th June, 2005)

Objectives:

- To collect large size Tilapia brooders from different areas of Pakistan.
- To control over breeding of Tilapia by different techniques.
- To produce marketable size fish.
- To compare the economics of Tilapia with major carps Cultured in saline water areas.
- To utilize the waste saline lands for profitable fish farming system.

Achievements/Progress:

In Pakistan, six fish species are cultured in fresh water pond system. These include *Labeo rohita*, *Calla calla*, *Cirrhinus mrigala*, *Ctenopharyngodon idella*, *Hypophthalmichthys molitrix* and *Cyprinus carpio*. These are profitably reared in soft water but the production in saline water is very low. So, there is need to identify such a fish which can be cultured profitably in these areas. Tilapia seems to be the suitable culturable fish species for such saline water areas. But the culture of tilapia is however is still beset with problem of their prolific breeding habit and stunted growth.

In the present project, repeated experiments were conducted to control the prolific breeding of tilapia and to increase the size of individual fish. For this purpose, monosex; culture, sex reversal and predatory-prey cultured technique are used.

For monosex culture, the experiment was conducted in three earthen ponds (200 m²), located at Fisheries Research Farms, University of Agriculture, Faisalabad. In Pond-I, 100 males and in Pond- 2, 100 females were stocked. In Pond-3, 50 males and 50 females were stocked. All the ponds were manured by cowdung at the rate of 0.2gN/100g of fish body weight daily. After fortnightly intervals, a sample of 10 fishes was captured randomly, their body weight was recorded and average was calculated.

Many experiments were conducted for the sex reversal of tilapia. For this purpose fertilized eggs were collected from the mouth of breeding females, and eggs were transferred to the cemented circular tank. The four days old fries were transferred to four glass aquaria. One of these group was kept as control, whereas the other three were considered as treated group designated as T1, T2, T3. The experimental feed was prepared by using rice polish, maize gluten (30%), fish meal, vitamins premix and the hormone 17- alpha methyltestosterone was added at the rate of 50, 70 and 90 mg/kg in T1, T2 and T3, respectively. After 25 days the fish fry were transferred in four earthen ponds. The manuring was done by applying cowdung at the rate of 0.1 N/100 gm/day of

fish body weight. The fry were also fed on supplementary feed (35% C.P) @ 2% body weight daily, containing sunflower meal, rice polishing and Maize gluten (30%) for a period of three months. Increase in body weight was estimated on fortnightly basis.

In predatory prey experiment, *Channa marulius* was used as predatory fish to control the over breeding of tilapia. This experiment was conducted in four earthen ponds having the area of 200 meters sq., located at Fisheries Research. Farms, University of Agriculture, Faisalabad. *Channa marulius* and tilapia was stocked in the ratio of 1: 10, 1 :30, 1 :50 and 1 :70 in pond 1, 2, 3 and 4, respectively. The manuring was done by cowdung at the rate of 0.1g N/100 gm of fish weight daily. The supplementary feed (35% C.P) was given at the rate of 2% body weight daily. The feed was formulated by using feed ingredients rice polish, fish meal, maize gluten and vitamin premix. A sample of at least 5 fishes of *Channa marulius* were netted out randomly on monthly basis with the help of nylon drag net and their body weight was recorded and their average was calculated.

Conclusions:

From the repeated experiments following conclusions were drawn:

1. In monosex culture, Tilapia showed 1.12 and 1.32 times higher growth as compared with' female monosex and mixed sex culture, respectively while female tilapia in monosex culture obtained 1.17 times fast growth than mixed culture.
2. The oral administration of 17 alpha methyltestosterone @ 50,70 and 90 mg/kg of feed for 25 days resulted in sex reversal of tilapia as 88%, 100% and 61 %, respectively.
3. It is quite feasible to use *Channa marnlius* as predator to control over population of tilapia and 1: 50 ratio of *Channa marnlius*: tilapia was found to be the best.
4. Hybrid tilapia could not be produced as it was difficult to identify different pure lines of tilapia.

Project Title: *Molecular characterization of Pakistani infectious bronchitis virus variants and development recombinant vaccine.*

Principal Investigator: *Dr. Khalid Naeem*
Senior Scientific Officer

Location of Project: *ASI, NARC, Islamabad.*

<i>Duration:</i>	<i>36(months)</i>	<i>Total Cost (million):</i>	<i>2.967</i>
<i>Start Date:</i>	<i>3/4/2002</i>	<i>Funds Released (Rs):</i>	<i>2967000</i>
<i>Project Status:</i>	<i>Completed</i>	<i>Funds Utilized (Rs):</i>	<i>1664125</i> <i>(Upto 30th June, 2005)</i>

Objectives:

- Isolation and molecular characterization of Pakistani strains of IBV.
- Cloning of S1 gene of IBV in pBHCX402 vector and transfection of Fowl poxvirus.
- Characterization and evaluation of immunogenicity of the recombinant vaccine.
- Examine the protection against challenge with virulent strains of IBV.

Achievements/Progress:

The current study reports the seroprevalence of infectious bronchitis virus in commercial egg and meat-type chickens in Pakistan. The objectives of the study were to monitor chicken flocks for the presence of various IBV variants, to determine their pathogenicity, to develop effective diagnostic measures for IBV variants and to develop and examine the efficacy of a killed mv vaccine. Several commercial flocks (16 layers and 9 broilers) were bled and the serum samples tested for the presence of antibodies against M-41, D-274, D-1466 and 4-91 mv variants. M-41 was found to be most prevalent (100% layers flocks and 77% broiler flocks) followed by D-1466 (52%), D-274 (40%) and 4-91 (8%) was the lowest. The HI titers were also determined and were found to be generally comparable between the layers and the broilers within a given IBV variant. The mv antigen from clinically IBV suspect chickens was also found to be detectable using the Indirect Immunofluorescence Assay (IFA).

Lungs and trachea were the only organs tested with IF A in which 40% of lungs submitted were positive for M-41 variant whereas only 10% of tracheas were found positive. The M-41 IBV variant was readily detectable in homogenate of these tissues. The direct haemagglutination (HA) assay was least sensitive however, its sensitivity improved significantly when the homogenates were pre-treated with phospholipase C (1.3 % to 30.6%). In addition, agar gel precipitation test (AGPT) was also effective but detected only 5.3 % of the homogenate samples when tested for M-41 antigen. Reverses Transcriptase Polymerase Chair Reaction (RT-PCR) was most sensitive and 57.3% of the tissue homogenate samples were found to be positive when tested against S10LIGO5' and S10LIGO3'neucleotide primers. A total of 43 out of 75 IF A positive samples showed a viral PCR product around 1700 base pair. The tissue homogenates were passaged through the embryonated eggs, which sequentially increased their teratological effects with each passage. The effects included dwarfing, curling, stunting and urates deposits in challenged embryos. These effects were effectively neutralizes by using IBV variant specific antisera in a viral neutralization test. The IBV variants isolated and present in the embryonic fluid were used to prepare a formalin-killed IBV vaccine. This vaccine induced high levels of anti-IBV titers as determined by -haemagglutination inhibition assay. The booster vaccine

inoculation enhanced the titers as expected. The vaccine protective effects could not be tested in this study.

The results of this study which has shown the prevalence of various mv variants in chickens suggest that despite an existing vaccine program, IBV infection is still prevalent in Pakistan. Nevertheless, by using proper diagnostic tools and reagents, the disease can be effectively and quickly diagnosed in affected flocks. In addition, indigenous vaccines representing the native IBV strains would be most effective since IBV is known to undergo significant antigenic changes overtime.

Conclusions:

The current study presents evidence that IBV variants are prevalent in various meat and egg-type commercial chickens in Pakistan. The incidence of disease is not well documented since there is no such mechanism at the national level. Nor are the economic effects well documented for this particular disease. It would be nice if using a well-defined longitudinal epidemiological study over a longer period of time can do this. One factor, which may ensure a reduction in the incidence of IBV perhaps, could be strict enforcement of vaccination of all poultry flocks in Pakistan. Along with vaccination, it is imperative to continuously monitor the existence of various serotypes so that the vaccines used can be customized depending upon the prevalence of particular serotypes in a given geographical area. The current study has certainly identified and utilized several techniques, which will be helpful in seromonitoring and disease diagnosis. Although IBV vaccines are very efficacious, the best countermeasure against IBV or for that matter any other poultry disease is the implementation of strict bio-security measures. The application of various commercial anti-viral terminal disinfectants has been found to be useful (personal observation). In addition simple commonsense measures such as limit people movement, avoid visitors, controlling site traffic to a minimum, spray vehicles especially wheels, use of appropriate clothing and boots, use of foot dips and hand washing facilities, etc. can most certainly assist in disease prevention.

Project Title: *Implementation of NIR technique for the evaluation of animal feeds.*

Principal Investigator: *Dr. Mohammad Mohsin Siddiqui*
Associate Professor

Location of Project: *Department of Livestock Management, NWFP Agricultural University, Peshawar.*

Duration: 24(months)

Start Date: 27/4/2002

Project Status: Completed

Total Cost (million): 1.946

Funds Released (Rs): 1555000

Funds Utilized (Rs): 1542711
(Upto 30th June, 2005)

Objectives:

- Use various chemical and biological procedures to measure the quality of available feeds and fodder.
- To identify chemical and biological parameters, which can be used for developing equations to predict digestibility and energy values of ruminant feeds.
- To develop an inventory of locally available feeds and fodder for farmers, extension workers feed manufacturers, feed dealers and researchers.

Achievements/Progress:

The project documents were signed on March 23, 2002 and funds were made available at the end of May 2002. The project was completed on May 2004. The import of equipments was required for the project. Un-expectedly the import took longer time due to security measures on the export of equipments by the technologically advanced countries. This delay in import also delayed the processing/ analysis of samples. Livestock feed ingredients and forage samples were analyzed for the required parameters. Compositions tables were developed and made available for the interested users.

Collected samples along with their chemical composition data will be used for the calibration of NIR equipment (phase II) and developing of prediction equations for use in genetic selection programs for various crops, especially for wheat and oat. Equations will also be used for the evaluation of commercial and research feed samples.

Results:

Straw samples of 64 wheat varieties were analyzed for straw grain ratio and protein and ash contents. These samples were also analyzed for gross energy value and in vitro digestibility.

Eighty samples of oat fodder grown under different agronomical conditions were analyzed. In addition barley, berseem, mott grass, maize, sorghum and tritical samples were also analyzed. Thirty-seven samples of range grasses were also analyzed for their proximate composition.

552 samples of concentrate ingredients and 137 samples of different poultry feeds were also analyzed.

Composition tables of locally available feed sources are developed. Efforts for on line availability of these tables are also in progress. Constant update of these tables will be required to cater changes in the composition of feed and forages due to environment, season, variety, processing procedures and agronomical practices.

The equipments procured under the project installed and are being used very efficiently in the already existing laboratory. Permanent staff members were trained on the application and handling of these equipments. In addition to the equipments purchased under the project, the already existing equipments at AUP were also used for the project purposes. The laboratory facilities improved under the project will also be used for the second phase of the project.

Conclusions:

Wheat straw is extensively used as a basal diet in ruminant livestock round the year. At many occasions straw is the sole feed available to ruminant livestock. Little improvement in the straw quality can make a difference in livestock productivity especially in arid areas of the country. In integrated farming system quantity and quality of wheat straw are as important as the wheat grain. Varietal differences exist in some quality attributes of wheat straw and thus potential for its improvement. Previous work in this laboratory has revealed that improvement in straw quality is possible through selection and cross breeding. Higher protein contents of straw can exclude the need for straw ammoniation. However, grain yield is still a major criterion in developing new crop varieties. To improve livestock productivity straw quality for livestock should be included as a parameter in genetic selection program of wheat and other important cereal crops. However, it is very difficult to perform chemical analysis of large number of wheat varieties and their crosses to a plant breeder during a selection process. NIR spectroscopy has great potential to be used for assessing the nutritive value of plant components during genetic selection. Similarly affect of various agronomical practices on the nutritive value of cereal straws and fodder varieties can be evaluated through NIR. Present analysis of wheat straw of different varieties and oat fodder grown under different agronomical practices will help to develop calibrate NIR equipment to predict chemical composition.

Project Title: *Characterization of tannins in feeds and forages of Pakistan and their evaluation for anthelmintic activity.*

Principal Investigator: *Dr. Zafar Iqbal*
Associate Professor

Location of Project: *Department of Veterinary Parasitology, University of Agriculture, Faisalabad.*

<i>Duration:</i>	<i>24(months)</i>	<i>Total Cost (million):</i>	<i>0.968</i>
<i>Start Date:</i>	<i>18/7/2002</i>	<i>Funds Released (Rs):</i>	<i>922881</i>
<i>Project Status:</i>	<i>Completed</i>	<i>Funds Utilized (Rs):</i>	<i>871232</i> <i>(Upto 30th June, 2005)</i>

Objectives:

- To investigate the condensed tannin contents of some indigenous feedstuff.
- To evaluate the effect of condensed tannins on nematodes and performance of livestock
- To standardize safe doses of condensed tannin for best performance of livestock

Achievements/Progress:

This research project was undertaken to i) investigate the condensed tannin (CT) contents of some indigenous forages and feedstuffs, ii) evaluate the anthelmintic activity CT and their effect on performance of sheep and layers, and iii) standardize safe doses of condensed tannin for best performance of livestock.

CT content: The forage samples were collected from Kherimurat rangeland, District Attock and analysed for CT content. Butanol-HCl reagent method was used for the determination of CT content. The CT content in different forages/plants in descending order was found in Kandair (*Cassia spomerum*, 14.5 g/kg DM), Jungle Beri (*Zizyphus nummularia*, 14.3 g/kg DM), Snatha (*Dodonea viscosa*, 13.5 g/kg DM), Desi beri (*Zizyphus jujuba*, 12.4 g/kg DM), Amaltass (*Cassia fistula*, 12.4 g/kg DM), Commercial tannin (Kenya source, 11.9 g/kg DM), Dheelaa (*Cyperus rotundus*, 11.1 g/kg DM), Jaman (*Eugenia jambolana*, 10.9 g/kg DM), Kachnar (*Bauhinia variegata*, 10.7 g/kg DM), Jungle swank (*Echinochloa colonum*, 8.5 g/kg DM), Iple Iple (*Leucaena leucocephala*, 6.4 g/kg DM), Dhaman (*Cenchrus setigerus*, 2.5 g/kg DM), Kahuw (*Olea cuspidata*, 2.1 g/kg DM), Shehtoot (*Morus indica*, 1.2 g/kg DM), Amla (*Phyllanthus emblica*, 1.0 g/kg DM), Dodh Tibel (0.9 g/kg DM), Kahawe (*Stuntedolea didata*, 0.6 g/kg DM), Waree (Grow on trees, 0.6 g/kg DM), Bhkair (0.4 g/kg DM), Shreen (*Albezia lebbek*, 0.3 g/kg DM) and Waree (Grow on beri, 0.08 g/kg DM). The tannin content in the commercial cattle feed sample. obtained from the Department of Animal Nutrition, University of Agriculture, Faisalabad was 9.8 g/kg DM; whereas, in seven different samples of sorghum it ranged from 0.02 to 5.34% of the DM.

Anthelmintic activity of tannins: Anthelmintic activity of tannins was evaluated both *in vitro* and *in vivo*. *In vitro* tests included Egg Hatch Assay and Paralysis/Mortality tests on mature *Haemonchus contortus*. Results of Egg Hatch Assay revealed Anthelmintic activity of Tannins; whereas, there was no effect of tannins on mature *H. contortus*. Tanniferous feeds also exerted anthelmintic effects in sheep naturally infected with mixed species of gastrointestinal nematodes. The data revealed better -performance of sheep fed on rations supplemented with tannin. The

digestibility parameters were positively influenced by the supplementation of tannins in rations. In contrast to the findings in sheep, tannins did not exhibit anthelmintic activity in layers; rather there was a negative correlation of tannin supplemented diets and performance of layers.

Safe/beneficial doses of tannins: The results revealed that tannin supplemented up to 4% in rations is beneficial for better performance of sheep; whereas, beyond 4% levels, it starts negatively affecting the performance. In layers, however, use of tannins should be avoided at any level as it adversely affects performance of the birds.

Conclusions:

It was concluded that i) majority of the plants in Kherimurat rangeland evaluated for CT content in this study contain safe levels (maximum up to 14.5 g/kg DM) of tannins, ii) tannins do possess indirect anthelmintic effects by improving nutrient utilization in sheep, but not in poultry. Therefore, these plants may be recommended for propagation on rangelands after detailed investigations as to their nutritive value. Long-term use of plants containing tannins may be useful both for anthelmintic purposes and for an increase in the production performance in sheep. Results of the present study, therefore, provided a scientific rationale for the traditional feeding of leaves of trees containing tannins, like *Acacia* species (keekar), *Albezia lebbek* (shreen), *Zizyphus* species (beri), etc. to sheep and goats. A number of plants used in the present study may provide suitable alternative to scarcity in feed resources of the country/rangelands, which should, however, be subjected to in vivo feeding experiments before finally recommending their use.

Project Title: *Efficient utilization of local feed resources for sustainable increase in livestock production.*

Principal Investigator: *Dr. Ghulam Habib*
Associate Professor

Location of Project: *Animal Nutrition, N.W.F.P. Agriculture University, Peshawar.*

Duration: 36(months)

Start Date: 13/8/2002

Project Status: Completed

Total Cost (million): 1.854

Funds Released (Rs): 1677000

Funds Utilized (Rs): 1550833
(Upto 30th June, 2005)

Objectives:

- To determine the nutritional characteristics of native tree fodders for ruminant livestock to optimize the use of local feed resources for sustainable development of livestock production.
- To identify promising species of tree fodder that could be used as reducing the cost of livestock feeding.
- To help alleviate the current feed gap through efficient management of local tree fodders, the untapped feed source, with in the existing farming system.

Achievements/Progress:

During the period under report, two metabolism experiments with sheep and one lactation trial with goats were performed. In experiment-I an investigation was carried out to reduce the adverse effect of tannins in *Ziziphus mauritiana* leaves on nitrogen utilization and digestibility in ruminant animals. A metabolism trial in a 3X3 Latin square design was performed with sheep (duration 60 days). A basal diet of oat hay was supplemented with *Ziziphus* leaves (300g/day) with or without 5g or 10g urea/day. Faeces and urine were collected over five consecutive days after adaptation of 15 days in each of the three periods. These were analyzed for dry matter and total nitrogen. Dry matter digestibility increased from 49.38% on un-supplemented diets to 56.63 and 57.93 % on diets containing 5g and 10g urea, respectively. Urea supplementation also increased nitrogen retention two folds in body of the sheep.

The second metabolism experiment was conducted in a 4x4 Latin square design of 60 days total duration and the substitution of conventional concentrate mixture with *Grewia oppositifolia* leaves was investigated in sheep. Four diets containing different ratios of *Grewia* leaves and concentrate mixture as 100/0 (A), 75/25 (B), 50/50(C) and 0/100 (D) respectively were formulated. The results showed that *Grewia oppositifolia* leaves effectively replaced the mixture of cottonseed cake and wheat bran without affecting digestibility of the diet and nitrogen balance in sheep. Dry matter digestibility on diets A, B, C and D was 50, 52, 51, and 53%, respectively and the difference was not significant ($P>0.05$). Similarly, nitrogen retention in the body of sheep given diets A, B, C and D did not vary ($P>0.05$) and was 6.78, 6.45, 6.64 and 6.98 g/day. Respectively showing that *Grewia* leaves successfully replaced concentrate part of the diet.

The 3rd experiment of 80 days duration was conducted with 24 milking goats to compare daily milk yield and changes in body weight in response to supplementary feeding of cottonseed cake, *Grewia oppositifolia* leaves or *Ziziphus mauritiana* leaves. Quantity of the supplements was calculated on iso-nitrogenous basis and added to a basal diet or maize silage plus grazing. Daily

milk yield was affected ($P < 0.05$)-by diets and averaged 390, 532, 446, and 422 ml on diets supplemented with *Grewia oppositifolia* leaves, *Ziziphus mauritiana* leaves, combination of both leaves or cottonseed cake, respectively. -Milk fat contents were 5.51, 5.19, 5.02 and 5.61 % and milk protein concentrations were 3.7, 3.5, 3.5 and 3.6%, on the four supplements, respectively. Both milk fat and milk protein did not respond to difference in the supplements ($P > 0.05$): All the goats lost body weight (mean -66g/day) irrespective of the diets.

Conclusions:

Results of the above studies concluded that expensive concentrates can be successfully replaced with on-farm available leaves of *Grewia oppositifolia* in the diets of ruminant livestock. Utilization of *Ziziphus mauritiana* leaves as a supplement can be further enhanced by adding urea as 10g/day for feeding to sheep. *Ziziphus mauritiana* leaves supported higher milk yield in goats as compared to feeding of *Grewia* leaves or cottonseed cake. This demonstrated that tree foliage is a preferred and less expensive supplement than cottonseed cake for milking goats. Farm economics of rural small holdings can be improved by reducing cost of animal feeding through integration of livestock and tree cropping systems.

Project Title: *Studies in the effect of Bovine Somatotropins on productive and reproductive parameters of Kundi buffaloes in Sindh.*

Principal Investigator: *Dr. Saghir Ahmed Sheikh*
Professor (Meritorious)

Location of Project: *Department of Vet. Physiology & Biochemistry, Sindh Agriculture University, Tandojam*

Duration: 36(months)

Start Date: 26/7/2004

Project Status: On-going

Total Cost (million): 2.975

Funds Released (Rs): 1572000

Funds Utilized (Rs): 1014561
(Upto 30th June, 2005)

Objectives:

- Evaluate the raise in meat and milk production of rbST treated buffaloes
- Evaluate productive and reproductive performance of rbST treated bullaloes.
- Determine the biochemical and hematological changes in rbST treated animals coupled with hormonal imbalances if any.
- Determine quality of meat and milk from rbST treated animals.
- Appraise feasibility of rbST use.
- Produce manpower with Ph. D degree as part of Human Resource Development.

Achievements/Progress:

- Sixteen primiparous Kundhi buffaloes were purchased from the markets.
- Sixteen buffaloes were randomly divided into four groups i.e. Group-A, Group-B, Group-C and Group-D placing four buffaloes in each group.
- Feed intake of all groups was recorded and computed.
- Milk yield of each buffalo recorded and computed.
- Nutritive value of feed stuffs analyzed.
- High energy protein and low energy protein rations were computed.
- Blood samples were collected for biochemical and haematological analysis.

Results:

Animal health was generally excellent throughout the experiment. Lameness, digestive anomalies, metabolic, disorder, tetany or abortions were not observed. Clinical mastitis was not observed and SCC did not indicate the presence of subclinical mastitis. Similarly, rbST administration did not affect urine analysis. Rectal temperature were elevated in rbST administration did not affect urine analysis. Rectal temperature were elevated in rbST treated buffaloes by approximately 0.5⁰ C. A corresponding non significant increase in respiration and heart rates of treated buffaloes was observed. Respiration was also increased nonsignificantly, which may have been increased partially as a mechanism to alleviate elevated deep body temperature. No effect of treatments on ruminal motility was observed. Milk production and composition for the first 12 weeks of lactation, when no rbST was administrated, were analyzed by a randomized statistical model.

Conclusions:

Milk yield response to rbST averaged 0.6 ($P<0.05$) and 0.8 kg/d ($P<0.01$) in group-A than group-B and group-C than group-D respectively through experimental period. Within each 14 day treatment period, milk production increased steadily through the middle of each cycle and diminished towards basal production thereafter. This peak and valley pattern of Galactopoietic response was repeatedly observed through out the study and milk production after treated buffaloes never returned to concurrent control levels. Milk best concentrations were at below sensitivity level of the assay for most buffaloes (Ing/ml). Hameotological parameters were generally not affected by rbST treatment. During different level of concentrate glucose, lipid, protein, cholesterol and uric acid remained unaffected whereas calcium concentrations in group-C and group-D were increased significantly ($P<0.05$) and ($P<0.01$) respectively. Lipid and cholesterol did not change by rbST treatment. Whereas calcium returned to non-significant level in all groups. Protein decreased significantly ($P<0.05$) in group-A than group-B, whereas there was no significant difference in group-C and group-D. T3 and T4 were unaffected by rbST treatment in buffaloes.

Project Title: *Genetic improvement of buffaloes in Pakistan (GIBP).*

Principal Investigator: *Dr. Abdul Ghaffar*
Senior Scientific Officer

Location of Project: *ASI, NARC, Islamabad*

Duration: 36(months)

Start Date: 12/11/2004

Project Status: On-going

Total Cost (million): 2.287

Funds Released (Rs): 516000

Funds Utilized (Rs): 455063
(Upto 30th June, 2005)

Objectives:

- To initiate a strategic buffalo breeding program on Kundhi buffaloes in Sindh province.
- To supplement the on-going improvement program in the Punjab province.
- To produce performance tested buffalo bulls and superior frozen semen for domestic use and export.

Achievements/Progress:

- Some of the essential equipment has been purchased. The detailed work plan for Punjab in consultant with PI of Punjab was finalized and executed.
- A workshop on "Buffalo breeds improvement: options and strategies" was held on 22nd June 2005.
- A questionnaire was developed and tested to collect Kundhi buffalo performance data from Kundhi farm Rohari.
- Production performance data from 1976 to 1989 was collected and computerized. The leftover data will be collected and computerized for analysis in the current year.

Project Title: *Effect of civic pollution on fish and fisheries in the riverine system.*

Principal Investigator: *Mr. Muhammad Afzal*
Senior Scientific Officer

Location of Project: *Fisheries, ASI, NARC, Islamabad*

Duration: 36(months)

Start Date: 21/5/2004

Project Status: On-going

Total Cost (million): 1.996

Funds Released (Rs): 1120000

Funds Utilized (Rs): 1051541
(Upto 30th June, 2005)

Objectives:

- To determine water quality of rivers/streams including estimation of the pollutants such as heavy metals and pesticide/ insecticides
- To study the effect of civic/industrial pollution on planktons, fish and fisheries of our riverine system.
- To devise managemental- plan for sustaining fish population in our
- riverine system and to suggest measures to protect and sustain/increase
- present fish production level.

Achievements/Progress:

Survey of River Kabul, Soan, Korang and Nala Lai was conducted for site selection for water and fish sampling. Eleven sites from Nala Lai, 11 from Soan River, 11 from Korang River and 18 from Kabul River were selected for water, fish and plankton sampling. Ten months data of Rivers Kabul, Korang, Soan and Nala Lai regarding physico-chemical parameters i.e Temperature, Dissolved oxygen, pH, and Alkalinity, Hardness and Electrical conductivity of water were recorded and statistically analyzed. Results showed some of highly polluted sites were found in River Kabul, Korang River ,Soan River and Nala Lai. Four sampling sites of Nala Lai Rawalpindi/Islamabad (F- 7 /1 Christian Colony), 1-9/1 Kachiabadi, New Katarian Bridge and Gawalmandim, one site of River Soan near Soan bus stand, three sampling sites of Korang River (Samli Sanitorium, Shakrial and Khanna Dak) and Six sampling sites of Kabul River at Peshawar, Nowshera and Kund were found to highly polluted and showed poor water quality.

Total seven fish species were caught from River Kabul and River Korang. Concentrations of Zinc, Copper, Lead and Cadmium in different organs of fishes, viz. *Clpisoma naziri* (Shermahi), *Labeo dyocheilus* (Torki)), *Cirrhina reba* (Bhangan), *Cyprinus carpio*(Gulfam), *Tor putitora* (Mahseer), *Oreochromis niloticus* (Tilapia) and *Puntius ticto* (Chidoo) were studied and it was found that fish liver appeared to be an organ which accumulates significantly higher quantities of heavy metals. The organs like gills, kidney also accumulated metals. Eleven genera of zooplankton and sixteen genera of phytoplankton were identified from all sampling site.

Project Title: *Maintaining genetic diversity of 'Kari' sheep breed for sustained development of chitrali patti cottage industry and mutton production*

Principal Investigator: *Mr. Sohail Ahmed*
Lecturer

Location of Project: *Veterinary Sciences, NWFP Agri. University, Peshawar*

Duration: 36(months)
Start Date: 24/8/2004
Project Status: On-going

Total Cost (million): 3.15
Funds Released (Rs): 1690500
Funds Utilized (Rs): 1546218
(Upto 30th June, 2005)

Objectives:

- To study and document the population and characteristics of the Kari sheep.
- To study productive and reproductive performance of sheep under the prevailing small farming system at the habitat.

Achievements/Progress:

Kari is an un-described potential breed of sheep originating from northern parts of NWFP called Chitral. The history of the breed is as old as the history. According to initial reports, the breed is producing wool of fine quality and could make a sound basis for establishing a woollen textile cottage industry locally and could prove helpful in raising the living standard of the local farmers. The breed is under study. Socio-economic aspect of farm life and different aspects of flock like herd composition, marketing, feed resources and health were studied through survey. Breed-characterization, on-farm performance, fleece analysis, Karyo-typing and phylogenetic analysis are under investigation.

Project Title: *Effect of long term use of bovine somatotropic (bST) hormone on milk production, reproduction, health and various physiological parameters in Nili-ravi buffaloes*

Principal Investigator: *Dr. Makhdoom Abdul Jabbar*
Chairman/Associate Professor

Location of Project: *Department of Animal Nutrition, University of Veterinary and Animal Sciences, Lahore*

Duration: 36(months)

Start Date: 17/7/2004

Project Status: On-going

Total Cost (million): 3.464

Funds Released (Rs): 1084500

Funds Utilized (Rs): 1081327
(Upto 30th June, 2005)

Objectives:

- To study the long term effect of Bst hormone on milk production in Nili-Ravi buffaloes.
- To study the effect of use of bST on reproductive behaviour and other physiological parameters in buffaloes.
- To compare the efficiency and economics of milk production of treated animals versus control.
- To determine the quality of milk under influence of Bst hormone through chemical composition.

Achievements/Progress:

Thirty lactating buffalo at about same stage of lactation and 8-10 lit. of milk were randomly allotted to two groups. One group A was treated with BST-hormone, while group B was kept as control. The group A was further divided into two sub groups, A-1 and A-2. The animals in group A-1 were given BST hormone injection at the interval of 14 days while the group A-2 was given the same injection at 3 equal sub doses on alternate days. All the 3 groups were kept under similar feeding and management conditions. The trial started in December 2004 and completed in May 2005. Duration of study was 6 months.

Nutritional requirements of animals were met through fodder and concentrate ration. The maintenance requirements were met through fodder while the production requirements were provided through concentrate ration. The weighment of fodder offered was made on weekly basis. The per animal fodder offered was 65 kg/animal/ day. The ration was given @ half of milk production. This was given mainly at the time of milking and rest of ration if any was given in the morning before offering fodder. Composition of fodder and ration are given in results section.

Milk production of each animal was recorded in the morning and evening time. Both records were then added and processing of data was done on daily milk production basis. Both weight of experimental animals were recorded on monthly basis. The animals were observed for postpartum estrous, service period and service per conception.

The milk samples were analyzed for fat, SNF and total solids percentage. The fat % was determined using Gerber test while SNF & TS were determined using lactometer reading Richmond formula.

Project Title: *Influence of altering dietary cation anion difference on productive and reproductive efficiency of buffaloes*

Principal Investigator: *Dr. Muhammad Sarwar*
Associate Professor

Location of Project: *Department of Animal Nutrition, University of Agriculture, Faisalabad*

Duration: 36(months)
Start Date: 28/5/2004
Project Status: On-going

Total Cost (million): 5.058
Funds Released (Rs): 2582600
Funds Utilized (Rs): 2263767
(Upto 30th June, 2005)

Objectives:

- The main objectives of the present project are to examine the influence of altering DCAD on
- Reproductive efficiency
- Milk fever incidences
- Milk yield and its composition in buffaloes under different physiological and environmental conditions and
- Extension of DCAD technology to dairy farmers.

Achievements/Progress:

The experiment was conducted to examine the influence of varying DCAD on productive and reproductive performance of early lactating Nili Ravi buffaloes in a randomized complete block design during summer. Four iso-nitrogenous and iso-caloric diets were formulated with -110, +110, +220 and +330 DCAD levels. These DCAD levels were attained by using CaCl_2 and NaHCO_3 . Twelve early lactating buffaloes were randomly allocated to four dietary treatments, three buffaloes in each treatment. The experiment lasted for six months.

The results revealed a linear increase in DM intake and milk yield with increasing the DCAD of diets. The DM, acid detergent fiber and neutral detergent fiber digestibilities increased in buffaloes fed -110 DCAD diet. Nitrogen balance remained unaltered across all diets. A significant increase in blood pH was noticed by elevating the DCAD of diets. Serum (Na + K) - (Cl + S) increased linearly with increasing the DCAD of diets while serum chloride was higher in buffaloes fed -110 DCAD diet. The serum calcium increased significantly with decreasing the DCAD of diets. Serum magnesium and phosphorus remained unaffected. Urine pH increased significantly with raising the DCAD of diets. Urinary excretion of calcium and chloride increased in -110 DCAD diets. A gradual increase in cortisol level was observed with decreasing the DCAD of diets. An improved ovarian cyclicity was noticed in buffaloes fed +220 and +330 than those fed -110 diet. This may be use to better energy status of buffaloes fed high DCAD diets. Increased DCAD not only significantly increased the DMI and milk yield but also improved reproductive performance of early lactating buffaloes.

Conclusions:

The findings revealed that ratio of cation and anion in the diet was an important determinant of dietary impact on systemic acid base status of lactating buffaloes. A linear increase in dry matter intake was recorded with increased DCAD. Buffaloes fed higher DCAD diets not only produced

more milk but also showed better energy status that lead to improved reproductive performance whilst its reverse was true for buffaloes fed low or negative DCAD diets. The manipulation of this technology may prove useful in attenuating dietary acids or base challenges for dairy animals affected by feeding regimens i.e. high concentrate diet.

Project Title: *Promotion of animal balanced feed in farmer community*

Principal Investigator: *Mr. Abdul Rehman Soomro*
Technical Coordinator

Location of Project: *Indus Resource Center Haji Allam Channa Colony, Sehwan, District Dadu, Sindh*

Duration: 24(months)
Start Date: 29/5/2004
Project Status: On-going

Total Cost (million): 2.376
Funds Released (Rs): 1861885
Funds Utilized (Rs): 1674805
(Upto 30th June, 2005)

Objectives:

- To exploit leadership potential of both men and women at the local level and build their skills to benefit from modern knowledge and technology;
- To reduce gender disparities with regard to socio-economic indicators of the partner communities;
- To design and implement community-based poverty alleviation programs as tools for individual and institutional strengthening;
- To pick up issues from the field and turn them into subjects of meaningful research, workshops, seminars, advocacy and policy dialogues;
- To facilitate and network with other resource organizations for field testing of innovative and cost effective ideas for income generation;
- To collect and disseminate information leading to awareness, development and empowerment of marginalised communities on a regular and routine basis;
- To bring out publications and use print and electronic media extensively for development education and image building of the civil society;
- To join other civil society organizations in the struggle for good governance and democratization.

Achievements/Progress:

Indus Resource Centre (IRC) conducting an action research project titled "Promotion of Animal Balanced Feed in Farmer Community" through testing the PARC animal balanced feed in rural field circumstances through adopting changes and test the viability of the process of promoting the feed in farmer community' was initiated in 20 villages of two talukas of district Dadu, Sindh, Pakistan. Main activities during the reported period were selection of potential villages, formation of Livestock Management Committees (LMCs), capacity building of organizations regarding animal balanced feed and livestock management, organization strengthening to continue the feed promotion in farmer community; PARC feed demonstration and promotion of animal balanced feed.

Out of 40 identified villages 20 were selected at particular criteria and baseline survey was conducted of selected villages. A comprehensive baseline survey report is also ready for publication. In potential villages 38 (20 male & 18 female) livestock owners' organizations formed in three steps (i.e. introductory meetings; consultation meetings and organization formation meetings). After organization formation, conducted 94 village level training workshops in three series, each series was conducted with each organization and two Office

Bearers' level workshops conducted at IRC office. Consequently 663 (437 male and 226 female) farmers' trained against targeted 400 (200 each male & female) farmers'. Manuals and training material was developed before each training. All the three series of trainings were documented and would be included in final project report.

During capacity building activities the demonstration of P ARC balanced feed was the core activity from October to December 2004, to evaluate the performance of feed in rural field conditions. For the purpose 40 milking and 40 meat animals selected at particular criteria in farmers' workshop and fed PARC feed for 90 days. Performance indicators were set, pre-demonstration data of each milking animals was collected through a questionnaire. During demonstration weekly monitoring conducted through monitoring formats. Data analyzed and revealed that 20 % more use of P ARC feed than local concentrate with usual fodder:

- The lactating buffalo significantly decreased the dry fodder consumption (14.56%) while lactating cow have non significant effect.
- Lactating buffaloes increased milk production and profit 23.8% and 74.4% respectively and lactating cows increased 25.55% milk production per animal per day.
- Lactating buffaloes and cows improved health and milk quality parameters like eye conditions improved from pasted to moderately shine; skin improved from rough to moderately shine; hairs improved from rough to smooth and digestibility remained soft.
- Regarding milk quality, the density recorded normal to moderate dense and milk sweetness recorded normal to moderate sweet averagely.

In rural field circumstances buffalo and cow calves and male goat raised at P ARC feed for 90 days and gained weight $42.5 \pm 13.06 \pm 33.13 \pm 16.49$ and 9.0 ± 3.563 kg in 90 days per animal respectively. Beside this considerable improvement in health was also noted, like eye conditions improved from normal to moderately shine; skin improved from rough to moderately shine; hairs improved from rough to smooth; digestibility remained soft and average fat deposition observed from poor to excellent.

All the activities enabled the environment to promote the PARC feed in farmer community. In seven months period from December 2004 to June, 2005 at a total 26 PARC feed shops have been opened, highly encouraging feed sale 951 bags (71 %) out of 1.332 bags was recorded.

Project Title: *Aquaculture of fin fishes (Snappers and groupers) in ponds along Hub river Estuary/ Gharo Creek*

Principal Investigator: *Syed Makhdoom Hussain*
Professor

Location of Project: *Centre of Excellence in Marine Biology, Karachi University, Karachi,*

Duration: 36(months)
Start Date: 17/4/2004
Project Status: On-going

Total Cost (million): 4.679
Funds Released (Rs): 2248000
Funds Utilized (Rs): 1812376
(Upto 30th June, 2005)

Objectives:

- Growth potential and survival rate of one species each from Snapper and Grouper out of the two species mentioned below will be studied Snappers: *Lutjanus lutjanus* Bloch, 1790 and *L. johni* (Bloch, 1792)
- Groupers: *Epinephelus fuscoguttatus* (Forsskal, 1775) and *E. tauvina* (Forsskal, 1775). The selection of the species will be based on the easy availability of seed from wild.
- Step wise development of grow-out techniques on different protein level diets based on locally available ingredients.
- Determine economic feasibility of marine fin fish culture.

Achievements/Progress:

Site Selection:

Various efforts to find suitable site were made by organizing regular trips to coastal areas from East to West coast of Karachi. Some private farms close to coastal areas were also visited and their owners were contacted. Available facilities of NIO, Sindh Fisheries, IUCN and WWF Karachi were also examined with the co-operations of these organizations.

Finally land (10.2 Acres) near Gharo with built in 18 ponds is hired on annual rental basis. The infrastructure such as ponds, water in and outlet to the pond etc. was present. This site was selected for following reasons. The site had built in ponds thus no land excavation/digging was required. Each pond has monks and dykes with sufficient capacity of water retaining (3-4 m) depth during low tides. All the ponds had regular flow of water in and out which was beneficial in terms of fresh water supply with high oxygen. High tides brought additional natural food to cultured species however regular monitoring and sufficient steps to avoid unwanted species was desired. The in coming and out going tides could be controlled if required with gates installed at the monk of each pond.

From the provided funds and facilities it was impossible to construct new ponds however the grant was sufficient enough to repair some of these ponds as required for the studies. The site had small cottage with room that are being used by staff and as laboratory. The proposed studies required 4 ponds however 5 ponds were selected and renovated. Most of the ponds had leakage in monks, which have been repaired so that the stocked fish may not escape. The dykes of 5 ponds have been replenished and necessary earth filling is being maintained as and when required.

Experimental Plan:

Experiments were designed as per original plan of work. Four ponds are being utilized for four experiments and the fifth pond will be used as control with sufficient natural food for fish while fishes in the experimental ponds will be provided additional artificially prepared feed.

Seed collection:

Marine fish seed including seed of the selected species is not available from any farm or fishermen. It is very difficult to pursue fishermen to work for seed collection and specially the selected species. Special nets gears were purchased prepared and even hired on daily basis. These nets were operated in coastal shallow water areas from Gharo channel to Korangi creek east of Karachi and Sandspit, Bulaji, mangrove swamps towards the west coast of Karachi. Finally some sites like Gharo channel provided ample number of *Lutjanus* species. The Korangi Creek site provided various localities that were source of *Epinephelus* but their catches proved very expensive. Presently fishermen are hired to catch seed and live seed of *Epinephelus* is being purchased.

Stocking:

The stocking of ponds is being continued and will be continued will enough seed is collected that could be maintained in ponds. So far four ponds have been stocked.

Pond No. 1: with 600 *Lutjanus* species monoculture setup. (Finalized)

Pond No. 2: With few *Lutjanus* sp monoculture setup (to be continued)

Pond No. 3: With 100 *Lutjanus* and 100 *Epinephelus* Bi-culture setup (Finalized)

Pond No. 5: With 200 *Epinephelus* sp monoculture setup (Finalized)

Pond No. 4: With 200 *Epinephelus* sp. Monoculture (Finalized)

Project Title: *Development of local starter culture technology for preparation of fermented milk products.*

Principal Investigator: *Mr. Tariq Aziz*
Senior Scientific Officer

Location of Project: *Animal Sciences Institute, National Agricultural Research Centre, Islamabad*

Duration: 36(months)

Start Date: 14/4/2004

Project Status: On-going

Total Cost (million): 3.75

Funds Released (Rs): 2427500

Funds Utilized (Rs): 851147
(Upto 30th June, 2005)

Objectives:

- Identification and characterization of local strains of starter cultures.
- Maintenance and preservation of defined local starter culture in lyophilized form.
- To develop and expand the modern cheese and yoghurt production technology.

Achievements/Progress:

The major thrust in the 1st phase/ year of this project has been on isolation and characterization of indigenous strain of lactic acid bacteria (Lab). Under this activity, so far 77 milk/dahi samples of indigenous origin have been processed to hunt potential strains of these bacteria. On the basis of growth pattern on selective media, staining and biochemical characteristics and a negative response to catalase test 30 strains of cocci and 27 that of rods (totaling 57) have been identified as "potential starter strains". On the basis of another test of "quantification of lactose fermentation", 21 strains have been preserved in a special medium/ container, the "Microbank".

This preliminary study on the morphological and biochemical behavior of the isolates has revealed a strong potential of the isolates as dairy starter. These isolates will serve as a screening material for identification through protein profile investigation by electrophoresis.

Project Title: *The status of shrimp's fisheries in Sonmiani Bay Lagoon, Balochistan, Pakistan*

Principal Investigator: *Dr. Naureen Aziz Qureshi*
Assistant Professor

Location of Project: *Centre of Excellence in Marine Biology, University of Karachi, Karachi*

Duration: 36(months)
Start Date: 28/7/2004
Project Status: On-going

Total Cost (million): 4.471
Funds Released (Rs): 1547000
Funds Utilized (Rs): 1341939
(Upto 30th June, 2005)

Objectives:

- To study and analyze the state of shrimp stock in the Sonmiani lagoons by carrying out a full-scale population dynamics analysis of the shrimp population in Sonmiani Bay area (Miani Hor) in order to describe the current state of the shrimp fishery and population.
- Biology of one important commercial shrimp of Balochistan.
- To assess the fishing fleet and link it to the fishery productivity of the areas by developing relationship between shrimps stocks and fishing pressure.

Achievements/Progress:

During first year of the project following progress has been made:

- Review of previous landing data of shrimps of Balochistan (Pakistan) from different government departments, NGO's and CBO's working in the study area.
- Survey of fishing crafts at Sonmiani Bay in summer season (closed season) has been accomplished and is reported.
- Assessment of companies and mole holders involved during the off-season landing of shrimps has been, done and is reported.
- Regular monthly/fortnightly collection of experimental data using gill net, beach seine net have been done for the stock assessment of different species of shrimps. Preliminary data analysis has been done.
- Socio-economic survey of coastal population involved in the fishery dependant activities of three villages of Sonmiani (Damb, Bhaira, and Miani) in under way. So far, 50 questionnaires (8 pages questionnaire was developed and it was field tested) have been filled and preliminary analyses of data is being done

Project Title: *Application of molecular techniques for differential diagnosis of rinderpest and related diseases*

Principal Investigator: *Dr. Qaiser Mahmood Khan*
Principal Scientific Officer

Location of Project: *National Institute for Biotechnology and Genetic Engineering(NIBGE),
Jhang Road, Faisalabad*

Duration: 36(months)

Start Date: 17/7/2004

Project Status: On-going

Total Cost (million): 2.76

Funds Released (Rs): 830600

Funds Utilized (Rs): 782296
(Upto 30th June, 2005)

Objectives:

- To develop and apply molecular-based technologies (mainly PCR based) for more effective diagnosis and differential diagnosis of rinderpest and related diseases.
- Designing & Synthesis of primers (universal, nested, hemi nested)
- Devising successful PCR based methods which can be applied to local conditions
- Development of Multiplex PCR
- National level training workshop
- Molecular Epidemiology

Achievements/Progress:

Clinically it is very difficult to differentiate Rinderpest disease from the other related ones is very difficult task. Conventional diagnostic techniques used include; virus neutralization, agar gel immunodiffusion and virus isolation in cell culture followed some times by reproducing the disease in susceptible animals. All these techniques are either time consuming, labour intensive, insensitive or expensive to perform. .Polymerase Chain Reaction (PCR) based methodology has shown great promise, providing the potential of high sensitivity combined with specificity. Sequences analysis of morbilliviruses suggests that there are sequences across the N and P gene which are conserved ones and primers targeted to these regions can amplify all the morbilliviruses. On the other hand sequences across the F gene of PPRV will amplify specifically PPRV in biological samples.

In our present project by this time we have been able to differentiate the PPRV from RPV on the basis of RT -PCR technique. For the facilitation of multiple analyses, the reverse transcription step was performed using random hexanucleotides primers and aliquots of cDNA were then amplified using a panel of primer sets to identify and differentiate between the virus nucleic acids in the samples. Two sets of primers were used; one is universal primers corresponding to conserved region and second specific primers namely: FI b, F2d and FI, F2 and Fla and F2a corresponding to F region which gave the band size of 448bp, 372bp and 308bp specifically. For the study of genetic relationship between isolates of distinct geographical origin, the amplified fragment of 372bp of the fusion (F) protein gene was cloned and sequenced for the phylogenetic analysis, which showed the virus belongs to lineage4 group.

Another vesicular disease the Foot and Mouth Disease (FMD) is very important disease in terms of economics in the shape of very heavy economical losses and even the restrictions on the

export of animals and animal products. RT-PCR based technique for the diagnosis of FMDV by using universal primers has been developed and tested on the field samples.

Project Title: *Studies on biology & mapping of warble fly infested areas.*

Principal Investigator: *Dr. M. Qasim Khan*
Senior Scientific Officer

Location of Project: *National Agricultural Research Centre, Islamabad*

Duration: 36(months)

Start Date: 21/5/2004

Project Status: On-going

Total Cost (million): 6.072

Funds Released (Rs): 1833000

Funds Utilized (Rs): 1402833
(Upto 30th June, 2005)

Objectives:

- To study the biology of warble fly in different ecological zones of Pakistan.
- Mapping of warble fly areas and identification of high and low intensity habitats.
- Development and demonstration of controlled strategies in different disease frequency zones.

Achievements/Progress:

Warable fly is an economically important pest of cattle and goats in hilly and semi-hilly areas of Pakistan. The fly makes perforation in hides and skins and lowers down their market value considerably. Other economic losses caused by this pest include lowered milk production and degradation of meat quality.

Six seminars were held in all the four provinces. A pre-designed proforma was circulated amongst the field staff for getting information on warable fly. During the year a total of 588 proformae (NWFP-229, Balochistan-114, Punjab-125 and Sind-170) were received indicating the prevalence of disease in all the four provinces.

Project Title: *Development of milk replacer and early weaning diets for sustainable calf rearing.*

Principal Investigator: *Dr. Abdul Ghaffar Khan*
Principal Scientific Officer

Location of Project: *Animal Nutrition (ASI), NARC, Islamabad.*

Duration: 36(months)
Start Date: 24/8/2004
Project Status: On-going

Total Cost (million): 6.076
Funds Released (Rs): 2863000
Funds Utilized (Rs): 409888
(Upto 30th June, 2005)

Objectives:

- Development of milk replacer and early weaning diets for calf feeding.
- Evolving suitable feeding systems based on milk replacer and early weaning diets for sustainable and bio-economical calf rearing.

Achievements/Progress:

Proforma for socio economic survey has been formulated, structured and 200 copies have been prepared. Strategy to conduct survey is planned in consultation with respective provincial departments of Livestock & Dairy Development. Districts to be surveyed have been identified.

Potential feed ingredients for early weaning diets i.e., Canola Meal, Rapeseed Meal, Guar Meal, Sunflower Meal, Cottonseed Meal, Soybean Meal; Wheat, Corn, Rice and Wheat bran, Corn Gluten 30%, Corn Gluten 60% and Rice Polish have been collected. These feed ingredients have been analysed for their proximate composition, TDN, mineral composition, pH and aflatoxin contents. Furthermore, these samples were analyzed for their true protein contents and Pepsin-HCl digestibility.

Ingredients potentially to be used for the development of milk replacer i.e., different three sources of skimmed milk, casein, whey, soya flour, chick pea fine powder and wheat super fine powder were collected from various sources and markets of Punjab. These ingredients were analysed for their proximate composition, TDN, aflatoxin contents, pH, Pepsin-HCl digestibility and mineral composition.

Different vegetable oil sources to be used in milk replacer development were also collected and analyzed for their peroxide value and free fatty acids.

Different animal and vegetable feed ingredients to be used in the development of milk replacer were also tested for their physical properties such as solubility and sedimentation rate at different time intervals with different concentrations.

Procurement of laboratory equipments is finalized and the equipment is being supplied. The total cost of the equipments being procured is Rs.9,32,825/-.

Design for remodelling of Animal Sheds was prepared and the tender was floated and opened. The process for award is being considered and will be finalized as soon as the release will be made for year 2005-06

Blue print/design for the machinery of milk replacer has been finalized after consulting the literature and detailed discussion with the manufacturer of feed mills.

However, it is worth to mention here that this kind of machinery does not exist in Pakistan and will be the first of its nature in the country.

CROPS SCIENCES

BACKGROUND

1st Batch:

ALP Secretariat received 314 preliminary proposals relating to crops sciences for funding under the 1st batch. In process of preliminary appraisal 122 proposals were short listed for the invitation of detailed projects and 192 proposals which were not up to the standard were dropped. Finally, 62 projects costing Rs.159 million were approved by the Board of Director (BOD) of ALP for funding research in the different disciplines.

2nd Batch:

ALP Secretariat received 347 preliminary proposals relating to crops sciences for funding under the 2nd batch. In process of preliminary appraisal 128 proposals were short listed for the invitation of detailed projects and 219 proposals which were not up to the standard were dropped. Finally, 58 projects costing Rs.155 million were approved by the Board of Director (BOD) of ALP for funding research in the different disciplines.

There are projects on development of better cultivars having resistance to biotic and physico-chemical stresses (heat, drought) on mungbean, sugarcane, wheat, soybean and cotton. Further, there are two projects for development of hybrid seeds in sunflower and tomato. There is a project very well conceptualized to evaluate quality characteristic of oilseed crops.

Besides, there are two projects on farm mechanization, which are demand driven i.e. development of dryer for canola and sunflower, and development of resource conservation tillage implements. There are projects for integrated pest management in termites, weeds, rodents, nematodes and spiders control in apple. Again there are projects to solve major production problems of farmers in chilies and apples. Biotechnological tools are innovative approaches to understand molecular and genetic basis of resistance. There are six projects on biotechnology emerging from different institutions. The region wise detail of the on-going projects is summarized as under:

S.No	Region	No. of Projects	
		1 st Batch	2 nd Batch
1	PARC/NARC	27	12
2	PUNJAB	9	20
3	NWFP	8	9
4	SINDH	4	3
5	BALUCHISTAN	5	3
6	NGO/ OTHERS	2	-
7	OTHER FEDERAL	7	11
TOTAL		62	58

IMPLEMENTATION STATUS

1st Batch:

Out of 62 approved projects, 35 are on-going, 23 have been completed, two projects are in process of agreement and two projects have been dropped/ terminated due to one or other reasons.

2nd Batch:

Out of 58 approved projects, 47 are on-going, eight projects are in process of agreement and three projects have been dropped/ terminated due to one or other reasons so far.

FINANCIAL STATUS

1st Batch:

So far an amount of Rs.86 million has been released against the overall total cost of Rs.159 million in respects of approved projects. Till 30th June, 2005 overall expenditure of Rs.74 million has been incurred as reported by the PIs of the projects.

2nd Batch:

So far an amount of Rs.33 million has been released against the overall total cost of Rs.155 million in respects of approved projects. Till 30th June, 2005 overall expenditure of Rs.22 million has been incurred as reported by the PIs of the projects.

MONITORING & EVALUATION

ALP Secretariat with the active involvement of concerned Technical & Finance Divisions, PARC has completed on-site review of 33 projects. In addition to that annual/ mid term review in respect of 32 on-going projects also conducted at PARC Headquarters. The recommendations of review teams have been conveyed to concern PIs.

On the recommendation of external reviewers and other team members, 8 projects have been granted extension in the period of execution. The recommendations of the reviewers/ experts have been conveyed to concern PIs for further guide and planning.

Currently, most of the projects have completed two years of their life span. The annual progress reports of the projects shows that significant task has been completed and the outcomes are very encouraging/cheering. The salient achievements of these projects have been compiled in subsequent chapters of this annual report.

Project Title: *Development of canola quality mustard (Brassica juncea L) genotypes.*

Principal Investigator: *Syed Anwar Shah*
Principal Scientific Officer

Location of Project: *Nuclear Institute for Food and Agriculture, P.O.Box 446, Tarnab,
Peshawar*

Duration: 36(months)
Start Date: 22/3/2002
Project Status: Completed

Total Cost (million): 1.35
Funds Released (Rs): 1262000
Funds Utilized (Rs): 1262000
(Upto 30th June, 2005)

Objectives:

- To develop improved mustard genotypes with the following desirable traits:
- Low erucic acid. (< 1%) and glucosinolates (less than 18 micro moles/ gram of oil free meal)
- High oil content (> 45%)
- High seed yield (~2.5 t/ha), short stature (~100-120 cm) and early maturity.
- Resistance/ tolerance to biotic and abiotic stresses such as diseases, insects and heat/ drought.

Achievements/Progress:

The project has been completed and during the entire project period, a total of 394 useful putative mutants were selected in M₂, M₃ and M₄ mutagenized population of exotic mustard genotypes for earliness, short stature, heavy bearing, stress tolerance and ideotype, canola traits i. e. low erucic acid content & low glucosinolates etc. Dose wise selection indicated that 144 putative mutants were selected at 1.0 k Gy, 132 at 1.2 k Gy and 118 at 1.4 k Gy doses of gamma rays. Genotype wise selection of induced mutants showed that 119 putative mutants were selected from mutagenized population of DLJ-3, 92 from MM-1285, 89 from 95102/51-5 and 94 from 95101/163.

Trait wise selection revealed that maximum mutant plants were selected for earliness followed by short stature (due to high selection pressure) and ideotypes etc. Similarly, 106 mustard recombinants were selected in F₂ hybridized population for desirable agronomic and quality traits. Some mutants exhibited very useful fatty acid profile i. e. desirable level of oleic, linolenic and erucic acids, and low levels of total glucosinolates; hence they will be useful sources of canola quality germplasm. Some single low (low in erucic acid) mutants have also been selected and their oil can be used for edible purposes. On the contrary, these single-low mutants can also be used for condiment mustard e. g. MM-K-III/04-2, as it contained high total glucosinolates (~119.4 uM) and low level of erucic acid content (~2.7%) and a desirable level of oil content (~44.2%). Similarly MM-K-IV/04-6, MM-K-IV/04-20, and MM-K-II/04-8 could also be used as condiment mustard germplasm provided their quality do not contaminate in future.

In the yield trials, 18 mutants matured significantly earlier than the check cultivar (cv). Three mutants significantly out yielded the check in Advanced Yield Trials while 36 out yielded the respective check cultivars in Preliminary Yield Trials during 2003-04 and 2004-2005. Nevertheless, the canola type mutants and recombinants needs to be further assessed aggressively for agronomic and quality characteristics in diversified environments of Pakistan to find out the superior ones as potential future commercial cultivars.

Project Title: *Development of high yielding and well adaptive indigenous Canola Hybrids.*

Principal Investigator: *Dr. Naazar Ali*
National Coordinator/CSO

Location of Project: *Oilseed Research Programme, NARC, Islamabad.*

Duration: 36(months)
Start Date: 18/7/2002
Project Status: Completed

Total Cost (million): 1.869
Funds Released (Rs): 1575000
Funds Utilized (Rs): 1119784
(Upto 30th June, 2005)

Objectives:

- To identify and provide essential rapeseed germplasm to encourage local hybrid development progress in Pakistan.
- To provide/adapt and uniformly maturing hybrids at affordable price to enhance canola cultivation in Pakistan.
- The preliminary work on the hybridization in canola was started 4 years limited program funds. The researchers were able to find and maintain the cytoplasmic male sterile source in canola. Through this project oilseeds research program will materialize on the earlier work of scientists.
- An active collaboration of private seed companies and provincial Agricultural Extension Department will also be established for sale and promotion of the released hybrids.

Achievements/Progress:

Evaluation of canola hybrids: There were significant differences among parents as well as among crosses for most of the traits. In heterosis study, seed yield varied from 2134 to 2736 kg/ha among the crosses. The highest seed yield of 2736 kg/ha was produced by the F1 hybrid (We star x R-26) followed by the cross (We star x R -40 I) with seed yield of 2664 kg/ha. The maximum heterosis (24% seed yield increase over mid parent) was recorded in the crosses of We star x R-26 and Rainbow x R-26. The maximum heterosis over better parent was recorded (22% seed yield increase over better parent) in the cross of Rainbow x R-26 followed by the crosses Westar x R-26, Sponsor x R-26 and Hybridol x R-26 with seed yield increase of 17% over the better parent. The lowest seed yield of 2134 kg/ha was recorded in the cross of BLN-877 x R-4QI. It also showed maximum negative heterosis (3% seed yield decrease over mid parent).

The male parent R-26 proved a best restorer and showed highest GCA effects for days to flowering and maturity, plant height, branches/plant, pods/plant and seed yield. Among females parents, W estar, CCS-O 1, Sponsor and Rainbow showed significantly higher GCA effects for seed yield and proved better parents for seed yield than others. It is indicated that CMS of W estar, CCS-O 1 Sponsor and Rainbow are the best parents to produce hybrids using CMS-Restorer system.

Development of restorer lines: The 79 new hybrid combinations from 7 new restorer and 12 stable CMS lines were evaluated for fertility restoration. It was found that 3 restorer R-02, R-18 and R-24 contain genes for fertility restoration but further improvement in fertility restoration is in progress.

Development of CMS lines: The existing 12 CMS lines (A-line) and their respective maintainer lines (B-lines) were maintained successfully. In this regard, intensive crosses were made between CMS and B-lines. At the same time plants from B-line were also self-pollinated to maintain their genetic purity.

The 9-BC₂F₁ and 4-BC₁F₁ CMS lines were successfully backcrossed with their respective parents. The male parents were also self-pollinated to produce genetically pure seed.

In addition, 42-F₁ were also successfully backcrossed with their respective varieties/strains and sufficient seed was produced. At the same time plants from each varieties/strains were also self-pollinated to maintain their genetic purity.

Project Title: *Genetic improvement of Brassica oilseed by integrative use of conventional and molecular biological approaches.*

Principal Investigator: *Dr. Zahoor Ahmad Swati*
Director

Location of Project: *Institute of Biotechnology and Genetic Engineering, NWFP Agriculture University, Peshawar.*

Duration: 36(months)
Start Date: 22/3/2002
Project Status: Completed

Total Cost (million): 1.919
Funds Released (Rs): 1291000
Funds Utilized (Rs): 1280474
(Upto 30th June, 2005)

Objectives:

- To identify, locate and characterize insect resistant genes in the wild relatives and cultivated Brassica grown in Pakistan
- To introduce the aphid resistant source gene or quantitative trait locus (QTL) into Brassica napus genome which has improved cultivars for low erucic acid and glucosinolates contents with higher oil yield.
- To follow the introgression of useful traits from the B.napus germplasm to the B. juncea and or B.carinata, both are well-adopted germplasm in Pakistan.
- Development of improved cultivars of oil seed rape for high oil content with low erucic acid and glucosinolates, and resistant to insect pests (aphids).

Achievements/Progress:

The Project was designed to improve Brassica oilseeds for aphid resistance, particularly of Mustard aphid (*Lipaphis erysimi*) that is of major economic consequences to Brassica crops in Pakistan (Landin, 1982; Bakheta, 1987; Rahman et al 1987) by transferring of genes associated with this trait among elite and exotic germplasm through markers assisted inter and intraspecific crosses.

To achieve the desired objectives, Genetically diversified germplasm belonging to four Brassica species including *Brassica napus*, *Brassica Juncea*, *Brassica campestris* and *Brassica carinata* were procured and used in selected inter and intraspecific crosses. Successful development of these crosses set the platform for F2 through F5 selection and screening of superior material having resistance towards mustard aphid and better in yield and oil content.

Although success rate in attempted inter and intraspecific crosses was 30%, still we were able to successfully shuttle the desirable genes across Brassica species and new combinations hence developed proved to be very useful, and led the attempted selection in F2 through F5 generations in the development of 29 superior lines. These lines, under aphid screening tests, have proven to be highly resistant to mustard aphid and are carrying combination of other desirable characteristics like improved yielding ability and oil contents. These lines are now in their final season of selection at Kagilan and selected/ retained 5-10 will be tested in replicated yield trails and best promising lines will be released as improved varieties within 2 years time. In addition to research accomplishments, postgraduate students were involved and trained on handling researches experimentation at field as well as laboratory level.

Project Title: *Integrated pest management of aphids in canola.*

Principal Investigator: *Dr. Mohammad Aslam*
Associate Professor

Location of Project: *University College of Agriculture, Bahauddin Zakria University, Multan*

Duration: 36(months)

Start Date: 1/7/2002

Project Status: Completed

Total Cost (million): 1.346

Funds Released (Rs): 899000

Funds Utilized (Rs): 614856
(Upto 30th June, 2005)

Objectives:

- Collection and identification of aphids and their natural enemies from the field grown canola.
- Screening of available canola varieties for resistance against aphids.
- Determine the relationship between aphid numbers/plant and yield loss to establish Economic Threshold level.
- Testing insecticides for their effect on aphids and natural enemies.
- To develop an IPM package by integrating the use of resistant varieties, biological control agents and insecticides, particultural soft insecticides.

Achievements/Progress:

Canola (*Brassica napus* L.) and Raya (*Brassica juncea*) crops are attacked by a number of insect pests. Among the insects feeding on these crops, cabbage aphid (*Brevicoryne brassicae* L.) and mustard aphid (*Lipaphis erysimi* Kalt.) are relatively more serious. In addition to direct damage these aphid species also transmit viral diseases in Brassica. Integrated pest management (IPM) is an economical, sustainable and environmentally safe control strategy. Thus, the present project was started in 2002 to develop an IPM strategy for aphid management on canola by combining host plant resistance, cultural and chemical control methods.

The research was carried out at Multan and Bahawalpur. Two aphid species, i.e. cabbage aphid (*Brevicoryne brassicae* L.) and mustard aphid (*Lipaphis erysimi* Kalt.) were predominant species on canola (*B. napus*) and Raya (*B. juncea*) at both locations. Population of *Brevicoryne brassicae* L. was relatively more on both the crops at both locations. Among the predators, *Chrysoperla* sp. Was recorded at both locations at very early stage of the crop. Ladybird beetle, *Coccinella septempunctata* L. appeared very late in the season. The population of this predator was too low to provide any biological control of aphids. At Multan 31.41 % aphids were found parasitized by *Diaeretiella rapae* (M'Intosch).

During 2002-2003 season, *Brassica napus* varieties viz. Dunkald, Rainbow, Oscar, Westar, Shiralee,-CON. I, CON. II, CON. III, KS- 7 5 and Abaseen and *Brassica juncea* viz. BARD-I, Sultan Raya, BRS-3, PIIR-1, UCD-6/10, P63R5, UCD-44/4, UCD-636, P- 37 and RC-280 and during 2003-2004 Dunkald, Rainbow, Oscar, Westar, Shiralee, CON- I, CON-II, CON-III, KS-75, Abaseen, 19-H and 20-E and Raya, *Brassica juncea* viz. BARD-I, Sultan Raya, BRS-3, PIIR-1, UCD-6/10, P63R5, UCD-44/4, UCD-636, P-37, RC-280, 95101/163 and 95102/51 were screened by recording aphid population in the field at Multan and Bahawalpur. Mean seasonal population of both cabbage aphid and mustard aphid was non-significantly different among the tested varieties of *Brassica napus* at both locations. Population of mustard aphid was also non-

significantly different among *Brassica juncea* varieties at Multan, whereas cabbage aphid population was different on Raya varieties tested at Multan during 2002-2003. Highest population was found on UCD-636 (28.16 aphids per 10cm inflorescence) and lowest on BRS-3 (9.6 aphids per 10cm of inflorescence).

Population of both cabbage aphid and mustard aphid was non-significantly different among the tested varieties of both crops at both locations during 2003-2004 also. Population of cabbage aphid was more than mustard aphid on both crops at both locations. Lady beetle, *Coccinella septempunctata* L. was very low on both crops at Multan and Bahawalpur. In planting date experiment at Multan, lowest population of aphids was recorded on canola planted in second week of October as compared to that on the crop sown in first and second week of November. At Bahawalpur, lower population of cabbage aphid was found on canola planted in mid November and mustard aphid population was lower on crop planted in late October. Yield loss by aphid was 35 % at Multan. The insecticides sprayed at Multan provided good control of aphids. Among these, Confidor, Talstar and Advantage were better than others. It was found that appropriate strategy for aphid management was to plant the canola crop early at Multan and late at Bahawalpur and to apply insecticides when necessary.

Project Title: *Studies on malformation of mango.*

Principal Investigator: *Dr. Ahmed Saleem Akhtar*
Director

Location of Project: *Plant Protection Institute, Faisalabad.*

Duration: 36(months)

Start Date: 29/3/2002

Project Status: Completed

Total Cost (million): 2.241

Funds Released (Rs): 1544000

Funds Utilized (Rs): 1526160
(Upto 30th June, 2005)

Objectives:

- To conduct studies on etiology to establish the cause of the disease.
- To identify and classify fungal isolates through DNA finger printing.
- To devise a suitable integrated strategy to overcome a major problem of mango production in the country.

Achievements/Progress:

Mango is an important commercial fruit of the world. It is attacked by various biotic and abiotic diseases. Malformation has become a crux among several biotic diseases of mango. Since its first record in 1891, it is causing colossal losses every year. Yield losses may range as high as from 80% (Ginai, 1965) to 90% (Ploetz, 1999). Despite hectic efforts, complete control has not been achieved yet. The problem has been reported from Pakistan, Egypt, South Africa, Brazil, Israel, Central America, Mexico, USA, Sudan, Cuba, Australia, Bangladesh, and UAE (Kumar et al., 1993). Two types of malformation viz. vegetative and floral have been characterized with same etiology (Singh et al., 1961; Varma et al., 1969; Schlosser, 1971a). Symptoms of vegetative malformation appear on seedlings and saplings while floral malformation may significantly impact the floral organs. Both symptoms are confirmed to be the manifestation of the same disease (Kumar and Beniwal, 1987b). Viral, acarological and physiological etiologies have previously been claimed. Recent literature confirms the presence of a fungus, *Fusarium mangiferae*. The prime objectives of the present studies are to examine the association of different fungi, determine the actual cause of the disease and devise suitable strategies of control.

Disease assessment:

Assessment was done in 40 orchards of eight districts of the Punjab province. Malformation showed 100% prevalence in the surveyed orchards. Jhang was the most affected district with 66.23% severity followed by 24.67 and 24.57% in Multan and Vehari, respectively. All the traditional mango cultivars were disposed to the disease. Seedling mango proved to be highly susceptible giving 42.93% severity while Sindhri and Anwar rataul showed 36.24% and 31.02% infected panicles, respectively.

Morphological characteristics of malformed and healthy organs:

Observations on morphological characteristics of central axis and primary peduncles of healthy and malformed mango inflorescences showed that malformed panicles were significantly shorter and broader than normal ones.

Determination of fungi associated with malformed tissues of mango:

- i. A total of 1500 malformed tissues obtained from five local cultivars of 10 districts of the Punjab were assayed. Data revealed the association of five fungi. *Fusarium mangiferae* was the dominant fungus causing 65.0% tissue infection. *F. pallidoroseum*, *Alternaria alternata*, *F. oxysporum* and *F. equiseti* showed 1.59, 1.53, 0.46 and 0.26% tissue infection, respectively. Comparative distribution of *F. mangiferae* in three cultivars of ten districts exhibited cumulative infection of 85.72% (1543 of 1800 tissues) as compared to non malformed ones which showed only 20.44% infection (368 of 1800 tissues).
- ii. The examination of malformed parts of 5 exotic cultivars viz. Tomyatkin, Swamika, Maya, Zill and Kensington revealed the dominance of fungus *Fusarium mangiferae*. Tomyatkin proved to be the most susceptible variety showing 96.0 % infection followed by Kensington with 93.0 % infection.
- iii. Twenty isolates of fungus *F. mangiferae* were identified from 14 locations of Pakistan. Macroconidia were three septate, slightly sickle shaped to straight with dorsal and ventral surfaces almost parallel. Microconidia were fusiform and oval to elliptical. The size of macro conidia fell in the reported range of 3.5-5 x 45-60 μ m.

Determination of fungus *F. mangiferae*:

The determination of fungus *F. mangiferae* at proximal and distant sites of panicles revealed maximum recovery of 85.71% at 0 cm, 47.14% at 1-10 cm, 34% at 10-20 cm, 18.46% at 20-30 cm, 10.91% at 30-40 cm and only 4% at above 40 cm distance from the panicles in malformed branches. There was a gradual decrease in recovery of the fungus from panicles to the main stem in malformed organs. An infection of 16.36% was recorded at 0 cm distance in case of healthy panicles while no isolations could be made from branches that supported non malformed panicles.

Selective growth media:

In in vitro studies on selective media for growth of fungus *F. mangiferae*, Potato dextrose agar (PDA) and Carnation leaf agar (CLA) media proved to be the best for mycelial growth and macroconidial production with least phenotypic variation, respectively.

Nutrient deficiency:

Comparative analysis of malformed and non-malformed organs for nutrient deficiency showed that different nutrients have no role in malformation development

Pathogenicity studies

The attempt to manifest disease by artificial inoculations proved successful. Four, 6 months old mango seedlings out of six and one 2 years old plant of Chaunsa cultivar produced malformation to the extent of 66.66 and 33.33% respectively. Symptoms were produced by wound inoculation (flap cut method) only as compared to spore spray, carborundum abrasion and control. The studies provided the evidence that the fungus *F. mangiferae* is the cause of the disease.

Characterization of isolates:

Random amplified polymorphic DNA (RAPD) analysis was employed for genomic. DNA of twenty isolates using 50 random primers. A total of 393 amplification products were produced with an average of 7.86 bands per primer. The size of the amplified products was in the range of 250 bp to 3 kbp. Contrary to morphological and cultural similarities, variation in banding pattern of isolates was reflected. The isolates were discriminated into two clusters with 13 and 7 isolates in A and B cluster, respectively. The most closely related isolates were FM-4 and FM-6 with 92.5% genetic similarity.

Electron microscopy:

Malformed and healthy mango buds were assayed using Transmission Electron Microscope. The ultrastructural studies confirmed the inter and intracellular presence of the fungus *F. mangiferae* in malformed mango buds and its role in disease causation. No fungal infection was detected in healthy bud cells.

Immunogold labeling:

The immunogold labeling provided the potential for precise localization of fungal sections. Polyclonal antisera raised were found specific towards the isolates of *F. mangiferae*. The ultrathin sections trimmed from buds infected with isolate FM-2 and FM-17 showed labeling specificity when sections coated with respective IgG were examined under Transmission Electron Microscope (TEM). The results indicated the precision of labeling reactions.

***In vitro* evaluation of fungicides:**

Eight fungicides were tested against fungus *F. mangiferae*. Benlate 50 WP and Carbendazim proved to be the best fungicides giving 100% suppression of the colony growth. Generally a decrease in colony growth was observed with increasing concentrations of the fungicides.

Consecutive clipping and chemical spray:

The trial on consecutive clipping and chemical spray showed good results. The treatment where clipping was done at 1.5 ft. distance from 'top to downward followed by spray of Topsin-M proved to be the best :giving 59.31 % decrease over previous years count.

Project Title: *Integrated management of fruitflies in Pakistan.(NARC, Component)*

Principal Investigator: *Dr. Ghulam Jilani*
Program Leader

Location of Project: *Insect Pest Management Program, Institute of Plant and Environmental Protection, NARC, Islamabad*

Duration: 36(months)

Start Date: 21/3/2002

Project Status: On-going

Total Cost (million): 3.675

Funds Released (Rs): 2281500

Funds Utilized (Rs): 2172454
(Upto 30th June, 2005)

Objectives:

- To enhance quality and quantity of various exportable fruits, i.e., mango, guava and citrus through the reduction of economic losses caused by fruit flies.
- To ensure pest and pesticides free fruit production of export, to meet WTO standards.
- To develop capabilities in farmer communities for controlling fruit flies through IMP technologies/eco-friendly management of fruit flies in the country.

Achievements/Progress:

Fruit flies have attained importance with respect to WTO. Application of insecticides for controlling fruit fly infestation resulting into toxic insecticide residues and quality deterioration of fruit has adversely affected economy of farmers and traders. A thorough review of fruit fly management in Pakistan has revealed that work has been concentrated on Male Annihilation Technique for reducing population levels.

Under the present project, Integrated Pest Management Model has been developed and tested on 450 acres Mango Orchards in Multan and 35 acres in guava orchards in Sharaqpur. This model consisted of Male Annihilation Technique, Bait Application Technique, Sanitation, and application of 2 % neem seed extract to the most susceptible variety. In this model, small amount of insecticide are still applied which can be eliminated if biological control is implemented on large areas. Extracts of various plants have been intensively evaluated and a few have shown promise. The promising plant extracts/chemical fractions need to be further studied to develop biopesticide based IPM model for the management of fruit flies.

Conclusions:

- *V. officinalis* was an effective repellent at 2 and 1% application rate
- Feeding fruit flies on petroleum ether extract of *V. officinalis* caused significant inhibition of reproduction.
- Minimum number of pupae 46.33 were observed from the progeny of flies fed upon 1000 ppm concentration followed by 56.67 and 69.33 in case of 500 and 350 ppm as compared with 144.3 in control.
- Acetone extract of turmeric was better repellent than its petroleum ether and ethanol extracts. Feeding 250 pm of this extract caused significant effect on reproduction of *B. zonata*.
- Chemical fraction obtained with Methanol: Chloroform (1: 1) was the most repellent.

Project Title: *Integrated management of fruitflies in Pakistan.*
(CABI Bioscience - Component)

Principal Investigator: *Dr. M. Ashraf Poswal*
Director

Location of Project: *CABI-Biosciences Centre, Data Gunj Bakhsh Road, Satellite Town, Rawalpindi.*

Duration: 36(months)

Start Date: 21/3/2002

Project Status: On-going

Total Cost (million): 4.254

Funds Released (Rs): 3977000

Funds Utilized (Rs): 3736917
(Upto 30th June, 2005)

Objectives:

- To enhance quality and quantity of various exportable fruits, i.e., mango, guava and citrus through the reduction of economic losses caused by fruit flies.
- To ensure pest and pesticides free fruit production of export, to meet WTO standards.
- To develop capabilities in farmer communities for controlling fruit flies through IMP technologies/eco-friendly management of fruit flies in the country.

Achievements/Progress:

The fruit importing countries need certification of presence/ absence of fruit flies species of quarantine importance as well as data of the year round catches of flies in traps to assess prevalence of fruit flies and their activity period in the area from where fruit is being imported. Therefore, monitoring of fruit flies via catches of fruit flies in traps baited with dorsa lure remained the continued activity of the project.

Certification of absence of Mediterranean fruit fly *Ceratitis capitata* from Pakistan was made out of survey data collected on attraction of different species of fruit flies to different types of pheromones and rearing of fruit flies from different host fruits. This information was conveyed to Pakistan Horticulture Development and Export Board (PH DEB) to address the concerns shown by fruit importing countries for fruits imported from Pakistan.

The fears about chances of contamination of other fruit flies like oriental fruit fly (*Bactrocera dorsalis*) and peach fruit fly (*B. zonata*) in Kinnow were also removed by providing the scientific evidence of the habit of these fruit flies going into hibernation from December to February at Sargodha and Bhalwal. This is the period when Kinnow matures and harvested, so the export of Kinnow from this area of Pakistan during this period is safe. In 2003-04 record export of 150,000 tons of Kinnow was obtained earning over US\$ 30 million and target of 250,000 tons has been fixed for next year to take the figure of earning to US\$ 50 million. Recently safety protocols were signed between government of Pakistan and China on provision of this data and agreement on export of Kinnow from Pakistan to China has also been signed.

Mass production of parasitoids (*Diachasmimorpha longicaudata* and *Trybliographa daci*) of fruit flies in the laboratory and their releases in the guava orchards at Sharaqpur remained a continued activity. About 58,000 *D. longicaudata* and 73,000 *T. daci* were released at Nazar Labana (Sharaqpur) from February to October 2004. The parasitoids started attacking fruit flies

in guava from March and percentage parasitism was in the range of 11.1-60% in orchards where augmentation of parasitoids was done. In orchards about 15 km away where augmentations of parasitoids were not done no parasitoids were reared in March and April, however, some parasitoids were reared in October. The infestation of fruit flies in guava was in the range of 1-28% in orchards where parasitoids were released compared with 28-93% in control.

FFS is the latest extension methodology of technology dissemination through participatory, non-formal training method primarily based on discovery-based learning. The program was initiated to conduct experimentation for development of holistic integrated crop management approach on mango. Two FFS were established, one each at Moza Ameer pur Tehsil Kabirwala and at Chak 5 Faiz near Basti Lar on Bahawalpur Road Multan, since September 2003. One of the major inputs for the better understanding of mango crop and participatory learning was the delivery of information, insight and detailed discussion by the experts in different fields.

During the course of training some issues were identified as outcome of mango eco- system analysis (MESA) in FFS plots. Mango midges and quick decline disease in mango were recorded as the most serious constraints in mango yield. Scale insects and mealy bugs populations were also found increasing to high population levels and in some cases trees were turning black because of development of sooty mold development on honeydew secreted by the scale insects. This impacted on mango yield indirectly by interfering with 'photosynthesis.

The farmers from Sindh also reported serious outbreak of quick decline disease and scale insects in mango. On examination of samples of diseased mango brought by them beetles adults and immature stages in green and dry twigs were found. Thus insects seem playing role in spread of disease. Farmers and researchers in Sindh, who contacted CABI in this regard, reported that insects seem to play the primary role in mango decline.

To solve such issues appropriate resource persons from leading national .research institutes were invited for facilitation and help participants to guide them.

Project Title: *Integrated management of fruitflies in Pakistan. (NIFA, Peshawar Component)*

Principal Investigator: *Dr. Sana Ullah Khan Khattak*
Head, Entomology Division/PSO

Location of Project: *Nuclear Institute for Food & Agriculture (NIFA), Tarnab, Peshawar.*

Duration: 36(months)

Start Date: 22/3/2002

Project Status: Completed

Total Cost (million): 2.368

Funds Released (Rs): 2079200

Funds Utilized (Rs): 2074250
(Upto 30th June, 2005)

Objectives:

- To enhance quality and quantity of various exportable fruits, i.e., mango, guava and citrus through the reduction of economic losses caused by fruit flies.
- To ensure pest and pesticides free fruit production of export, to meet WTO standards.
- To develop capabilities in farmer communities for controlling fruit flies through IMP technologies/eco-friendly management of fruit flies in the country.

Achievements/Progress:

Fruit flies have gained immense importance in Pakistan as well as throughout the world. The pest causes colossal losses and damage to fruits and vegetables in various agro-ecological zones of Pakistan. To handle this problem, farmers usually depend on using organic pesticides which has resulted in environmental contamination, residue problem, destruction of non-target and beneficial organisms and development of resistance in insects. To combat fruit flies problem, it is imperative to develop an IPM protocol. Under this ALP project, we have used MAT, BAT and BP (Bio-pesticide) for the management of fruit flies in two guava producing areas i.e. Kohat and Haripur.

Due to application of IPM component, at Kohat, fly population was reduced by more than 74% in MAT, BAT and Bio-pesticides, while at Haripur, this figure ranged from 51-58%. Infestation and damage was decreased 56 and 90.5% in plucked fruit respectively. At Haripur, decrease in % infestation was 48.9 -49.6 while decrease in damage ranged between 79.8 -85%. Two parasitoids were collected from Kohat.

During 2nd year, at Kohat, population was reduced by 58.4% while at Haripur, it was 39.0%. Infestation was decreased by 60.9, 59.0 and 57.6% using neem oil, seed extract and bait respectively. At Haripur the corresponding figures were 62.6, 50.7 and 48.5% for fruit infestation while 42.6, 41.9 and 24.8% decrease in damage was recorded respectively.

During 3rd year at Kohat, population was reduced by 54.1% in umbrella (MAT, BAT, BP) orchard and 38.35% in MAT only than control while at Haripur, the corresponding figures were 56.9 and 21.11 % respectively. At Kohat, infestation reduction was more than 57% in umbrella and 24.29% in MAT while reduction in damage was 53 -61% and 34.37% in above mentioned treatments respectively. At Haripur, % decrease in fruit infestation was 54.4 -63.9% and 48.8% in MAT while decrease over control in damage was 54.3 -72.7% and 38.6% in umbrella and MAT respectively. Among fruit fly species, *Bactrocera zonata* was dominant at Kohat while *B. dorsalis* at Haripur throughout the study period.

Project Title: *Integrated management of fruitflies in Pakistan.*
(ARI, D. I. Khan Component)

Principal Investigator: *Dr. Abdul Latif*
Entomologist

Location of Project: *Agricultural Research Institute, D.I. Khan.*

Duration: 36(months)

Start Date: 22/3/2002

Project Status: On-going

Total Cost (million): 2.063

Funds Released (Rs): 1858500

Funds Utilized (Rs): 1858741
(Upto 30th June, 2005)

Objectives:

- To enhance quality and quantity of various exportable fruits, i.e., mango, guava and citrus through the reduction of economic losses caused by fruit flies.
- To ensure pest and pesticides free fruit production of export, to meet WTO standards.
- To develop capabilities in farmer communities for controlling fruit flies through IMP technologies/eco-friendly management of fruit flies in the country.

Achievements/Progress:

Research Trial on Management of fruit flies infesting muskmelon:

The period of pupal diapause in melon fruit fly (*Myiopardalis pardalina*); a monophagous pest, was determined in previous years. The duration of which lasted for 9 months, from July to March. Based on this behavioural finding, a research trial was designed for the management of pest with the inference that adults after emergence from the pupal diapause get refuge in the fauna around the melon fields. The diurnal activities like foraging, mating, sheltering etc. are sustained in the surrounding vegetation of non-host plants. At the time of fruit setting the gravid females go into field, oviposit fruits that are in close proximity to surrounding vegetation.

The design of the trial was according to RCB with following 5 treatments, each replicated 3 times in independent field.

- i. Cover spray around fauna of melon field with synthetic insecticide.
- ii. Cover spray around fauna of melon field + periphery of host field
- iii. Intermittent bait application on surrounding fauna.
- iv. Intermittent bait application on surrounding fauna + periphery of host field

Treatments were administered twice; before and after fruit setting stage. Fruit infestation data was recorded twice at the time of fruit picking by randomly taking 80 fruits from the heap in each picking. Mean percent infestation was worked out and compared by applying LSD test.

Parasitoid recovery from fruit flies pupae:

Parasitoids recovery from the pupae of melon fruit flies (*M. pardalina*, *B. cucurbitae*) being carried on under laboratory condition, using rearing chambers and in the transparent rearing cages specially designed for the parasitoid recovery.

Research Trial on Management of fruit flies infesting mango:

Efficacy studies on behaviour-modifying semio-chemical cues (sex and food lures) and extracts of biochemical are being carried out under the following protocol:

The design of the experiment is according to RCB with following 05 treatments, replicated 03 times. Each replication is carried on in independent orchard.

- T1, Male sex-kure traps (3/acre)
- T2, Foods bait application (Twice)
- T3, Neem Extract (5%) application
- T4, Male sex-lure traps+ bait application
- T5, Male sex-lure traps + Neem Extract
- T6, Check

Poluation Dynamics in guava fruit flies:

Weekly data on population fluctuation in relation to seasonal variations are being carried on from the guava and mango orchards. Platic traps impregnated with male sex lures have been installed in the orchards and number of files caught is regularly monitored.

Transfer of Technology:

Audiovisual Training: Trainings sessions for stakeholders were continued. Preventive control measures with special reference to crop hygiene / cultural practice and proper use of MAT/ BAT neem application techniques were conveyed. Also Urdu bulletin written on control of melon, mango and guava fruit flies were distributed among the extension field workers, fruit growers and field officers of NGOs.

Implementation of IPM Technology:

Trainings were imparted by demonstrating management techniques, such as preparation & application of: traps, bait and neem extracts on vegetable mango and melon.

Project Title: *Integrated management of fruitflies in Pakistan.
(NIA, Tandojam Component)*

Principal Investigator: *Mr. Nazir Ahmed
Head, Entomology/PSO*

Location of Project: *Nuclear Institute of Agriculture, Tandojam, Sindh*

Duration: 36(months)

Start Date: 26/4/2002

Project Status: Completed

Total Cost (million): 2.012

Funds Released (Rs): 1225500

*Funds Utilized (Rs): 1219540
(Upto 30th June, 2005)*

Objectives:

- To enhance quality and quantity of various exportable fruits i.e. mango, guava and citrus through the reduction of economic losses caused by fruit flies.
- To ensure pest and pesticides free fruit production of export, to meet WTO standards.
- To develop capabilities in farmer communities for controlling fruit flies through IMP technologies/eco-friendly management of fruit flies in the country.

Achievements/Progress:

Survey of the fruit fly fauna conducted under the project confirmed that *Bactrocera zonata* is the only predominant species attacking guava, mango, ber and chekoo fruits. Mango fruits are also attacked by another species, *B. dorsalis* but its incidence was less than 7 percent. Chekoo fruits were attacked by *B. zonata* only, whereas *Carpomya visuviana* infested the fruits of ber with 10.5 percent intensity. Naturally two species of larval cum pupal parasitoids, *Diachasmimorpha longicaudata* and *Trybliographa* spp. were observed but their rate of parasitism was very low. Results manifested that with conserving the beneficial insects in the orchards the parasitoids could be exploited as a component of fruit flies Integrated Management Program. Hence mass rearing of the two species of the parasitoids has been established at the Nuclear Institute of Agriculture, Tandojam. These parasitoids are being released in the field for the management of fruit flies. Preliminary results indicated that although the population of parasitoids enhanced more than 7 times in the orchards where they were released but the infestation was significantly less in the plots received the treatment of male annihilation technique in combination with bait spray technique.

Plastic Multi-lure Traps (PMT) baited with 3 tablets of torula yeast (9 g) in 300 ml water attracted maximum number of the peach fruit flies (37 % males and 63 % females). Whereas, protein hydrolysate and diammonium phosphate in 3:7 ratio captured 48 percent males and only 52 percent females in PMT. Protein hydrolysate in combination with diammonium phosphate and torula yeast in combination with Borax showed potential for attracting both sexes of fruit flies and could be sprayed as bait for effective control of fruit flies in mango and guava orchards.

Male annihilation technique in conjunction with bait spray technique proved effective for the control of fruit flies in guava and mango orchards. Whereas, separate application of these techniques proved significantly less effective as the fruit flies catches in traps and fruit infestation were higher in the separate treatment of the techniques. An identical trend of fruit flies infestation was recorded at the three selected sites in Mirpur Khas, Hyderabad and Larkana

districts. Higher population of fruit fly was recorded at Larkana as compared to the other sites. Similarly the fly's pupal recovery from the dropped guava fruits was also higher from Larkana districts.

Higher concentrations of peppermint and neem oils increased the inhibition percentage of fruit flies and treatment of the oils to mango and guava fruits decreased the survival rate of the maggots in the fruits. Treatment of mango and guava fruits with 3% solution of neem seed oil and 4% solution of peppermint oil proved effective to inhibit completely the oviposition of *B. zonata* in the laboratory. The low concentrations of the oils increased the larval survival in the fruits and maximum survival was observed at the lowest dose applied. On the basis of these results, 3 % solution of neem oil or 4 % solution of peppermint oil is recommended for the environment friendly management of fruit flies in mango and guava orchards.

Sterile Insect Technique (SIT) proved statistically at par with insecticide treatments when it was applied on 20 acres. However, application of SIT on small scale proved significantly less effective than insecticide.

The project also proved effective to increase the awareness among the farmers for application of eco-friendly techniques for the management of fruit flies as number of farmers purchased the fruit fly traps from this Institute. The IPM Model developed under the project was implemented at farmers field in Mirpur Khas and Hyderabad districts.

Project Title: *Integrated management of fruitflies in Pakistan.
(ARI, Sariat, Quetta Component)*

Principal Investigator: *Mr. Muhammad Karim Shawani
Entomologist*

Location of Project: *Agricultural Research Institute, Sariat, Quetta.*

Duration: 36(months)

Start Date: 1/3/2003

Project Status: On-going

Total Cost (million): 2.031

Funds Released (Rs): 1432000

*Funds Utilized (Rs): 1222761
(Upto 30th June, 2005)*

Objectives:

- To enhance quality and quantity of various exportable fruits, i.e., mango, guava and citrus through the reduction of economic losses caused by fruit flies.
- To ensure pest and pesticides free fruit production of export, to meet WTO standards.
- To develop capabilities in farmer communities for controlling fruit flies through IPM technologies/ eco-friendly management of fruit flies in the country.

Achievements/Progress:

A survey was conducted during the report year in Khuzdar, Sibi, Bolan Lasbela and Quetta. Different fruits and vegetables including guava, peaches, chickoo, melons, squashes & cucumber, were observed; infested fruits were collected and kept in lab, for collection of natural enemies of the pest, *Bectrocera (Dacus) zonata* species which is the most serious insect pest of fruits & vegetables. From the infested fruit only adults of *Bectrocera zonata* were emerged, no beneficial organism were found.

Experiments were conducted on guava orchards on three sites at Vinder area, site No. 1 ten acres guava orchards was treated with four IPM techniques (a) Male Annihilation Technique (MAT), (b) Bait Application Technique (BAT), (c) Spray of bio-Pesticide and (d) Cultural Practice (CP) this site was managed & monitored by the project staff. At site No 2. same four IPM techniques used by the farmers himself & The 3rd site was kept on farmers own practices as control plot. The results showed that the site No 1 managed by the Project staff was better then the Farmer's field (site No 2) where IPM techniques were done by farmers. It is concluded that the trained staff managed & executed IPM techniques in a better way but over all the site no. 1 and site No.2 were better then control.

Other experiment on reduction of Fruit fly used by MAT against Fruit flies on Melon crop at Dhadar and Sibi was conducted where Six Pheromone traps per acre were installed and data was recorded on weekly basis. The results showed that the male fruit flies were trapped through out the fruiting season of muskmelon. In pheromone traps plot fruit infestation reduced to 28.34 % at Sibi, and 25.7% at Dhadar.

The farmers were using chemical spray to control fruits fly after every 10 days. The costs of pesticides is higher then pheromone traps. Trainings were also conducted at Vinder, Sibi and Hub in the month of February 2005. Seventy five farmers and extension workers attended the training.

Project Title: *Mass scale production of disease free true-to-type peach rootstock (GF 677) plantlets through tissue culture for productivity enhancement/ economic self reliance.*

Principal Investigator: *Dr. Hafeez-ur- Rahman*
Senior Scientific Officer

Location of Project: *Horticulture Research Institute, National Agriculture Research Center, Islamabad.*

Duration: 36(months)

Start Date: 21/3/2002

Project Status: Completed

Total Cost (million): 2.129

Funds Released (Rs): 1511000

Funds Utilized (Rs): 1346154
(Upto 30th June, 2005)

Objectives:

- Mass clonal multiplication of GF-677 rootstock (givorus, performs better and longer than local rootstock used commercially and is also tolerant to some of the biotic and abiotic stress factors) for budding commercial varieties of peach, almond, plum and apricot.
- Supply of healthy clonal peach, plum, apricot, almond nursery plants to orchardists budded on GF-677 rootstock to bridge the gap between supply and demand of healthy planting material to the end users/gardeners.

Achievements/Progress:

GF 677 is a interspecific hybrid (Peach x Almond). It is clonally propagated cutting; micropropagation) and is specially used on alkaline soils because it is resistant to iron induced chlorosis and is also useful in replant situations. Highly vigorous counteracts low soil fertility), do not produce suckers, resistant to peach rust, crown gall and root knot. However, it is difficult to multiply on mass scale through cutting because of very low rooting percentage. Through micropropagation it can be multiplied at a much faster rate as compared with conventional propagation. Thus present investigation is attempted to standardize a protocol for *in vitro* propagation of this rootstock.

In vitro culture establishment & shoot proliferation:

Explant sterilization was done with various concentrations of NaOCl (0.25, 0.5, 75, 1.0, 1.25 % w/v) to find out the optimum dose for minimum in vitro infestation. The best treatment was 0.25% NaOCI, where minimum necrosis (5%) and maximum survival (55%) was achieved.

For shoot proliferation study, MS (a high salt medium) and AND (a low salt medium) media were compared with different BAP concentrations (0.3, 0.6, 0.9 mg l⁻¹). Data were recorded on shoot proliferation rate, total number of shoots per proliferating explant and number of shoots more than 2.0 cm in length per proliferating explant after 4 weeks.

Non significant differences were noted between culture media (MS & AND) in the rate of shoot proliferation. Similarly the interaction between the culture media (MS & AND) and BAP was non significant for proliferation rate. Significant differences were observed between culture media (MS & AND) for the number of shoots per proliferated explant. MS medium produced

higher number of shoots (3.75) per proliferated explant as compared to AND medium, which produced (2.93) shoots per proliferated explant. The interaction between the culture media (MS & AND) and BAP was significant for number of shoots per proliferated explant. MS + 0.6 mg l⁻¹ BAP produced maximum number of shoots (6.22) per explant. While AND 0.6 mg l⁻¹ BAP produced (3.83) shoots per explant.

Significant differences were observed between culture media (MS & AND) for the number of shoots more than 2.0 cm in length per proliferated explant. Maximum number of shoots (2.23) more than 2.0 cm in length per proliferated explant were produced on MS medium as compared to AND medium which produced (0.77) shoots more than 2.0 cm in length per proliferated explant. Interaction between the culture media (MS & AND) and BAP was significant for number of shoot more than 2.0 cm in length per proliferated explant. MS + 0.6 mg l⁻¹ BAP produced maximum number of shoots (3.94) more than 2.0 cm in length per proliferated explant. While AND + 0.6 mg l⁻¹ BAP produced (1.72) shoots more than 2.0 cm in length per proliferated explant.

From the combined results of these parameters, it was concluded that, of the two media tested, MS was the best for the multiplication of peach rootstock GF 677. BAP showed a strong interaction with the salts of culture media (MS & AND). In both media (MS & AND), 0.6 mg l⁻¹ BAP was the most affective concentration but the response was dependent on salts concentration of culture media (MS & AND).

In vitro Rooting Acclimatization & in vivo Nursery establishment

For rooting, half strength MS medium was used with different IBA concentrations (0.0, 1.0, 2.0, 3.0, 4.0, mg l⁻¹). Data were recorded after 4 weeks of subculture. Significant differences were noted between the treatments for the rooting rate, number of roots per rooted explant and number of roots more than 1.5m in length per rooted explant.

Of the different concentrations of IBA tested during 2003, 3.0 mg l⁻¹ IBA (T₃) were suitable, resulting in 73.33 % root initiation, 5.86 number of roots per rooted explant and 3.13 number of roots more than 1.5 cm in length per rooted explant.

For *in vitro* rooting of peach rootstock GF 677, three auxins (IAA, IBA and NAA) were tested at concentrations of 0.2, 0.4, 0.6, 0.8 and 1.0 mg l⁻¹ during 2004. The root number and root length were significantly (p<0.05) affected by auxins type and concentrations. The optimum concentration was different for each auxin. Maximum number of roots (5) and roots >1.5 cm in length (4) were obtained with 0.4 mg l⁻¹ IBA without callus inter phase whereas 3.0 mg l⁻¹ IBA in the previous experiment although gave good rooting percentage but with lot of callusing however, NAA and IAA affected the root growth negatively. Callus formation was strongly stimulated by NAA. For these reasons IBA is preferable auxins for *in vitro* rooting of peach rootstock GF 677. Well rooted plantlets were transferred to greenhouse successfully and grown with 80% survival.

- Protocols for *in vitro* shoot proliferation has been standardized
- Protocols for *in vitro* rooting has been standardized
- Acclimatization of the plants has been standardized
- Field nursery of the greenhouse acclimatized plants has been developed (700 plants has already been budded 2004)
- Field nursery consisting of two thousand acclimatized plants of the rootstock is ready for buddy this year (2005)

Project Title: *Post Harvest Research on Perishable Fruits (Guava, Peach) and Vegetable (Tomatoes) In NWFP.*

Principal Investigator: *Mrs. Manzoor Nazli
Grading & Packing Specialist*

Location of Project: *Food Technology Section, Agriculture Research Institute, Tarnab, Peshawar.*

*Duration: 36(months)
Start Date: 22/3/2002
Project Status: Completed*

*Total Cost (million): 1.637
Funds Released (Rs): 1477000
Funds Utilized (Rs): 1476742
(Upto 30th June, 2005)*

Objectives:

- To reduce product losses occurring on the farm and in the marketing system.
- Increase the amount of food marketed by introducing improved Post Harvest techniques.
- To improve the welfare of the farming community.
- Development of Post Harvest Techniques that delay senescence and easy to adopt by the farmers.

Achievements/Progress:

Experiment on the "Effect of Grading, Packing Material and Cold Storage Behavior on the Shelf Life of Peaches" has been conducted.

Experiment on the "Effect of Grading, Packing Material and Cold Storage Behavior on the Shelf Life of Tomato" has been conducted.

Experiment on the "Effect of Grading, Packing Material and Cold Storage Behavior on the Shelf Life of Guava" has been completed.

Field day on Grading and Packing of Peaches was organized in Matta, Swat District on 17-08-2004. Farmers of the area trained in the packing and grading techniques of Peaches that will help in reducing the postharvest losses.

Field day on Grading and Packing of Tomato was organized in Urmer village of Peshawar District on 6-7-2004. Farmers of the area trained in the packing and grading techniques of Tomato that will help in reducing the postharvest losses.

Field day on guava fruit was held on 5-3-2005 in Thanda Dam, Kohat. 20 guava growers participated in the said field day.

One day on training on peach fruit was held on 25-7-2004 in Drosh Khela, Swat. The participants were delivered lectures as well as practically demonstrated the grading techniques. 30 growers participated in the said training.

Project Title: *Morphological and biochemical variability of the genus Trichogramma (Hymenoptera: Trichogrammatidae) in Pakistan.*

Principal Investigator: *Mr. Riaz Mahmood*
Senior Scientific Officer

Location of Project: *CABI Regional Biosciences Centre, Opposite I-A Data Gung Baksh Road, P.O. Box 8, Satellite Town, Rawalpindi*

Duration: 36(months)
Start Date: 21/3/2002
Project Status: Completed

Total Cost (million): 4.166
Funds Released (Rs): 3114000
Funds Utilized (Rs): 3039370
(Upto 30th June, 2005)

Objectives:

- Survey and collection of different *Trichogramma* spp. from different ecological zones of Pakistan.
- To document morphological variability in *Trichogramma*.
- To document genetic variability due to DNA
- Electrophoretic studies of *Trichogramma*.
- To prepare taxonomic keys.

Achievements/Progress:

Comprehensive survey for *Trichogramma* was carried out throughout the country and the areas surveyed included Rawalpindi, Haripur, Taxila, Islamabad in foot hills; Abbottabad, Murree, Swat, Kalam, Dir, Chitral, Booni, Kalash, Malakand, Kaghan, Balakot, Mansehra, Gilgit, Butagram, Hunza, Sakardu in northern hills; Gujrat, Gujranwala, Sialkot, Shakar Garh, Narowal, Changa Manga, Lahore, Faisalabad, Mian Wali, Sargodha, Toba Tek Singh, Jhang in northern plains; Quetta, Mastung, Pishin, Ziarat in western hills; Peshawer, Mardan in Peshawer valley; Multan, Bahawalpur, Rahim Yar Khan, Khair Pur, D G Khan, Bhakkar Jacobabad in semideserts; Karachi, Badin, Thatta, Turbat in coastal areas and Hyderabad, Nawab Shah in subcoastal areas.

Lepidoptera are the main hosts of *Trichogramma*, therefore, mainly their eggs were collected, however, eggs of insects other than Lepidoptera were also collected. The plants examined for insects included crops and fodders (maize, sugarcane, rice, cotton, sunflower, sorghum, clover, mustard, alfa alfa, tobacco, gram, dhencha (12)); fruits (apple, walnut, citrus, mango, guava, grapes, litchi, date palm, plum, peach, pomegranate, banana, jujube, locquat, apricot, fig, mulberry (17)); vegetables and melons (cauliflower, cabbage, brinjal, radish, carrot, peas, turnip, tomato, potato, spinach, pumpkin, okra, onion, garlic, chili, cucumber, jinger, coriander, mint, *Citrulus sp*, melons (21 plants)); ornamental plants (rose, jasmine (2)); medicinal plants (castor); weeds (*Withania somnifera*, *Solanum nigrum*, *Heliotropium eutopecum*, *Datura innoxia*, *Coronopus didymus*, *Trianthema portulacastrum* and unknown 3 species (9)) forests (*Dalbergia sissoo*, *Eucalyptus sp*, *Olea cuspidate*, *Ficus religiosa*, *F. bengalensis*, *Milletia ovalifolia*, *Chlorisa insigni*, *Anogeissus acuminata*, *Pongamia glomerata*, *Albizia lebbek*, *Pinus roxburghii*, *Jacquinia cristata*, *Sophra secundiflora*, *Terminalia arjuna*, *T. belerica*, *Mimosops, elengi*, *Pistachia integrima*, *Cedrella toona*" *Cupana blabra*, *Acacia arabica*" *Populus nigra*, *Alestonia scholaris*, and *Cassia fistula*) (23).

From the plants mentioned above about 92,000 eggs of Lepidoptera and other insects were collected. They were kept in laboratory and parasitoids reared from these eggs were preserved as dried specimens as well as in alcohol for onward preparation of slides of genitalia and other body parts for identification. The unidentified immature stages of host insects were also reared to adult stage for identification.

Trichogramma was reared from the host insects including *Pieris brassicae*, *Pieris rapae*, *Helicoverpa armigera*, *Spodoptera litura*, *Euproctis lunata*, *Chilo infuscatellus*, *Chilo parlellus*, *Scirpophaga nivella*, *Mythimna separata*, *Crocidlomia binotalis* and eight unknown species of insects.

Based on morphological studies four species namely *Trichogramma chilonis*, *T. chilotreae*, *T. pintoi* and *T. semblidis* were described and keys for their distinguishing characters were developed. The specimens of undescribed species of *Trichogramma* have been preserved as dried specimens as well as in alcohol and have been deposited in the National Insect Museum for future studies by other authors.

Crossing compatibility was investigated among *Trichogramma* species identified on the basis of morphological characters. These experiments were helpful in providing a test of the value of certain morphological characters for species discrimination. In seven interspecific crosses i.e. *T. pintoi*, *T. semblidis*, and *T. chilotreae*, with code numbers BNI-20, F,12, QT -6 and BNI -19 respectively, no females were produced. This proves that they are distinct. However, in two interspecific crosses involving (female) BNI-19 X BNI-20 (male) and (female) F- 12 X P-12 (male) small numbers of hybrids were produced. The production of small numbers of hybrids in F 1 progeny in these cases does not necessarily indicate conspecificity. It does however, indicate the levels of evolutionary divergence attained by the given species. Inter-specific crosses involving different populations of *T. chilonis* with code numbers B-5,K-17, P-12, P-15, B-7, MG-16, MR-2 showed production of large numbers of females. The female production in each cross was more than 75% of the conspecific crosses. This confirms that they are same species.

Molecular characterization using ITS-2 region of rDNA were made in some cases. Bands of similar molecular weight were obtained during PCR and they show number of base pairs equal to *T. chilonis*. For the analysis of similar band size restriction enzyme analysis was done to further obtain species specific banding pattern. No molecular difference were found by restriction analysis using Mn 11 endonuclease. However, we hope to get these bands by using other enzymes.

The picture of the distribution of different species is gradually emerging. This study has made it evident that more species of *Trichogramma* exist in Pakistan.

Project Title: *To develop drought resistant wheat (Triticum aestivum L.) genotype under water stress condition.*

Principal Investigator: *Mr. Sheikh Muhammad Mujtaba
Principal Scientific Officer,*

Location of Project: *Nuclear Institute for Agriculture, P.O.Box 70060, Tandojam, Sindh.*

*Duration: 36(months)
Start Date: 26/4/2002
Project Status: Completed*

*Total Cost (million): 1.070
Funds Released (Rs): 784000
Funds Utilized (Rs): 683644
(Upto 30th June, 2005)*

Objectives:

- To find out method through suitable field and laboratory screening techniques for identifying drought resistant genotypes.
- To identify the mechanism of adaptation to drought, i.e escape, avoidance and tolerance and the nature of modification (morphological and physiological) induced in plant, to establish effect of drought on different physiological stage.
- To identify the biochemical and physiological change in resistant and susceptible genotypes.

Achievements/Progress:

On the basis of agronomical parameters like plant height, number of spikes, spike length, number of tillers, straw weight, grain weight, leaf area, 1000-grain weight, physiological and biochemical markers like proline, NRA, out of 52 wheat genotypes/ lines 29 wheat genotypes viz Iqbal, V-8001, V-8003, Zardana, V-7004, V-8004, GP-2, GP-7, AGA, Bucs,C-228, C-591, Chakwal-86, CM-24/87, DS-11, H-68, P-15800, PKV-1600, QM-4531, QM-4934, RG-24, SARC-1, V-8319, M-172, HT-37, HT-29, ESW-9525 AND ZA-77 were screened out as drought resistant. These genotypes performed significantly well in water stress condition and reduction as compared to control was 11-20% in all mentioned agronomical parameters.

The wheat germplasm screened as drought resistant will prove fruitful for the growers as they can grow them in drought prone areas of the country. This phenomenon will definitely help in alleviating the poverty of the farmers by brining more and more drought land under cultivation by growing drought resistant wheat genotypes.

Conclusions:

Out of 52 wheat genotypes/ lines, 29 were found drought resistant upto maturity stage.

Project Title: *Propagation of sparsely seeded/ seedless kinnow mandarin using cell and tissue culture techniques.*

Principal Investigator: *Dr. Mrs. Nafees Altaf*
Principal Scientific Officer

Location of Project: *Nuclear Institute for Agriculture and Biology, P.O.Box 128, Faisalabad.*

Duration: 36(months)

Start Date: 4/4/2002

Project Status: Completed

Total Cost (million): 1.328

Funds Released (Rs): 919000

Funds Utilized (Rs): 861798
(Upto 30th June, 2005)

Objectives:

- Screening and selection from natural variability for seed-lessness using fruit marker from various orchards of Punjab.
- Clone propagation of selected fruits for seedlessness.

Achievements/Progress:

Citrus is major fruit of Pakistan, which covers 194234 hectares with 1830276 tonnes production. In Punjab Kinnow production is 1079270 tonnes in 105407 hectares. An export of 41 million \$ is made with Kinnow mandarin. It is important for Citrus industry to have superior cultivars adaptable to different climate and soil conditions, which should increasingly meet the demands of international market.

The merits of Kinnow tree are its vigorous growth, high yield potential, large and attractive fruit size, good blend of sugars and acids, deep orange colour, adaptation of Kinnow with soil and climatic conditions of Punjab. Demerits are alternate bearing, seedliness, limonin contents in juice, acidity, fruit and leaf abscission, and low shelf life. Kinnow mandarin has extreme variabilities because of its hybrid nature. It reverts to precursor form via chance genetic combinations or normal polyembryogenic genetic variation. Somatic mutations and large scale propagations mostly without proper budwood selections is also important in creating variability in Kinnow mandarin. Variability in fruit characteristics itself has a negative economic impact.

Genetic improvement within Kinnow cultivar is by selection and vegetative multiplication of natural mutant branches. Importance of nucellar embryony for isolation of somatic cell lines having desirable fruit characteristics cannot be ignored. Low seeded/seedless Kinnow fruits were screened on the basis of styler ring and narrow new emerging leaves of the sprouts and shoots. The natural change of narrowness of new emerging leaves is linked to low ovule viability. Variability in seed number per Kinnow fruit was 0 – 52. We found 0 – 3, 2 – 6 developed seeded fruit branches. The seedless trait was 0 – 6 and the most common was 14 – 32 in seedy background. The developed seeds were of different shapes and sizes. Fruits also have variable characteristics in size, colour, shapes, peel thickness with its tightness or loose nature, aroma, acidity, sweetness, juice contents etc. The seedless trait was also found in normal fruits. Parthenocarpy is absent in Kinnow mandarin, although in 0.4% selected marker fruits, ovules aborted at the stage that it was difficult to recognize between juice vesicle and ovule. It was observed that narrow new emerging leaves of embryos have similarity to new emerging leaves of

the branch from where the low seeded fruits were harvested. Narrow embryonic leaves are related to over 20 seed shapes and in small seed size. However the intensity of leaf narrowness varied in different seeds.

Fruit and leaf drop have same genetic mechanisms. The sprout grafts helped screening against abscission. If the branch has fruit drop tendency, its leaves and petioles fell within 72 – 75 hours under graft stress. The detachment of leaves and petioles is from abscission zones. The stem regenerate new leaves after 2–3 months of graft union with rootstock. Such grafts were eliminated because they have leaf fall tendency in harsh weather conditions. The dropped fruits had 13% embryos without root system, which upon grafting had 100% plants with leaf abscission trait without any stress conditions. This indicated that the trait is of genetic origin as the embryos are derived from cell lines present in the vegetative parts. The plants selected on the basis of leaf retention had no fruit drop in harsh hot temperatures of field. This study will be continued till fruit physiological maturity time of all strains to find out the clone with best retention. Because of retention character, we never used chemical sprays on these plants.

We continuously observed that plants with dominant characteristics of cultivar willow leaf cannot survive hot temperatures (above 40°C). Only 0.5% of these plants had heat tolerance. While a higher proportion of plants (80%) with dominant characteristics of cultivar king can survive harsh hot field temperatures. The embryogenic plants have extreme low frequency (0.05%) of heat tolerance. They are sensitive to summer heat even if the plants were transferred to field at the age of 2 years.

Seedlessness is because of pollen self incompatibility, weak parthenocarpy, defective ovules and embryo abortion. Monoembryonic pollen self-incompatible clones have seedless potential if the potted plants were kept isolated from other pollen sources and bees. The polyembryonic clones have tendency of apomictic seed formation. However, these strains were low seeded if ovule sterility is high. Seed formation in pollen self-incompatible clones is because of type of Citrus pollinator in mixed plantings and the bee population around at flowering time because if we took the Kinnow material for grafting from any orchard and if it has ovule fertility, the developed plant in NIAB orchard has different seed number as compared to its parent orchard, depending upon the compatibility of the available pollen in the two orchards.

We developed plants through natural existing variability, somaclonal variation, polyploidy and induced variability created by chemical mutagen and radiation of fruit before nucellar embryogenesis and budwood. More than half of our plants are still in vegetative phase. In 2005, we had fruiting in 600 plants. Nearly 200 plants have 0 – 6 seeds per fruit. Early maturity, low acidic strains will be selected for commercialization. The commercial plantings will be isolated from other Citrus pollen sources as these are autosterile. Kinnow farmers will enjoy new cultivars having retention, heat tolerance, low seeded and low acidic with different fruit physiological maturity times.

Conclusions:

- Kinnow cultivar is highly variable, with 0-52 seeds per fruit.
- The parental characters segregate in Kinnow population.
- Clones having seedless trait have different vegetative characteristics.
- Seedless trait can be cloned into plant by sprout/shoot apex/embryo grafts.

- The seedless trait is highly associated with fruit abscission since fruit and leaf drop have same genetic mechanism. The final selections were made on the basis of leaf retention under graft stress.
- The clones retained stability of selected seedless trait.
- The use of undeveloped ovules with optimum culture conditions can avoid loss of potentially valuable genes because high or complete degeneration of ovules occur in seedless mutants despite selection of healthy ovules for culture.
- Spontaneous triploid and tetraploid plants were obtained from invitro culture of ovules.
- A unique seedless plant was obtained from nucellus callus embryogenesis.
- The monoembryonic clone have seedless potential while polyembryonic clone have low seeded trait. Two clones have different fruit shapes.
- Pollen self incompatibility, monoembryony, defective ovules and embryo abortion are responsible for seedless trait.
- Reversion of delayed style abscission to normal abscission by invigourization of plant was made.

Project Title: *Adaptation & commercialization of throw-in-type rice thresher.*

Principal Investigator: *Mr. Abdul Waheed Zafar*
Principal Engineer

Location of Project: *Farm Machinery Institute, NARC, Islamabad.*

Duration: 36(months)

Start Date: 29/3/2002

Project Status: Completed

Total Cost (million): 2.332

Funds Released (Rs): 2291000

Funds Utilized (Rs): 1766150
(Upto 30th June, 2005)

Objectives:

- To test the throw-in-type rice thresher to evaluate its field performance in the local conditions on local varieties.
- To identify the modifications and further improvements needed for local adaptation of thresher based on test results.
- To incorporate the modifications in the thresher by involving a local manufacturer.
- To commercialize the throw-in-type rice technical assistance to local manufacturers and demonstration of machine in the rice growing area.

Achievements/Progress:

- Technical assistance has been provided to collaborating manufacturers as per agreement. As a result about 450 units of thresher have been manufactured and purchased by the farmers.
- The services have been provided for pre-delivery inspection of locally manufactured units at the premises of the manufacturers. The threshers manufactured by our collaborating manufacturers were visited at the farmer's field during operation to study the problems being encountered by the users. The manufacturer were given the feed back of the field visit and the problems observed were get solved by making necessary improvements in the machines.
- More than 500 threshers have been operated at the farmer's field in Sindh and Balochistan during this season. Almost every thresher has threshed more than 1000 tons of paddy and recovered double of its cost during the one season.
- More than 20% of paddy crop has been threshed mechanically in both the provinces which have saved 40,000 tons of grains which were lost in traditional system.
- The milling quality of mechanically threshed rice is much superior to conventionally threshed rice, therefore farmers have got higher price of their output which increased the profitability of farm.
- Rice thresher was tested at local Basmati varieties at RRI, Kala Shah Kaku as well as at farmer's fields to assess its suitability for long stature crop. The thresher performance was found satisfactory on these varieties when the crop moisture was below 16%.
- Field demonstrations of thresher were arranged in Rice growing areas of Punjab (Gujranwala, Sheikhpura and Sialkot) for popularization of technology among the end users. The small scale paddy growers particularly, who have no access to combine harvesters took keen interest in its adoption.
- A field survey has been conducted at the end of paddy threshing season to study the net economic benefit of thresher to the farmers.

Project Title: *Development and commercialization of mobile seed processing unit.*

Principal Investigator: *Dr. Tanveer Ahmad*
Senior Engineer

Location of Project: *Farm Machinery Institute, NARC, Islamabad.*

Duration: 36(months)

Start Date: 29/3/2002

Project Status: On-going

Total Cost (million): 2.679

Funds Released (Rs): 1980000

Funds Utilized (Rs): 1525423
(Upto 30th June, 2005)

Objectives:

- To adapt mobile seed processing unit.
- To test and evaluate the performance of mobile seed processing unit.
- To demonstrate mobile seed processing unit to end-users.

Achievements/Progress:

A seed processor has been designed and developed by FMI under ALP funding. The machine was tested on wheat, paddy, mung and grams. It has 2 tons/hour capacity for paddy seed cleaning and grading. The cleaning efficiency of the FMI seed processor is 97%. If 100 machines are adopted 630 tones extra, wheat will be produced by using quality seed processed by FMI Seed Processor.

Organized a one day seminar on processing machinery on April 13, 2005 at NARC. At Badaruddin Soomro, Chairman PARC was the Chief Guest at the occasion. The key speakers included Dr. Akhlaq Hussain, Director General, Federal Seed Certification and Registration Department, Islamabad; Dr. Rafiq-ur-Rehman, Director General Agriculture (filed), Punjab, Lahore' and Dr. Tanveer Ahmad, SE, FMI. Representatives of seed companies, progressive farmers, multinational seed companies, manufacturers, line departments and other stakeholders attended the seminar. Chairman, PARC, Dr. Badaruddin Soomro, inaugurated a Mobile Seed Processor on April 13, 2005 at NARC.

Benefits:

The FMI seed processor removes inert material, weeds, broken grains and shriveled grains from healthy grains. It also grades seeds into three components: healthy seeds, light seeds, broken and shriveled seeds. It has a seed processing capacity of 2 tons/hr for wheat and 1 ton/hr for paddy. Saving/ machine as compared to conventional methods is Rs. 1.5 million/annum and saving for 100 machines adopted will be Rs. 150 million/annum. Expected yield increase for wheat will be 630 thousand tons/annum and expected yield increase for rice will be 290 thousand tons for 100 machines. Employment for 300 unskilled laborers and 50 skilled machines will be generated.

Project Title: *Studies on viral diseases of major pulses crops and identification of resistant sources.*

Principal Investigator: *Dr. Muhammad Bashir*
Principal Scientific Officer

Location of Project: *Pulses Program, Crop Sciences Institute, NARC, Islamabad.*

Duration: 36(months)
Start Date: 22/3/2002
Project Status: Completed

Total Cost (million): 2.701
Funds Released (Rs): 2527000
Funds Utilized (Rs): 2408079
(Upto 30th June, 2005)

Objectives:

- Conduct survey in pulses growing areas of Pakistan to assess viral disease incidence, distribution and crop losses in major pulse crops such as chickpea, lentil, mungbean and mashbean (urdbean).
- Evaluation of lentil, mung and mash germplasm under greenhouse and field conditions to identify sources of resistance against PSbMY, MYMV and ULCV for including in breeding program to develop disease resistant varieties.
- Development of integrated disease management strategies against, MYMV, ULCV, PSbMY involving host resistance, healthy seed, vector management and cultural practices.

Achievements/Progress:

Two hundred and fifty four mungbean germplasm and breeding lines were evaluated under field conditions at five locations in the country for viral diseases resistance. Sixty- eight and 103 lines were found as highly resistant and resistant to MYMV and ULCV respectively under high disease pressure. Twenty lines were moderately resistant to MYMV.

Fifty-three germplasm and breeding lines of urdbean were evaluated at five locations for virus resistance. Twenty-one and 30 lines were found resistant to MYMV and ULCV respectively. Six lines were highly resistant to ULCV at Sargodha. Eighteen 13 and 4 lines were resistant to MYMV at Chakwal, Sargodha and Bhakkar respectively.

Two hundred and four lentil germplasm lines were evaluated at five locations to identify resistant sources to viral diseases. Only three lines; 02KL-304, 02KL-305 and 2575 x 8008/1 were found highly resistant to viral infection under field conditions.

One hundred eighty two lines of chickpea were evaluated at five different locations for resistance to viral diseases. Forty eight, 43, 10, 5 and 27 lines were found resistant to virus infection at NARC, Islamabad BARI-Chakwal, AARI-Faisalabad, AZRI- Bhakkar and Kot Naina, Narowal respectively.

Thirty-four mungbean lines were screened by sap inoculation method against two viral diseases such as CABMV and BYMV. Eleven and eight genotypes were found resistant to BYMV and CABMV respectively. Three genotypes; NIFA-6, NIFA-7 and NIAB-18 were found with multiple resistance (resistant to both viruses).

Twenty genotypes of mungbean and urdbean were evaluated against seed transmission. Of ULCV. Two mash advanced lines; Mash-95017 and Mash-95009 were found resistant to seed transmission of ULCV.

Five different types of field trials were conducted at NARC, Islamabad for the control of MYMV and ULCV. In one trial, the effect of different sowing dates was studied on the incidence of MYMV and ULCV in mungbean and urdbean. The sowing dates effect was significant on the yield and whitefly population. However, the effect was non-significant on the reduction of MYMV and ULCV incidence. The maximum grain yield (723 gms/plot) was obtained with mungbean when planted on 20th June, 2004, whereas minimum yield (214 gms/plot) was obtained with late planting i.e. 10th August, 2004.

In case of row spacing trial, the effect of different row spacing (narrow-20 cm to wide 75 cm) was studied on the incidence of MYMV in mungbean crop. There was no significant effect on the reduction of virus disease severity among all the treatments. Similar trend was observed in yield. However, there was significant effect on the whitefly population. Maximum number (18.4 whitefly/plot) of whitefly was recorded in case of 20 cm row spacing while it was minimum (6.2 whitefly/plot) with 60 cm row spacing.

In another field trial, the effect of Rhizobium inoculation and nitrogen fertilizer (urea) application was studied on the incidence of MYMV and ULCV. All the treatments have significant effect on the number of nodules/plant, grain yield per plot as well as reduction of virus disease incidence when compared with control. Rhizobium inoculation with 20 kg urea/acre proved best treatment in increasing grain yield of mash crop (943.6 gms/plot) with lowest disease infection. Whereas the grain yield was 654.9 gms/plot in case of control plots.

In order to control MYMV in mungbean crop, a trial was conducted under field conditions at NARC. The efficacy of insecticides (Karate, granular furadon), neem extract and neem seed powder, and mineral oil were applied for the control of these two diseases and to see the effect on whitefly population. All the treatments have significant effect in the reduction of disease severity, increasing grain yield and whitefly population when compared with control. But among the treatments the effect was non-significant. Maximum grain yield (1097 gms/plot) was obtained with insecticide application (Karate) whereas the grain yield in control plot of mung bean crop was 627 gms/plot. In another field trial, the effect of MYMV was studied on yield and yield contributing factors in mungbean and mash crops. In case of mungbean, the yield loss was 63.3%, 29.5%, and 15.4% with early, mid and late infection of MYMV respectively. Similarly, the effect of MYMV was significant on the reduction of plant height (25.3%), number of seeds/pod (7.5%), number of pods/plant (13.4%) and pod length (15.6%). The same trend was observed in mash crop. However, the yield loss in case of mash was less as compared to mungbean and it was 38.5%, 25.1% and 16.3% respectively with early, mid and late infection.

Molecular characterization of MYMV isolates from mungbean plants was completed and reported for first time in Pakistan. Full length DNA A and DNA B, movement protein (MP) gene, and nuclear shuttle protein (NSP) gene were amplified through PCR and after purification cloned in TA cloning vector pTZ57R. Southern Hybridization using radioactive labeled probe of NSP of MYMV revealed the presence of MYMV in 30 mungbean samples out of 32 probed. Restriction with Bam HI, Hin dIII and ZbaI resulted in release of fragments of appropriate size, confirming the presence of these sites in insert. This showed similarity of MYMV prevalent in

Pakistan with of Indian MYMV. On the basis of PCR analysis, it was proved that MYMV also infects cowpea and some other legumes in Pakistan.

Extensive surveys of mungbean, mash, lentil and chickpea crops were conducted to assess the significance of viral diseases. Based on the visual observations and ELISA results of the samples, It is concluded that MYMV and ULCV are two important viruses in mungbean and mash crops. PSbMV and CMV are important in lentil. CCDV and CMV are important in chickpea. At present viral diseases are not serious in chickpea. The situation is serious in mungbean, mash and lentil crops. Sources of resistance in local germplasm are available to be included in breeding program to develop virus resistant legume cultivars.

Project Title: *Management of parasitic weeds in rapeseed and mustard and legume crops in NWFP.*

Principal Investigator: *Dr. Khan Bahadar Marwat*
Chairman

Location of Project: *Department of Weed Science, NWFP Agriculture University, Peshawar.*

Duration: 36(months)
Start Date: 23/3/2002
Project Status: Completed

Total Cost (million): 1.753
Funds Released (Rs): 1730531
Funds Utilized (Rs): 1403004
(Upto 30th June, 2005)

Objectives:

- To generate the parasitic weed management technology and integrate it with the existing indigenous knowledge of the farmers to form an Integrated Weed Management package for parasitic weeds.
- To quantify the losses caused by parasitic weeds.
- To document the parasitic weeds associated with the major crops of NWFP.
- To transfer the generated technology to the end users.

Achievements/Progress:

The term parasitic species refers to those species that derive their food totally or partially from other plants, thus out-competing them. According to Gause's competitive exclusion principle, the two species occupying the same niche cannot survive simultaneously for ever. The more aggressive one thrives and the poor competitor vanishes. Therefore, parasitic plants must be separated from the same niche including the main crop plants. The most aggressive and serious parasitic weed is Orobanche, the broomrape in the studied area. The broomrape family comprises of 17 genera & 150 species. The genus Orobanche contains about 60 species of unbranched parasitic herbs without chlorophyll. The broomrapes are variable in color. Ranging from yellowish brown and reddish violet to blue and orange.

The parasitic broomrapes live directly on their hosts by attaching strong haustoria to their roots, penetrating the tissues, and absorbing the food gathered by the host plants for their own development. Upon germination, broomrape seed develops a small radical which penetrates a fine rootlet of the host and becomes firmly connected with it. For germination, broomrape seed requires exposure to biochemical exudates produced by the root of the host plant. Orobanche species grow chemotropically towards host plant's roots. As there is lack of information regarding study of parasitic weeds in NWFP, therefore the survey was conducted in District Swat (Malakand Division) where parasitic weeds and specially Orobanche is a serious problem in different crops. The objective of the survey was specifically to know the spread and impact of the parasitic and general weeds on agricultural crops i.e. rapeseed, onion, shaftal (trifolium) and chickpea crops in the project area

A survey was conducted during June 2004, to record the losses due to Orobanche in rapeseed in District Swat, Malakand Division. A total of 100 farmers from 5 villages were randomly selected and interviewed, using a specific format of a questionnaire. Seventeen weeds were reported as problem weeds in the region. According to the survey report these weeds cause 20-30 % losses

in rapeseed production. Overall, 51 % of the farmers regarded weeds as the most important constraint related to rapeseed production. Almost, none of the farmers use herbicides while 35% reported mechanical weed control. While 65% of the farmers, do not control weeds. 45% of the farmers interviewed considered that weeds infestation increased over the last ten years. The yield reported ranged from 650-950 kg acre⁻¹. Among these weeds, Orobanche was recorded as a serious weed in rapeseed and tobacco, causing upto 50% losses.

Project Title: *Investigation of mechanism for seed dormancy in rice based cropping system.*

Principal Investigator: *Dr. Gul Hassan*
Asstt. Professor

Location of Project: *Department of Weed Science, NWFP Agriculture University, Peshawar*

Duration: 36(months)
Start Date: 22/3/2002
Project Status: Completed

Total Cost (million): 0.400
Funds Released (Rs): 405000
Funds Utilized (Rs): 402921
(Upto 30th June, 2005)

Objectives:

- To study the dynamics of weed seeds in seed bank of different ecological zones in the rice based cropping system.
- To figure out the dormancy patterns of different weed species in rice involving cropping system.
- To investigate the probable causes of dormancy among different species in the referred cropping system.
- To suggest possible measure(s) to break the dormancy before planting of Rabi crops, as the weed management tactics.

Achievements/Progress:

Rice-based cropping system is feeding millions in Asia including Pakistan. Rice- wheat cropping system envisages an area of 1.6 million ha in Pakistan. The declining trend in productivity has alarmed the planners to address the situation. The factors responsible for the dwindling production include differential weed infestation under the rice based system. Dormancy among weeds is responsible for the success of some species under the system.

To understand the dormancy mechanism under the rice based system, investigations were initiated from April 1, I2002 and continued upto June 30, 2005. During the investigations, the focus was maintained on finding the probable cause of dormancy, let the weeds asleep while planting or to contain the adverse effect of weeds through effective and judicious management. With the inception of the project, soil samples were collected from the rice growing areas of Dera Ismail Khan, NWFP and Sheikhpura, Punjab to test the weed dynamics in the soil seed bank. The studies on soil collected from 0-30 cm depth from the said rice-based areas showed different germination in soils collected from different locations and depths. The highest weed seed activity was recorded from 0-10 cm soils depth. Grasses dominated the rice based area of Dera Ismail Khan, while broad leaves were predominant in Sheikhpura soils. Moreover, seeds of the prevailing major weeds of wheat viz. field bindweed (Lehli), wild oats Uangli jai), little seed canary grass (dumbi siti), meadow peavine Uangli mattar), curly dock Uangli palak) and fumitory (shahtra) were collected from the wheat fields in rice growing areas of Dera Ismail Khan, Faisalabad and Sheikhpura during the month of late April and early May, 2002. The seeds were tested for their germination pattern in petri dishes.

The germination pattern is quite different in different weed species. A single seed of curly dock Uangli palak) and fumitory (shahtra) could not be germinated in any of the several runs of lab.

Experiments. The germination of some species was favored by the comparatively higher temperatures like field bindweed while, the germination in some other species like wild oats was favored by low temperatures. The investigations on weed seed dormancy under the controlled environment were initiated with the use of dormancy breaking chemicals and exposure to different temperature regimes. The investigations on the mechanism of weed seed dormancy revealed that the chemicals like GA₃ and KNO₃ can break the dormancy in the studied weed seeds of wild oats and curly dock (Uangli palak) under the laboratory conditions. The lower temperature was instrumental in promoting germination of both wild oats and curly dock. To devise the farmer friendly and weed management effective technology, experiments on chemical control of weeds each on wheat and gram under the zero and conventional tillage were undertaken at Agricultural Research Institute, Dera Ismail Khan.

The two year data exhibited the merit of zero tillage as economically viable in planting wheat and gram and effective in reducing the weed population. Investigations on allelopathic potential of some weedy and tree species exhibited the potential of Ammi visnaga and field bindweed in reducing weed population with a consequent increase in wheat grain yield. A Lab. experiment on tree extracts exhibited the potential of Acacia and Prosopis in inhibiting weeds, but lower or no effect on wheat. For containing weeds in wheat, different herbicides and their combinations were investigated. It was evidenced that maximum grain yielded was recorded in the Puma super+ Buctril-M (3194 kg ha⁻¹) mixture followed by Topik +Buctril-M (3074 kg ha⁻¹) treated plots. While, the minimum grain yield (614 kg ha⁻¹) was recorded in weedy check plots. The herbicide mixtures of Topik and Puma super with 2,4-D, however exhibited an antagonistic response, hence such mixtures are avoided to be used in weed management in wheat. Student involvement in the project was the prime consideration since the inception of the project. Students were thoroughly involved in research, data recording, data analyses and interpretation and research paper compilation. The students were also involved in the presentation of experimental results in conferences. Papers were presented in the First International Weed Science Conference 2003, 6th National Weed Science Conference March 2005 and the First Kashmir Conference September 2005.

Project Title: *Survey and integrated pest management of cotton insect pests in Balochistan.*

Principal Investigator: *Mr. Muhammad Karim Shawani*
Entomologist

Location of Project: *Agriculture Research Institute Sariat, Quetta.*

Duration: 36(months)
Start Date: 1/3/2003
Project Status: On-going

Total Cost (million): 1.200
Funds Released (Rs): 883000
Funds Utilized (Rs): 822077
(Upto 30th June, 2005)

Objectives:

- Survey, collection and identification of cotton insect pests and their natural enemies.
- To evaluate different varieties of cotton for the insect pests and diseases resistance and their suitability for specific area in the Balochistan.
- To study the biology and population dynamic of bollworms i.e. spotted bollworm and American bollworm. These two insects have been recorded in preliminary survey.
- To find out the most effective insecticide and best time of application of insecticides against different insect pests of cotton.
- Training of farmers, publication of booklets and leaflets for the dissemination of IPM technology development under this research project.

Achievements/Progress:

The Entomology Section, ARI Sariat- Quetta under the Agriculture Linkages program (ALP) for Balochistan initiated a pest Management program of cotton insect pests from the season 2003. The results of first year were presented in 1st annual report. The survey was continue in second year to confirm the insect pests and diseases present in the area last year, it was necessary to get basic information, then the survey was started from genllination of crop till the end of November, 2004. In pests thrips, white flies, aphids, Jassids Mites and in bollworm spotted bollworm and in the end of the season in some areas Haliiothis were recorded.

Many varieties for tolerance of insect pests at different cotton growing areas were tested. All varieties were equally performed against insect but no high infestation was recorded for any pest on any of the tested variety. Apart from these experiments, few commonly used insecticides were also evaluated for their effectiveness against sucking pests, All pesticides gave better results an other set of insecticides were also tested for their efficacy against bollwonlls specially against spotted bollworm, which gave good control as compared to control plots.

Project Title: *Collection, conservation, evaluation and documentation of horticultural crop germplasm and its wild relatives.*

Principal Investigator: *Dr. Rashid Anwar*
Director/ CSO

Location of Project: *Institute of Agri. Biotechnology and Genetic Resources, NARC, Islamabad.*

Duration: 36(months)

Start Date: 18/7/2002

Project Status: On-going

Total Cost (million): 3.000

Funds Released (Rs): 1966310

Funds Utilized (Rs): 1652556
(Upto 30th June, 2005)

Objectives:

- Survey and collection of Vitis and its related species germplasm
- Establishment of field genebank at NARC, Islamabad.
- Evaluation of germplasm in collaboration with respective horticultural/agronomists.
- Documentation of genetic resources information and its circulation to horticulturists in the country.

Achievements/Progress:

Sixty four samples of different grape species were collected from Balochistan areas during 2004-05. The area covered includes: Loralai, Ziarat, Mustung, Khad Koocha, Alooh, Khateeg Dori, Kuchlak, Mukki, Mughtian, Nilai Pishin, Khanozai, Killa Saifullah, Ismail Abad, Zoab, Quetta and Kan Meher Zai.

Different areas of these districts were explored including orchards, farmers' houses, farmers fields and road sides. About four/ five cutting from each plant were taken as bud wood. Each bud wood was labeled with collection number. All bud wood were packed in a polythene bags to avoid desiccation. All cutting were brought back to Islamabad and planted in pots for further transplantation in the field in the forth coming monsoon season properly maintained in field.

The collection expedition was arranged from 19 to 28th February, 2005 i.e. during the dormant season. Cuttings were brought to PGRP, NARC where these were planted in a pots with 3 to 4 cuttings for callusing and rooting. As it was not a right time to transplant the sprouted cuttings therefore it was decided to shift the plant in the field during monsoon, 2005. Plantation was carried out according to the recommended plant to plant (8 Ft.) and row to row distance (11 ft.) The bamboo sticks were inserted into the soil along each plant for stacking. All other cultural practices continued throughout the year and 'Grapes Clonal Repository' was established and maintained. The last year collection as well as current year collection planted in pots were preliminary characterized and data was recorded at young stage for different characters such as Form of tip, Shoot attitude, Color of leaf, Size of blade, Shape of blade, Number of lobes, Shape of teeth, Length of teeth, Length of petiole and Length of internodes.

Project Title: *In vitro conservation and cryopreservation of plant germplasm of vegetatively propagated crops.*

Principal Investigator: *Dr. Mustafa Sajid*
Senior Scientific Officer

Location of Project: *Plant Genetic Resources Institute (PGRI), NARC, Islamabad.*

Duration: 36(months)
Start Date: 15/5/2002
Project Status: On-going

Total Cost (million): 2.100
Funds Released (Rs): 1214000
Funds Utilized (Rs): 1208077
(Upto 30th June, 2005)

Objectives:

- Acquisition of germplasm cuttings, buds and meristematic tissues of proposed species for in vitro preservation.
- Establishment of rooted cuttings in the green house to serve as the explants source
- Evaluation of hormonal regimes for successful culture establishment and their effect on growth parameters.
- Cry preservation of in vitro propagules of horticultural plant species cultured deterioration and mortality.
- Establishment of rooted cultures in the soil in green house and field conditions under protected cultivation.

Achievements/Progress:

- Plant germplasm biodiversity is a valuable raw material which has been exploited by plant breeders and geneticists in their research and development activities for varietal improvement. Germplasm biodiversity has played a pivotal role in addressing food security and poverty reduction issues and meeting the food requirement of the world's ever increasing population. However, urbanization, desertification and industrialization activities have depleted the crop biodiversity and many valuable species have already become extinct and will never be available to be used in crop improvement activities. Thus, biodiversity needs to be conserved at all costs to avoid further depletion of genetic resources.
- The technologies for conservation of seeded plant species are relatively straight forward as the seeds are more suited for storage over longer period of time particularly at lower temperatures and reduced humidity levels. On the other hand, vegetatively propagated plant species which either do not possess seeds or whose seeds are not used for raising crops due to genetic heterogeneity, can be conserved by using in vitro technology in combination with other methodologies such as field gene bank establishment. A systematic approach to germplasm conservation must be based on collection of plant germplasm from diverse ecologies, storage of germplasm and revival studies after removal from the storage treatments. Germplasm collection, storage and data on such studies will bear long term and term benefits in plant research system of the country.
- Germplasm collection activity continued in the 3rd year of the project as per original plan of work. Grape germplasm was collected from different areas of Baluchistan and rooted for subsequent transplantation in the field conditions to strengthen the field clonal repository at

the PGRP premises. This repository is being used for consistent retrieval of explants from the field grown plants to be disinfected using mercuric chloride for different durations of time before they were inoculated onto the defined media for ensuring the successful establishment of in vitro cultures. Expansion of range of accessions of in vitro cultures was attempted during this year along with the studies on growth responses of diverse accessions to a multitude of plant growth media containing plant growth regulators and other metabolites for either growth promotion or growth reduction targets.

- In one of the experiments, more than a dozen accessions were studied for in vitro culture establishment. Buds were excised from the field grown plants and treated with 0.05% mercuric chloride for either 1, 2, 3 or 4 minutes and effect of duration of these treatments were studied on the culture viability, contamination, mortality and shoot mass accumulation parameters. It was observed that duration of treatment was critical for successful culture establishment and it was also dependent on the accession or genotype as well. As a result of these experiments, all the accession tested for successfully established in vitro and degree of success varied from accession to accession.
- In another set of experiments, the cultures obtained from the other experiments, were subjected to a number of treatments involving kinds and levels of plant growth hormones. In particular, BAP, Adenine sulfate, kinetin, IAA, IBA" NAA were employed. The growth response was measured in terms of shoot mass, number, nodes, root mass and number. The data indicated that the response of cultures to different plant hormonal regimes was genotype specific. These findings are significant in providing the best possible conditions for optimal performance of the accessions in question. It was also possible as a result of these experiments to induce rooting in the cultures and to obtain multiple cultures for maximizing the growth potential of the cultures.
- In one of the experiments, the cultures harvested from the fore-mentioned experiments after data recording, were grown on media containing a range of sorbitol and mannitol to determine the levels of these osmotica required for growth reduction. The growth response was found to be dependent on the nature of the osmotica, its concentration and the accession. These studies have importance in the fact that the plants can be stored for relatively longer durations of time without the need to repeatedly sub culturing them to save resources and labor.
- In yet another set of experiments, buds were excised from the shoot apices of the cultures and subjected to cryopreservation as per approved plan of work for the 3rd year of the project. The buds were first grown on defined media and then treated with a solution to bring about reduction of water content of the buds to protect them against losses form freezing process in the sequence of events which follow. The buds were plunged in liquid nitrogen (minus 196C). The buds were then stored for a given length of time and then thawed and cultured on defined media for determining the viability of cultures as against the harsh treatment of cryopreservation. The viability and sensitivity varied from genotype to genotype and the average survival rate was 20%. Cryopreservation is recommended for long term storage of cultures and has a great potential for economic and labour saving and technologically and capital intensive means of germplasm storage. The germplasm which was planted about 2 years before have started bearing fruit in the current year and data is being recorded on fruit yield and quality. Some of the exotic accessions acquired from Japan appear to have promising characters for field evaluation and future recommendations.

Project Title: *Acquisition screening and utilization of peas germplasm for development of superior cultivars.*

Principal Investigator: *Dr. Abdul Ghafoor*
Senior Scientific Officer

Location of Project: *Plant Genetic Resources Institute (PGRI), NARC, Islamabad.*

Duration: 36(months)

Start Date: 15/5/2002

Project Status: On-going

Total Cost (million): 2.100

Funds Released (Rs): 1269000

Funds Utilized (Rs): 952252

(Upto 30th June, 2005)

Objectives:

- To identify /produce base material with high yield potential and disease tolerance, i.e powdery mildew and blight.
- Collection and assessment of genetic bio-diversity based on characterization, evaluation and biochemical markers.
- Screening of pea germplasm for powdery mildew and blight to identify resistant sources.
- To identify linkage between qualitative/biochemical markers and quantitative traits for future utilization by the breeders.

Achievements/Progress:

The project aims to identify base material of peas with high yield potential and disease tolerance, i.e., powdery mildew along with collection and acquisition of peas germplasm from Pakistan and abroad. Since the start of project, first priority was given to collection and acquisition of peas germplasm from Pakistan and abroad. Initially gene bank of Plant Genetic Resources Program maintained 102 accessions of pea and out of these 88 were viable. During first year 102 accessions of diverse origin were introduced from ICARDA Genetic Resources Unit. These accessions along with local germplasm were evaluated for plant and agronomic traits.

Similarly ninety-nine accessions were acquired from Genetic Resources Unit, Netherlands which were collected from 40 countries. During 2004, one hundred and forty accessions from Genetic resources Unit, Netherlands and 29 from Nordic gene bank were acquired. In order to collect local germplasm from Pakistan, exploration missions were conducted in Punjab, NWFP and AIK. In total 71 accessions were collected, 61 from Punjab, 20 from NWFP, 2 from AJK, 2 from Sindh, 3 from Northern Areas and 3 from Baluchistan.

Genetic diversity of 241 genotypes of Pea (*Pisum sativum* L.) investigated at phenotypic level for 33 traits and SDS-P AGE markers. Genetic diversity revealed by qualitative, quantitative and molecular traits suggest that variations can be used further for producing high yielding cultivars. Five genotypes 10473, 10603, 10607, 10644 and 11114 displayed high grain yield and these are suggested to be tested under a wide range of agro-ecological conditions to exploit in breeding high yielding cultivars in pea. Sixty five accessions have also been analyzed for protein, fat, ash, fiber and carbohydrates, and protein varied from 19.22 % (DMR 4) to 25.98 % (16724). Three accessions (16718, 16719, 16724) produced high protein contents and are suggested to use in the breeding program for improving yield potential and protein.

During first year, 3 cultivars (DMR-4, DMR-7, DMR-20) of Indian origin were observed tolerant to powdery mildew, during second year in addition to these new source of resistance (10599,3279 and 3196) were identified against powdery mildew for further utilization. On the basis of combine results of three years, twenty four genotypes (3313, PS610152, PS010128, PS810240, Shawnee, Fallon, PS810765, PS9910188, PS99102238, 3104, 3270, 3271, 3284, 3318,3326, 10599, 10603, 10607, 10610, 16720, DASAN, DMR-20, DMR-4, DMR-7) were observed tolerant to powdery mildew and are suggested to use for their yield potential.

Although peas are not consumed as dry seed at present in the country, but due to identified accessions for dry seeds, this crop could also be tested for the production of dry pea as used in many Western and Mediterranean countries. This will increase total production of vegetable protein. *Pisum sativum* germplasm collected from Pakistan was evaluated for agronomic traits and analyzed for biodiversity within each district. The differences proved its validity in substantiating the postulated regions of diversity or gene centers. Migration of landraces into new regions, followed by some degree of contamination by mixture or out crossing with other landraces were observed that might be due -to frequent exchange of germplasm or transportation of grains from one place to others. The areas with a high level of stress is expected to present tolerance to environment~ stresses, but homogeneous mixtures that needs less extensive sampling for genetic resources conservation purposes. The study confirmed the existence of a wealth of phenotypic divergence in the local pea germplasm and identified pure-lines are suggested to be utilized in crop improvement through simple ~election or using in hybrid program. The variation appears attributable to different districts without influence that how frequently area was explored. Further collecting missions to main pea areas with greater diversity could concentrate efforts on sampling as many geographically and ecologically distinct areas as possible, rather than collecting extensively from fields close to motorable roads. The germplasm with high mean values along with medium to high genetic variance should be exploited through simple selection.

To estimate diversity at molecular level SDS-P AGE technique was used. SDS- PAGE results showed comparatively significant variations in major bands, although significant variations in minor bands were there. Variations were there in density of some common bands.

The electrophoretic banding profile of seed proteins provides a powerful tool for estimating diversity existing in the genotypes. Moreover, this technique is hardly affected by experimental conditions. Genetic diversity revealed by qualitative, quantitative and molecular traits suggest that the significant variations were there in the genotypes. These variations can be used further for producing high yielding hybrids. Moreover, they are helpful in maintaining gene pool of a particular species and desirable traits. Breeding program primarily depends upon genetically diverse genotypes with high yield potential.

Pea an important grain legume crop, suffers significant yield and quality losses because of infections by the parasitic fungus *Erysiphe pisi* Syd., the causal agent of powdery mildew. Fallon, PS99102235, Ps0010128 and PS610152 were selected as resistance accessions, while Shawnee, Lifter, Franklin, PS819240, PS710048, PS610324, PS810191, 3273, 3212, and PS9910188 showed symptom but the infection was not severe and were selected as disease escaping accessions, while the reaming accessions were susceptible to powder mildew. It was investigated that powdery mildew caused 86% loss to the germplasm at maturity level. The severity of the disease is directly proportional to the plant different phases and also to the time period. It was also concluded that the pathogen inhibit seeds development in the pod and

produced locules, so the pathogen affects the grain yield. As continuous severe infection by the pathogen will eradicate the susceptible germplasm, so the gene pool will be affected adversely, it is suggested to bring conventional breeding between the susceptible and resistance or transfer the gene responsible for the resistance using biotechnological procedures.

Project Title: *Study on genetic variation in Xanthomonas campestris pv.oryzae in relation to resistance in rice.*

Principal Investigator: *Dr. M. Afzal Akhtar*
Principal Scientific Officer

Location of Project: *Crop Diseases Research Institute, NARC, Islamabad.*

Duration: 36(months)
Start Date: 21/3/2002
Project Status: Completed

Total Cost (million): 4.821
Funds Released (Rs): 2680500
Funds Utilized (Rs): 2450535
(Upto 30th June, 2005)

Objectives:

The overall aim of these studies is to investigate pathogen city/virulence pattern of the bacterial blight population in order to develop cultivars with long lasting resistance to BB, to characterize bacterial strains on differential host/isogonics lines and through modern molecular techniques.

Achievements/Progress:

Bacterial blight of rice (*Xanthomonas campestris* pv. *Oryzae*) has become a severe problem in all the major rice growing areas of Pakistan. This survey was conducted during the crop year 2004 in Punjab, Sindh, Balochistan and NWFP to study the latest situation of this menace. In Punjab the mean incidence (% of infected plants) of bacterial blight was recorded 43, 58, 50, 40, 65, in Lahore, Gujranwala, Wazirabad, Gujarat, and Sheikhpura respectively and severity (% of infected tissue/area expressed on 0-9 scale) ranges form 1-2,5-7,5-7, 3-5,and 5-7, in Lahore, Gujranwala, Wazirabad, Gujarat and Sheikhpura respectively.-In Sindh the mean incidence (%) was 25, 35, 45, 20, 20, 45, 40 and 20 in Dadu, Larkana, Shikarpur, Sukkhar, Tando Muhammad Khan, Badin, Hyderabad and Thatta respectively and severity was 0-3, 0-3, 1-5,0-1,0-1, 1-3, 1-3,0-1 Dadu, Larkana, Shikarpur, Sukkhar, Tando Muhammad Khan, Badin, Hyderabad and Thatta respectively. In Balochistan the mean incidence (%) range was 20% with severity 0-1 at Usia Muhammad. In NWFP the mean incidence (%) range was 25, 10, 25, 65, 90, 70, 90 and 50 in Khazakhela, Gulabad, Sikandarabad, Farhatabad, Thana, Arikot, Termargarah and Rahimabad respectively whereas severity ranges from 1-5,0-3, 0-3, 1-5, 3-7, 1-5, 5-7, 1-5 and 0 in Khazakhela, Gulabad, Sikandarabad, Farhatabad, Thana, Arikot, Termargarah and Rahimabad respectively. The causal agent of bacterial blight of rice was confirmed through biochemical, physiological, hypersensitive reaction and pathogenicity. Reaction of differential /isogenic lines was recorded against *Xanthomonas oryzae* pv. *Oryzae* isolates. Protective and curative action of plant decoction was checked.

Project Title: *Investigation of role of Germin-like proteins (Glps) during germination/ early development by construction of rice plants engineered for sense and anti-sense expression of rice Glps.*

Principal Investigator: *Dr. S.M.Saqlan Naqvi*
Professor

Location of Project: *Dept. of Biological Sciences, University of Arid Agriculture, Murree Road, Rawalpindi.*

Duration: 36(months)

Start Date: 22/3/2002

Project Status: On-going

Total Cost (million): 2.473

Funds Released (Rs): 1910000

Funds Utilized (Rs): 1906893
(Upto 30th June, 2005)

Objectives:

- Determination of the functional importance of GLPs in early development.
- Exploration of possible contribution of Glps in alleviation of salinity stress

Achievements/Progress:

Transformation of LBA 4404, EHAI01 and EHA 10S with p1301 and p1391Z through freeze-thaw method was done.

Screening of calli for natural resistance against, cefotaxime showed absence of resistance in KS-282, JP-5 and Pakhal. Agrobacterium mediated transformation of calli is in progress and 17% regeneration is achieved in Pakhal so far.

A new setup for plant molecular biology/ genetic engineering has been established (alongwith help from HEC), outside the realm of the heavily funded mega institutions. Based on this foundation, another project of cloning of different components of Banana Bunchy Top Virus has been obtained from PSF.

Most of the routine materials/ plasmid vectors have been obtained/ purchased. So with a modest input in future, research in different areas of plant-technology can be sustained at the campus. The manpower generated will keep contributing towards the overall National Development.

Project Title: *Increasing production of Kabuli chickpea for its import substitution.*

Principal Investigator: *Dr. Muhammad Afzal*
Director

Location of Project: *Pulses Research Institute, Ayub Agricultural Research Institute,
Faisalabad.*

Duration: 36(months)
Start Date: 6/4/2002
Project Status: Completed

Total Cost (million): 1.328
Funds Released (Rs): 898500
Funds Utilized (Rs): 730297
(Upto 30th June, 2005)

Objectives:

- Screening/testing of ICARDA lines for introduction of blight resistance varieties of Kabuli gram for raising successful crop in Pothowar areas.
- Introgression of kabuli and desi types of chickpeas for the development of bold seeded, high yielding, widely adapted, diseases resistant varieties of kabuli gram suitable for rain fed areas of Pothowar and irrigated areas.
- Dissemination of kabuli chickpea varieties and package of its production practices for promotion of kabuli gram production in Pothowar areas, rice-growing area and as intercrop in September planted sugarcane

Achievements/Progress:

Existing varieties of Kabuli chickpea i.e. Noor-91 (released in 1991) and Pb. 1 (released in 1930) have become susceptible to patho-types of fungus *Ascochyta rabiei* and wilt/ root rot diseases. This necessitates immediate replacement of these varieties with new high yielding, resistant to the aforementioned diseases and suitable for sowing in September planted Sugarcane and Rice based farming. Rejuvenation of old variety Pb. 1 is also needed under the existing circumstances. Feasibly studies of Kabuli chickpea intercropped in sugarcane and sown after rice have shown positive/ encouraging results.

During the year 2004, 106 new and 138 existing accessions were evaluated at Pulses Research Institute, Faisalabad. Out of 106 new accessions 103 performed normal/showed tolerance against root-rot. Ten tolerant accessions were crossed with the high yielding local material during 2004-05. Ten cross combination made during 2003-04 were sown as F1 during the month of October, 2004.

For creation of variability 9 cross combinations were sown during the year 2004- 05 which have been harvested. The data are being compiled.

In Rice based areas i.e. Sheikhpura, Gujranwala, Sialkot and Norawal, 20 demonstration trials were sown at Research farms whereas, 18 demonstration plots intercropped in sugarcane have been sown.

Project Title: *Pathobiology of Foliar Spots of Wheat and their Integrated Management.*

Principal Investigator: *Mrs. Shamim Iftikhar*
Senior Scientific Officer

Location of Project: *IPEP, NARC, Islamabad.*

Duration: 36(months)
Start Date: 1/7/2003
Project Status: On-going

Total Cost (million): 4.069
Funds Released (Rs): 2523000
Funds Utilized (Rs): 1445843
(Upto 30th June, 2005)

Objectives:

- Assessment of distribution, incidence and severity of foliar diseases of wheat in different agro-ecological zones of Pakistan.
- To understand variability in the pathogen causing foliar disease in relation to resistance in host.
- Identification of new source of multiple disease resistance with other promising traits.
- Devise an integrated strategy for foliar disease management.
- Enhance Pakistani research knowledge base across the disciplines of this project.

Achievements/Progress:

Wheat diseases, in general, are one of the most important factors limiting the yield. Among fungal diseases spot blotch (*Bipolaris sorokiniana*) is of increasing concern in developing countries. Spot blotch mainly occurs in warm, humid wheat growing areas. In Pakistan *Helminthosporium* leaf spots (spot blotch) has been noted in southern province of Sindh, where winter temperatures are warmer. *Bipolaris sorokiniana* was isolated. as predominant pathogen during last year survey conducted in different agro-ecological zones of Pakistan for path biology of foliar spot of wheat. Out of one hundred and five leaf samples collected during current crop season, *Bipolaris sorokiniana* has the highest incidence 83% in NWFP area (zone 9 & 10) followed by 52% in Punjab area (zone 5, 6 & 7) and the lowest percent incidence is observed in Sindh area (zone 3 & 4).

This year 51 isolates of *B. sorokiniana* have been collected from zone 3, 4, 5, 6, 7, 9 and 10. Thirty six mono conidial isolates (previous year's collection) of *B. sorokiniana* were tested for their virulence. P2 9 has been found the most virulent by standardized test tube method. Further work on identification of source of resistance is in process with synthetic elite I & II (95 & 34 entries respectively).

Project Title: *Evaluation and incorporation of new genetic diversity in Pakistani wheats for stripe (yellow) rust resistance.*

Principal Investigator: *Dr. Iftikhar Ahmad*
Dy. Director General

Location of Project: *IPEP, NARC, Islamabad.*

Duration: 36(months)
Start Date: 1/7/2003
Project Status: On-going

Total Cost (million): 3.000
Funds Released (Rs): 1293000
Funds Utilized (Rs): 1225362
(Upto 30th June, 2005)

Objectives:

- Survey and gather pathogen virulence in Pakistan.
- Acquisition of novel wheat genetic stocks and their parents for conducting stripes rust screening in the seedling and adult plant stage in Pakistan.
- Identify stable genetic stocks from the test germplasm and seed increase.
- Transfer resistant gene/s from the novel sources into some leading Pakistani varieties.
- Screening of segregating populations of the crosses, selecting desired derivatives, and stabilizing them by maize mediated double haploid protocol.
- Develop a genome based partial monosomic analysis population for subsequently facilitating gene localization on wheat chromosomes.
- Transfer of resistant stable advanced genetic stocks to wheat breeding programs.

Achievements/Progress:

To meet the objective of virulence analysis, TRAP nurseries were planted at National Agricultural Research Center (NARC), Islamabad, Cereal Crop Research Institute (CCRI), Pirsabak and Nuclear Institute of Food and Agriculture (NIFA), Peshwar to trap the virulence present in different wheat growing areas of Pakistan. Farmer fields survey was also conducted to collect representative samples from Punjab, NWFP and Sindh and Azad Kashmir. In total 451 diseased samples were collected randomly from the farmer's fields during this study period. Virulence analysis of 47 samples (27 collected during 2003-2004 and 20 in 2004-2005) was conducted. Ten races were identified on the basis of virulence analysis. Inoculum from 200 disease samples was multiplied and preserved for virulence analysis in the next season, as time span with favorable environmental conditions ended in the last week of April 2005.

To identify stripe rust resistant germplasm 200 accessions of *Triticum turgidum* (durum), 40 accessions of *Aegilops tauschii*, 12 accessions of *Aegilops* spp. 6 accessions of *Aegilops triuncialis* and 6 accessions of *Agropyron* were obtained from PGRI, and 179 lines of synthetic hexaploid from CIMMYT wheat wild cross lab were screened. The result showed that 35 accessions of *Triticum turgidum* (durum) were resistant 20 accession were Moderately resistant, while 14 accession of *Aegilops tauschi* were resistant and 12 were moderately resistant 2 accession of *Aegilops* spp, and 1 accession of *Aegilops triuncialis* were found resistant Screening of the synthetic hexaploids under glasshouse conditions showed that in total 18 lines were resistant and 73 lines were moderately resistant to present virulence.

Adult plant resistance evaluation showed that 66 lines of Synthetic Elitel and 23 lines of Synthetic Elite II have good adult plant resistance against stripe rust wheat under field conditions.

Project Title: *Identification of sources of resistance to Karnal bunt disease of wheat.*

Principal Investigator: *Mr. Javed Iqbal Mirza*
Scientific Officer

Location of Project: *CDRI, Sunny Bank, Murree Substation, Murree.*

Duration: 36(months)

Start Date: 3/7/2003

Project Status: On-going

Total Cost (million): 2.540

Funds Released (Rs): 1590500

Funds Utilized (Rs): 1103589
(Upto 30th June, 2005)

Objectives:

- Identification of Karnal bunt disease resistance sources.
- Making available Karnal bunt resistant germplasm to breeders.

Achievements/Progress:

To identify Karnal bunt disease resistance sources in local wheat germplasm 37 commercial wheat cultivars and 38 candidate wheat lines included in National Uniform Wheat Yield Trials 2004-05 were screened. Most of the commercial wheat varieties of Pakistan were found highly susceptible to Karnal bunt. Only two varieties namely. Blue silver and Soghat 90 did not develop any disease symptoms under when inoculated with Karnal bunt pathogen. Among 38 lines included in National Uniform Wheat Yield Trial 2004-2005 only five did not develop Karnal bunt symptoms when screened for resistance under field conditions. Susceptibility of commercial wheat cultivars and most of the candidate wheat lines to Karnal bunt confirms the lack of disease resistant germplasm in National wheat breeding program. A set of Synthetic Elite-I consisting of 95 lines, a set of Synthetic Elite-II consisting of 33 lines and a set of 51 Durum parents, acquired from CIMMYT wheat wild cross program was screened against Karnal bunt disease under glasshouse and field conditions to identify new sources of Karnal bunt resistance. Results from the field are presented in this report while results from glasshouse are not yet available for inclusion in this report. The inoculated spikes of the plants in glasshouse are at grain filling stage. Among 95 Synthetic Elite-Is, 81 did not produce any disease symptoms while out of 33 Synthetic Elite-IIs, 29 were resistant. Among Durum parents 28 lines did not develop any Karnal bunt disease. Although Synthetics found resistant under field conditions can directly be used in breeding program after the availability of glasshouse screening results, their crosses with leading bread wheat lines will provide a better option for transferring resistant genes to the desired bread wheat lines. Comparing susceptibility of Durum parents with that of synthetics identifies sources of resistance in later derived from *Aegilops squarossa* accessions. Combination of this resistance with that of Durums, through double haploid mediated synthetics, can give excellent resistance against Karnal bunt disease.

Data from glasshouse will be presented in the next report. This data will confirm the susceptibility of the lines to Karnal bunt disease, as glasshouse conditions are ideal to develop the infection under controlled environmental conditions.

Project Title: *Investigation on barley yellow dwarf virus (BYDV) in wheat crop in Pakistan.*

Principal Investigator: *Dr. Shahid Hameed*
Senior Scientific Officer

Location of Project: *CDRI, NARC, Islamabad.*

Duration: 36(months)
Start Date: 1/1/2004
Project Status: On-going

Total Cost (million): 3.892
Funds Released (Rs): 2221000
Funds Utilized (Rs): 2120286
(Upto 30th June, 2005)

Objectives:

- Epidemiological studies on BYDV
- Characterization of Pakistani isolates of BYDV
- Identification of source of resistance against BYDV.

Achievements/Progress:

A survey was carried out during the wheat cropping season of 2004-05. The Sindh province was surveyed in early March whereas Punjab/NWFP in April and Balochistan in May. Seventeen fields sampled in Sindh, 89 in Punjab, 21 in NWFP and 2 in Balochistan. BYDV was detected in all fields irrespective to wheat, barley and oats.

Based on the results obtained from testing the random samples collected from four different provinces, the overall incidence was around 34.63%. The highest incidence of BYDV observed in NWFP, Punjab, Sindh and Balochistan was 56.29, 29.61, 18.46 and 11.0 percent, respectively. However, the incidence was variable among the locations observed in the provinces. In the case of all persistently transmitted viruses by insect vector, epidemics seldom occur every year, but most likely occur once every 4-7 years. Thus it is important to keep monitoring the occurrence of the virus over a number of years.

Under controlled conditions, the following plants of different families were found susceptible to BYDV on the basis of transmission by aphids, symptoms and confirmation of virus with DAC-Elisa

- a. *Zea mays* (maize)
- b. *Avena sativa* (oats)
- c. *Saccharum officinarum*
- d. *Sorghum halepense*
- e. *Echinochloa colonum* *Eragrostis minor*
- f. Wheat var. (Fakhar-e-Sarhad)

R. padi is continuously maintained for virus transmission whereas *S. graminum* were dropped due to the shortage of space and requirement of different environmental conditions.

All isolates of BYDV are difficult to purify as different isolates purified with yields ranging from 0.5 mg per kilogram of tissue extracted, which are meager relative to some viruses. So far substantial quantity of virus was not obtained to produce antiserum. Difficulties faced in purifying BYDV like isolates have been a constraint in this study and development of polyclonal antiserum differentiating the strains.

Fifteen lines obtained from ICARDA were screened under natural conditions at NARC. On the basis of symptoms and DAC-Elisa, they were scored for virus presence/ absence. The data for the average of response of genotypes to the BYDV infection in field test indicated differences in resistance level, which may be explained by the fact of genetic background and genotype environment interaction. Out of fifteen tested lines, seven were found moderately resistant and remaining showed various levels of susceptibility.

Project Title: *Sustainable Cropping Patterns for Pothowar Plateau.*

Principal Investigator: *Dr. Shahbaz Ahmad*
Professor

Location of Project: *Department of Agronomy, University of Arid Agriculture, Rawalpindi.*

Duration: 36(months)

Start Date: 1/5/2003

Project Status: On-going

Total Cost (million): 3.036

Funds Released (Rs): 1673000

Funds Utilized (Rs): 1224231
(Upto 30th June, 2005)

Objectives:

- Identification of cropping patterns for efficient soil moisture and fertility use under rainfed conditions.
- Identification of the most ruminative cropping pattern under rainfed conditions.
- Demonstration and popularization of the best cropping pattern to the farmers.

Achievements/Progress:

The second year (2004-05) experiments were laid out at five locations i.e. University of Arid Agriculture, Rawalpindi (UAAR), National Agricultural Research Center, Islamabad, (NARC), Barani Agricultural Research Institute, Chakwal (BAR!), Barani Agricultural Research Station, Fateh Jang (BARS) and Groundnut Research Station, Attock (GRS). There were ten cropping patterns including wheat, canola, groundnut, sunflower, maize (grain/fodder), mungbean and fodder oat crops. Each trial was replicated thrice at all the locations. Spring crop 2004 (groundnut) and rabi crops 2004-05 (wheat, canola and fodder oat)- were planted according to plan of work. The results of spring 2004 indicated that groundnut performed better at UAAR than all other locations followed by BARI. The lowest groundnut yield was recorded at BARS. Monetary benefit of the groundnut showed that groundnut based cropping patterns fit well for high rainfall regions as compared to low rainfall regions. The rabi crops (wheat, canola and oat-fodder) performed better at UAAR followed by NARC and BARI. The monetary benefits of rabi crops was better in high rainfall zones than the medium and low rainfall zones; however, the monetary benefits for growing these crops at GRS and BARS were lowest. Canola and fodder oat are possible alternative for wheat as their economic return was 2-3 times higher than wheat.

Soil moisture in the fields having all the four crops differed significantly due to variation in the environmental conditions and physiochemical properties of soil. Locations differed significantly for soil moisture availability for the crops that was translated into yields.

Soil fertility status was also different among the locations. The nutrient status of the soil at the time of harvesting was lower than at the time of planting before fertilizer application. The general trends of the data were similar at different locations and for all the crops.

Project Title: *Introduction of soft fruit (strawberry, black berry, rasp berry, black currant) in the potential areas of Pakistan for economic returns.*

Principal Investigator: *Dr. Khalid Mahmood Qureshi*
Senior Scientific Officer

Location of Project: *IFHC, NARC, Islamabad.*

Duration: 36(months)
Start Date: 1/7/2003
Project Status: On-going

Total Cost (million): 4.000
Funds Released (Rs): 1894000
Funds Utilized (Rs): 1667437
(Upto 30th June, 2005)

Objectives:

- The primary objective of the programme is the introduction of improved exotic planting material of soft fruits.
- To select the best adapted one to local climate soil and biotic condition for commercial exploitation.
- To develop appropriate production technology.
- To established plants nursery for production of pedigree plants.

Achievements/Progress:

During this year survey was continued for identification, selection and collection of germplasm of strawberry, black berry, raspberry and black currant. Planting materials were collected from Malam Jabba, Matta, Bakain, Shoogran, Mingora, Murdan, Peshawar, Murree, Rawalakot, Chakar, Ghari Dopata, Muzaffrabad, Quetta and Islamabad surrounding areas. Overseas Cooperating Scientist visited project activities this year. During his stay in Pakistan he visited all sites at Muzaffarabad, Quetta, Mingora, Peshawar and Islamabad where project activities are in progress and also helped in characterization of wild species growing at these sites. He also delivered seminar at NARC about his finding during his stay in Pakistan. He suggested to include blue berries as new fruit in project activities. He bought some varieties of strawberry, raspberry, black currant and blue berry and agreed to provide more germplasm in future. Plants were planted in 'green house and are being maintained for research purpose and multiplication at NARC. Plants multiplied at NARC were distributed to ARI Mingora and Tarnab Peshawar. Experimental trials were conducted to observe growth behavior of cultivars at NARC. Following experiments were repeated this year. Data regarding vegetative and reproductive growth are being collected.

- Response of strawberry cultivars to different chilling and durations.
- Effect of different environments on growth and yield of strawberry.
- Effect of crown size on growth and yield of strawberry cv. Chandler.
- Comparison of strawberry cultivars under Islamabad conditions.
- Characterization of various wild soft fruit species.

Observations were made on number of runner produced per plant, leaf area, leaf fresh and leaf dry weight, number of fruits per plant, fruit weight and fruit size. Data showed that chilling treatments increased vegetative and reproductive growth. Plant chilled 4 C performed better comparatively and plants grown under green house yielded earlier compare to other environments.

Project Title: *Mutation breeding for high grain yield, improved quality and earliness in non-aromatic rice (Oryza sativa L).*

Principal Investigator: *Mr. Abdul Wahid Baloch*
Principal Scientific Officer

Location of Project: *Nuclear Institute of Agriculture, P.O. Box 70060, Tandojam, Sindh.*

Duration: 36(months)

Start Date: 1/8/2003

Project Status: On-going

Total Cost (million): 1.112

Funds Released (Rs): 488000

Funds Utilized (Rs): 411710
(Upto 30th June, 2005)

Objectives:

- To evolve new rice varieties with i) Early maturity ii) Superior grain quality iii) High yield and iv) tolerant to biotic and abiotic stresses.

Achievements/Progress:

Pure seeds of rice varieties Sarshar, Shua-92 and IR 8 were irradiated with ⁶⁰Co gamma rays (150, 200 and 250 Gy) to determine their mutagenic effectiveness through the appearance of mutants in chlorophyll and agronomic traits. The most effective dose in detecting useful chlorophyll mutations was found to be 200 Gy. Highest number of mutants was observed in irradiated populations of Sarshar than Shua-92 and IR8. Wide variation was observed in M2 generation and 97 mutants were selected on the basis of high yield and earliness in maturity.

M2 Population:

Wide variation was observed in the M2 generation, and compact plants were carefully screened for earliness in maturity, grain quality and high yield. Out of 97 plants in this generation 25 were selected for narrow grain, 37 for earliness in maturity and 35 for high yield. The data of M2 generation presents number of survived plants at maturity, plant height (cm), number of productive tillers per plant, panicle length (cm), number of total grains per panicle, number of sterile grains per panicle, number of fertile grains per panicle, grain branches per panicle, seed index and grain yield per plant (g). The results indicated that out of 55133 seeds sown in M2 only 54757 plants (99%) reached to maturity. Higher dose of (250 Gy) gamma rays has reduced the plant height (cm), number of fertile florets per panicle, total florets per panicle as compared to 200 Gy and 150 Gy respectively. The results of paddy yield of an individual plant basis, the mutant plants of Sarshar 1510/H, 1511/H, 1513/H, 1514/H, 208/H and 209/H had produced higher yield than parent and other entries. The mutants of Shua-92 viz., 159/H, 1510/H, 1511/H, 206/H, 207/H, 208/H and 256/H have given better performance than their parent Shua-92 and other genotypes. While the mutant plant of IR8 viz., 207/EHN, 209/H, 2S8/H and 259 have best performance among the other entries respectively.

Chlorophyll studies in M2:

To induce chlorophyll mutation, the effective dose was 200 Gy and the rice variety Sarshar showed the maximum number of mutations followed by varieties Shua-92 and IR8. The highest frequency of chlorophyll mutations was of albina types followed by straita types. The xantha, viridis and tigrina types of mutations were less frequent.

Conclusions:

The use of induced mutation was considered as an appropriate approach for developing short duration mutants accompanied by high yield and excellent grain quality. This will boost the income of farming community and help enhancing the foreign exchange earnings.

Project Title: *Production of doubled haploids wheat with longer coleoptile.*

Principal Investigator: *Dr. Fida Muhammad*
Associate Professor

Location of Project: *Department of Plant Breeding, NWFP Agriculture University, Peshawar.*

Duration: 36(months)

Start Date: 1/8/2003

Project Status: On-going

Total Cost (million): 1.859

Funds Released (Rs): 1108000

Funds Utilized (Rs): 986785
(Upto 30th June, 2005)

Objectives:

- To enhance wheat production in the province by utilizing agricultural land more efficiently. The exotic and indigenous wheat varieties will be hybridized to develop high yielding wheat cultivars for specific environment.
- Develop wheat genotypes with longer coleoptiles.
- Determine the narrow-sense heritability of coleoptiles length.
- Determine genotypic and phenotypic correlations of coleoptiles length with yield components.

Achievements/Progress:

Wheat varieties with longer coleoptiles were hybridized with high yielding semi dwarf wheat cultivars to get high yielding wheat cultivars with longer coleoptile. The F₁ seed was advanced to F₂ at Peshawar and then planted at higher altitudes of Kaghan and Kalam to get F₃ material during May 2004. The F₃ material at Kaghan and Kalam was harvested, threshed and replanted at Peshawar during November and December, 2004. Wheat spikes were emasculated in F₂ at Kaghan as well as in F₃ at Peshawar in July, 2004 and March, 2005 respectively. Intergeneric crosses were made at both locations with maize pollen to get haploid wheat embryos. This helped in standardizing the protocol for doubled haploid wheat production. Haploid embryos were excised and cultured in test tubes to get haploid plantlets. Some haploid embryos grew into plantlets and some were discarded due to fungi growth in test tubes. The plantlets were transplanted to pots for further growth but they did not survive. However, the material was advanced to next generation and protocol was standardized. The development of haploid embryos was established but the production of haploid embryos would be refined further.

To determine the narrow-sense heritability and correlations of coleoptile length and other traits, the material was planted in the field as well as in laboratory at five different dates. Data on coleoptile length and other yield components were taken. Data were analyzed statistically and interpreted. Heritability for coleoptile length and its correlations with other traits were determined. A detailed manuscript titled as "Heritability estimates for coleoptile length and other traits in bread wheat" has been submitted to a reputable journal for publication.

Project Title: *Control of phytopathogenic microorganisms by bacteriocins from indigenous strains.*

Principal Investigator: *Dr. Sheikh Ajaz Rasool*
Senior Professor

Location of Project: *Department of Microbiology, University of Karachi, Karachi-75270.*

Duration: 36(months)
Start Date: 1/7/2003
Project Status: On-going

Total Cost (million): 2.133
Funds Released (Rs): 1559000
Funds Utilized (Rs): 1518502
(Upto 30th June, 2005)

Objectives:

- Isolation & identification of the pathogenic organisms (from different diseased fruits, vegetables)
- Bacteriocin production potential of the isolated strains against the isolated and other standard phytopathogenic bacterial strains.
- Genetic determination location monitoring experiments for positioning the bacteriocin regulating genes by curing experiments.
- Plasmid isolation and characterization by mini-prep method and agarose-gel electrophoresis.
- Purification (partial) and characterization of the representative bacteriocin preparation w.p.r. to molecular weight/sizing etc.
- Technology development for mass application.

Achievements/Progress:

Bacteriocins and antimicrobial peptides have attracted attention as potential substitutes or as addition to currently used antimicrobial compounds. They are proteinaceous compounds of bacterial origin that are lethal to bacteria other than the producing strain (Joerger, 2003). These bacteriocins are highly specific, cost effective and safe for the users and the environment. Most of the well-characterized bacteriocins are plasmid determined and the entire Gram positive bacteriocins are also plasmid borne (Hardy, 1975). Biagi and Azevedo (1995) reported the drug-induced elimination of bacteriocin production in the phytopathogenic bacteria *Erwinia* and *Pseudomonas* indicating the plasmid borne factors involved in this activity. The presence of plasmid responsible for bacteriocin production was evaluated by the isolation of plasmid by Kado and Leu. (1981) and Hardy (1993) and its characterization done by horizontal agarose gel electrophoresis (Maniatis et al. 1989).

The aim of the present work was to study the plasmid and to locate the gene(s) responsible for the bacteriocin production of the Phytopathogenic *Erwinia carotovora* strains that were characterized for bacteriocin. Different interchelating dyes (acridine orange and ethidium bromide) and SDS were used. The curing of plasmid after ethidium bromide treatment suggests that the gene(s) responsible for the bacteriocin production, (Erwinicin NA4) is located on plasmid. Plasmid isolation from uncured and cured *Erwinia carotovora* strains revealed that the uncured strains retained the plasmid in contrast to the cured. The molecular weight (in terms of Kbp) of the plasmid was determined by horizontal agarose gel electrophoresis with known plasmid i.e. λ (Lambda) DNA Hind III digest. Thus, the molecular weight of plasmid was calculated to be about 24 kb.

Project Title: *Conservation and sustainable utilization of agro-biodiversity of under-utilized crops.*

Principal Investigator: *Dr. Zahoor Ahmad*
Principal Scientific Officer

Location of Project: *Plant Genetic Resources Institute (PGRI), NARC, Islamabad.*

Duration: 36(months)
Start Date: 1/7/2003
Project Status: On-going

Total Cost (million): 1.896
Funds Released (Rs): 1058698
Funds Utilized (Rs): 796652
(Upto 30th June, 2005)

Objectives:

- To expand germplasm collections of underutilized crops (upto 10 species)
- Evaluation of collected germplasm (10 to 50) for various morphological and agronomic traits.
- To increase the yield of under utilized crops through selection/ breeding and substantially increasing the income of small farmers.
- To open up marginal lands by cultivating underutilized crops.

Achievements/Progress:

Eighty three accessions of Sesame (*Sesamum indicum* L.) were evaluated for plant height, days to maturity, number of branches per plant, number of capsule per plant, 100 seed weight and biological yield. The data revealed that high diversity was observed for all the quantitative traits. The plant height ranged from 68-180 cm, with Mean±SE 145.59±2.73; days to harvesting ranged from 88-93 days, with Mean±SE 89±0.21; number of branches pr plant ranged from 1-66, with Mean±SE 10.2±1:0.67; number of capsules per plant ranged from 12-366, with Mean±SE 146.5±7.22; biological yield ranged from 1.18- 336.34 with Mean±SE value 75.96±7.55 and 100 seeds weight ranged from 0.03-0.99, with Mean±SE 0.63±0.02. The maximum diversity was recorded for number of branches per plant and number of capsules per plant. The single branched genotypes having fruit capsules in clusters were recognized as elite lines with high yield potential. The correlation coefficient. Was computed among all the traits i.e. plant height, days to harvesting, number of branches, number of capsule per plant, total weight (biological yield) and 100 seeds weight. The results regarding correlation revealed that all the characters were correlated positively.

Forty three accessions of Linseed (*Linum usitatissimum*) were planted in augmented design at NARC in October, 2004. The data on plant height, No. of branches per plant, flower colour, days to maturity, yield per plant, seed yield per row were recorded. There was low genetic diversity for days to maturity while high genetic diversity was recorded for other quantitative traits.

Eighty one accessions of *Hibiscus* species were evaluated for various qualitative and quantitative traits and high genetic diversity was recorded particularly for plant height and yield. Based upon yield, PK-4019, PK-4025, PK-3987 and PK-4018 were found high yielding for fiber content and seed yield.

Thirty six accessions of *Trigonella foenum graceum* germplasm were evaluated at NARC and data for various genetic characters (qualitative and quantitative) were recorded. High diversity was recorded for plant height, biomass and 1000 seed weight. All the accessions were also subjected to bio-chemical evaluation (total seed protein) using SDS-PAGE. The banding pattern in all the accessions were almost similar indicating narrow genetic base at seed protein levels.

Sixty two accessions of Kalongi (*Nigella sativa* L.) were evaluated for days to first flower, days to 50% flower, days to initiation of capsules, flower color, plant height, plant size, growth vigor, plant color, plant type, plant hairiness, days to maturity, days to harvest, biological yield, number of branches, number of capsules per plant, capsule weight, capsule length, capsule width, number of locules, 1000 seed weight, seed yield, Physio-chemical properties of oil, oil contents. Highly significant diversity was recorded for character leading to yield (i.e. number of branches per plant, number of capsule per plant, number of seed per capsule, 1000 seed weight). Based upon the yield data, four germplasm lines (MP-007, MPOO13, :MP-0022 and MP-0024) were found high yielding lines in comparsion to other material. These lines have been selected and seeds are being multiplied for further research and development. The SDS-P AGE data revealed narrow variability for total seed protein. The statistical analysis of evaluation data based upon quantitative traits put all the germplasm in five different clusters.

The germplasm of all the ten plant species (*Cyamopsis .tetragonoloba*, *Mentha spp.*, *Plantago ovata*, *Ricinus cummunis*, *Hibiscus cannabinus*, *Sesamum indicum*, *Trigonella foenum graceum*, *Linum usitatissimum*, *Nigella sativa* and *Vigna unguiculata*) collected during the execution of this project has been multiplied and conserved in the Genebank under active and base collection. The germplasm of *Nigella sativa*, *Cyamopsis tetragonoloba* and *Mentha spp.* Has been distributed to various research organizations and some farmers to create the awareness about the importance and production technology. The demonstration plots of *Nigella sativa* were planted at Ludan, Vehari and Kasur while of *Plantago ovata* at three different localities in Hasilpur and Bahwalpur.

Project Title: *Studies on mycotoxins in corn.*

Principal Investigator: *Dr. Yasmin Ahmad*
Principal Scientific Officer

Location of Project: *IPEP, NARC, Islamabad.*

Duration: 36(months)

Start Date: 1/8/2003

Project Status: On-going

Total Cost (million): 2.500

Funds Released (Rs): 1317000

Funds Utilized (Rs): 1209842
(Upto 30th June, 2005)

Objectives:

- Survey and mapping for the incidence of mycotoxin producing fungi in corn grains under storage and field conditions.
- To determine the incidence of mycotoxins in corn stalks.
- Isolation and characterization of mycotoxins.
- Developing strategies for the management of identified mycotoxins.

Achievements/Progress:

Survey for the incidence of mycotoxin producing fungi in corn grains under storage in different areas of NWFP (Nowshera, Mardan, Swabi, Charsada, Peshawar, Kohat and Bannu) and Punjab (Pakpattan, Depalpur and Sahiwal). Fungal pathogens viz. *Fusarium moniliforme*, *Fusarium graminearum*, *Aspergillus flavus* and *A. niger* were identified, and characterized.

Moreover, different strains *F. moniliforme* and *A. flavus* were also isolated. Fumonisin mycotoxin with different concentrations (0.3, 0.5 and 6 ppm) was observed in three corn samples collected from NWFP (Janangira Swabi, Malangi, Peshawar) and Punjab (Khoshab) areas.

Project Title: *Planning, Coordination, Monitoring and Dissemination of Technology on Management of Indian Crested Porcupine, Hystrix indica, in Pakistan.*

Principal Investigator: *Mr. Muhammad Munir*
Director

Location of Project: *Plant Protection, CSD, PARC, Islamabad.*

Duration: 36(months)

Start Date: 1/9/2003

Project Status: On-going

Total Cost (million): 0.618

Funds Released (Rs): 192000

Funds Utilized (Rs): 101719
(Upto 30th June, 2005)

Objectives:

- To plan, coordinate and monitor the three subject activity components for smooth implementation of the project.
- To identify uniform parameters of data collection, methods, materials and analysis of results/ data.
- To conduct annual planning meetings and reviews to monitor the progress of all components.
- To organize training and workshops for the stakeholders to disseminate developed technologies for the management of porcupine and publish literature.

Achievements/Progress:

Planning and implementation meetings:

The main objective of these meetings was to coordinate activities of different components of the umbrella project for overall smooth implementation of the work plans. Also, to establish linkages with institutes/agencies and stakeholders. A couple of meetings were held individually with the P.I.'s of components 2, 3&4 and stakeholders. The following activities/actions were undertaken:

- Designed data sheets for recording porcupine damage and bait consumption.
- Finalized design of live-traps, snares, leg-hold traps and observation box.
- Manufacturers/suppliers of traps, snares, rodenticides, immobilization drugs were identified.
- Finalized design of indoor porcupine keeping facility at SARC, Karachi (Component-4).
- Six wire-meshed cages were erected, each measuring 10x18x12, sufficient for free/ natural movement and delining activity.

On the occasion of 2nd International ALP Workshop, a planning and review meeting was held in which the PIs and Research Fellows participated. All of them updated the progress and identified bottlenecks in the implementation of work plans. The following items/points were agreed:

- Administrative action will be taken by National Coordinator for the appointment of Research Fellow for Component-2.
- List of equipment/supplies was discussed and their supplier identified.
- PI of Component-4 will supply tile design of pelleting and block formation machines and address of manufacturer to other PIs.

- P.I. of Component-4 will, also, make available the design of "Porcupine Handling Chamber" to PI Component-3 for indoor observations and study of morphometrics.
- Fecal analysis methods and procedures will be provided by PI Component-4 to 2 and 3 components.
- Tagging, baiting and immobilization's common procedures were identified for adoption.
- PIs of component-2 and 3 shared their experience in trapping of live porcupine by using "Door Drop" traps and snares. Snares did not prove effective. Therefore, it was decided to use "Fox Type" live traps. It was suggested by Nat. Coord. to try "Trail Baiting" when using snares.

Convened a meeting of Project Director and Divisional Forest Officer (HQs) of Tarbella Watershed Management Project at Abbottabad for the selection of suitable experimental sites in five Watershed Divisions of the project for smooth implementation of various activities of the work plan of Component-2. P .D. of the project extended full cooperation to carry out the study in different areas of the project. Information such as PC-I of the project, area maps, bio-diversity of plantations, hot-spots of porcupine population and damage areas and complete contacts of DFO's and Range Forest Officers (RFO's) were obtained from the P .D. office.

Planning meetings were held in Balochistan with Director General (Research), ARI, Quetta and Project Director of F AO/UNDP -Balochistan Area Development Project, Quetta. Both extended full cooperation in the implementation of the project activities.

Selection of experimental study sites

Selection of experimental locations/sites were carried out for Component-3 in the central Punjab. Two sites were selected near Ratwal, Kherimurat and one site was selected in the vegetable growing areas of Behlot and lang Bahtar villages. Survey of the fields showed severe porcupine damage to potato and cabbage. All sites were located in Fateh lang, Tehsil of Attock district of Pothwar plateau.

For Sindh and Balochistan, sites were selected in Thatta district (Ghora Bari) and Karachi (Jokheo Farm near Bin Qasim Town) out of five sites suggested by the P .I. of the Component-4. On these sites damage to seedlings and matured sugarcane was reported by the farmers of Ghora Bari. Uprooting of young plants of papaya was about 30%. Severe damage to melons and vegetables was also reported. On this site den's baiting with zinc phosphide (2%) and brodifacoum was designed and to be implemented.

On Jokheo Farm, high population and activity of porcupines was observed along the foot hills. Porcupine trails and urine marking was observed for the first time. On or near site damage to vegetables (25-75%) was recorded. On this site, in various areas, bait stations using zinc phosphide (2%) and brodifacoum (0.005%) was planned. Using strychnine (0.6%) sodium salt blocks and leg hold traps were suggested to PI.

In Balochistan survey was made in Quetta district, Pashin, Muslim Bagh, Zargon and Mastung. As a result of this survey two sites each were selected in Muslim Bagh and Mastung. On a site, 25 km from Muslim Bagh, wild *Pistacia* spp forest plantation are being severely damaged. To ascertain the damage detailed survey will be carried by the PI of Component-4. Socio-economic importance of these plantations for the local communities is manifold. They use *pistacia* fruit in winter to save themselves from severe cold and earnings by selling to town markets and its wood for fuel. The CBO's of this area will participate in baiting with zinc phosphide (2%) bags (250 g)

and brodifacoum (0.005%) bags of 250-350 g. On the second site of Muslim Bagh near Kan Mehtar Zai serious porcupine damage to tomato, onion, maize and potato was reported by the farmers which in majority cases ranged from 20-95%. On two sites in Mastung, damage to onion, tomato, potato, maize, melons and debarkation of apple tree was reported which according to farmers 30 to 90% was common to all these reported commodities. On these sites live trapping was planned by using modified Tomahak traps. An other site was selected in Hanna Valley, 25-30 km from Quetta. In this area severe damage to potato, tomato, peas, onion and cabbage was observed. Damage to young and medium sized apple trees was also recorded. On this site, 10 killis (small sized human settlements), covering an area of approximately 16 sq. km were selected for den's baiting with zinc phosphide (2%) mixed with maize and molasses. From each killis a facilitator will be selected by the communities for organized baiting. The baiting will be conducted under the supervision of Mr. Jumma Khan, the local (Balochistan) focal person in the following killis:

- | | | |
|-----------------------|----------------------------------|-------------------------------|
| - Killi Sheen Kach | - "Sara Zoor | - "Babu Jan Muhammad |
| - "Malik Ahmad Khan | - "Malik ghulam Sarwar Yaseenzai | - "Baktiyar |
| - "Haji Gul Muhammad | - "Malik Samand Khan | - "Malik W Ali Mohammad Kakar |
| - "Haji Atta Muhammad | | |

In 2004, selection of experimental sites of Components 2, 3 and 4 was completed, materials and methods finalized and porcupine damage information by way of interviewing farmers and other stakeholders was completed. NARC component gathered damage data by a fixed procedure. Porcupine damage to *Pinus roxburghii* and *Robinia pseudoaccacia* in Tarbela-Mangla watershed areas was completed. At SARC (Component-4), wild trapped porcupines successfully acclimatized in indoor breeding enclosures and gave birth to litters.

Feeding trials on cereals, in captivity, indicated high rate of consumption by porcupines. This is the first ever information reported on porcupine feeding habits. Earlier to it porcupines were reported to be feeding on vegetative materials. Component-2 gathered useful data on breeding biology specifically on development at embryology.

Training of stakeholders:

The following activities were carried out by the PI of the PARC Coordinated Component Unit-I.

- Training to farmers and agricultural functionaries was imparted on the management of porcupines at the field office of D.D. Officer (Agri. Ext.), Fateh Jang in which 55 persons participated. Baiting and fumigation techniques were demonstrated to the participants. The training was organized/conducted on the request of D.D. Officer, Fateh Jang, district Attock.
- Near Behlot village, Research Fellow of Component-3 was trained on assessing damage of porcupine to potato and cabbage.
- In Balochistan, 25 km away from Muslim Bagh, training in porcupine control was imparted to 62 farmers of Aghbar Gai village. The 2nd training session was conducted at Karez Amanullah near Mustung town in which 40 farmers participated. (Fig.3). These two training sessions were conducted in cooperation with FAO / UNDP Balochistan Area Development project.
- Planned two training workshops with Component-4 during 2004-05 for the irrigation staff of Kotri and Sukker Barrages canal irrigation system.

Project Title: *Investigations on Indian Crested Porcupine, Hystrix indica, Damage to Forest Flora and Development of Prevention Practices in Tarbela-Mangla Watershed Areas.*

Principal Investigator: *Mr. Rafiq Massih*
Senior Scientific Officer

Location of Project: *VPCL, NARC, Islamabad.*

Duration: 36(months)

Start Date: 1/7/2003

Project Status: On-going

Total Cost (million): 2.866

Funds Released (Rs): 1141000

Funds Utilized (Rs): 1036059
(Upto 30th June, 2005)

Objectives:

- To quantify porcupine damage to tree stockings, trees, surface vegetative cover (plant communities) and crops.
- To study reproductive biology, population structure (distribution, density etc.), behavior and food habit preferences, energy budgeting and seasonality.
- To develop environment friendly and sustainable management strategies to prevent porcupine infestations and damage.
- To train forest staff and stakeholders (farmers) on the management of porcupine damage.

Achievements/Progress:

Survey to study the damage by porcupine to field crops (maize, wheat, peas, potato, radish and cauliflower) revealed that there was no damage to all these crop except that to maize in which only 0.56% damage was recorded at maturity stage of the crop.

Stomach contents analysis of 15 animals revealed that the food of the porcupine in Tarbela watershed area included more than 26 plant species. Among them the 5 most preferred plant species were; *Pinus roxburghii* > *Sorghum helepense* > *Zea mays* (Maize) > *Malia azadrach* (Dharek) > *Cyprus rotundus* .

In a total area of 98 ha surveyed for burrow density there was an average of 0.39 burrows per ha. Average number of porcupine occupying and living in a single burrow system were estimated to 2.14 porcupines per burrow. It was estimated from these data that there is not more than one porcupine in one hectare of Tarbela watershed area.

Morphometric data of 12 porcupines (8 males and 4 females) revealed that females were heavier and larger than the males while rest of the body parameters were almost similar. The average body weight of all the 12 animals was about 11 Kg while the body length was about 92 cm. In these porcupines the sizes of upper and lower incisors are 2 and 3 cm respectively. Observations and measurements of the male and female reproductive organs showed that all the animals were reproductively active.

Experiments conducted to evaluate the most preferred food for porcupine in the habitats of Tarbela watershed area showed a significantly high preference for groundnut seeds. The 2nd preferred grain food was maize. Among the fresh food the guava was at the top. When tested in a

choice test, preference for guava was more than that to the groundnut. To reduce the cost of the bait materials the groundnut was tested by mixing in maize. The ratio of these two grains at 50:50 was found as the most suitable and preferred food.

Evaluation of body snares and live traps as a mean of physical or non-chemical methods for control of porcupine revealed 3.4% and 20% capturing/trapping success respectively.

Project Title: *Biology and Management of Porcupine, Hytrix indica in Central Punjab.*

Principal Investigator: *Dr. Afsar Mian*
Dean

Location of Project: *Faculty of Sciences, University of Arid Agriculture, Rawalpindi.*

Duration: 36(months)
Start Date: 1/7/2003
Project Status: On-going

Total Cost (million): 2.094
Funds Released (Rs): 1071600
Funds Utilized (Rs): 914400
(Upto 30th June, 2005)

Objectives:

- To quantify porcupine damage to tree stockings, trees, surface vegetative cover (plant communities) and crops.
- To study reproductive biology, population structure (distribution, density etc.) behavior and food habit preferences, energy budgeting and seasonality.
- To develop environment friendly and sustainable management strategies to prevent porcupine infestations and damage.
- To train forest and irrigation staff and stakeholders (farmers) on the management of porcupine damage.

Achievements/Progress:

Continuing the research on the porcupine biology, carried out during the first year of the project life, field studies have been attempted during the 2004-05. The objectives of the present year demanded research on continuation of studies on population ecology food and feeding habits, reproductive biology, along with studies on behavior and damage estimates. Taking the advantage of the available material, studies have been conducted on the hematology, histology and skeleton, so as to develop better picture species biology.

The further collection of data indicates that I: I sex ratio is followed in the animals trapped from the area, which suits the species, which is believed to have strong family bonds. Equally probability of falling into traps also suggests that both the sexes equally share the predation and/or mortality rate. The data on the age structure is limited and no individual weighing below 8kg has been trapped, which is attributed to behaviour of the species, where adults lead the family group and probably inability of the presently used traps to capture the smaller individuals. The available data indicates that 54.6% of the adult females are pregnant, which is an indication of a good breeding population. The analysis of the testosterone levels in a limited number of males suggest a higher hormonal levels during March as compared with August, which may indicate that that males are though sexually active in the two seasons, yet the reproductive performance increases in March. The analysis of the follicle stimulating hormone (FSH), leutinizing hormone (LH) and progesterone suggest individual variation, which is expected under that that associated with estrus and/or pregnancy. However, this may hint towards the fact that most of the females are sexually active. The average number of fetuses per females suggests that majority of females implant two fetuses with an average of 1.83:f:0.17. This value is lower than the previous suggestion that Indian crested porcupine has a litter size of 2-4.

The feeding trails conducted at the mouth of the 14 live burrows through multiple choice test, suggested that, out of the 7 seed foods offered, groundnut is the most preferred, followed by barley, wheat, rice, sorghum, maize and black grams. Out of the five seasonal vegetables, the potato is the most preferred, followed by carrot, radish, turnip and onion. The animals appeared to be shy at attempting the food available at the entrance of the burrow during first night, but went for the normal up to the appetite feeding during the other two nights. The animals tried to pull the food items into the burrow, but did not take these into the deeper parts of the burrows, suggesting that animals do not go for storage and/or for the young ones which are probably nursed by the milk of mother.

The digging of two burrow suggest that there are rather simple burrowing patterns, with sharp bents, probably for protection, and chambers, used as resting or turning points. All the animals spotted are in singles and during the night, giving a strict nocturnal and solitary behavior to the species. Though the data is limited but a few animals are sighted soon after the sun set, while the majority has been sighted after mid night. The long starvation of the previous night probably forces some of the animals to come out in the early hours of the night, but keeping the nocturnal character, the species basically exploits the middles and safer parts of the night for foraging. The animal basically is shy and tries to escape but when forced the animal may try to scare the intruders by erecting its quills and/or production of hissing sound by quills and or chattering of teeth.

Porcupine damages 16.5% of the mature mulberry, 8.6% of *Eucalyptus* sp. Plantations, through partial or complete debarking. Poplar and Sumbal plantation are not prone to damage. One year old Sheesham stockings are inflicted a damage of 8.7%, while no damage has been observed to Kikar. Sheesham nurseries are inflicted 4.7% damage by porcupine. Amongst cultivated crops melon faces 4.6% damage, while the damage remains low (0.5%) for onions.

The locally designed snares (cost Rs. 12. US \$ 0.2) have been successfully used for trapping the porcupine, though the technique for setting the snares needs to be further refined.

The hematological and histological studies have been undertaken for the first time in the species, and provide base line information for future reference. The labeled sketches/ photographs of skull, lower jaw, pelvic and pectoral girdles have been produced for the first time for the species and correlation between different parameters of skull and lower jaw have been attempted.

Project Title: *Developmental Biology, Feeding Pattern and Management Strategy against Indian Crested Porcupine (Hystrix Indica) in Sindh and Balochistan Provinces.*

Principal Investigator: *Mr. Amjad Pervez*
Senior Scientific Officer

Location of Project: *VPCI, Southern Zone Agriculture Research Centre (SARC), Karachi University, Karachi.*

Duration: 36(months)

Start Date: 1/7/2003

Project Status: On-going

Total Cost (million): 1.962

Funds Released (Rs): 1406300

Funds Utilized (Rs): 1158530
(Upto 30th June, 2005)

Objectives:

- To enhance the productivity of agricultural and forestry system of Sindh and Balochistan provinces.
- To quantify porcupine damage to tree stocking, surface vegetation cover and crops in Sindh and Balochistan provinces.
- To study reproductive biology, behavior and food habit preferences, energy budgeting and seasonality.

Achievements/Progress:

The project was initiated in July, 2003 with main objective to gain in-depth knowledge related to porcupine biology, feeding pattern and the management strategy in Sindh and Balochistan. During 2nd year of project life, one birth was recorded having two young. New born young weighted 350 gms. To ascertain the food and feeding performance of Indian crested porcupine *Hystrix indica* for cereal grains, rice millet and black gram were preferred over alternative candidate baits under paired choice test. Overall intake for rice remained the highest (352.00+30.42 gms) while wheat remained the least sampled grain (299.50+32.83 gms) for porcupine.

To undertake, porcupine damage and its management techniques, following sites were selected in Sindh province:

- i. Makli, Thatta
- ii. Pir Patho, Thatta
- iii. Jokhio Farm, Bin Qasim Town

Like-wise in Balochistan, following locations were selected in three districts of Balochistan Province:

- i. District Muslim Bagh
- ii. District Mustung
- iii. District Quetta

Pre-treatment damage survey of the sites revealed high damage to Pistacia spp especially fruit and tree trunk in Muslim Bagh area. Overall burrows (dens) were baited in which 66 burrowers were found inactive resulting in 93% success of control trials. A total of 425 personal including provincial Agricultural Department, NGO's and farmers participated in on field demonstration.

Project Title: *Quantification of maize yield losses from leaf blights and improving maize populations for grain yield and leaf blight resistance.*

Principal Investigator: *Dr. Hidayat-ur-Rehman*
Professor

Location of Project: *Department of PBG, NWFP Agriculture University, Peshawar.*

Duration: 36(months)
Start Date: 1/7/2003
Project Status: On-going

Total Cost (million): 2.173
Funds Released (Rs): 1225000
Funds Utilized (Rs): 889902
(Upto 30th June, 2005)

Objectives:

- Improve the existing maize germplasm for resistance to leaf blights and yield potential and therefore, enhance maize crop productivity in the maize growing belt of Pakistan in general and NWFP in particular.
- Obtain an estimate of the yield losses caused by leaf blights in maize growing belt of Peshawar and Swat valleys of NWFP.
- Determine the relationship between disease severity and grain yield loss caused by leaf blight.
- Develop yield loss models for estimating potential losses caused by leaf blight.
- Adopt an effective maize breeding methodology for improving yield and disease resistance to leaf blights.
- Quantify the expected gains in resistance to leaf blights using S₁ family selection.
- Develop maize populations having stay characters for dual use as green fodder for livestock.
- Increase the research capability of the institution by establishing foundation for long term maize breeding programs.

Achievements/Progress:

Preliminary results from the comparison of leaf blight inoculum as sporal suspension and ground powder were repeated during 2004 to further quantify the relative efficiency of the two inoculum forms.

During the second year 400 S₁ lines were produced by manual self pollination in each of the two populations which were tested in the field for yield and leaf blight resistance. Using 10% selection intensity, 40 superior lines were selected in each population for recombination in isolation during winter 2004 at Thattah (Sindh). The seed obtained from the recombined populations has been planted at NWFP AUP in March 2005 for producing S₁ lines and is under observation for yield and disease resistance testing in the subsequent crop season.

Project Title: *Integrated Nematode Disease Management (INDM) in some cereals, fruits and vegetables of Pakistan.*

Principal Investigator: *Dr. Shahina Fayyaz*
Officer Incharge

Location of Project: *National Nematological Research Centre, University of Karachi, Karachi.*

Duration: 36(months)
Start Date: 1/5/2003
Project Status: On-going

Total Cost (million): 3.435
Funds Released (Rs): 2579000
Funds Utilized (Rs): 2557750
(Upto 30th June, 2005)

Objectives:

- Nematode investigation of cereal, fruit and vegetable crops of Pakistan for the preparation of locality wise map indicating the nematode problem in different regions of Sindh, Punjab and N.W.F.P.
- Survey, taxonomy and morphology of nematodes associated with economically important cereal crop (rice and maize), sugarcane, vegetable, (tomato, potato) and fruit (Citrus, banana and coconut).
- Estimation if damage caused by nematodes to these important crops.
- To educate and train researchers and the extentionists for the identification of nematode problem in the field through a series of lectures and practical demonstration at NNRC.
- Chemical, biological and other methods of control will be demonstrated at the NNRC.

Achievements/Progress:

During the period of 1st July, 2004 - 1st June, 2005, extensive surveys of Sindh, Punjab and NWFP regions were carried out from 13 economically important agricultural crops viz., rice, sugarcane, tomato, okra, citrus, papaya, banana, mango, coconut, maize, cabbage, potato and apple plants and about 1000 root and soil samples were collected.

More than two hundred species of plant parasitic and soil nematodes belonging to about 9S genera 46 families and ten orders have been identified. One genus and 28 species are new to science, while 4,) genera and 22 species have been recorded for the first time from Pakistan. The various nematodes isolated from these samples were identified up to genus and species level. Among plant parasitic nematodes, the infestation of root-knot nematode *Meioidogyne* species and cyst nematodes were observed throughout these regions. Infestation of *Meioidogme* species was 60-700/1 indicating that the root-knot nematodes are on~ of the major 'pests of these agricultural crops followed by cyst nematodes with 50-60% infestations.

Besides plant parasitic and soil nematodes, entomopathogenic nematodes were also extracted from these samples and were identified as *Steinernema pakistanense* Shahina *et al.*, *S. asiaticum* Anis *et al.*, *S. feltiae* Filipjev, 1934 and *Heterorhabditis indica* Poinar *et ai.*,1992

These four virulent nematode species were cultured successfully in vitro mass scale using the chicken offal method (Bedding, 1984) for the control of insects pests of agricultural importance this technique of mass culturing of IJs is used for the first time in Pakistan.

Entomopathogenic nematodes are characterized by their ability to carry specific pathogenic bacteria *Xenorhabdus* for Steinernematidae and *Photorhabdus* for Heterorhabditidae. *Xenorhabdus* and *Photorhabdus* (family Enterobacteriaceae) are unique in the bacterial world and beneficial due to their ability to form a mutualistic symbiosis in one host and mount an aggressive pathogenic attack against a totally different phylum. They are reported for the first time from Pakistan.

For the management of plant parasitic nematodes aqueous extracts of various weed species were found effective in reducing the nematode soil treatment and bio-fertilizer (to be named later) also gave the same results.

Laboratory and field application of EPNs as bio-control agents have been made successfully against cotton pests and mango fruit flies and positive and promising results were obtained.

These results demonstrated the feasibility of using entomopathogenic nematodes to control insect pests on a commercial scale.

Project Title: *Development of heat tolerant wheat varieties.*

Principal Investigator: *Dr. Muhammad Aqil Khan*
Director

Location of Project: *Wheat Research Institute, AARI, Faisalabad.*

Duration: 36(months)

Start Date: 1/10/2003

Project Status: On-going

Total Cost (million): 2.955

Funds Released (Rs): 1555000

Funds Utilized (Rs): 1529963
(Upto 30th June, 2005)

Objectives:

- Screening and testing of wheat germplasm for heat tolerance and disease resistance.
- Incorporating of genes for heat tolerance into commercial and high yielding varieties.
- Testing of heat tolerant lines/ varieties at farmer's field/ Govt. Agri. Farms.

Achievements/Progress:

During the first year of study, 28 lines out of 442 lines tested showed heat tolerance. These and other 442 lines are tested again this year for confirmation of their inherent tolerance. 18 lines out of 442 showed promising heat tolerance and out of these 18, six lines were common with the last year's heat tolerant. Selected heat tolerant lines were utilized in the wheat hybridization program during this season to transfer the tolerant genes in the high yielding wheat varieties/ lines. Seed of these lines will also be sown and crossed in Kaghan Research Station to get an advance generation before the next wheat season starts.

Project Title: *Development of low cost plant protection technologies through integrated pest management approaches and use of sacrificial crop/plants in Sindh.*

Principal Investigator: *Dr. Abdul Sattar Buriro*
Entomologist

Location of Project: *Agriculture Research Institute, Tandojam, Sindh*

Duration: 36(months)

Start Date: 29/4/2004

Project Status: On-going

Total Cost (million): 2.877

Funds Released (Rs): 1175000

Funds Utilized (Rs): 1134963
(Upto 30th June, 2005)

Objectives:

- To develop IPM package for cotton & okra crops. The technology will provide alternate to pesticides for control of insect pests and grower can save inputs expenditure by 20%.
- To minimize pesticide use in cotton & okra based on low cost plant protection technologies. The pesticide use will be reduced by 30% and also will fulfill the WTO requirements.
- Dissemination of proven pest control technologies among farmers & extension workers through extension approaches. After dissemination of farmers and extension workers through extension approaches. After dissemination of farmers and extension workers awareness will be increased by 25%.
- Training of manpower. Capabilities of technical staff will be improved by 50% in advanced technologies to combat insect pests through pest management techniques.
- Development of linkage between growers, research and extension workers. After linkages between growers, researchers and extension workers. The feed back and coordination will be improved and focus will be given on farmer research oriented problems.

Achievements/Progress:

Experiments on host plants resistant studies against major insect pests in cotton and okra were conducted during 2004 at the Experimental Field of Entomology Section, Agriculture Research Institute, Tandojam.

Other experiments conducted in year 2004-05 are:

- Studies on crop phenology in relation to major insect pests in cotton and okra.
- To develop reduce spray programme for cotton and okra including inter-cropping of sacrificial crops/plants.
- Impact of sacrificial plants on pest build-up in cotton and okra.
- Training/Lectures imparted to growers, Extension workers and NGO'S regarding pest management techniques in cotton and okra. Lectures delivered for control of insects pest resulting increased yield of both crop.
- Ten post graduate students have been facilitated, the field work of their thesis along with technical supervision/guidance all have completed their thesis data on cotton and okra crops in the Experimental Area of the Entomology Section

Project Title: *Introduction and yield improvement of mothbean (Vigna unguiculata L.) in NWFP.*

Principal Investigator: *Dr. Muhammad Yaqoob*
Scientific Officer

Location of Project: *Agri. Research Institute, D. I. Khan*

Duration: 36(months)
Start Date: 1/5/2004
Project Status: On-going

Total Cost (million): 1.03
Funds Released (Rs): 556740
Funds Utilized (Rs): 555172
(Upto 30th June, 2005)

Objectives:

- Screening of mothbean lines/ germplasm for yield and Yellow Mosaic Virus (YMV).
- Study of yield reducing as well as yield enhancing factors of moth bean.
- Acclimatization studies of moth bean for wider adaptation.

Achievements/Progress:

Mothbean is one of the minor pulses used as dual purpose (food and fodder) crop. Unfortunately, this crop is eliminating from the farming system of the country due to attack of insects pest and yellow mosaic virus disease. There is no any variety of mothbean available at any research institution of Pakistan. Mothbean crop planted by the farmer are highly susceptible to YMV. Therefore, main focus of present research on moth bean was development of high yielding and yellow mosaic resistant lines.

The germplasm collected from various part of country remained highly susceptible to YMV. The entire field was severely infested with this dread disease offering an opportunity to screen out the germ plasm under high-disease pressure in field conditions. Luckily, many resistant plant of mothbean (with diversified plant habit and seed color and leaf shape) were identified with reasonable grain yield unlike thousands of susceptible plants that could not bear the flowers etc.

The plant selected, are of great value and being multiplies/tested for further studies for development of varieties.

Project Title: *Utilization of seaweeds in the biological control of soil borne pathogens and growth of crop plants.*

Principal Investigator: *Dr. Jehan Ara*
Associate Professor

Location of Project: *Phytotherapy Research Unit, Department of Biochemistry, Univeristy of Karachi, Karachi*

Duration: 36(months)

Start Date: 26/7/2004

Project Status: On-going

Total Cost (million): 1.780

Funds Released (Rs): 662850

Funds Utilized (Rs): 655350
(Upto 30th June, 2005)

Objectives:

- To collect and identify the potential seaweeds having nematicidal and fungicidal activity.
- To use potential seaweed as organic amendments alone or with microbial antagonists.
- To compare the efficacy of seaweeds with chemical fertilizers and pesticides.
- To develop a simple and cost effective method for the field application of seaweeds.
- To produce seaweed-based agrochemicals such as seaweed-extract products and seaweed fertilizer.
- To isolate and characterize fungicidal and nematicidal compounds from potential seaweeds.

Achievements/Progress:

During the studies 22 species of seaweeds *Caulerpa racemosa*, *Coelarthrum muelleri*, *Codium iyengarii*, *Codium sp.*, *Colpomina sinuosa*, *Dicfyota dichotoma*, *D.indica*, *Halimeda tuna*, *Iyengaria stellata*, *Jania capillacea*, *Padina pavonia*, *P.tetrastromatica*, *Rhizoclonium implexum*, *Sargassum binderi*, *S.swartzii*, *S. variegatum*, *Sciania shameelii*, *Solieria robusta*, *Spdtoglossum variabile*, *Stoechospermum marginatum*, *Stokeyia indica* and *Ulva lactuca* were collected from costal areas of Karachi under low tides. Seaweeds were washed under tap water, dried under shade and powdered in miller.

Of the 19 water extract of seaweeds were tested for nematicidal activity against juveniles of root knot nematode *Meloidogyne javanica*, *Padina pavonia*, *Caulerpa racemosa* and *Sargassum variegatum* caused more 50% juveniles mortality after 24 hours at 1 mg/ml. With increase in dose level i.e 10 mg/ml mortality of nematodes further increased. In addition of these three seaweeds, *Solieria robusta* also caused more than 50% mortality at 10 mg/ml. After 48 hours 50% or more mortality of nematode larvae was caused by *P.pavonia*, *C.racemosa*, *S. variegatum* and *S.robusta*. At 10 mg/ml more than 90% mortality was caused by *D.dichotoma*, *P.pavonia*, *C.racemosa* and *S. variegatum*. In dual culture plate assay ethanol extract of *Coelarthrum muelleri* and *Sargassum tennerrimum* inhibited the growth of *Macrophomina phaseolina* by producing a zone of inhibition of 9 and 12 mm respectively. Ethanol extract of *Padina tetrastromatica*, *C. muelleri*, *S. tennerrimum* and *Halimeda tuna* also suppressed the growth of *Rhizoctonia solani*. While water extract of *Codium sp.* Inhibited the growth of *R.solani*.

Solvent fractions such as n-hexane, chlorofonn and methanol soluble fractions of ethanol extracts of *Sargassum binderi* and *Codium iyengarii* tested produced more than 50 % mortality of juveniles after 24 hours @ 10 mg/ml. n-hexane and chlorofonn fractions of *Stokeyia indica*,

methanol fraction of *S. robusta* and n-hexane fraction of *J. capillacea* produced more than 50 % mortality of juveniles @ 10 mg/ml after 24 hours. N-hexane fraction of *J. capillacea* showed more than 50 % mortality of juveniles @ 1.0 mg/ml. After 48 hours, almost all the fractions (n-hexane, chloroform and methanol) of the seaweeds viz., *Stokeyia indica*, *S. robusta*, *J. capillacea*, and *C. iyengarii* showed more than 50 % mortality of juveniles @ 10 mg/ml. Whereas n-hexane fraction of *Stokeyia indica*, *J. capillacea* and *C. iyengarii* and chloroform fraction of *S. robusta* also showed more than 50 % mortality after 48 hours @ 1.0 mg/ml.

In screen house experiment, application of *Stokeyia indica* and *Solieria robusta* as soil amendment alone or with *Pseudomonas aeruginosa* significantly suppressed the infection of root infecting fungi and root knot nematode on chili roots and enhanced plant growth. Application of *Stokeyia indica*, *Solieria robusta* and *benlate*, a fungicide also significantly reduced *M. phaseolina* and *Fusarium solani* infection on chili seedlings in field plots.

Project Title: *Utilization of seaweeds in the biological control of soil borne pathogens and growth of crop plants.*

Principal Investigator: *Dr. Jehan Ara*
Associate Professor

Location of Project: *Phytotherapy Research Unit, Department of Biochemistry, Univeristy of Karachi, Karachi*

Duration: *36(months)*

Start Date: *26/7/2004*

Total Cost (million): *1.780*

Funds Released (Rs): *662850*

Funds Utilized (Rs): *655350*
(Upto 30th June, 2005)

Objectives:

- To collect and identify the potential seaweeds having nematicidal and fungicidal activity.
- To use potential seaweed as organic amendments alone or with microbial antagonists.
- To compare the efficacy of seaweeds with chemical fertilizers and pesticides.
- To develop a simple and cost effective method for the field application of seaweeds.
- To produce seaweed-based agrochemicals such as seaweed-extract products and seaweed fertilizer.
- To isolate and characterize fungicidal and nematicidal compounds from potential seaweeds.

Achievements/Progress:

During the studies 22 species of seaweeds *Caulerpa racemosa*, *Coelarthrum muelleri*, *Codium iyengarii*, *Codium sp.*, *Colpomina sinuosa*, *Dicfyota dichotoma*, *D.indica*, *Halimeda tuna*, *Iyengaria stellata*, *Jania capillacea*, *Padina pavonia*, *P.tetrastromatica*, *Rhizoclonium implexum*, *Sargassum binderi*, *S.swartzii*, *S. variegatum*, *Sciania shameelii*, *Solieria robusta*, *Spdtoglossum variabile*, *Stoechospermum marginatum*, *Stokeyia indica* and *Ulva lactuca* were collected from costal areas of Karachi under low tides. Seaweeds were washed under tap water, dried under shade and powdered in miller.

Of the 19 water extract of seaweeds were tested for nematicidal activity against *juveniles* of root knot nematode *Meloidogyne javanica*, *Padina pavonia*, *Caulerpa racemosa* and *Sargassum variegatum* caused more 50% *juveniles* mortality after 24 hours at 1 mg/ml. With increase in dose level i.e 10 mg/ml mortality of nematodes further increased. In addition of these three seaweeds, *Solieria robusta* also caused more than 50% mortality at 10 mg/ml. After 48 hours 50% or more mortality of nematode larvae was caused by *P.pavonia*, *C.racemosa*, *S. variegatum* and *S.robusta*. At 10 mg/ml more than 90% mortality was caused by *D.dichotoma*, *P.pavonia*, *C.racemosa* and *S. variegatum*. In dual culture plate assay ethanol extract of *Coelarthrum muelleri* and *Sargassum tennerrimum* inhibited the growth of *Macrophomina phaseolina* by producing a zone of inhibition of 9 and 12 mm respectively. Ethanol extract of *Padina tetrastromatica*, *C. muelleri*, *S. tennerrimum* and *Halimeda tuna* also suppressed the growth of *Rhizoctonia solani*. While water extract of *Codium sp.* Inhibited the growth of *R.solani*.

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In screen house experiment, application of *Stokeyia indica* and *Solieria robusta* as soil amendment alone or with *Pseudomonas aeruginosa* significantly suppressed the infection of root infecting fungi and root knot nematode on chili roots and enhanced plant growth. Application of *Stokeyia indica*, *Solieria robusta* and benlate, a fungicide also significantly reduced *Mphaseolina* and *Fusarium solani* infection on chili seedlings in field plots.

Project Title: *Transgenic tomato with resistance to bacterial wilt.*

Principal Investigator: *Dr. Zubeda Chaudhry*
Scientific Officer

Location of Project: *Scientific Officer, ABP, NARC, Islamabad*

Duration: 36(months)

Start Date: 25/10/2004

Project Status: On-going

Total Cost (million): 4.085

Funds Released (Rs): 1453833

Funds Utilized (Rs): 879631
(Upto 30th June, 2005)

Objectives:

- Amelioration of tomato cultivars through Agrobacterium mediated transformation to develop resistance against bacterial wilt disease.
- Selection of desired R1 & R2 transgenic lines in the glass house.

Achievements/Progress:

Bacterial wilt of tomato, caused by *Ralsotonia solanacearum* is a major constraint in tomato production in Pakistan. Control of bacterial wilt is difficult because the pathogen is soil borne and has a wide range. Varying levels of resistance to phytopathogen occur naturally in crop plants and, resistance through conventional agriculture is only needed in situations where economic advantages are concerned like staple food in developing countries. Under these conditions the use of resistance varieties is a key method. The process of identifying new sources of resistance and moving genes for resistance in to commercial varieties through conventional breeding is very slow almost 12 years and longer. Therefore there is an interest in rapidly creating plant resistance to pathogens through genetic engineering. For development of resistance to bacterial wilt, high frequency regeneration from various tomato cultivars was established as a first step of transformation studies.

So this project is focused on developing transgenic tomato resistance to bacterial wilt. For this purpose, various varieties of tomato were used in the studies. The report comprised of results obtained from three tomato cultivars. Seeds of Roma, Riogarande and Moneymaker were inoculated on the MS plain medium for the growth of *in-vitro* seedlings. Eight different combinations were tested for callus induction. For callus induction MS medium supplemented with different concentrations of NAA, BAP, IAA, 2ip, 2, 4-D, GA3 and Kinetin were used. Maximum callus induction frequency was observed from Riogarande (83.3% in hypocotyls and 78% for the leaf discs), followed by Roma (80% for hypocotyls and 70 % for the leaf discs) and Money maker (70% for the hypocotyls and -50% for the leaf discs), The media combination of NAA 1mg/l along with 2ip 0.5 mg/l proved to best for callus induction in Riogarande, 2ip 2mg/l and IAA 0.5 mg/l for Roma, IAA 1mg/l and Kinetin 0.5 mg/l for money maker. *Calli* obtained from the leaf discs were fleshy green and having a regenerative potential, 4-5 shoots coming out from each callus.

Project Title: *Development of heat tolerant, early maturing and high yielding mungbean (Vigna radiata (L) Wilczek) genotypes*

Principal Investigator: *Dr. Gul Sanat Shah*
Senior Scientific Officer

Location of Project: *Nuclear Institute for Food and Agriculture (NIFA), P.O. Box 446, Peshawar*

Duration: *36(months)*

Start Date: *1/7/2004*

Total Cost (million): *1.674*

Funds Released (Rs): *747000*

Funds Utilized (Rs): *593974*
(Upto 30th June, 2005)

Objectives:

To develop improved mungbean genotypes with traits as bellow:

- Short duration (60-65 days to maturity)
- Heat tolerant (above 40⁰C)
- Short stature (50-60 cm)
- High seed yield (1.0-1.5 t/ha)

Achievements/Progress:

Two mungbean varieties i.e. NM 92 and NM 98 were selected to create genetic variability through induced mutation for heat tolerance, early maturity and high yield potential. One kg healthy seed with uniform size of each variety for each dose was prepared for irradiation. The seed was subjected to 0.2, 0.3 and 0.4 Kgy doses of gamma rays using ⁶⁰CO gamma cell. The treated seeds (M₁ seed) were directly planted in close spacing dose/variety wise in isolation in the field at NIFA research farm during kharif 2004. Nonnal cultural practices were carried out during the entire growth period. All M₁ plants were harvested dose/variety wise as single plants. Single pod per plant was randomly picked from each plant and bulked dose/variety wise to get bulk M₂ populations for bulk method of breeding.

M₂ seeds of each dose of the two varieties harvested from kharif 2004 were planted along with parents during summer 2005. Due to unexpected rains this year, the summer crop sowing was delayed till first weak of April instead of planting in mid March. The temperature-below 40⁰ C during flowering and pod formation was another natural factor, which made difficult the evaluation of segregating populations in high temperature environment and to select heat tolerant plants in M₂ generations. Next year in summer season, the selected material will again be evaluated for heat tolerance if temperature rises above 40⁰C during flowering and pod formation. However single plants have been selected dose wise from M₂ -populations of NM 92 and NM 98 on the basis of visual observation for early maturity, short stature, more number of branches and pods, and good plant type. The crop is in field at maturity stage. Harvesting, threshing and laboratory grading for seed size of the selections will be completed soon. The final selected single plants will be planted during kharif 2005 as M₃ populations. The bulk M₁ seed of NM 92 and NM 98 picked during kharif 2004 will also be planted as bulk M₂ generation during kharif 2005.

Hybridization of selected germplasm i.e. NM 19-19, NM 54, NM 92, ML-5 and NM 98 is in progress for enhancing genetic variability through classical breeding approaches. F₁ generation of the successful crosses will be raised in kharif 2005.

Project Title: *Development and evaluation of a mobile flat-bed dryer for sunflower and canola.*

Principal Investigator: *Dr. Munir Ahmad*
Principal Scientific Officer

Location of Project: *FMI, National Agricultural Research Centre, Islamabad*

Duration: 36(months)

Start Date: 1/7/2004

Total Cost (million): 2.550

Funds Released (Rs): 1498000

Funds Utilized (Rs): 903044

(Upto 30th June, 2005)

Objectives:

- To develop and evaluate a drying technology for sunflower and canola in order to reduce post harvest losses.
- To develop a mobile flat-bed dryer for sunflower and canola.
- To evaluate the performance of this dryer by drying sunflower and canola.
- To perform the economic analysis of the mobile flat-bed dryer.
- To demonstrate this dryer to sunflower and canola growers and local manufacturers.

Achievements/Progress:

A survey of sunflower growers was conducted in Gujranwala, Sialkot, Vehari, and Multan Districts in order to assess their status quo. The key questions were asked about the acreage sown under sunflower crop, method of harvesting, method of drying, percent loss during drying, need for dryer, capacity of the dryer, and preferable fuel to be used for the dryer.

The survey results revealed that in Gujranwala, and Sialkot Districts on average the land holding of the sunflower growers was about 67 acres. Forty four per cent of the sunflower growers have the rented land. The average sunflower cultivation per grower was about 42 acres. And the average yield was about 870 kg/acres. Almost all the sunflower growers harvest sunflower manually, and then they thresh it with the combine harvester. They were not satisfied with this technique, because in case of rainfall on manually harvested crop, the sunflowers absorb moisture, and do not remain fit for threshing. In case of heavy rain, the whole crop can be wasted. At present, the farmers are sun drying their crop, however, they are not satisfied with this method of drying. On average about 20 to 25% crop was wasted, because of the un-timely rainfall. They were of the opinion that there is need for dryer, and the capacity of the dryer should be about 2.8 tons/batch. Fifty percent growers were in favour of gas as preferable fuel for dryer, thirty three percent was in favour of both gas and diesel, whereas 17% were in favour of diesel.

In Multan and Vehari Districts, the majority of the farmers were of the view that the drying capacity of the dryer should be about 2.5 to 3.0 tons/batch. The preferable dryer fuel for 49% farmers were diesel, 42% were in favour of both gas and diesel, whereas the remaining (9%) were in favour of gas. In Chakwal, and Attock Districts the canola growers were in favour of having a dryer. They proposed the drying capacity of about 2.0 tons/batch. About 50% canola growers were in favour of gas as a preferable fuel, whereas the rest (50%) were in favour of both gas and diesel.

Based on survey results, and the literature review the design specifications of the flat-bed dryer were prepared and the requirements of the material needed for developing flat-bed dryer was worked out, and necessary steps were taken to purchase this material through NARC consolidated tender. After ten months struggle, finally we had received the material for developing the first prototype of the dryer.

Project Title: *Management of weed in wheat-Maize cropping system in Barani areas of Potohar. (Component - NARC)*

Principal Investigator: *Dr. Tahira Zafar Mehmood*
Principal Scientific Officer

Location of Project: *IPEP, National Agricultural Research Centre, Islamabad*

Duration: 36(months)
Start Date: 1/4/2004
Project Status: On-going

Total Cost (million): 4.036
Funds Released (Rs): 1438500
Funds Utilized (Rs): 315826
(Upto 30th June, 2005)

Objectives:

- Improvement of weed management techniques.
- Campaign against problem weeds.
- Transfer of long term weed control techniques to the farmers.

Achievements/Progress:

Weeds are a part of agriculturists every day life. Through weed control is being carried out by our farmers, unfortunately it is never planned. The decision is not made until the weed problem has become serious. Therefore, it is imperative, that the management of weeds may be done at the right time in the right way to get a long-term stabilization of weed density at a sub-economic level. The project work was initiated on April 1, 2004. Results have been summarized below.

Maize (*Zea mays* L.) after wheat and rice is the third important cereal in Pakistan. Rainfed maize fields are mainly dominated by grasses. In 2004, two experiments were laid out in maize, one at NARC in the experimental area and the other at Fatehjang in the farmers field. Weeds recorded at NARC from the maize fields included grasses, sedges and broad leaf weeds. At harvest, lowest density of weeds was recorded in Primextra sprayed plots followed by Dual Gold and Round up sprayed. Total number of maize plants, stalk weight and other components were highest in Primextra sprayed plots followed by Dual Gold. Grain yield was significantly high in Primextra sprayed plots as compared with other treatments. Eighteen weeds were recorded from Fatejang. Considering the yield components, significantly highest grain yield was recorded in Primextra followed by Hand Weeding. Therefore, Primextra appears to be the best treatment.

Nutgrass, *Cyperus rotundus* is widely regarded as the worst and most widespread weed in the world it is considered to be among the worst 10 weeds. Within the arable ecosystem there are many beneficial organisms that feed on crop pests to the extent that pesticide use may be reduced or made unnecessary. Nutgrass was infested both by *Athesapeuta cyperi* that commenced from 12-07-04 and terminated after 5-08-04 and *Bactra* spp. (*B. venosana* = *B. truculenta* and *B. minima*) that was first recorded on 2-8-04 and continued till 16-9-04. The infestation peak:was reached in the first week of August and lasted till the second week of August. In the first week of August both the insects were found. After which only the tortricid was recorded. In 2004 *A. cyperi* and *Bactra* spp. remained in the field for 25 days and 46 days respectively. An artificial increase in the population of *Bactra* spp. early in the season would result in greater damage to nutgrass.

Wheat (*Triticum aestivum* L.) is the number one crop of Pakistan. Broadleaf as well as grassy weeds are responsible for causing crop losses. The weed problem in wheat has increased with the introduction of dwarf varieties.

At NARC and Fatehjang all herbicides showed sufficient control of weeds. Among the herbicides, Affinity showed the lowest weed density followed by Buctral-M.

While studying the effect of sowing dates of wheat on weed population it was obvious that weed density gradually decreased from January to May in wheat of both sowing dates. Overall weed population was higher in wheat sown on 14-12-2004. In an experiment on the effect of wheat seed density on weed population, it reached its highest peak in March, thereafter it declined in April and May.

Project Title: *Integrated weed control for major rabi crops (wheat & rapeseed) and fallow land in Pothwar. (UAA, Rawalpindi Component-II)*

Principal Investigator: *Dr. Muhammad Azim Malik*
Professor

Location of Project: *Department of Agronomy, University of Arid Agriculture, Rawalpindi*

Duration: 36(months)

Start Date: 9/7/2004

Project Status: On-going

Total Cost (million): 2.236

Funds Released (Rs): 674350

Funds Utilized (Rs): 625205

(Upto 30th June, 2005)

Objectives:

- To develop economically suitable weed control technology package for wheat, rapeseed/ mustard and fallow land in Pothwar by the combined use of mechanical, chemical and cultural methods.
- To study the economics of integrated weed control methods to be developed in comparison with traditional weed control practices in Pothwar and their impact on

Achievements/Progress:

The project started in July, 2004. A planning meeting of Principal Investigator (PI.), Co-PI and the collaborating scientists was arranged. Two experimental sites Rawalpindi and Chakwal, high and medium rainfall, respectively, were selected. Rabi trials were carried out at farm area of University of Arid Agriculture, Rawalpindi and experimental area of Barani Agricultural Research Institute, Chakwal.

The rabi trials were planted according to the plan of work. The results of the rabi trials showed that performance of canola was better at Rawalpindi as compared to Chakwal. This might be due to good soil texture and good moisture regime of Rawalpindi soil. Among the different integrated weed control practices chemical + tirplali and herbicide treatments along with side dressing/ banding of NPK suppressed weeds and produced relatively less weed biomass at harvest. Similarly, the performance of wheat was better at Rawalpindi site relative to Chakwal. Among the different weed control methods, barharrow (2 way) treatment along with side dressing of NPK and narrowest row spacing of 6 inches, produced highest grain yield. These treatments were on the top when the questions of weed control arose.

Efficacy of nine different post emergence herbicides was also determined at Rawalpindi site. All herbicides increased grain yield as compared to weedy check, but the differences between herbicides for grain yield was non significant. It might be due to heavy rain after treatment application. Weed survey of the two districts of Rawalpindi division was carried out during the rabi season, 2004.

Trials regarding integrated weed control in fallow land have been finalized and different treatments for this purpose have been applied. Certain recommendations will be made after collecting and analyzing the two-year data, but now its a pre-mature stage to recommend any integrated weed control practice for the farmers of Pothwar region in wheat and canola crop.

Project Title: *Weed management studies of wheat and cotton crops in Sindh (ARI, Tandojam Component-V)*

Principal Investigator: *Dr. Muhammad Allah Ditta Jarwar
Plant Pathologist*

Location of Project: *Agriculture Research Institute, Tandojam*

Duration: 36(months)

Start Date: 13/5/2004

Project Status: On-going

Total Cost (million): 2.154

Funds Released (Rs): 989646

*Funds Utilized (Rs): 859528
(Upto 30th June, 2005)*

Objectives:

- To study different methods of weed control, including, cultural, mechanical and chemical for wheat and cotton crops.
- To determine weed crop competition periods and their effects on yield of wheat and cotton crops.
- To determine the economics (cost benefit ratio) of different weed control methods.
- To develop modern weed control technology for farming community.
- To disseminate the technology developed of the farming community through training manuals advisory leaflets, farmers training extension workers training field open days farm trials workshop and seminars.

Achievements/Progress:

Experiments on new weed management techniques like, mulch techniques in cotton crop was conducted during kharif-2004 season at the experimental field of Plant Physiology Section, Agriculture Research Institute, Tandojam. Diagnostic survey regarding the weed problems in wheat and cotton growing areas of Sindh i.e. Sanghar and Mirpurkhas districts have been conducted. Experiments related with cultural and chemical weed control in wheat crop, during Rabi 2004-05 season was conducted at the experimental area of Plant Physiology Section, Agriculture Research Institute, Tandojam.

Training events for growers/ NGOs and have been organized and lectures/ regarding weed and weed control crops have been delivered for maximizing the yield of both crops in the project area. Four post graduate students have been facilitated the field work of their thesis alongwith technical supervision/ guidance, all have completed their thesis data on cotton and wheat crops in the experimental area of the section. Plant Physiology Section has been strengthening with necessary facilities and laboratory material like computer P-IV alongwith scanner/ all other accessories power sprayers and hand sprayers, office chairs, book/ journals and refrigerator under ALP Project assistance as fixed assets.

Project Title: *Screening of drought tolerant wheat genotypes and estimation of genetic basis.*

Principal Investigator: *Dr. Muhammad Munir
Professor & Chairman*

Location of Project: *Dept. of Plant Breeding and Genetics, University of Arid Agriculture,
Rawalpindi*

Duration: 36(months)

Start Date: 1/7/2004

Project Status: On-going

Total Cost (million): 1.967

Funds Released (Rs): 967000

Funds Utilized (Rs): 390082

(Upto 30th June, 2005)

Objectives:

- Testing and screening of drought tolerant wheat germplasm.
- To study the genetic basis of drought tolerance.
- Incorporation of genes for drought tolerance into high yielding varieties.

Achievements/Progress:

To screen drought tolerant wheat genotypes, the following activities were undertaken during the period under report.

Field Trial Conducted at UAAR

One set of field trial comprising of forty wheat genotypes was conducted at UAAR during the period under report.

The results revealed that there were very limited differences among genotypes for days to heading. Least days to heading were taken by INQLAB-91 (117) whereas maximum days to heading were taken by three cultivars VIZ., CHAKW AL-86, 2495 and 3C061 (129). Similarly Inqlab-91 took least days to maturity (163). Wheat cultivars HAIDER-2000, 99-FJ016, 99-FJ03 and 3C061 took maximum days to maturity (173). A wide range for grain filling period was exhibited by the material under trial. It ranged from 31 days (2495) to 52 days (IQBAL-2000, 00-FJ03, 1CO07). Maximum dry weight at heading was produced by 98CO10 (684.5) followed by 00-FJ03 (644.5), 00BTO04 (642.8) and V-02169 (630.1). The lowest dry matter at heading was produced by 3C069 (340.6). Rawal-87 produced maximum dry weight at maturity (2714) that produced second lowest dry weight at heading (390.8). It was followed by INQLAB-91 (2525) and CHAKWAL-97 (2480). Thousand grain weight appeared to be independent of grain filling period as 3C069 despite availing 45 days as grain filling period produced highest 1000 grain weight (47.4) as compared with OOCO 10 that utilized 43 days for grain filling and only succeeded to accumulate only 28.4g as 1000 grain weight. Uqab-2000 produced second boldest grain by producing 45.8g for 100 grain weight. Highest yield of 6313 kg/ha was produced by NR-234 followed by 3C062 (6173 kg/ha) and I C020 (6063). Lowest yield kg per hectare was produced by 3C066 (2810).

Field Trial Conducted at BARI, Chakwal

Field testing of second set was conducted at BARI, Chakwal to evaluate the performance of same forty wheat cultivars under rainfed conditions. The data were analyzed according to standard analysis of variance techniques and genotypic means were separated through LSD at 5% level of probability. The analysis revealed significant differences among genotypes for all the parameters studied depicting differential response of genotypes under rainfed conditions.

Dry matter production at flowering stage ranged from 113.5 (V-02169) to 348.7 grams (3C067). Wheat cultivar 3C068 produced highest biomass whereas Khyber- 87 produced minimum biomass (234.5 grams) at maturity. Though wheat cultivar 2495 took least days to flower but 99-FJO16 was earliest on overall basis. The wheat cultivar despite utilizing longest grain filling period produced medium 1000 grain weight (46.7g) and yield (4542 kg/ha). It is interesting to note that wheat cultivar 3C068 utilized least grain filling period, however it exhibited reasonably good 1000 grain weight (43.2 g) and yield (4016kg/ha). Highest 1000 grain weight (55.8g) was produced by NR-234 whereas maximum yield was produced by 3C067 (5095 kg/ha). Wheat cultivar 3C068 beside being the highest yielder was also among top 1000 grain weight (50.3 g) producing cultivars though it had a relatively shorter grain filling period (34.7 days).

Laboratory Experiment

Forty varieties lines of wheat were evaluated over four different moisture regimes (control, 15% PEG, 20% PEG & 25% PEG) and data for nine traits viz., germination percentage, germination rate index, shoot length, root length, coleoptile length, fresh shoot weight, dry shoot weight, fresh root weight and dry root weight were recorded.

To find out drought tolerant genotypes, for each said trait, percent of control values on the basis of highest drought stress treatment (25% PEG) were obtained. The genotypes were ranked on the bases of percent of control data for each trait by assigning 40 points for the genotype which showed maximum tolerance and 1 point for the genotype which showed minimum drought tolerance among the 40 genotypes. By this way cumulative ranking was assigned to each genotype by adding the ranking of all the traits under report. The line 1C007 showed the highest drought tolerance followed by 3C066 with 308 and 290 cumulative points, respectively. The minimum drought tolerance was showed by 3C062 and 1C001 with cumulative points of 23 and 35, respectively. The 20 lines showing relatively best drought tolerance were selected to include in crossing program for next year.

Project Title: *Development of integrated pest management for Subterranean Termites in agro-ecosystem.*

Principal Investigator: *Dr. Sohail Ahmad*
Assistant Professor

Location of Project: *Deptt. of Agri. Entomology, University of Agriculture, Faisalabad.*

Duration: 36(months)
Start Date: 1/7/2004
Project Status: On-going

Total Cost (million): 2.625
Funds Released (Rs): 1113000
Funds Utilized (Rs): 663221
(Upto 30th June, 2005)

Objectives:

- To determine the like range of biotic and abiotic factors that will influence termite establishment
- Applied research, using knowledge of the basic biology and behavior of termites to develop and assess control strategies, that precisely target the economically important subterranean termites in the crops, and that minimize the use of pesticides in and around structures, and crops.

Achievements/Progress:

Development of soil samplers for estimation of termites counts in experiments. In order to take soil sample of size to specify termites number per unit, following implements were tested viz. Soil auger, soil samplers (three types of different dimension) and corrugated cardboard bait in PVC pipe, latter being represent the relative number of termites. Detail of each method with advantages and demerits are explained in report.

Comparison of methods for monitoring the termites population:

In this experiment, various baiting materials were evaluated for use in agro-ecosystem.. The wooden stakes (poplar and Eucalyptus), coriugated cardboard and toilet roll were used as baits. The termites in the field of sugarcane occupied the corrugated cardboard rapidly. The sign of the attack on toilet roll was seen after 15 days and 1½ month was taken for the total consumption of a toilet roll. Wooden stakes showed sign of the attack at the second month of installation.

Vertical distribution of termites in sugarcane fields:

Population of the termites at 10, 20 and 45 cm depth of different soil types was determined in the sugarcane fields in order to standardize the sampling of the termites, which were mostly present in samples of 20 cm depth of soil. At all three places, 45 cm harboured minimum number of termites followed by 10 cm.

Population Dynamics:

Population dynamics of the subterranean tennites was studied in maize, sorghum, bajra, groundnut, mungbeans, chickpea, wheat and sugarcane at Chakwal, Bhakkar Jhang, Faisalabad. In Chakwal, seasonal mean number of termites in ridge and flat sowing of maize was

30.80±2.98 and 34.65±2.27, respectively. The number of termites in sorghum and bajra is given in table. The number of termites was higher in the fields of bajra than sorghum with seasonal average 229.5 and 160.3 respectively; peak population was observed in 2nd fortnight of December in wheat. In Bhakkar, number of termites in fields of mungbean was high in June but decreased in July and rose in August to maximum, (ca. 200 per pipe), and declined to minimum in second fortnight of September; number declined in chickpea field during January and from February to April termites count was high but not level of November 2004; number of termite foraged rose from 24-11-2004 to 24-12-2004, but then declined up to 22-2-2005. The foraging termites again build up their number in pipes during March and April. In Faisalabad, termites showed peak population in May and in Jhang, January was peak time for maximum activity of termites; these peaks vary with sowing time of the crop. The relationship of termites count with various chemical features of soil and physical factors of the environments has also been studied.

Assessment of damage by termites in different crops

Damage to crops by termites was also assessed in groundnut, maize and wheat. This damage can be attributed to additional food search by termites. No regular pattern was present and damage was mostly in patches but appearance of these patches was highly unpredictable.

Population and damage assessment in roses

Cut flowers (especially roses) are attacked by termites if not given proper attention, which relates with timely irrigation and use of insecticides.

Chemical control of termites in different crops

For the protection of the sugarcane setts, insecticide dip method was adopted. Solution of imidacloprid 200SL, cypermethrin IOEC, fipronil 50SC, basudin 60EC, bifenthrin 10EC and chlorpyrifos 40EC were made in water in 3 concentrations, viz., 0.25, 0.5, and 1 %. Setts were dipped in the solution for 5 minutes.. Apart from control with 14.33 % damage cypermethrin proved least effective in protecting the sugarcane setts, it was statistically at par with imida.cloprid, basudin and bifenthrin at 1, 0.5 and 0.25% concentration. Though statistically at par with cypermerthrin, bifenthrin and basudin had more than half less eyes damage.d. Chlorpyrifos and fipronil recorded lowest eye damage and had non-significant difference between each other.

Comparison of two methods of insecticide application for termites control in a field of cotton showed that on numerical basis 88% reduction in the number of the termites at 3rd day after application was observed and the reduction percentage further increased up to 21 5t day after application. The number increased slightly after that but was never to level at 3rd day when insecticides were applied with irrigation water. Application of the insecticides preceding irrigation did not follow the above trend.

The control of termites with insecticides was highly variable at different places e.g., In Bhakkar, chlorphyrifos gave the best control with minimum seedlings damage as compared to the_plots treated with imidacloprid and the monomehypo, whereas, Actara (thiamethoxam) was as effective as Lorsban (chlorpyrifos) on setts, however, chlorpyrifos proved more efficacious than Actara as soil application in Jhnag.

Termites infestation on trees neighboring the field crops

Shisham was the most abundant trees at most of agricultural setting and was heavily infested at certain places. After shisham, *Acacia arabica* was second most infested tree in the areas survey for the study.

Habitat diversity

In this section, a number of experiments were carried out which are as follows:

- i. Comparison of termite count in plots provided with organic matters;
- ii. Termites in fallow vs ploughed agricultural fields;
- iii. Termites in wheat field with and without addition of organic matter (rice husks);
- iv. Comparison of termite counts in zero tillage and normal tillage methods in wheat at Faisalabad and Gujranwala;
- v. Studies on termites count by use of different methods of sowing and types of implements in wheat fields.

A non-significant difference was among the treatments at all intervals, from 13-3-2004 to 5-1-2005 between plots provided with chopped parts of *Calotropis procera*, rotten leaves debris of shisham and rotten farmyard manure.

The difference of termite individuals in fallow and ploughed land (wheat) was calculated by Mann Whitney Confidence interval and test at $p=0.05$. The individuals foraged on fallow land were more in number as compared to ploughed up land, which was later sown by wheat. Kruskal Wallis test was performed to compute the difference in fallow and ploughed up land. P-value was again $P<0.05$, indicating a significant difference between termites in fallow and ploughed up land.

Kruskal Wallies-test also reveals statistically significant difference between termite individuals in the field with and without rice husk, having $P<0.05$. A non-significant difference in number of termite individuals, appeared in pipes installed in zero tillage and normal tillage wheat field, was found on overall basis. Statistical difference between zero tillage and normal tillage field was non significant ($P=0.61$) and median termites were 4.0 and 3.0, respectively. This is based on all the observation at Faisalabad and Gujranwala, collectively.

Overall, median termites were 10 and 17 in drill and broadcast methods, respectively, having highly significant difference ($P<0.0002$) between each other. On overall basis, termite average rank were 1070.4, 1117.5 and 1053.6, respectively in T1, T2 and T3 with $P>0.05$, a non-significant difference among the ploughs with regarding to foraging of termites. T1, T2 and T3 represent chisel, moldboard and normal plough. The termites were counted on cardboard in PVC pipes. The dynamics of chemical and physical characteristics of soil in all these experiments was also determined. Effect of these has been related with termites counts and discussed in detailed report.

Evaluation of plant chemicals against gut bacteria in different species of termites. Seed and leaves extract of *Withania somnifera*, followed by *Croton tiglium* and *Solanum nigrum* were toxic to two termite species studies. These chemicals not only disrupted the tunneling behaviour

but also affected the gut bacterial colonies. Relationship of concentration and time has also been reported extensively.

Effect of Tenniticides (insecticides) on the total number of soil bacteria under laboratory and field condition

Bifenthrin and carbofuran under laboratory and field conditions stimulated the growth of bacterial colonies at certain concentrations, whereas chlorpyrifos reduced the number of bacterial colonies.

Project Title: *Development and testing of a resource conservation tillage implement.*

Principal Investigator: *Dr. Jehangir Khan Sial*
Professor

Location of Project: *Faculty of Agri. Engineering & Technology, University of Agriculture, Faisalabad.*

Duration: 36(months)
Start Date: 1/10/2004
Project Status: On-going

Total Cost (million): 1.910
Funds Released (Rs): 375625
Funds Utilized (Rs): 378425
(Upto 30th June, 2005)

Objectives:

- Select and test the locally available materials for construction of sweep shovels.
- Investigating variations in different engineering parameters (suction, pitch, lift, angle of attachment and thickness of plate) for design of the shovels.
- Attachment and testing of a depth wheel with the sweep cultivator for facilitating its penetration control.
- Comparative testing of the sweep cultivator developed using local materials and workmanship.
- Information dissemination for adoption of the implement

Achievements/Progress:

A detailed survey for identification and availability of materials for manufacturing weeps was conducted. The survey included visits to various places throughout the country. Generally it was learnt that the materials of varying qualities were available in sufficient quantities in the country for small/large scale manufacturing of the sweep shovels anticipated to be developed in the present project. Moreover, it was delightfully learnt that materials of desired composition can also be manufactured in Karachi shipyard facility. However, the order for such a consignment should not be less than one ton of material. This information was quite valuable since the project personnel are also interested in selecting a new material that should resist shocks and at the same time possess least wearing characteristics while working in the soil.

Similarly it was learnt that there are many implement manufacturing industry well equipped to manufacture sweep shovels, Faisalabad being the hub of such activities. During second half of the reported period, materials were selected for manufacturing of the sweep shovels and their development was initially started using local facilities at Faisalabad. Two companies of good repute for innovative development e.g. Danishmand & Company, Gobindpura were assigned the task of development. Sweep shovels of varying design specifications are at various stages of preparations. They are depth wheels is also compete. It was thoughtfully designed that two depth wheels installed on two sides of the implement would enable the depth control of implement in addition to maintaining the static as well as dynamic balance of the cultivator. Work is in progress and sailing smoothly as planned except that project started late due to availability of the last week of October. Now the project team is planning to embark upon the field testing of the tool and the implement.

Project Title: *Better utilization of food for healthy and productive life in agriculture sector*

Principal Investigator: *Dr. Alam Khan*
Professor

Location of Project: *Department of Human Nutrition, NWFP Agricultural University, Peshawar.*

Duration: 36(months)

Start Date: 1/7/2004

Project Status: On-going

Total Cost (million): 2.278

Funds Released (Rs): 1227000

Funds Utilized (Rs): 145550

(Upto 30th June, 2005)

Objectives:

- To know the eating pattern/habits, intake levels of energy, macro and micro nutrients of the agriculturists residing in the plain districts of NWFP.
- To analyzed the foods of agriculturists for macronutrients (Protein, Carbohydrate and Fat) and micronutrients i.e. vitamins A, C and Folic Acid and minerals Calcium, Iron and Zinc.
- To know the energy distribution amongst the macronutrients.
- To assess the nutritional status of agriculturists from the collected (questionnaire) and analyzed (duplicate samples) data.
- To prepare guidelines for good eating habits and develop methods for balanced diet from the findings of the research project for the Agriculture communities of the plain districts of NWFP.

Achievements/Progress:

Nutrient and energy intake, nutrimental status and composition of home prepared dishes of farmers living in three selected villages of district Peshawar and three selected villages of district Mardan were determined. Hundred farmers from each selected village of the districts were randomly selected with the criteria that the farmers should be of age 18 or above and he should be practically involved in farming. Information about his personal history and his dietary intake for three alternate days of the week was recorded in a questionnaire by dietary recall method to know the nutrients and energy intake and to determine the nutritional status of the farmers. From 20% of the selected farmers of each village, duplicate food samples were collected for laboratory analysis to know the nutrients and energy intake and to determine the nutritional status of the farmers by this method. Also from 20% of the selected farmers of each village, prepared dishes were collected for chemical analysis.

By dietary recall method, the farmers of the selected villages of Peshawar and Mardan were slightly deficient in protein intake, more deficient in fat intake and also deficient in folic acid and iron intake. Carbohydrate, vitamin A, vitamin C and zinc intakes were more than the requirement. Energy and calcium were in the normal range. The analyses of duplicate food samples are not finalized yet, but it seems that deficiencies of macro and micro nutrients are there. Except fiber, 99 prepared dishes are analyzed. The results will be discussed after fiber determination is complete.

Project Title: *Studies on Resistance Monitoring and Insecticide effects on chrysopid predators Chrysoperla carnea (Stephen) (Neuroptera; Chrysopidae)*

Principal Investigator: *Dr. Attaullah Khan Pathan*
Senior Scientific Officer

Location of Project: *Incharge, PARC-IMP Sub Station, University College of Agriculture B.Z. University, Multan*

Duration: 36(months)

Start Date: 26/8/2004

Project Status: On-going

Total Cost (million): 1.986

Funds Released (Rs): 671000

Funds Utilized (Rs): 434202
(Upto 30th June, 2005)

Objectives:

- To monitor insecticidal resistance in Chrysopids from different geographical zones of vegetable and cotton crops.
- To study and compare the predatory potentials of resistant Chrysopid strains with that of susceptible one.
- To study the effect of selection pressure on the developmental rates, fecundity, fertility, sex ratio and on the development of a resistant / tolerant Chrysopid strain.
- To use the information in integrated pest management strategies.

Achievements/Progress:

Chrysoperla carnea (green lacewings) are important general predators in many agricultural systems worldwide. Because of their voracious appetite for insect pests, the Chrysopid adult and larvae have been used for controlling pests. Chrysopids provide an easy and safe alternative to conventional methods of pest control. They are marked by their longevity, high fecundity and fast development rates. *Chrysopid larvae* feed on aphids, spider mites, leafhoppers, mealy-bugs, thrips, soft scales, lepidopterous eggs and other soft-bodied preys. Thus, *Chrysoperla carnea* plays an important role in limiting pests in crops where pesticides are used. The present study is designed to monitor insecticide resistance in *Chrysoperla carnea* for its efficient use in Integrated Pest Management (IPM).

Conclusions:

- *Chrysoperla carnea* larvae show resistance against the *Cypermethrin* either laboratory reared or field collection strains.
- Insecticides slightly affect on the biology of the *C. carnea* larvae, in his moulting period.
- Insecticide also affect on the egg laying capacity of the *C. carnea* female
- Insecticide slightly or non-significant affect the sex ratio, fecundity, fertility and longevity of the *C. carnea*
- *Chrysoperla carnea* larvae when released in the tomato field against tomato aphid, show non-significant difference as compared to the other insecticides.

Project Title: *Characterization of Pakistani isolates of chili veinal mottle potyvirus (ChiVMV) and cucumber mosaic cucumovirus (CMV) infecting chili crop.*

Principal Investigator: *Mr. Hussain Shah*
Scientific Officer

Location of Project: *IPEP, National Agricultural Research Centre, Islamabad*

Duration: 36(months)

Start Date: 26/8/2004

Project Status: On-going

Total Cost (million): 2.933

Funds Released (Rs): 1164500

Funds Utilized (Rs): 459075
(Upto 30th June, 2005)

Objectives:

- Serological characterization of Pakistani isolates of ChiVMV and CMV
- To study the biology of ChiVMV and CMV
- Antisera production against ChiVMV and CMV
- Management through identification of source of resistance against ChiVMV and CMV in available Capsicum germplasm

Achievements/Progress:

A total of 1191 samples of chili pepper (328 from Sind, 588 Punjab and 275 NWFP) were collected from plants showing virus like symptoms during 2004-05. The samples were tested against Chili *veinal mottle* virus (ChiVMV) and Cucumber *mosaic virus* (CMV) through direct Enzyme-linked immunosorbent assay (DAS-ELISA). The data indicate that relative occurrence of ChiVMV and CMV were 19.8% and 5.2% respectively. In case of Punjab, the relative occurrence of ChiVMV and CMV were 24.3% and 10.2% respectively while in NWFP the occurrence were 30.9% and 4.3% respectively. In case of Sindh province, the relative occurrence of ChiVMV and CMV were 19.8% and 5.2% respectively. Biological properties of ChiVMV showed that it is transmitted mechanically, through aphid vector (identified as *Aphis gossypii*) & grafting.

The virus has a limited host range restricted to few families particularly *Solanaceae*. Thus, out of 44 different hosts tested, six hosts become infected viz. *Nicotiana tabacum* cv. Samsun, White Burley, K-399, *N. glutinosa*, *Nicotiana benthamiana*, *Datura metel*, *Physalis floridana* and *Solanum nigrum*, while thirty eight hosts did not become infected and remained asymptomatic and were also ELISA negative. Immuno-sorbent electron microscopy (ISEM) revealed characteristic flexuous rod-shaped particles with optimum number in 100 dilution i.e. 454 number of particles in positive control. ChiVMV showed homology to Potyviruses i.e. PVY, PVMV, ZYMV, BYMV, PRSV, TEV, OYDV, SoyMV by 24.86, 20.2, 9.8, 8.2, 7.8, 7.5, 7.3 and 6.9 percent respectively while CMV (Cucumovirus) by 6.4 percent and PMMV (tobamovirus) by 9.4 percent in ISEM study.

Project Title: *Identification of superior soybean cultivars for different agro-ecologies of Pakistan.*

Principal Investigator: *Dr. Muhammad Ashraf*
Senior Scientific Officer

Location of Project: *Oilseeds Research Programme, National Agricultural Research Centre, Islamabad*

Duration: 36(months)

Start Date: 30/8/2004

Project Status: On-going

Total Cost (million): 2.796

Funds Released (Rs): 837000

Funds Utilized (Rs): 670133
(Upto 30th June, 2005)

Objectives:

- To screen/evaluate soybean germplasm for specific cropping systems.
- To Collect and acquisition various germplasm.
- To develop base material with high yield potential for future breeding needs.
- To enhance land utilization and farmers' income through induction of soybean in various cropping system.

Achievements/Progress:

Collection of Germplasm:

293 soybean germplasm accessories were collected from national international and local land races during 2004-05. 10 accessions were collected from Asian Vegetable Research Development Center (ACRDC) Taiwan. 177 from Oilseed Research Institute, Ayub Agricultural Research Institute, Faisalabad, 40 from Plant Genetic Resources Program, NARC-Islamabad and 39 from Oilseed Research Program, NARC, Islamabad.

Seed Multiplication (autumn):

256 accessions were sown at NARC, Islamabad and 217 accessions at Agricultural Research Station, Swat (Mangora) for seed .multiplication and evaluation. Out of these 256 accessions, 182 produced more than 400 g seed of each accession at both locations. 74 accessions produced low seed yield due to less quantity of seed which results low plant population. To produce enough seed for future testing, these 74 accessions along with 27 accessions collected from Gilgit areas, 10 accessions collected from AVRDC, Taiwan were sown at NARC Islamabad during July, 2005.

Screening and evaluation of soybean germplasm at NARC, Islamabad in autumn 2004:

256 soybean germplasm accessions were .planted at National Agricultural Research, Center (NARC) Islamabad. Each accession was sown. In a single row five meter long and within row-to-row distance was kept 60cm and' sowing was done on ridges. Agronomic data was collected viz. days to flower initiation, days to flower completion, days to maturity, plant height at flower initiation (cm), plant height at maturity (cm), number of branches per plant, number of filled pod per plant, 1st pod height (cm), 100 seed weight (g) and grain yield.

The data revealed that maximum variation 1504 were observed in seed yield followed by number of pods per plant and its value is 356. The lowest variation 1.66 was observed in number of branches per plant. Variation is important for breeding point of view. It provides the opportunity for better selection of required genotypes.

Frequency-distribution resulted that out of 256 accessions; four (95014, Cumberland, Flint & NARC-I) were flowering very early (>30 days) while three accessions (95083, IAC 100 & DB 1601) were started flowering very late < 55 days). Maximum number of accession (72) started flowering in the range of 46 to-50 days. For days to flower completion five accessions viz, ADA, NO 12, NO 58, NARC-I & NARC-V took more than 55 'days to complete flowering. While 84 accessions were completed flowering with the range of 61 to 65 days. Five accessions {849-294Q, DB 1601, V 1, PR 16 & SRE 14B) took more than 75 days to complete flowering.

Maximum number of accessions (65) matured in the range of 101 to 105 days. Four accessions viz, GC 269, HARK, PKN 140-3-1 & GC 90013-23,-6-1 matured very early took > 85 -days. While 18 accessions matured late and took < 111 days. At the flowering initiation stage plant height was measured. Five accessions GC 269, NARC-V, Flint, AGS 19 & A 3659 were observed short in stature > 20cm. Maximum number of accession (83) were in the range of 41 to 50 cm, while four accessions KANRICH, CLARK, 95091 & 95083 was tall at flowering < 80cm. Plant height (at maturity) resulted that three accessions viz, NO 10, AGS 314 & AGS 93 were observed short in stature and having > 30cm plant height, 109 accessions was measured plant height in the range of 46 to 60 cm. For number of branches per plant, higher frequencies 123 was observed in the range of 3 to 4 branches followed by 106 accessions in the range of 5 to 6 branches per plant.

The higher number of filled pods per plant (<111 pods) was counted in 18 soybean accessions. Maximum number of accession 65 was observed in the range of 41 to 50 pods/plant. For 1st pod height, 33 accessions were recorded >5cm. Maximum accessions (83) were measured in the range of 11 to 13 cm.

Six accessions viz., 95024-B, 95033-A, 95015, 95012, 95020 & 95024-A were observed very small in grain size and having 100 seed weight >6g. Maximum number of accession (119) was medium in grain weight and ranged in category of 12.00 to 15.00g of 100 seed weight. Fourteen accessions were observed bold seeded with <18g of 100 seed weight.. For grain yield 21 were produced very low seed yield (> 100g per m²). Maximum number of accessions (59) was observed in the range of 101 to 200 (g) and 201 to 300 (g) of seed yield per m². Eight accessions viz., GC 84058-8-4, 95037, Calquit, 95091,95083,95022, PC 82 & 95025 produced <800 (g) seed yield per m².

Screening and evaluation of soybean germplasm at ARS, Mangora (Swat) in autumn 2004

217 accessions were sown at Agricultural Research Station (ARS), Mangora (Swat) during autumn 2004. The experiment was sown with augmented design with single row 4 meter long and row-to-row distance was kept 45 cm. The data recorded for days to flowering, plant height (at maturity), days to maturity, number of branches per plant, number of pods per plant and grain yield per m². Maximum variation 29102 was observed in grain yield per m² followed by 458 in plant height. Number of branches showed lowest variation with the value of 3.8. Five accessions viz., HARK, SWAT -84, S-42-40 & HARLIN flowered vary early (>30 days) whereas two accession viz., HM-29 & SPRING SEED flowered very late and took < 60 days. Maximum

number of accessions 87 flowered in the range of 41 to 45 days followed by 60 accessions in the range of 46 to 50 days.

For plant height 12 accession viz., NO-13, AGS 19, 95033-A, IAC 100, Mld-96-A, HARK, HM-8488, SWAT-84, BOSSIER, 95029-C, GC 86017-70-11 & AGS 194 were observed short in stature and measured >30 cm. while three accessions viz., RX (5-2-1), BALCK HACK & R-315, were measured tall with < 120 cm. Maximum number of accessions 74 were ranged in 46 to 60 cm followed by 48 in the range of 31 to 45 cm. For day to maturity 8 accessions viz., CLARK-63, FOSTER, KURA, AGS-66, WILLIAMS, BONUS & COLUMBUS were matured very early and took > 105 days. Maximum number of accessions 92 was matured in the range of 111 to 115 days followed by 86 accessions in range of 106 to 1.10 days. Five accessions matured very late and took < 131 days.

Frequency distribution for number of branches per plant revealed that 28 accession beard minimum number of branches per plant >2. Maximum accessions 86 ranged in 3 to 4 branches per plant followed by 89 accessions in the range of 5-6 branches per plant. 10 accessions viz., WASHINGTON, CORSOY, HARDIN, A-3127, AUST-94-1, VALDER, EARLY SHORT FOOT, 95014, R X(48-52-71) & ADAMS beard branches per plant higher that is <8. Number of pods per plant is very important trait. Three accession viz., AGS 19, 95038-B, & 297-6F counted >25 pods per plant. Maximum number of accessions 88 was ranged in 51-75 pods per plant followed by 69 accessions in the range of 26-50 pods per plant. Maximum number of pods per plant <100 were recorded in 9 accessions viz., HARDIN, TN-71-27,.32, UDA, TN-80:-53-201,CAPTIAL, ADAMS, 95014, WASHINGTON & 95012-C. For grain yield per m², 21 accessions produced > 100g seed yield. While 13 accessions viz., GC 84058-8-4, 95037, Calquit, 95091, 95083., 95022, PC 82 & 95025 produced seed yield < 700g per m² and 201 to 300 g of seed yield.

Project Title: *Quality characterization of oilseed crops through NIRS.*

Principal Investigator: *Mr. Iftikhar Ali*
Principal Scientific Officer

Location of Project: *Nuclear Institute for Food and Agriculture (NIFA), Tarnab, Peshawar*

Duration: 36(months)

Start Date: 5/7/2004

Project Status: On-going

Total Cost (million): 2.013

Funds Released (Rs): 769600

Funds Utilized (Rs): 768992
(Upto 30th June, 2005)

Objectives:

- To establish NIR technology based oilseed quality analysis facilities and services for oilseed researchers, industry and growers.
- To increase the profitability of oilseed crops growing through the increased capability, availability and adoption of NIR technology based non-destructive quality analysis.
- To develop consistency in quality of oilseed crops through NIR technology based check.
- To develop calibration to determine oil, protein, moisture, fatty acids and glucosinolate on NIR instrumentation for major oilseed crops in Pakistan.

Achievements/Progress:

A total 685 different accessions of canola, rapeseed, mustard, sunflower, sesame and soybean collected from different agro-climatic zones of the country during the period under report. All the collected genotypes computerized documented using Microsoft Excel software programming. A total 138 genotypes from, the collected materials selected for total oil content analysis through "wet chemistry". The selection based on seed health, seed texture and seed quantity of the each genotype and oil content in seed samples determined through oil extraction on Soxtech system. The determination of protein content in 106 seed of collected samples completed, while fatty acid profiles of the 115 selected samples characterized. The total Glucosinolates in 66 canola/mustard/rapeseed samples analyzed. The results of all above mentioned analyses will be used for the initial reference database for the development of calibration equations on NIRS during the second year of the project.

A Beam Ratio Hitachi Model U-1800 Spectrophotometer with a cost of Rs. 0.359 million procured and installed in Oil Quality Lab in Crop Breeding Division at NIF A, Peshawar under the project during the period under report. A computer system Model Acer with Laser Printer & Scanner and a digital camera Model Nikon 8700 with a total cost of Rs. 0.143 million procured and installed under the project during the period under report.

A new Oil Quality Lab in Crop Breeding Lab for the new and costly instrument procured under the project designed and established during the period under report.

Project Title: *Evolution of wheat varieties for low water requirements using conventional and mutation breeding techniques.*

Principal Investigator: *Mr. Mahboob Ali Sial*
Senior Scientific Officer

Location of Project: *Nuclear Institute of Agriculture, Tandojam, P. O. 70060, Sindh*

Duration: 36(months)
Start Date: 26/7/2004
Project Status: On-going

Total Cost (million): 1.944
Funds Released (Rs): 490440
Funds Utilized (Rs): 386722
(Upto 30th June, 2005)

Objectives:

- To identify high yielding genotypes at low water requirements.
- To identify genotypes with early maturity and increased grain filling period.
- To develop germplasm tolerant to drought for future breeding.
- 4) Better grain quality

Achievements/Progress:

Water stress (drought) is the main environmental constraint to the wheat crop in the Province of Sindh. One way to face the situation is to evolve genotypes, those could produce sustainable yield at low water availability. Eighty four wheat genotypes/ advanced lines alongwith four local checks Sarsabz, Kiran-95, T. J.-83 and awn less variety Thori (known to be drought-tolerant) were screened for grain yield and yield components in experiment having different water stress conditions at experimental farm of NIA, Tandojam during rabi 2003-04. On the basis of high grain yield, early maturity, higher 1000-grain weight and better tolerance to low water, 21 genotypes identified as suitable for low water requirements were selected for further evaluation. Eight genotypes produced higher yield (>3100 kg/ha) than check varieties at two irrigations, which reflected tolerance of these genotypes at low water requirements. Similarly, 16 genotypes with medium tolerance to water shortage had higher yield (>3800 kg/ha) than checks with three irrigations were identified.

To confirm stability among 21 selected drought lines, the trials were conducted at five locations in Sindh viz. NIA, Tandojam (Hyderabad), Soomro Farm, Sijawal, Thatta; Rao Sikandar Farm Kot Ghulam Muhammad (Mirpur Khas); Bughio Farm, Moro (Naushahroferoze) and Korai, Pano Aquil (Sukkar). At Tandojam site, four experiments having a 4 irrigation levels were conducted. Whereas, at other 4 sites (Sijawal, Moro, Kot G. Muhammad and Pano Aquil) 2 irrigations were recommended during wheat crop season. Data on grain yield, yield components and physiological parameters were recorded and will be subjected to statistical analysis. The grain yield data were recorded from each site. Genotypes x environment interaction studies (Stability analysis) will be performed. It is expected that some of the lines might confirm drought tolerance and come forward as new entities.

Project Title: *Bread wheat (T. aestivum L.) improvement for late planting/ terminal stress and high yield potential.*

Principal Investigator: *Mr. Tila Muhammad*
Deputy Chief Scientist

Location of Project: *Nuclear Institute for Food and Agriculture (NIFA) Tarnab, Peshawar*

Duration: 36(months)

Start Date: 1/7/2004

Project Status: On-going

Total Cost (million): 1.868

Funds Released (Rs): 1129000

Funds Utilized (Rs): 1023825
(Upto 30th June, 2005)

Objectives:

- Development of early maturing wheat varieties with high grain yield, high biomass, high grain weight, wide adaptation and disease resistance for different wheat growing areas of NWFP.
- Creation of genetic variability for tolerance to late planting and terminal heat stress.
- Identification of plant traits showing high association with grain yield and late planting/heat stress.

Achievements/Progress:

The mean values for 1000-grain weight (TKW) ranged from 27.13-43.87 grams under normal conditions and 26.27-41.33 grams under late planting conditions in the test genotypes. The TKW values for the check varieties ranged from 29.81-37.07. Thirty-seven lines were found superior in 1000-grain weight than Inqilab-91, the variety having the highest TKW under normal conditions. Under late planting 50 lines showed superiority over Inqilab-91 in this regard. Regarding grain yield the values ranged from 2977.8-6644.4 kg/ha in the test genotypes under normal sowing and 533.3-4000 kg/ha under late sowing. Forty-nine lines out yielded the highest yielding check variety Inqilab-91 under normal sowing while 19 lines excelled in yield than the highest yielding check variety Fakhre Sarhad under late sowing.

The highest grain yield of 6622.2 kg/ha) was recorded for the wheat genotype CT -02362 followed by CT-02361 (6444.4 kg/ha), CT-02172 (6400 kg/ha), CT-02173 (6400 kg/ha) and CT-02026 (6355.6) under normal sowings. The wheat lines CT-02269 (4000 kg/ha) followed by CT-02268 (3911 kg/ha), CT-02165 (3866.7 kg/ha) and CT-02267 (3822.2 kg/ha) were among the top yielders under late planting. Thirty-one lines were found high yielding based on their combined performance under normal and late sowing conditions. The lines CT-02362 (4800 kg/ha), CT-02361 (4711.1 kg/ba), CT-02391 (4755.6 kg/ha), CT-02267 (4755.6 kg/ha) and CT-02359 (4600 kg/ha) were among the top yielders under both normal and late planting conditions.

One Computer System Model Acer with Laser Jet Printer, one Digital Seed Counter Model Count-A-Pack 801 series with Spare part kit for 10" feeder bowl model and one Portable Hectoliter Test Weight Kit were procured at a cost of Rs. 677181/-and installed in the laboratory in the Crop Breeding Division at NIFA, Peshawar during the period under report.

Project Title: *Molecular characterization of available germplasm of wheat in Pakistan (Component-II UAF).*

Principal Investigator: *Dr. Iftikhar Ahmad Khan
Prof. & Chairman*

Location of Project: *Department of Plant Breeding & Genetics, University of Agriculture
Faisalabad*

Duration: 36(months)

Start Date: 7/10/2004

Project Status: On-going

Total Cost (million): 5.23

Funds Released (Rs): 1886993

*Funds Utilized (Rs): 333149
(Upto 30th June, 2005)*

Objectives:

- Assessment of diversity and relatedness in the germplasm and breeding material of wheat.
- Documentation of DNA profiles of wheat germplasm.
- Training of the students at the graduate and postgraduate level.

Achievements/Progress:

Collection of germplasm

Initially a germplasm of 200 accessions of wheat belonging to *Triticum aestivum* L. were collected from different national sources including Plant Germplasm Research Institute, NARC, Pakistan Agricultural Research Council, Islamabad, Pakistan during 2004-05. Lately, during May 2005 a germplasm consisting of another 100 accessions of wheat belonging to *Triticum acstirum* L. were obtained from the plant Germplasm Resrach Institute, NARC, Isamabad.

Multiplication of germplasm

During November, 2004, the germplasm assembled for 100 accessions was sown in the field for multiplication as the seed samples collected from various agencies were too small in size. The seed of the 100 accessions planted in a field was harvested and thrashed separately and stored properly for future experimental use.

DNA extraction of the wheat germplasm

A good amount of seed was available for a few accessions of wheat. The seeds of those accessions were grown in the pots and germinated in the growth chamber. DNA extraction was carried out from one to two weeks old seedlings using the standard DNA extraction protocol and modified DNA extraction procedure developed in our laboratory (Khan et al., 2004). The locally developed method appeared to be more useful in saving cost of the extraction, labour and time. Therefore it was decided to use the modified method developed locally for DNA extraction of the wheat germplasm for the project studies.

Then, using the optimized method (Khan et al., 2004) DNA extraction from one to two weeks old seedlings of 100 wheat accessions and some F₁ hybrids and breeding lines was carried out for characterization using RAPD and SSR markers.

Project Title: *DNA marker for wilt (*Fusarium oxysporum*) resistant genes in chickpea.*

Principal Investigator: *Dr. Mohammad Saleem*
Associate Professor

Location of Project: *Plant breeding and genetics, University of Agriculture, Faisalabad*

Duration: 36(months)

Start Date: 5/7/2004

Project Status: On-going

Total Cost (million): 2.893

Funds Released (Rs): 1390000

Funds Utilized (Rs): 1376634
(Upto 30th June, 2005)

Objectives:

- Identification of DNA markers from intraspecific crosses and their utilization in marker assisted breeding program for wilt (*Fusarium oxysprumr*) resistance..

Achievements/Progress:

Chickpea wilt caused by the fungus *Fusarium oxysporum* is the second most important disease in Pakistan which has reduced the share of chickpea on irrigated lands from 10 to 50% (Hanif et al., 1999) in 1950s to only. The fungus is seed- born as well as soil- born and can survive in the soil for more than five years. The use of resistant cultivars to control wilt disease is the best and the cheapest method. A massive field screening program for wilt resistance is underway. A large number of germplasm accessions diverse materials have been screened against *Fusarium* wilt and elite germplasm lines have been earmarked which will be used in further hybridization program for the transfer of wilt resistant genes in existing commercial varieties. Field screening of Chickpea International *Fusarium* Wilt Nursery (CIFWN- 2005) has shown entries 29101,29132 and 29208 to be resistant genotypes whereas 29153, 29224 and 29245 appeared to be susceptible to wilt. From the advanced line developed at the Campus, 810, 96052 and 98144 were found to be susceptible and 1089, 5226 and 205 were moderately resistant. Screening of the material received from the Department Plant Pathology, lines 56, 80 and 121 were susceptible while 5, 30 and 74 have been identified as resistant to wilt. Genetic recombinations between susceptible and resistant types were made to study the mode of inheritance of the pathogen. Identification of molecular markers ("tags") for resistance genes could lead to a quicker assessment of susceptibility, allow screening of seeds for seedlings and reduce the need for maintaining virulent isolates of the wilt pathogen. The F₁ material was sown in Kaghan to raise F₂ generation. The F₂ and other segregating material will be studied at the molecular level for DNA finger printing and for tagging the gene. Chickpea germplasm and advance lines screened will be exchanged / exploited in national breeding program which will increase and stabilize pulses production in the country. The promising material will ultimately be adopted by the pulse growers for increased productivity. The scientific information generated is in the pipeline for publication in national and international journals.

Project Title: *Enhancement and evolution of germplasm for stressed environment through the use of agro-biodiversity.*

Principal Investigator: *Dr. Shafqat Farooq*
Principal Scientific Officer

Location of Project: *Nuclear Institute for Agriculture and Biology (NIAB), Jhang Road, Faisalabad*

Duration: 36(months)

Start Date: 1/4/2004

Project Status: On-going

Total Cost (million): 4.468

Funds Released (Rs): 3487950

Funds Utilized (Rs): 3292631
(Upto 30th June, 2005)

Objectives:

- To collect, create, and characterize diversity in the form of varieties/land races/ lines and lines relegated with wheat and incorporating their agronomically important character(s) including low fertilizer and irrigation requirement, salt and water deficiency tolerance into commercial cultivars.
- To develop systems and techniques for characterization of created and acquired biodiversity using molecular markers, stress proteins, and anti-oxidant enzymes.
- To streamline production and continuous availability of stress tolerant germplasm for developing environment friendly, sustainable and profitable agriculture for all times to come.

Achievements/Progress:

The experiment conducted during the season largely comprised multiplication of the germplasm acquired through PARC and Czech Republic which comprised various accessions of different wild *Aegilops* species. This material was provided to us in quantity of 10-15 grains which we have multiplied. In October 2004, we planted this material in 4 field blocks each of 15x19 feet area. Two of the blocks were used to check the incidents of disease attack (Rust, powdery mildew and aphids). These plot were given full irrigation as recommended by the wheat agronomist and is usually given. In the remaining two plots, incident of disease attack was observed in the plants that were given zero irrigation except the one which was pre-sowing.

Only rain water was considered as irrigation. We observed that aphids and powdery mildew appeared heavily on the plants given normal irrigation compared to other growing without normal irrigation. Some of the species obtained from Czech Republic and PARC appeared susceptible to various forms of rust and powdery mildew. This reaction was observed during seed multiplication. All the accessions with light, moderate and sever infection were destroyed after recording the data regarding disease incidence.

Project Title: *Development of high yielding, long grain varieties of rice for para boiling purpose.*

Principal Investigator: *Mr. Akbar Ali Cheema*
Chief Scientific Officer

Location of Project: *Nuclear Institute for Agriculture and Biology (NIAB), Jang road, Faisalabad.*

Duration: *36(months)*

Start Date: *11/5/2004*

Total Cost (million): *1.696*

Funds Released (Rs): *832000*

Funds Utilized (Rs): *607190*

(Upto 30th June, 2005)

Objectives:

- Induction of high-yielding long grain germplasm/varieties of rice for para boiling purposes.

Achievements/Progress:

The research efforts are being focused to the induction of high yielding long grain varieties/germplasm for parboiling purpose. For this purpose the dry dormant paddy seeds of three Basmati varieties were irradiated at different doses viz; 150, 200, 250, 300, 350 and 400 Gy of gamma rays. In preliminary studies shoot length decreased with increase of irradiation dose but the decrease was not proportionate with the increase in dosage. In root length 300 and 400 Gy showed the drastic effect in Super Basmati, whereas only 400 Gy exhibited the drastic effect in Basmati Pak. For seedling emergence only Super Basmati exhibited the dose dependent response at higher doses.

Significant effects were found in variety x dose interaction, for plant height, total spikelets per panicle and fertility %age. Drastic detrimental effects were observed for plant height at 400 Gy in Basmati-370 and Super Basmati. Gamma rays doses have some stimulatory effect on total spikelets per panicle in Super Basmati. Low panicle fertility was observed in all the three varieties after irradiation.

NATURAL RESOURCES

BACKGROUND

1st Batch:

ALP Secretariat received 125 preliminary proposals relating to natural resources for funding under the 1st batch. In process of preliminary appraisal 28 proposals were short listed for the invitation of detailed projects and 97 proposals which were not up to the standard were dropped. Finally, 23 projects costing Rs.67million were approved by the Board of Director (BOD) of ALP for funding to conduct the research in different disciplines.

2nd Batch:

ALP Secretariat received 114 preliminary proposals relating to natural resources for funding under the 2nd batch. In process of preliminary appraisal 49 proposals were short listed for the invitation of detailed projects and 65 proposals which were not up to the standard were dropped. Finally, 23 projects costing Rs.64 million were approved by the Board of Director (BOD) of ALP for funding to conduct the research in different disciplines.

For instance, three are projects implemented on management of salt affected soil and brackish water in Pakistan, soil fertility monitoring and management, recycling of organic wastes for sustainable crop productivity and micronutrient deficiencies in fruit plants of economic importance in Pakistan etc. There are also projects on use of nitrogen fixing, plant growth promoting rhizobacteria (PGPR) for development of bio fertilizer for crops on economic importance. The region wise detail of the on-going projects is summarized as under:

S.No	Region	Projects	
		<i>1st Batch</i>	<i>2nd Batch</i>
1	PARC/NARC	7	6
2	PUNJAB	5	7
3	NWFP	4	8
4	SINDH	1	-
5	BALUCHISTAN	2	-
6	AJK	1	-
7	NGO/ OTHERS	-	-
8	OTHER FEDERAL	3	2
	TOTAL	23	23

IMPLEMENTATION STATUS

1st Batch:

Out of 23 approved projects 16 are in operation, 6 projects have been completed and one project has been dropped due to one or other reasons.

2nd Batch:

Out of 23 approved projects 19 are in operation, one project is in process of agreement three projects have been dropped due to one or other reasons.

FINANCIAL STATUS

1st Batch:

So far an amount of Rs.37 million has been released against the overall total cost of Rs.67 million in respects of approved projects. Till 30th June 2005, overall expenditure of Rs. 30 million has been incurred as reported by the PIs of the projects.

2nd Batch:

So far an amount of Rs.19 million has been released against the overall total cost of Rs.64 million in respects of approved projects. Till 30th June 2005, overall expenditure of Rs. 14 million has been incurred as reported by the PIs of the projects.

MONITORING & EVALUATION

The progress of 11 projects located at Islamabad/ Rawalpindi, Faisalabad and Quetta has been reviewed with the help of presentations made by PIs, available Technical Progress Report and discussion of the evaluation team with the concerned PIs. On the recommendation of reviewers, three projects have been granted extension in the period of execution upto June 2006.

The projects of ALP 2nd Batch are in their 1st/ 2nd year of operation, the review of 17 projects have also been conducted during 2004-05 by Technical Divisions, ALP Secretariat, Finance Division of PARC.

Project Title: *Assessment of Nutritional Potential and Performance of Range Species in Balochistan.*

Principal Investigator: *Dr. Sarferaz Ahmed*
Senior Scientific Officer

Location of Project: *Arid Zone Research Center, Brewery Road, Quetta.*

Duration: 36(months)
Start Date: 22/3/2002
Project Status: Completed

Total Cost (million): 1.933
Funds Released (Rs): 1542000
Funds Utilized (Rs): 1529837
(Upto 30th June, 2005)

Objectives:

- To describe the chemical composition of native promising grasses, shrubs and trees relative to the nutrition requirement of small ruminants.
- To determine the seasonal variation in the concentration of non-protein nitrogen to describe actual amounts of protein instead of crude protein and the concentration of primary and secondary anti-nutritional components.
- To establish multi-purpose native and exotic range germplasm source.
- To evaluate and monitor the performance of potential range germplasm for adaptability and growth in different ecological zones.

Achievements/Progress:

Rang nurseries of different potential native and exotic shrubs and grasses were established at AZRC for range rehabilitation in Balochistan. Native shrubs like *Caragana ambigua*, *Prunus ebusnea*, *Stocksia brahvia*, *Berberis lyceum* and *Lycium barbarum* have potential of re-establishment. Exotic shrubs like *Atriplex canescens*, *Atriplex lentiformis* and *Atriplex helimus* have potential as a multiple uses in highlands of Balochistan. *Atriplex amnicola* and *Atriplex nummularia* can be used as forage reserve blocks in low lands of Balochistan. *Haloxylon persicum* has the potential in Chagai and Kharan deserts of Balochistan for sand dune fixation and forage production for sheep and camels. *Salsola vermiculata* has the potential of self-regeneration and establishment under good rainfall years.

Above ground current season growth biomass and dead accumulated biomass of *Chrysopogon aucheri* and *Cymbopogon jwarancusa* were evaluated during 2001 and 2002 in a protected site in highland Balochistan. *Cymbopogon jwarancusa* current season biomass ranged from 27 kg/ha in April to 51 kg/ha in June whereas *Chrysopogon aucheri* current season biomass production ranged from 2 kg/ha in April to 54 kg/ha in June. Above ground dead biomass of *Cymbopogon jwarancusa* ranged from 77 to 310 kg/ha whereas the dead biomass of *Chrysopogon aucheri* ranged from 50 to 320kg/ha. In both years the dead biomass remained more than 70% in growing season. Accumulated dead materials reducing the productivity of these grasses and planned grazing or clipping may improve the productivity and sustainability of these grasses.

Seasonal concentration dynamics of nitrogen (N), phosphorus (P), magnesium (Mg) and calcium (Ca) in *Chrysopogon aucheri* and *Cymbopogon jwarancusa* were determined at a protected site. The concentration of Nitrogen in spring ranged 12.4 to 13 mg g⁻¹, early summer 15.4-17.26 mg g⁻¹, late summer 6.7 to 10.7 mg g⁻¹, respectively during 2001 and 2002 seasons. In 2001, the

concentration of P in spring and early summer was (1.1-3.4 mg g⁻¹) and least in late summer (0.26-0.81 mg g⁻¹) while in 2002 the concentration of P in spring and early summer was significantly higher (1.28-3.35 mg g⁻¹) and least in late summer (0.38-1.01 mg g⁻¹). In both grass species, there was a similar response of concentrations of K, Mg and Na and the concentration of these elements were higher during spring and then dropped and remained static for the remainder of the year while the concentration of Ca was lower in early spring and significantly (P<0.05) increased with the passage of time during the season. In both grasses the N: P ratio was below <14 suggesting N-limitation during March and July and shows more than 16> during drier months of August and September. Overall, both the grasses are low in N, P and other nutrients except Na and Ca. These findings suggest that heavy but short-term grazing of very long protected grasslands after substantial rainfall may be one strategy to increase palatability and animal nutrition. Results of this study also indicate the need for direct, high quality mineral supplementation for grazing stock.

Mineral composition and anti-nutritional components of native shrub species were evaluated at two sites in highland Balochistan. Leaf nitrogen concentrations in all species showed similar patterns of change with season. At both locations, nitrogen concentrations in foliage of *Caragana ambigua*, *Prunus eburnean* and Wild Cherry were greater than the other species. Concentrations of N in leaves of all species increased after winter rains. In all species, non-protein nitrogen (NPN) accounted for more than 35-50% of total N. The effect of season on the concentration of phosphorus was highly significant and concentrations in leaves were generally greater after rains and decrease drastically as the soil moisture decreased in the later months. In all shrubs, there was similar response of concentration of Ca, Mg, and K. Concentrations of total phenols (TP) and condensed tannins (CT) fell between March and June after winter rains. Overall, concentration of TP in *Caragana ambigua*, *Prunus eburnean* and *Wild Cherry* were lower than other species. There was a significant effect of season on the concentration of both TP and CT all species.

Project Title: *Optimal Tillage Practices for Wheat-Fallow and Chickpea-Fallow Rotations in Southern NWFP.*

Principal Investigator: *Dr. Muhammad Jamal Khan*
Professor/Chairman

Location of Project: *Department of Water Management, NWFP Agricultural University, Peshawar.*

Duration: 36(months)
Start Date: 13/4/2002
Project Status: Completed

Total Cost (million): 2.5
Funds Released (Rs): 2139000
Funds Utilized (Rs): 2138624
(Upto 30th June, 2005)

Objectives:

- Effect of different tillage practices on soil moisture conservation, weed control and crop establishment under wheat-fallow, chickpea-fallow rotation in the Southern region of NWFP.
- Document yields and yield components of wheat and chickpea crops under experimentation.
- Effect of different tillage practices on physical properties of soils under wheat/ chickpea rotation.
- Selection of optimal tillage package for dissemination to the growers in collaboration with Agricultural Extension Department.

Achievements/Progress:

Field experiments on tillage were conducted at Nangul Khel, District Karak and Gera Gul Dad, Tehsile Kulachi of District D. I. Khan under rainfed condition on wheat and chickpea during 2002-2005. The main objective of this research study were to find the effect of different tillage practices on yield and yield components of wheat and chickpea as well as on physical properties of soil. At Karak research site, the soil was sandy loam, five tillage treatments, No Till (NT), Chisel plough once and Tine type cultivator twice (CPTC2), Mould board plough once and Tine type cultivator twice (MBTC2), Disc Harrow once and Tine type cultivator twice (DHTC2), and Tine type cultivator three times (TC3) were used. At D. I. Khan the experiments were conducted in Rod Kohi command area under clay loam soil condition. The implements used in the tillage experiments were Disc plow once and Tine type cultivator three times (DPTC3), Chisel plow once and Tine type cultivator three times (CPTC3), Mold board plough once and Tine type cultivator three times (MBTC3), Disc Harrow once and Tine type cultivator three times (DHTC3), and Tine type cultivator four times (TC4). In this study five tillage treatments were used and replicated four times under Randomized Complete Block Design (RCBD) set up at both research sites. The experimental plot size was 8m x 40m at both sites. Wheat and Chickpea were sown during October and November at both sites respectively and harvested in April-May. Data related to moisture content, bulk density, soil strength, germination, weeds and plant height and number of branches were collected.

Based on the three years (2002-2005) tillage data were collected which is related to yield and yield components at Karak Research site, wheat grains yield ranged from 2311 to 3425 kg/ha, maximum yield was attained by MBTC2 of 3425 kg/ha followed by TC3 of 3031 kg/ha, while the minimum yield was recorded for NT of 2311 kg/ha. The MBTC3 tillage treatment produced 48.20% and 13.00% more wheat yield as compared to NT and TC3 respectively. In chickpea

plots the yield ranged from 1695 to 1968 kg/ha, maximum grains yield was attained by CPTC2 of 1968 kg/ha, followed by MBTC3 of 1736 kg/ha, while the minimum grains yield was recorded for NT of 1739 kg/ha. In case of chickpea, CPTC2 produced 16.10 and 18.98% more yield as compared to NT and TC3 accordingly. The chickpea roots were four times longer than wheat; therefore CPTC2 produced better results than other tillage treatments. It can be concluded that chickpea requires less tillage as compared to wheat for better yield.

At D. I. Khan Research site the means grains yield of wheat ranged from 2190 to 2749 kg/ha, maximum yield was obtained from tillage treatment DPTC3 of 2749 kg/ha followed by DHTC3 of 2621 kg/ha, while the minimum yield was recorded for MBTC3 of 2190 kg/ha. The DPTC3 produced 23.11% higher yield, followed by DHTC3 (17.38%) as compared to TC4. In case of chickpea the three years mean grains yield ranged from 2143 to 2348 kg/ha, maximum yield was obtained from tillage treatment DPTC3 of 2348 kg/ha, followed by DHTC3 of 2305 kg/ha, while the minimum yield was recorded for MBTC3 of 2143 kg/ha. The tillage treatment did not significantly affect the grain yield of chickpea. In case of sandy loam soil MBTC3 should be used for better wheat yield, while in case of clay DPTC3 is recommended for better yield. For chickpea under sandy loam soil condition minimum tillage should be used, while in case of clay DPTC3 should be used for better yield.

Project Title: *Soil Fertility Monitoring and Management in major Cropping Systems of AJK (AJK, Muzaffarabad).*

Principal Investigator: *Dr. Muhammd Bashir Butt*
Soil Chemist

Location of Project: *Department of Agriculture, Gojra, Muzaffarabad, AJ&K.*

Duration: 36(months)
Start Date: 13/4/2002
Project Status: Completed

Total Cost (million): 1.150
Funds Released (Rs): 1129000
Funds Utilized (Rs): 1112952
(Upto 30th June, 2005)

Objectives:

- Investigate the nature, extent, severity and spatial variability of nutrient disorder in major cropping system of AJK.
- Determine nutrient management strategies for improving crop yield and sustaining soil productivity.
- Determine nutrient management practices for crops for maximum productivity without deteriorating the soil resources base.

Achievements/Progress:

The aim of this project was to explore the soil resources of the state of AJK under maize wheat cropping system. Wheat and maize are two major cereal crops of the state. Maize is grown as mono crop in the uplands of northern part of the state that receives more than 1600 mm of rain with very cold winter and mild summer. Maize and wheat are grown in rotation in the southern part with relatively high temperature. The project area, include, Muzaffarabad district in the north and Kotli and Mirpur in the south. The activities included a comprehensive and systematic evaluation of the national status of soil and crops. Plant tissue samples and associated soil samples at two depths were collected from one hundred randomly selected sites each for wheat and maize to explore the nutrient supplying capacity of the soil under different ecological conditions.

The soil and plant analyses results showed that there is a wide spread deficiency of various macro and micro nutrients. Based on these nutrient analyses results fertilizer research experiments for maize and wheat were also conducted. Four experiments on maize were conducted during 2003 and six experiments on wheat crop were conducted during 2003-04. In 2004 experiments for maize crop were redesigned on the recommendations of the co-ordination committee of the umbrella project while same experiments for wheat crop were repeated. The data collected from these experiments have been analyzed.

Project Title: *Recycling of Organic Wastes for Sustainable Crop Productivity (Uni of Agri..Faisalabad).(NR009)*

Principal Investigator: *Dr. Muhammad Arshad*
Professor

Location of Project: *Deptt. of Soil & Environmental Sciences, University of Agriculture, Faisalabad.*

Duration: *36(months)*

Start Date: *13/4/2002*

Total Cost (million): *2.013*

Funds Released (Rs): *1574500*

Funds Utilized (Rs): *1484376*

(Upto 30th June, 2005)

Objectives:

- Assessment of organic wastes materials in quantitative and qualitative from and their variability in space and time.
- Isolation and identification of effective microorganisms to enhance process of composting (in term of time and quality of compost).
- Test and evaluate selected effective microorganisms to document their effectivity in term of composting process (time and quality) and enrichment.
- Formulation of bio- fertilizer for selected crop.
- Development of composting technology transfer modules for selected ecologies.

Achievements/Progress:

Recycling of organic waste into a useful soil amendment is one of the major options for reducing the huge piles of organic waste s. Studies conducted under the project demonstrated the effectiveness of recycled organic waste (compost) enriched with nutrients (N), biologically active substances (L-tryptophan) and plant growth promoting rhizobacteria (PGPR) for improving the growth and yield of maize and wheat. Fruit and vegetable wastes were collected from different locations (fruit and juice shops, fruit and vegetable markets etc.) of Faisalabad city and subjected to composting in a locally-fabricated unit. Compost product was enriched with 25 or 50% of nitrogen fertilizer recommended for maize and wheat crops. Some batches of composted material were further enriched with L-tryptophan (L -TRP) at the rate of 5mg kg-1 compost. Similarly, inocula of plant growth promoting rhizobacteria (PGPR) were used to make the compost an effective biofertilizer. Full recommended doses of chemical fertilizer (NPK) were kept for comparison. Results of a series of pot and field experiments conducted in the Institute of Soil and Environmental Sciences (UAF) revealed that the application of enriched compost alone or in combination with N fertilizer significantly increased the growth and yield of maize and wheat in both pot and field experiments compared to control (PK fertilizer only). Application of L-TRP and PGPR caused further improvement in growth and yield of both the tested crops. Among the various treatments, enriched compost with L-TRP and PGPR supplemented with 50% N fertilizer was more effective than chemical fertilizers (NPK). It was also noted that 25% N enriched compost (without L-TRP or PGPR) along with 50% additional dos of N was equally effective to chemical fertilizers. This implies that the integrated use of enriched compost and chemical fertilizers can save more than 25% N-fertilizer.

The integrated nutrient supply and use of organic-, mineral- and biofertilizer could lead to sustainable crop production and soil health. The combined application of organic/biofertilizer (enriched compost) and chemical/mineral fertilizer could enhance the recycling of nutrients and may improve the supply of macr/miconutrients to plant along with extra benefits derived from PGRs and PGPR. The complementary use of various sources of nutrients is also advantageous as it helps in improving fertilizer use efficiency. It is therefore possible to get higher yield levels with complimentary use of organic biofertilizer along with chemical fertilizer than chemical/mineral fertilizer alone. The recycling of organic waste for the development of useful soil amendment through blending/enriching with nutrients, plant growth regulators or PGPR could not only help in achieving sustainability in agriculture but also in environments as piling up of huge amount of organic waste is posing serious threat to environment.

Project Title: *Recycling of Organic Wastes for Sustainable Crop Productivity (NWFP-Agri. Uni. Peshawar)*

Principal Investigator: *Dr. Zahir Shah*
Associate Professor

Location of Project: *Department of Soil & Environmental Sciences, NWFP Agriculture University, Peshawar.*

Duration: 36(months)

Start Date: 25/4/2002

Project Status: On-going

Total Cost (million): 1.642

Funds Released (Rs): 1540837

Funds Utilized (Rs): 1402168

(Upto 30th June, 2005)

Objectives:

- Assessment of organic wastes materials in quantitative and qualitative form and their variability in space and time.
- Isolation and identification of effective microorganisms to enhance process of composting (in term of time and quality of compost).
- Test and evaluate selected effective microorganisms to document their effectively in term of composting process (time and quality) and enrichment.
- Formulation of bio- fertilizer for selected crop.
- Development of composting technology transfer modules for transfer to farming community in selected ecologies.

Achievements/Progress:

During the course of the project, the following achievements were made:

- Potential organic wastes were identified for composting. These wastes include crop residues, fruit and vegetable wastes (such as corn stalk, rice straw, sugarcane bagas, wheat straw, fruit wastes, vegetable wastes), manures (such as cattle manure, poultry manure- both broiler and layers, sheep manure) and municipal wastes (such as refuse i.e. fruit mix, paper and so on, and city garbage).
- Manures had high N contents and low C:N ratios. Crop residues, on the other hand, were rich in C and high in C:N ratios.
- Corn stalk, wheat straw, rice straw were relatively dry; poultry manures, leaves and city garbage were moderately moist; cattle manure, sugarcane bagas, fruit wastes, vegetable wastes, and grass clippings were mostly wet; municipal wastes, sheep manure and poultry manure (layers) were moderate to high in moisture.
- Cattle manure and municipal waste were converted to compost within 120 days when the two wastes mixed together to maintain C:N ratio between 25 and 30, moisture content at around 50%, and the mix turned over 7 times during this period.
- Cattle manure alone was also converted to compost during 120 days but with difficulty. Turning over of cattle manure alone pile was difficult. Compost formed from cattle manure alone was rich in N and relatively alkaline and saline.
- Poultry manure and municipal waste were converted to compost within 120 days when the two wastes mixed together to maintain C:N ratio between 20 and 25, moisture content at around 50%, and the mix turned over 7 times during this period.

- Poultry manure alone was also converted to compost during 120 days but with difficulty. Turning over of poultry manure alone pile was difficult. Compost formed from poultry manure alone was highly rich in N and was both alkaline and saline.
- Municipal waste alone did not convert to actual compost by the end of 120 days. It is thus recommended that cattle manure or poultry manure must be mixed with municipal waste to convert both into good compost.
- The inoculation materials with effective microbes (EM) was ineffective in expediting the process of compositing under aerobic or anaerobic conditions.
- Compositing under aerobic conditions was effective than under anaerobic conditions.

Project Title: *Impact of sewage wastes (effluent and sludge) on soil properties and quality of vegetables.*

Principal Investigator: *Dr. Muhammad Qasim Khan*
Chairman

Location of Project: *Department of Soil Science, Gomal University, D.I.Khan.*

Duration: 36(months)

Start Date: 1/7/2003

Project Status: On-going

Total Cost (million): 4.153

Funds Released (Rs): 2308472

Funds Utilized (Rs): 1725810

(Upto 30th June, 2005)

Objectives:

- To evaluate the quality of sewage waste (effluent and sludge) of different sewerage channels of D. I. Khan city and Zafarabad town being used as a source of irrigation/fertilizer for vegetable crops.
- To determine the quality of soil and vegetables being treated with sewage wastes.
- To investigate about the quality of soil and vegetables as affected by different levels of sewage wastes application.
- To propose a most suitable dose/concentration of sewage waste which could be used by the farmers for raising improved quality of vegetables.

Achievements/Progress:

The analysis of the soils showed that there was a slight increase in soil pH with increasing dose of effluents & sludge. The increase ranged from 0.1 to 0.4. The EC of the waste treated soil also increased in comparison to control treatment. The increase was maximum in sludge treatments in comparison with those treated with effluents. % O.M. of the soil increased by 9.92 % after treatment with the sewage wastes. However, the increase in NPK was more in treatments receiving fertilizer only (Nitrogen 0.76%, P 52 ppm & K 198 ppm), followed by effluents & sludge treated soil (N 0.3 to 0.246 %, P 2] to 42 ppm & K I] 0 to 154 ppm) as compared to untreated soil. The soluble cations ($\text{Ca}^{2+} + \text{Mg}^{2+} + \text{Na}^{+}$), chloride & sulphate also showed an increase in the waste treated soil in comparison with other treatments, while there was no obvious increase in anion HCO_3^{-1} & carbonate was found non detectable in all the samples.

The concentration of trace elements was high in waste treated soil samples & was maximum where sludge was applied (Fe 6.55, Cu 3.54, Pb 5.47 'B 0.95, Zn 5.20 & Mn 3.34 mg kg⁻¹). The contents were high enough compared with maximum permissible levels (F AO, 1985). In vegetables samples, maximum nitrogen was found in radish (3.55 %), phosphorous lettuce (1.10 to 0.88 %) and K contents in cauliflower (2.99 %) treated with NPK fertilizer. Mg content was highest (2.95 %) in spinach treated with S7 as compared to all other treatments. Na content of vegetables also increased with increase in levels of sewage waste. It was maximum (3.25 %) in turnip treated with S7, while Ca & S increased slightly in all the wastes treated vegetables.

Fe & Mn contents were found to be highest in turnip (25.31 & 2.94 mg kg⁻¹, respectively), Cu & Zn in spinach (3.29 & 3.99 mg kg⁻¹, respectively) treated with S7. The Pb content was .maximum (5.66 mg kg-I) in radish getting S7 treatment while Cr & Cd were not detectable in any of the vegetable samples.

The bacteria species isolated from effluents were *E. coli*, *Salmonella* spp., *Streptococcus* spp., *Pseudomonas* spp., *Proteus* spp. & *Staphylococcus* spp.; from the- sludge it was *E.coli*. *Staph aureus*, *Streptococcus* spp., *Bacillus subtilus* & *Pseudomonas* spp. from the soil *E. coli*, *Salmonella* spp., *Pseudomonas* spp., *Staphylococcus* spp. & *Bacillus* spp., & from the vegetables were *E.coli*, *Staph.aureus.*, *Staph citreus* & *Bacillus megatarium*, Fungi identified from the effluents were, *Aspergillus* spp., *Mucor* spp., *Alternaria* spp., *Geotrichum* spp., & *Trichoderma* spp. in the sludge *Mucor* spp., *Geotricum* spp., *Rhizopus* spp., *Aspergillus* spp., *Alternaria* spp. & *Penecillium* spp. in the soils *Aspergillus*, *Coccidiodes* spp., *Mucor* spp., *Paecilomyces* spp. *Fusarium* spp. & *Geotriticum* spp., & in the vegetables were *Xanthomonas* spp., *Mucor* spp., *Rhizopus* spp. & *spergillus* spp. Number of Coliform bacteria per 100 gram of vegetables treated with sewage wastes ranged from 48 to 160 with maximum in effluents treated lettuce getting E7 treatment. Data on growth & yield parameters of vegetables revealed that increase in all the growth parameters was higher in NPK treatments followed by S7, S6, E7 & E6 as compared to all other treatments.

The maximum number of leaves plant⁻¹, leaf length, & yield were recorded in case of spinach, cauliflower & lettuce having S7, S6,E7 & NPK treatments, while maximum root length was obtained from radish, turnip & carrot receiving the same treatments. It could be concluded from the present findings that application of effluents at a concentration ranging from 50-75 % & sludge from 100-150 tons ha⁻¹ may improve soil properties & produce better quality of winter vegetables.

Project Title: *National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan. (Component 2: SSRI, Pindi Bhatian)*

Principal Investigator: *Dr. Abdul Rasool Naseem*
Agriculture Chemist

Location of Project: *Soil Salinity Research Institute, Pindi Bhatian.*

Duration: 36(months)

Start Date: 30/6/2003

Project Status: On-going

Total Cost (million): 3.19

Funds Released (Rs): 2388000

Funds Utilized (Rs): 2282768
(Upto 30th June, 2005)

Objectives:

- Generation of comprehensive technology for economic utilization of salt affected soils and brackish waters with the production of crops (wheat, rice, and medicinal crops) and fruit trees (guava, jamin, ber) at 10 different sites.
- Ensuring short and long-term income for the owners of salt affected lands through demonstration of 5-10 acres and dissemination in the project area.
- To reverse environmental degradation and improve soil health by growing crops, forest trees and fruit plants. The soil health will be monitored after the harvest of each crop.

Achievements/Progress:

Second year of the project has been reported, in which 3 more sites were established comprising of 4-5 acres of each, two in Sheikhpura and one in Hafizabad districts. Gypsum was applied in 3 acres at each after leveling and deep ploughing. Guava and eucalyptus plants were planted on the other two acres

practicing improved technology. For this purpose, channels 2 feet wide and 1.5 feet deep were made in the field and pits measuring 2x2x2 feet were dug on the shoulders of these channels. The pits were filled with silt which avoids early stage salinity stress. Five sites developed last year were also maintained. The average paddy and wheat yield of the five mentioned sites were recorded as 2.53 and 2.78 ton/hectare respectively. A gradual improvement in soil health was recorded. Parameters of EC, pH and SAR reached almost nearer to normal values.

The result of four experiment revealed that compost prepared from crop residues (at the rate of 10 to 20 t ha⁻¹) can successfully be used for reclamation of saline sodic/sodic soils. One experiment was conducted to evolve technology for the usage of brackish water. The preliminary data indicated that bad effects of brackish water (EC=2.48dSm⁻¹, SAR=16.46 and RSC=3.6 me L⁻¹) can be avoided through application of 10% additional water as leaching fraction or application of gypsum in the required amount. Pot experiment was conducted to assess the tolerance of *Acacia ampliceps* against salinity/sodicity and their combinations. The primary data of the experiment indicated that *Acacia ampliceps* can tolerate Ece 50 dS mol, SAR 40 and combination of EC + SAR(30 dS m⁻¹ +50).A field experiment was conducted to identify best transplantation technique for *Acacia ampliceps* to avoid early age salinity stress. The treatment, filling the pits with silt, was observed best of all as it produced more number of leaves, gain in stem girth and height of the plants. Non-conventional/high value crops like Saunf, Ajwain, Onion, Garlic and Aspaghol were sown on the shoulders of the ridges in salt affected soils. The

germination of other non-conventional/high value crops except Saunf, and Ajwain was patchy. However, the experiment will be repeated next year for reliable results.

Regarding academic activities, a letter of memorandum was signed with Prof. Dr. Schmeisky, University of Kassel, Germany, last year for enrolment of SSRI staff members as Ph. D Scholars, who will conduct research work at this institute and degree will be awarded by that University. The research work and compilation of thesis has been completed by one enrolled scholar. He will defend his thesis in Germany in September, 2005. The admission of other two students in the University of Kassel, Germany has been confirmed. Research Fellow is student at U.A.Faisalabad while another student is at Punjab University. .

Forty acres barren land was rehabilitated by supervised reclamation activity. The average paddy and wheat yield at 5 different locations was recorded as 2.4 to 3.0 and 3.1 to 3.7 t ha⁻¹ respectively.

A comprehensive brochure has been prepared, printed and is being distributed among the farmers. A future plan was also prepared to strengthen the ALP practices. Two farmers' days were celebrated at Kahairpur Malian, District Sheikupura and Thatta Langer, District Hafizabad. More than one hundred farmers participated in each of the farmers' day. They were briefed for successful plantation of fruit trees and earning more through utilization of salt affected soils to improve their living standard.

Fifty five acres of land rehabilitation through different activates of the ALP project, has returned to its original potential of crop production, worth Rs. 21000/- per acre income to the farmer. The benefits to the farmers of salt affected lands in monitoring terms equal to Rs. 1.47 million per annum.

Project Title: *National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan. (Component 3: UA, Faisalabad)*

Principal Investigator: *Dr. Javid Akhtar*
Associate Professor

Location of Project: *Department of Soil Sciences, University of Agriculture, Faisalabad.*

Duration: 36(months)

Start Date: 1/8/2003

Project Status: On-going

Total Cost (million): 4.287

Funds Released (Rs): 2582000

Funds Utilized (Rs): 2095478
(Upto 30th June, 2005)

Objectives:

- Generation of comprehensive technology for economic utilization of salt affected soils and brackish water with the production of appropriate crops/plants species.
- Ensuring short and long term income for the farmers of salt affected lands through popularization and dissemination of selected package of technology by appropriate means.
- To reverse environmental degradation and improve soil health enhancing the value of waste lands.

Achievements/Progress:

- The project activities are in progress in two districts Toba Tek Singh (Village 286 G.B) and Faisalabad (126 R.B Pharang). Kharif fodder (Sorghum, maize and millet) and Rabi crop (wheat and Barley) were cultivated in the farmers field to test their yield potential. Sorghum, maize and wheat varieties were tested in green house initially in solution culture then cultivated in fields as mentioned above. The results of our experiments are summarized as follows:
- Eight varieties of sorghum were tested against salinity in solution culture studies, F-9902 was considered as salt tolerant and JS-263 was considered as sensitive.
- Eleven maize genotypes were tested against salinity, 2414w was considered as salt tolerant and 2094 was considered as sensitive.
- Millet was cultivated in field at both sites and performed well under salt affect soil conditions.
- Wheat genotypes/ varieties were tested initially in solution culture studies. Fifteen varieties were tested, at 250 mol m⁻³, SARC-1 and SARC-2 were considered as salt tolerant and SARC-4 was sensitive on shoot fresh weight basis. Then selected SARC varieties were compared with Inqulab, SARC varieties produced more yield as compared to Inqulab.
- Three varieties of barley were cultivated at both sites; Haider 93 performed well under salt affected soil conditions.
- In brackish water experiment, tube well water was used as source of brackish water and in combination with canal water. Results of the experiments indicated that the combined use of brackish and canal water is effective and resulted better yields as compared to alone brackish water application.
- Wheat testing trials were also conducted in number of villages like 407, 409, 410, and 411J.B. Seed of selected SARC varieties were provided to the farmers and tested against recommended varieties like Inqulab and Parwaz. SARC varieties gave good yield, under higher salinity as compared to Inqulab and Parwaz.

Project Title: *National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan. (Component 4: SALU, Khairpur)*

Principal Investigator: *Dr. Abdul Razak Mahar*
Associate Professor

Location of Project: *Department of Botany, Shah Abdul Latif University, Khairpur.*

Duration: 36(months)

Start Date: 1/7/2003

Project Status: On-going

Total Cost (million): 3.513

Funds Released (Rs): 2526000

Funds Utilized (Rs): 2316384
(Upto 30th June, 2005)

Objectives:

- To generate the salt affected soils for re-using for the production of different crops for human being and livestock.
- Re-use of brackish water and analysis of salt affected soils at various affected areas will be brought under this system.
- To encourage and train farmers to actively adopt the new approach for short and long terms income.

Achievements/Progress:

A series of experiments were designed under different field conditions having various salinity levels during the reporting period.

The 1st experiment under the title "Reclamation & improvement of saline-sodic soil" was carried out at experimental field of SALUK. The treatments were FYM, RH, FYM+RH and Gypsum under canal water, as a source of irrigation. The findings proved significant reduction in the soil ECe and SAR. Similarly, the crop growth and yield of rice and wheat improved significantly. The gypsum and combination of RH+FYM performed better in comparison to other treatments in relation to soil health and crop production.

The 2nd experiment entitled "Management of brackish water on saline-sodic soil" was designed by using brackish water only as an alternate source of irrigation for the rice and wheat crops under FYM, RH, FYM+RH, and Gypsum soil treatments. Significant differences were observed among the treatments in found most effective in reducing soil salinity as well improved crop yield minimizing the hazardous effects of brackish water. It was concluded that use of brackish water is not suitable without organic amendments.

The 3rd experiment "Cyclic use of brackish + canal waters for crop production on saline-sodic soils" was managed using canal and brackish, as an alternate irrigation source, with FYM, RH, FYM+RH and Gypsum soil treatments for rice and wheat crop production. It was concluded that cyclic use of brackish+canal waters can be used during short spell of irrigation water.

Regional Workshop and Coordination Meeting of PARC-ALP Salinity Project 15-17 February 2005 at Department of Botany, Shah Abdul Latif University, Khairpur" was organized attended by a number of participants including professors, students, farmers and scientist of various organizations.

Project Title: *National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan. (Component 5: NWFP Agriculture University, Peshawar)*

Principal Investigator: *Dr. Izhar-ul-Haq
Professor*

Location of Project: *Department of Soil & Environmental Sciences, NWFP Agriculture University, Peshawar.*

Duration: 36(months)

Start Date: 26/7/2003

Project Status: On-going

Total Cost (million): 3.094

Funds Released (Rs): 2278000

*Funds Utilized (Rs): 1870440
(Upto 30th June, 2005)*

Objectives:

- Generation of comprehensive technology for economic utilization of salt affected soils and brackish waters with the production of appropriate crops/plants species.
- Ensuring short and long-term income for the farmers of salt affected lands through popularization and dissemination of selected package of technology by appropriate means.
- To reverse environmental degradation and improve soil health enhancing the value of wastelands.

Achievements/Progress:

Salient features of the results from experiments conducted at various salt affected sites on the farmers' fields in Charsadda, Mardan and Swabi districts of NWFP during the crop year 2004-2005 under the Coordinated Project "Management of salt affected soils and Brackish waters in Pakistan" are summarized as under:

- An experiment was conducted at two sites to study the effect of amendments on wheat and their residual effect on succeeding rice crop. Of the amendments such as gypsum, manure and pressmud used in the experiment, gypsum was found most effective in increasing the yield of wheat crop to an extent of 26% over control compared to the other two organic amendments. Succeeding crop of rice grown on the same field was also found benefited due to the residual effect of gypsum giving a yield increase of 15% over control. However, unlike wheat maximum yield of paddy was obtained with combined application of gypsum, pressmud and farm yard manure followed by the treatment where gypsum and pressmud were used together. These amendments were also found effective in reclaiming the soils by reducing pH and gypsum requirement to an extent of 6 -12% and 40-76% respectively. On average 44% increase in paddy was recorded due to the residual effect of the combined application of gypsum, pressmud and animal manure. The effect of manure and press mud was greater in the second crop compared to the 1 st crop. The results further indicate that organic amendments have extended the beneficial effects of gypsum on the 2nd crop.
- To assess the beneficial effects of different amendments for combating the impact of use of brackish tube well water, an experiment was conducted at Majoki area, Charsadda during Kharif 2004. Paddy yield increased with increasing level of gypsum. Gypsum application at full rate gave 55% higher paddy yield, 22% more harvest index and 15% more 1000-grain

weight than half of recommended rate. The increase in yield, harvest index and 1000-grain due to FYM were 57%, 21 % and 16% respectively when used with half rate of gypsum and 16%, 11 % and 2% when used with full rate of gypsum as compared with gypsum application alone. The results suggest that both these amendments helped in boosting the yield of rice through 1000-grain weight, which may be the result of direct nutritional effect as well as indirectly through improving soil properties.

- A study was conducted on salt affected soils at Charsadda and Swabi to evaluate the effects of using gypsum and zinc sulfate on rice. Both these amendments were applied in one part of the experiment as solid applications in various combinations and incorporated in soils. In another part various solutions of these salts were prepared and rice seedlings were dipped in the respective solutions for half an hour before transplantation. The results indicated that Paddy yield was improved both with gypsum as well as Zn treatments. Paddy yield got slightly increased by only 3% and 3.9% when seedlings were dipped in 2% and 4% gypsum solutions respectively. Whereas, relatively higher increases i.e. 10.8% and 8.8% in paddy yield were recorded in the treatments of 0.2% and 0.4% Zn solution respectively. Like wise the increase in paddy yield by application of ZnSO₄ to the soil was 6 -7 % and by application of gypsum powder was 13 -35%. It can be concluded from the results of these experiments that both Zn and gypsum treatments help improve rice yield in saline-sodic conditions. However, in case of Zn dipping of seedlings in 0.4% Zn solution before transplantation is effective and in case of gypsum its application in powder form and incorporation in soil is rather useful.
- The data of the experiment conducted on the management of salt affected soils for sugarcane production show that the use of manure and gypsum increased cane yield on medium textured sodic soils. Both growth and cane yield and quality were improved when the soils were treated with gypsum and/or manure. Cane height increased by 55% over control with 25% gypsum application and increased further with higher rates. Similarly cane height was increased by 69% with manure application. Manure application along with gypsum improved the effect of gypsum regarding cane height and cane diameter. Maximum cane and juice yields of 70606 and 28446 kg ha⁻¹ representing 237 and 180 % increases over that of control were obtained in the treatment of 100% gypsum along with 10 tons FYM per hectare. Gypsum application at various rates increased cane yield by 9.9 to 125% over control. Farm yard manure application increased yield by 44%. Manure application along with various rates of gypsum gave a yield increase of 15 to 74% than at corresponding rates of gypsum alone. Juice quantity per unit cane weight and sucrose content of juice were also maximum with the treatment of gypsum 100% + FYM 10 tons ha⁻¹. The results conclude that profitable yield of good quality sugarcane is possible by treating medium textured sodic soils with the application of gypsum @ 100% along with FYM @ 10 tons ha⁻¹.
- Ten wheat lines such as SR-2, SR-4, SR-7, SR-19, SR-20, SR-22, SR-23, SR-24, SR-25 and SR-40 were evaluated against the performance of a local variety in a study conducted in saline sodic environment. The experiment was conducted Tangi area, Charsadda under a RCB design with three replications. The results show that SR-40 gave the maximum average yield of 1515 kg/ha followed by SR-20 and SR-23 giving a yield of 1330 kg/ha. Minimum yield of 765 kg/ha was obtained by the local variety. It was observed that all the lines performed very well and showed good salt tolerance in non-ameliorated soils. Salt tolerant varieties have an edge over non-tolerant varieties under more saline field conditions. This suggests that selection of the most salt tolerant wheat varieties in addition to the use of

improved planting techniques and proper nutrition are important factors for achieving improved yields.

- The data of the experiment conducted on sugar beet. show that maximum beet yield was recorded when both gypsum and FYM were applied together to saline- sodic soils. FYM application gave, on average, a yield increase of 32% over control treatment and gypsum application gave the same results. Comparing both these amendments it was observed that on average, FYM @ 10 t/ha gave a yield increase of 15% against 12% increase with gypsum @ 50% and FYM @ 20 t/ha increased yield by 23% as compared to 25% increase with gypsum @ 100%. Thus at low levels of their application, manure was more effective than gypsum and at higher levels gypsum turned out to be more effective than manure for improving sugar beet yield on salt affected soils. The results provide conclusive evidence that application of both these amendments are better than their application alone in boosting sugar beet yield on saline sodic soils. Farm yard manure application helps in amelioration of the soil physical properties such as porosity, bulk density, permeability etc. providing better environment for seed germination coupled with supplying nutrients for crop growth. Gypsum at 50%, 100% and 200% of the soil GR and FYM @ 5 kg and 10 kg per guava plant were used in a factorial combination of 12 treatments. The treatments were replicated 3 times having 2 trees per treatment. Guava nursery plants of one-year age were transplanted in the experimental fields during the months of February & March, 2004. Different growth parameters such as plant height, shoot diameter, leaf area, plant survival percentage etc. were recorded. The growth data were taken at an interval of 2 months and that of the soil analysis were taken at an interval of 6 months after transplantation. Results show that of the amendments gypsum was relatively more effective than FYM. Gypsum application alone increased plant height, stem diameter, number of leaves and leaf area by 104-136%, 13-39%, 107-154% and 23-68% respectively. FYM application on the other hand increased these growth parameters by 55-115%, 22-105%, 53-64% and 28-40% respectively. It can be inferred from the results discussed above that both the amendments helped growth of guava plants in salt affected soils. However, best effects were recorded with the combined application of gypsum @ 200% G.R. and FYM @ 10 kg per plant. Highest increase in each of the parameters mentioned above was 115, 144, 395 and 153% respectively. A study was conducted to characterize of tube well waters of the selected salt affected area in district Mardan and to study their effect on associated soils. The results showed that almost all the sites had slightly alkaline ground water. It was observed that almost all the water samples contained RSC values greater than 2.5. Ground water of 50% of the sites under study was moderate to severely saline. Ground water of 60% of the sites had moderate to severe levels of SAR. Almost all the water samples were found hazardous and unsafe for irrigation. Regarding characteristics of the soils under the command of respective tube wells, results indicated that pH of the soil samples was highly alkaline. Due to high RSC of water and high soil pH accumulation of exchangeable sodium occurred as a result of the precipitation of Ca^{2+} and Mg^{2+} from soil solution. The data showed that ECs of soils was on average 1.49 dS mol and SAR 11.18. SAR was significantly correlated with salt load (EC_w) and particularly with Na^+ of water. EC and concentration of anions and cations in irrigation water had significant relation with those of soils suggesting that most of the salts were deposited through the continuous use of tube-well water. Soils of all the sites were alkaline in reaction, highly calcareous and low in organic matter indicating that some of these factors were catalytic in the promotion of soil salinity and sodicity. It was recommended that good quality water, if available, is required for irrigation to supplement tube- well water. Rain water should be stored for irrigation purpose. Amendments such as gypsum, pressmud and manure should be applied to reduce the effect of ground water on soil. Growing salt tolerant crops need also due consideration.

Project Title: *National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan. (Component 6: ARI, Quetta)*

Principal Investigator: *Mr. Shahjahan Khan*
Deputy Director

Location of Project: *Soil Fertility Section, ARI, Sariab, Quetta.*

Duration: 36(months)

Start Date: 1/8/2003

Project Status: On-going

Total Cost (million): 2.93

Funds Released (Rs): 1226000

Funds Utilized (Rs): 1065339
(Upto 30th June, 2005)

Objectives:

- Generation of comprehensive technology for economic utilization of salt affected soils and brackish water with the production of appropriate crops/plants species.
- Ensuring short and long term income for the farmers of salt affected lands through popularization and dissemination of selected package of technology by appropriate means.
- To reverse environmental degradation and improve soil health enhancing the value of waste lands.

Achievements/Progress:

Annual report for period August 2004 to July 2004 has not been provided by the PI. The achievements as per previous reports is as follows:

Rice experiment was conducted at Nasirabad where gypsum was used as an ameliorant of brackish ground water. All the treatment increased the rice yield and gypsum proved the best in reclaiming the soil with regard to pH. To see the effect of sulphur on yield and growth of onion crop in salt affected soil, the results of experiments conducted at Nohsar, Muslak and Panjpani were very encouraging. The production was very high compared to control. Experiments were also conducted at Nohsar, Muslak and Panjpani to see effect of sulphur on yield and growth of tomato in salt affected soils. The result showed that tomato production and size increased where T4 gave the maximum yield.

Experiment on barley was conducted at Nasirabad on use of gypsum as an ameliorant of brackish ground water where T4 gave maximum results with increase in yield up to 50% over control. Application of sulphur on yield and growth of wheat crop in salt affected soil at Nasirabad showed clear response and yield increase up to 35% in T3 over control.

Project Title: *National Coordinated Project on Management of Salt Affected Soil and Brackish Water in Pakistan. (Component 7: NARC, Islamabad)*

Principal Investigator: *Dr. M. Salim*
Chief Scientific Officer/DDG

Location of Project: *INRES, NARC, Islamabad.*

Duration: 36(months)
Start Date: 1/7/2003
Project Status: On-going

Total Cost (million): 3.993
Funds Released (Rs): 2664000
Funds Utilized (Rs): 2068913
(Upto 30th June, 2005)

Objectives:

- Generation of comprehensive technology for economic utilization of salt affected soils and brackish waters with the production of appropriate crops/plants species.
- Ensuring short and long-term income for the farmers of salt affected lands through popularization and dissemination of selected package of technology by appropriate means.
- To reverse environmental degradation and improve soil health enhancing the value of wastelands.

Achievements/Progress:

The overall coordination, supervision and management of the project activities is being carried out by NARC/PARC, Islamabad. The applied research as well as dissemination of technology is being carried out in the farmers' field located in various parts of the country.

The selection of salt-tolerant varieties of cash/cereal/medicinal crops, fodder, and forest and fruit trees is being carried out. The hydroponics and more sophisticated studies are in progress and being conducted while the screened lines are being further investigated in salinity blocks followed by field studies. For the field component, farmers' fields are being used. The following plants are included in this part of research:

Cereal crops: Wheat, Barley, Cotton, Rice and Sunflower

Forest trees: Kikar (*Acacia nilotica/A. Arabica*) Siris (*Albizia lebbek*),
Vilaiti Kikar (*Parkinsonia aculeate*) and Eucalyptus (*Eucalyptus camaldulensis*)

Fruit trees: Falsa (*Grewia asiatica*), Date palm (*Phoenix dactylifera*), Guava (*Psidium guajava*), Jaman (*Syzgium cuminii*) and Ber (*Ziziphus mauritiana*)

Oil seed crops: Mustard, Castor

Vegetable crops: Spinach, Cabbage, and Garlic

Medicinal crops: Fennel, Henbane, Fleeseed and Omum etc.

Fodders: Alfalfa, Sesbania, Sorghum, Millet, Oats, Barley, Leucaena and green manuring crops.

The experimental studies under NARC component started during September 2003 at Pind Dadan Khan area as well as at Tehsil Sahiwal, Distt. Sargodha, continued for acquisition of detailed field data, validation of results and further investigation. A new site was selected for fruit tree plantation and intercropping trials at village Haranpur of Tehsil Pind Dadan Khan. Experiments at two already selected sites were laid out for confirmation of previous results obtained during experiments on mustard crop. One of the fields was selected for brackish water irrigation while second irrigated with river water brought from tube well bored on the bank of river Jhelum (Fresh Water). This time two varieties of Mustard i.e. Sultan raya and 19-H were selected on the basis of best performance in the previous trials. The selection was based on the early maturing with maximum number of pods and yield.

In Sargodha, four sites were selected at village Jalalpur Kangra, located on Sargodha-Jhang Road. The soils are highly salt affected. Two of the fields were laid out for fruit tree plantation i.e. Ber and guava. Sixty percent of the ber plants survived in the field. However, 95% of the Guava, while in the rest of the two fields mustard crop was sown.

During February 2005, field selection for fruit tree plantation was carried out in different field of same experimental areas. Initially Ber, Guava (two varieties) and Falsa transplanted at Rakh Sahiwal and Pind Dadan Khan sites with mechanical digger/augar. Various doses of gypsum and farm yard manure were applied at the time of transplantation. The experiment is in progress. Data on stem girth, height of plants and fruit production will be recorded at Diameter at Breast Height (DBH) basis. Six combinations of planting methods and soil amendments are tested for salt tolerant tree plantation. Salt-tolerant tree species (*Eucalyptus camaldulensis*, *Acacia nilotica*, *Tamarix Aphylla*, *Casuarina equisetifolia*) raised at the experimental sites are planted using augur hole method technique with various soil amendments.

Screening of castor oil seed plants under graded level of NaCl and their nutrition status: A hydroponics study was conducted on castor bean plant in the glass house with the following objectives:

- To identify the salinity level where 50% reduction in the yield is indicated.
- To quantify the nutrient status under saline/ sodic conditions.

Analysis of the growth parameters and chemistry revealed that there was a highly significant ($p < 0.01$) effect of the applied treatments on the growth parameters as well as on the ionic concentration in the shoot and root portion of the plant. With the increasing concentration of NaCl in the root medium, the length of shoot decreased. The same trend was observed for root length as well.. There was a sequential decrease in fresh mass (FM) of shoot in ascending order of the applied NaCl in rang of 14 to 85 percent at 4 to 100 mm of the applied NaCl. Salinity disturbs metabolic pathways for protein, carbohydrates and fats synthesis. This results in decrease of tissue growth and development. An antagonistic relationship between sodium ion and dry mass was recorded in the plant tissue. In shoot 100 unit increase in sodium ion caused a decreased of 105 units of dry mass. The correlation between shoot DM and sodium ion concentration was -0.97.

In field trials castor bean is tested for its salt tolerance in a saline sodic soil at Jalalpur Kanghra, Jhang Road, Tehsil Sahiwal. Two gypsum levels were selected i.e. 4 ton and 8 ton gypsum per hectare as treatments. The experiment is in progress.

Project Title: *Increasing and sustaining crop productivity of water eroded lands through rainwater.*

Principal Investigator: *Dr. M. Shafiq*
Principal Scientific Officer

Location of Project: *WRRP, NARC, Islamabad.*

Duration: 36(months)

Start Date: 27/7/2004

Project Status: On-going

Total Cost (million): 7.49

Funds Released (Rs): 1064000

Funds Utilized (Rs): 965655

(Upto 30th June, 2005)

Objectives:

- Develop and disseminate rainwater and nutrient management technologies for increasing and sustaining productivity in eroded lands.
- Participatory diagnosis of constraints and opportunities (PDCO) related to rainwater, soil and nutrient management.
- Identify factors of soil physico-chemical degradation due to water erosion.
- Determine water-nutrient interactions and nutrient imbalances under rainfed agriculture in eroded lands.
- Develop intergraded nutrient and water management strategies for increasing and sustaining crop productivity.
- Promote proven and cost-effective available/ developed technologies for water conservation and soil fertility restoration by means of innovative extension approaches.

Achievements/Progress:

Conducted survey with the assistance of Soil Pedologist/Soil Survey Expert. Two target areas (Fatehjang and Gujar Khan) have been selected and characterized. Report has been established under the title “The Soils and Their Agricultural Development Potential in Pothwar” which has been used for selection of experimental fields and designing of experiments.

Participatory diagnosis of constraints and opportunities related to rainwater, soil and nutrient management, was carried out in Fatehjang and Gjar khan Tehsils. Soil and water conservation practices are not properly adopted because of increasing cost of energy. The use of fertilizer is imbalanced and decreasing as result of high cost of fertilizers.

Soil samples from 90 erosion affected fields of two target areas have been collected and analysed for different soil characteristics and nutrient status. The soil of Fatehjang and Gujar Khan target areas are slightly alkaline froo from salinity problem. About 92% of samples collected from Fatehjang are highly to very highly calcareous. Whereas, in Gujar Khan 42% of surface and 52% of subsoil samples are highly to very highly calcareous. Nearly 100% of soil samples collected from Fatehjang and Gujar Khan targets area is deficient in NO₃-N and Phosphorus. Only 15% top soil and 38% of subsoil of Fatehjang are deficient in Potassium. It is further observed 95% and 85% of top soil and 100% and 90% of sub-soil samples collected from Fatehjang and Gujar Khan target area are deficient in Zn and B. No top and sub-soil sample is deficient in Cu and Mn. However, 17% and 24% of top and sub-soil samples are deficient in Fe. The nature and extent of

soil erosion has affected nutrient status of soil. The detail report entitled “Nutrient Status of Water Eroded Lands in Pothwar Plateau” has been printed.

Based on soil erosion hazards eight fields each at Fatehjang and Gujar Khan target areas have been selected and characterized. Field experiments adopting rainwater conservation and soil fertility management practices have been conducted on wheat. Improved fertilization increased grain yield 15% to 25% under three soil series. In addition one experiment was initiated at NARC for testing/evaluation of nutrients and water (supplemental irrigation) interactions. The crop samples are being processed for yield estimates and nutrient uptake.

Project Title: *Sustainable Rice-Wheat Farming System on Salt-Affected Soils Using Brackish Water and Amendments.*

Principal Investigator: *Dr. Ghulam Murtaza*
Assistant. Professor

Location of Project: *Deptt. of Soil Science, Institute of Soil & Environmental Sciences, University of Agriculture, Faisalabad.*

Duration: 36(months)

Start Date: 24/11/2004

Project Status: On-going

Total Cost (million): 2.923

Funds Released (Rs): 765000

Funds Utilized (Rs): 759936
(Upto 30th June, 2005)

Objectives:

- Screening of existing salt tolerant rice and wheat varieties (3-4 each) against ambient soil salinity and sodicity levels.
- Growth response of saline-sodic soils to the Rice and Wheat varieties (proved tolerant from Lab. Study) in rice-wheat cropping zone to amelioration strategies.
- Farmer education to utilize salt-problem soils and brackish irrigation waters.
- Economic viability of the strategies under investigations.

Achievements/Progress:

Evaluation of commonly grown rice and wheat cultivars at different EC: SAR ratios may help to cope with the venture of the crop failure in salt-affected soils. Rice and wheat crops were grown in a pot experiment to compare the growth performance of some existing salt tolerant cultivars of rice and wheat at different salinity/sodicity levels during 2004-05 in the wire house, Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad. Pots filled with 11 kg sandy clay loam soil spiked with different salts to achieve various EC:SAR ratios (3.08:8.57, 3.87: 14.29, 6.38: 15.40, 7.58:27.79, 10.26:25.60, 11.85:47.38 against designed levels of 4:8,4:16, 8:16, 8:32, 12:24, 12:48) were arranged in completely randomized design. Two rice seedlings per hill (5 hills per pot) of seven rice cultivars [S8RI-8 (VI), PB-95 (V2), SSRI-13 (V3), IRRI-9 (V4), IRRI-6 (V5), KS-282 (V6), Shaheen Basmati (V7)] were transplanted and the pots were irrigated with canal water having leaching provision. Fertilizers NPK @ 2.27, 0.49, 0.91 g per 11 kg soil were applied. The crop growth characteristics were recorded at maturity and statistically analyzed. After rice harvest, wheat cultivars [MA W-1 (VI), Inqlab-91 (V2), Ufaq (V3), Auqab-2000 (V4), SIS-27 (V5), SIS-32 (V6)] were sown in the same pots following recommended cultural practices.

The crop growth characteristics (tillers, plant height, 100-grain weight, and grain and straw yields) were recorded and statistically analyzed. Maximum productive tillers (62) and paddy yield (49 g/pot) were recorded in S8RI-8 while maximum 100-grain weight was observed for 88RI-13 (2.23 g/pot). Maximum straw yield (77 g/pot) was obtained for IRRI-9. In general, soil ECe (up to 8 d8 m-l) tended to counter the adverse effects of SAR on rice growth. Regarding wheat crop, maximum 1000-grain weight was observed for Inqlab-91 (26.68 g/pot), while maximum plant height (72 cm), productive tillers (28) and grain yield (14.88 g/pot) was observed for SIS-32. Decrease in ECe and SAR after wheat harvest with treatments was in the decreasing order of T6 followed by T5, T4, T3, T2 and T1. Among the tested rice varieties,

SSRI-8 gave maximum paddy yield, maximum productive tillers and minimum non-productive tillers. Among the tested wheat cultivars, 818-32 gave maximum plant height, productive tillers and grain and straw yields. The EC:8AR ratios proved more hazardous for rice at the highest levels of EC and 8AR than that of wheat. Promising varieties screened out from pot studies will be tested under field conditions at selected experimental saline-sodic fields during the following years.

Irrespective of the varieties tested, the highest levels of EC and 8AR (T5 and T6) caused significant reduction in paddy yield while at the lowest levels of EC and 8AR (T1 and T2) paddy yields were not affected significantly when compared with control. But in case of wheat crop, all the levels [i.e. lowest (T1 and T2), medium (T3 and T4), and highest (T5 and T6)] of EC and SAR tested, affected wheat yield adversely with significant differences along EC:SAR ratios compared to the control. For both the crops, there were non-significant differences in yield for both the tested ratios (i.e. 0.50 and 0.25) at all the levels of EC and SAR. A decrease in ECe (13-32 %) and SAR (41-59 %) after wheat harvest over the initial levels was observed. However, the treatments differed statistically, the treatment sequence being was T6 (EC:SAR ratio of 12:48) followed by T5 (EC:SAR ratio of 12:24), T4 (EC:SAR ratio of 8:32), T3 (EC:SAR ratio of 8:16), T2 (EC:SAR ratio of 4:16) and T1 (EC:SAR ratio of 4:8).

Project Title: *Evaluation and formulation of calcium carbide based soil amendment for improving crop production.*

Principal Investigator: *Dr. Muhammad Arshad*
Professor

Location of Project: *Deptt of Soil Sciences, Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad.*

Duration: 36(months)

Start Date: 17/5/2004

Project Status: On-going

Total Cost (million): 2.993

Funds Released (Rs): 1427000

Funds Utilized (Rs): 1064901
(Upto 30th June, 2005)

Objectives:

- Evaluation of concentration dependent release of C_2H_2 and subsequently C_2H_4 from added CaC_2 .
- Formulation of cost effective CaC_2 – based formulation for improving growth and yield of cereals.
- Effectiveness of CaC_2 formulation under different soil conditions (texture, moisture, organic matter, temperature and pH for C_2H_2/C_2H_4 production).
- Development of technology transfer package for the farmers for general use.

Achievements/Progress:

Recycling of organic waste into a useful soil amendment is one of the major options for reducing the huge piles of organic wastes. Studies conducted under this project demonstrated the effectiveness of recycled organic waste (compost) enriched with nutrients (N), biologically active substances (L-tryptophan) and plant growth promoting rhizobacteria (PGPR) for improving the growth and yield of maize and wheat. Fruit and vegetable wastes were collected from different locations (fruit and juice shops, fruit and vegetable markets, etc.) of Faisalabad city and subjected to composting in a locally-fabricated unit. Compost product was enriched with 25 or 50% of nitrogen fertilizer recommended for maize and wheat crops. Some batches of composted material were further enriched with L-tryptophan (L-TRP) at the rate of 5 mg kg⁻¹ compost. Similarly, inocula of plant growth promoting rhizobacteria (PGPR) were used to make the compost an effective biofertilizer. Full recommended doses of chemical fertilizers (NPK) were kept for comparison.

Results of a series of pot and field experiments conducted in the Institute of Soil and Environmental Sciences (UAF) revealed that the application of enriched compost alone or in combination with N fertilizer significantly increased the growth and yield of maize and wheat in both pot and field experiments compared to control (PK fertilizer only). Application of L-TRP and PGPR caused further improvement in growth and yield of both the tested crops. Among the various treatments, enriched compost with L-TRP and PGPR supplemented with 50% N fertilizer was more effective than chemical fertilizers (NPK). It was also noted that 25% N enriched compost (without L-TRP or PGPR) along with 50% additional dose of N fertilizer was equally effective to chemical fertilizers. This implies that the integrated use of enriched compost and chemical fertilizers can save more than 25% N-fertilizer.

The integrated nutrient supply and use of organic mineral and bio- fertilizer could lead to sustainable crop production and soil health. The combined application of organic/biofertilizer (enriched compost) and chemical/mineral fertilizer could enhance the recycling of nutrients and may improve the supply of macro/micronutrients to plant along with extra benefits derived from PGRs and PGPR. The complementary use of various sources of nutrients is also advantageous as it helps in improving fertilizer use efficiency. It is therefore possible to get higher yield levels with complimentary use of organic biofertilizer alongwith chemical fertilizers than chemical/mineral fertilizer alone. The recycling of organic waste for the development of useful soil amendment through blending/enriching with nutrients, plant growth regulators or PGPR could not only help in archiving sustainability in agriculture but also in environments as piling up of huge amount of organic waste is posing serious threat to environment.

Project Title: *Management aspects of surface and groundwater resources for irrigated areas.*

Principal Investigator: *Dr. Rai Niaz Ahmed*
Associate Professor

Location of Project: *Deptt of Irrigation & Drainage, University of Agriculture, Faisalabad.*

Duration: 36(months)
Start Date: 29/5/2004
Project Status: On-going

Total Cost (million): 2.534
Funds Released (Rs): 1124000
Funds Utilized (Rs): 786692
(Upto 30th June, 2005)

Objectives:

- To determine variability in the available surface water supplies, demands, and potential of safe use of ground water resources in Bari Doab.
- To apply the MODFLOW computer model in Bari Doab for developing practical guidelines and water quality maps for development and use of groundwater to avoid secondary salinization.

Achievements/Progress:

Experimental sites have been selected in Bari Doab across the Lower Bari Doab canal (LBDC), near Renala Khuard, District, Okara. The sites are located in the command areas of Bairwali minor and 1-R distributary off taking from LBDC and irrigate an area of a number of villages. Ten piezometers have been installed at a distance of 100 meters from the minor across the LBDC leading towards the fields and eight piezometers have been installed across the 1-R distributary.

Daily water table data is being recorded from these piezometers. After selection of the experimental sites, map of the district Okara was scanned to acquire it in the computer environment. Using Geographical Information System (GIS) technique, geo-referencing of the map was done to give it a shape of a proper coordinate system and relate it to the real world. Moreover, the area of experimental sites was digitized to the level of union councils and villages in the union councils. The surface water supplies data regarding discharge, operational time of LBDC, Bailwali minor and 1-R distributary including design discharge of watercourses at the outlets was collected from the Irrigation and Power department. Moreover, a detailed survey was conducted for the number of tubewells in both the experimental areas. Presently, 335 tubewells are available in all eight villages which are owned by different farmers.

Data of cropping pattern at the experimental sites have been completed on village basis for the last Rabi season from November, 2004 to May, 2005. The data of crop and cropped area was used to determine the actual evapo-transpiration and crop water requirement on the area basis. Results obtained so far revealed that there is an increasing trend of using the groundwater without knowing the consequence of using low quality water. During interaction with farmers it was noted that there is a lot of potential to improve the existing/ traditional practices for making safe use of existing quality groundwater.

Project Title: *Testing and Evaluation of Lining and Control Structure Alternatives for Irrigation Channels.*

Principal Investigator: *Dr. Muhammad Rafiq Choudhary*
Professor

Location of Project: *Deptt of Irrigation & Drainage, University of Agriculture, Faisalabad.*

Duration: 36(months)
Start Date: 28/5/2004
Project Status: On-going

Total Cost (million): 4.128
Funds Released (Rs): 987000
Funds Utilized (Rs): 813622
(Upto 30th June, 2005)

Objectives:

- To identify nationwide problems of existing control structures adopted for watercourse improvement.
- To develop economical and efficient control structure at tertiary level to overcome chipping, leakage and durability problems for sustainable watercourse improvement.
- To test the hydraulic and economic performance of the developed control structures for improving watercourse conveyance efficiency leading towards productivity enhancement in agriculture on sustainable basis.

Achievements/Progress:

- In accordance with the "Plan of Work" the following accomplishments have been made during the reported period of the project (April 28, 2004 to June 30, 2005).
- Selection of existing watercourses in the Districts of Faisalabad, Toba Tek Sing and Sheikhpura for performance evaluation of control structures has been completed (Although selection in only one District i.e. Faisalabad, T. T. Singh 'Or' Sheikhpura was desired).
- Selection of Watercourses in other Provinces (NWFP and Sindh) has been completed, and in Balochistan it is in progress. The requisite data have been collected.
- Survey interview with farmers and manufacturers has been completed. .
- Coordination with the manufacturer has been accomplished in principle and it is in progress through MOU with the University.
- Collection and Visual observation of existing (earlier) control structures has been accomplished. Their past evaluation has been reviewed thoroughly in the report.
- Design of improved control structure is in progress as performance study of the control structures installed during 4 phases of the OFWM projects has been completed and inventory of problems has been established.
- Manufacture of control structure requires training of project staff as agreed upon with Husnain RCC Ltd. Sargodha. Manufacture of modified control structure will start as soon as the MOU is signed.

Project Title: *Silicon nutrition for enhancing crop productivity.*

Principal Investigator: *Dr. Rahmatullah*
Associate Professor

Location of Project: *Department of Soil Science, University of Agriculture, Faisalabad.*

Duration: 36(months)

Start Date: 19/7/2004

Project Status: On-going

Total Cost (million): 3.431

Funds Released (Rs): 1396552

Funds Utilized (Rs): 1376600
(Upto 30th June, 2005)

Objectives:

- Evaluate effects of Si fertilization on growth performance of rice, wheat and sugarcane.
- Study role of Si nutrition in controlling fungal diseases of these crops.
- Identification of Si-accumulator genotypes/cultivars of these crops and their relationship with tolerance to diseases (especially fungal) and other abiotic stresses such as salt tolerance.

Achievements/Progress:

Silicon fertilization has a dual effect on plants. Firstly, Si nutrition of plants reinforces plant protective properties against abiotic including salt stress (Sodium toxicity in wheat and barley), Metal toxicity (Al- toxicity in wheat), drought stress, radiation damage, nutrient imbalance, high temperature, and freezing and biotic stresses (disease and insect attack). Secondly, amending soils with silicon improves, improves physical and chemical properties of soils and maintain nutrients in a plant available form. In the reporting period of the first annual year we collected soil, plant and water samples and analyzed Si range in 50 wheat varieties, 19 rice varieties and 10 different sources of water.

The result demonstrated a wide genotypic variation in rice and wheat plant for their Si content. This data will be used for Si fertilization of selected crops. We also conducted the experiments under controlled condition with different silicon treatments in soil and solution culture i.e. study the interactive effect of N and Si on coarse and fine varieties of rice, the results indicated that combination of N & Si enhance the growth of rice plants, the coarse varieties proved to be N responsive as compared to Basmati varieties.

In an other study, we evaluate the effect of Si on salt tolerance of wheat genotypes in soil and solution culture. The results of the study showed that addition of Si with salinity reduced the dry matter yield of wheat plant only by 4% as compared to 46% in the plants not treated with Si. Thus we, concluded that Si mitigating salt toxicity in plants. However, the mechanism for the alleviation of salt stress in plants by Si is still poorly understood.

Project Title: *Improving Root-association of Diazotrophs (Azorhizobium spp., Azospirillum spp.) in rainfed wheat.*

Principal Investigator: *Mrs. Shahida Nasreen Khokhar*
Senior Scientific Officer

Location of Project: *Soil Biology Lab, National Agricultural Research Centre, Islamabad.*

Duration: 36(months)
Start Date: 27/7/2004
Project Status: On-going

Total Cost (million): 2.233
Funds Released (Rs): 1401225
Funds Utilized (Rs): 246327
(Upto 30th June, 2005)

Objectives:

- To select microbial genetic resource of efficient diazotrophs which can perform well with rainfed wheat.
- To improve rainfed wheat productivity through increased endosymbiotic root colonization with diazotrophic microorganisms under dry as well as irrigated conditions.

Achievements/Progress:

During the present year, 246 root samples of wheat roots were collected from 82 farmers' fields from Potowar, D.I.Khan and Quetta. 250 isolates (*Azospirillum*) have been recovered on N-free medium from surface sterilized wheat roots. Seven *Azorhizobia* isolates (2 from NARC and five from Kala Shah Kaku) have been obtained from stem and root nodules of *Sesbania rostrata*. All were authenticated by re-nodulation test on *Sesbania rostrata*.

All isolates were characterized for their cultural and microscopic characters. The isolates were subjected to acetylene. Gas samples from assay chambers were stored for analysis. Since Gas Chromatograph was delivered on June 30, 2005 and is still in the process of installation, the samples could not be analyzed for acetylene reduction. For this reason screening process was severely delayed. As an alternative 67 *Azospirillum* and seven *Azorhizobium* isolates were subjected to evaluation test on the basis of their ability to fix nitrogen (in terms of total nitrogen content of shoot) in association with wheat (var. MH97) roots under sterilized sand culture conditions. The evaluation experiment for *Azorhizobium* had to be abandoned because of uncontrollable light period of growth chamber. Top ten *Azospirillum* isolates (the ones produced 4mg-6mg N per plant) and six *Azorhizobium* isolates were tested for their low temperature (15°C) tolerance. Two *Azospirillum* from D.I.Khan and three *Azorhizobia* from Kala Shah Kaku grow almost equally well at 15°C as on 30°C. Ten isolates selected for their Nitrogen fixation potential so far are in the process of marking for their Antibiotic Resistance against kanamycin and streptomycin.

Project Title: *Assessment of Productive Potential and Utilization of Rangelands and Sown Pastures in Pothwar Plateau.*

Principal Investigator: *Mr. M.I. Sultani*
Senior Scientific Officer

Location of Project: *Range Land Program, National Agricultural Research Centre, Islamabad.*

Duration: 36(months)
Start Date: 10/8/2004
Project Status: On-going

Total Cost (million): 3.580
Funds Released (Rs): 1424000
Funds Utilized (Rs): 893540
(Upto 30th June, 2005)

Objectives:

- To carryout various studies of grass/legume pertaining to different agronomic, physiological and utilization aspects.
- To find out the present status of range vegetation through phytosociological surveys and quantitative observation on vegetation dynamics.
- To determinate the forage production/utilization characteristics and performance of grazing lambs.

Achievements/Progress:

The project has activities at three locations:

- i) Rangeland Research Program, INRES, NARC, Islamabad
- ii) Pabbi Hills, Kharian Range and
- iii) Punjab Forest Institute, Gatwala, Faisalabad.

The annual report describe in detail the activities carried out at Pabbi Hills Kharian Range. It covers range analysis and contain useful information about the study area i.e. geology and soil, climate, forest, wind and rangeland inventory etc.

At NARC experiment to evaluate growth performance of exotic grasses germplasm under local condition was carried out and data collected and analysed. All grasses showed excellent performance under local environment of the northern Pothwar Plateau of Pakistan. Out of the six grasses (*Panicum maximum* var. *Gaton*, *Panicum maximum* var. *Tanzani*, *Bracharia humidicola*, *Bracharia brizantha*, *Eragrostis curvula* and *Panicum antidotale*), *Panicum antidotale* grass performed well as indicted by moisture contents of 65.92%.

Six grasses (Buffel grass, Blue panic (*Tanzanian*), Blue panic (Local), *Setaria anceps*, Elephant grass and Rhodes grass were established by using rootstocks at Punjab Forest Research Institute (PFRI) Gatwala, Faisalabad. Data regarding green manure production and crude protein after 4 months was recorded.

Project Title: *Modeling leaching losses of fertilizer nutrients from root-zone and environmental implications.*

Principal Investigator: *Dr. M. Mahmood-ul-Hassan*
Senior Scientific Officer

Location of Project: *Land Resources Research Instt., National Agricultural Research Centre, Islamabad*

Duration: 36(months)

Start Date: 17/7/2004

Project Status: On-going

Total Cost (million): 2.409

Funds Released (Rs): 1171150

Funds Utilized (Rs): 678683
(Upto 30th June, 2005)

Objectives:

- Study leaching losses of fertilizer nutrients with special reference to preferential flow and soil structure development
- Study possible occurrence and quantum of preferential flow of NO₃, P and K in soils of Pakistan
- Develop relationships between preferential nutrient transport and soil structure, and
- Validate models' simulated results.

Achievements/Progress:

- Twelve intact soil columns (26 cm diameter and 35 cm long), 3 from each soil -Lyallpur, Pacca, Shahdara and Sultanpur, from Okara, Sahiwal and Chiniot (District Jhang) were collected by encasing in PVC pipe for nutrient leaching laboratory experiments. Small cores and loose soil samples of different depths from each soil were also collected for physico-chemical analysis.
- The columns were transported to laboratory and prepared for nitrate and phosphate leaching experiments.
- Soil was characterized for physical and chemical properties.
- P-sorption capacity of Shahdara, Lyallpur, Pacca and Sultanpur soils was determined by constructing multi-point isotherms and equilibrating the soils with P solution of different concentrations.
- Nitrogen and phosphorus leaching experiments were completed using intact columns.
- Periodically collected leachate was analyzed for nitrate and P contents.
- Independent breakthrough curve (BTC) for each soil and solute was constructed by plotting average percolate concentration against cumulative percolates.

Results

- Four soils, used in the experiments, were texturally varied from sandy loam to clay; Shahdara soil -sandy loam, Pacca soil- silty clay, Lyallpur soil- clay loam, and Sultanpur soil- silt loam.
- The Shahdara soil was deep massive, moderately calcareous; Pacca was weakly coarse subangular blocky to moderate medium and fine subangular blocky, Lyallpur was weak coarse and medium sub angular blocky and Sultanpur was weak coarse subangular blocky.

- Shahdara had relatively high average bulk density (1.52 Mg/m^3) of soil whereas Pacca had 1.42 Mg/m^3 , Lyallpur 1.44 Mg/m^3 and Sultanpur 1.49 Mg/m^3 . Contrarily, Pacca had relatively larger total porosity ($0.46 \text{ m}^3/\text{m}^3$).
- However, Lyallpur columns had larger saturated hydraulic conductivity (190 mm/day) and mean pore velocity (452 mm/day) than other columns from all soils.
- The Pacca soil sorbed most of the applied P, whereas the difference between applied and sorbed was wide for Sultanpur soil and order of maximum sorption capacity was Pacca > Lyallpur > Shahdera > Sultanpur.
- Presence of N and P contents in leachate shortly after application indicates the nutrients losses from surface soil to subsurface soils.
- Particularly, the presence of a reactive nutrient -P in leachate of both the soils depicts phosphorus movement despite the soil P sorption capacity.
- Fraction of P collected through leachate was very small as compared with nitrate.
- Comparison of observed first arrival times and break through curves indicated that nutrients moved preferentially in all the columns from all the four soils. However, the magnitude of preferential flow was higher in the Lyallpur soil (relatively better structured) than in the Shahdara soil (massive).
- Breakthrough curves of Lyallpur and Pacca soils were more skewed, a quantitative indicator of preferential flow, than Sultanpur and Shahdera. Distribution of the breakthrough curves of Sultanpur and Shahdera soils were relative normal which indicate that solute moves with uniform wetting front.

Conclusions:

- Increase in clay content enhance P sorption, except in Shahdara, where CaCO_3 might be a sink source.
- Despite of the soils high P sorption capacity, a significant fraction (22-50%) leached down with effluent.
- Magnitude of preferential flow was higher in relatively better structured soils, i.e. Pacca and Lyallpur.
- Most of the applied nitrates were flushed away with effluent.

Project Title: *Determination of growth, wood properties and watertable control following afforestation of proven provenances/species under saline and waterlogged conditions in Pakistan.*

Principal Investigator: *Dr. Mohammad Khan*
Senior Research Officer

Location of Project: *Pak. Forest Institute, Peshawar*

Duration: 36(months)

Start Date: 28/12/2004

Project Status: On-going

Total Cost (million): 3.000

Funds Released (Rs): 357250

Funds Utilized (Rs): 307327
(Upto 30th June, 2005)

Objectives:

- To establish species cum demonstration plots on farmlands over 5-acre area at two sites in two districts in NWFP under waterlogged and saline conditions.
- To monitor watertable and to recommend suitable salt tolerant species for the specific sites in NWFP.
- To develop agroforestry models for problematic areas through community participation to overcome environmental issues.
- To determine wood properties of the species established on marginal lands for farmer's use.

Achievements/Progress:

- Visited a number of saline and waterlogged areas on farmlands in Mardan district in February 2005 and selected a site covering an area of 2 ha on farmland in Tooro village about 20 km south of Mardan. This area had become unproductive- due to salinity and water logging.
- Raised planting stock of 10 salt-tolerant tree species viz; *Terminalia arjuna*, *Eucalyptus microtheca*, *Euc. Camaldulensis*, *Albizia procera*, *Casuarina obesa*, *Casuarina glauca*, *Acacia nilotica*, *Acaica ampliceps*, *Tamarix aphylla* and *Eugenia jambulana* and procured willow shoot-cuttings and entire plants of date palm (*Phoenix dactylefera*) for planting in the field trial on farmland.
- Soil samples were collected from 33 uniformly spaced points using a grid system of 20 x 25 m spacing. These samples were collected by using soil auger in February, 2005 from two levels at each point i.e. 0-15 cm and 15-30 cm deep from the surface. These samples were analyzed in the soil laboratory for soil pH and electric conductivity (ECe).
- The land was ploughed and leveled before digging of pits in March, 2005. Pits of 40 cm x 40 cm size (Circumference x depth) were dug at 3 m x 3 m spacing. Planting of 12 salt tolerant tree species was done in March/April, 2005.
- Gypsum was added with the pit soil at the time of planting at the rate of 3% (1 kg per pit). Application of soil amendment (Gypsum) and planting were followed by irrigation.
- The experiment was laid out in randomized complete block design with 5 replications, testing 12 salt tolerant tree species planted at 3 m x 3 m spacing. The number of plants per species per replication is 28 and the total number of plants in the trial is 1680.
- The experimental area was fenced using barbed wire and wooden posts in May 2005.
- Survival data recorded in June 2005 indicated 90-95% success for species other than willow and date palm, which had about 10% survival.

Project Title: *Refinement of skimming well design and operational strategies for sustainable groundwater management.*

Principal Investigator: *Dr. Muhammad Ashraf*
Director

Location of Project: *Pak Council of Research in Water Resources, H# 3, St#17, F-6/2, Islamabad.*

Duration: 36(months)

Start Date: 5/5/2004

Project Status: On-going

Total Cost (million): 2.100

Funds Released (Rs): 929909

Funds Utilized (Rs): 929704
(Upto 30th June, 2005)

Objectives:

- To refine the skimming well design and develop operational strategies based on thickness of the freshwater layer.
- Determine depth to interface of the fresh and brackish groundwater in the target area.
- Conduct surveys and characterize design of skimming wells installed by farmers and their operational strategies.
- Fine-tuning of the design and development of operational strategies for sustainable groundwater management using skimming wells.

Achievements/Progress:

In the Indus Basin, the native groundwater is saline due to underlying marine geological formations. Over this saline water a thin freshwater layer exists as a result of seepage from the rivers and the irrigation systems. This thin fresh water layer can be harnessed by skimming wells. Various skimming well techniques are being used to extract freshwater. These include conventional shallow wells, multi-strainer (multi-point) wells, radial collector wells, scavenger wells, dugwells and re-circulation wells. Multi-strainers skimming wells are becoming famous among the farmers. However, these wells are designed and installed without considering the freshwater lenses. These wells are either installed below the interface or close to the interface due to which the interface moves upward resulting in increased salinity in the pumped water. Moreover, due to indiscriminate/continuous pumping, the fresh-saline water interface moves upward resulting in water quality deterioration. The objectives of this study are to refine the skimming well design and develop operational strategies for sustainable groundwater management to reduce the risk of soil salinization.

The study is being conducted in the Chaj Doab (the area between the rivers Chenab and Jhelum). The area has been divided into grid of 5 km x 5 km. A questionnaire was developed and pre-tested in the field. Information such as number of strainers, size of strainers, depth of strainers, distance of strainers from each other, depth of skimming wells, discharge of skimming wells, quality of pumped water etc. was collected through the questionnaire on the skimming wells installed in the area.

It is found that there was an abrupt increase in installation of skimming wells in the area from 2000 to 2002 which was the drought period and there is no set design criteria for the installation of skimming wells. The number and size of the skimming wells absolutely depends on the advice

of the drillers and the wishes of the farmers. Farmers normally believe that with greater number of strainers, they will get more discharge. The number of strainers vary from 2 to 20 and the size of the strainers from 2 to 6 inches with varying depth. Even one farmer of the area has installed 26 strainers of 2 inch diameter each. Six strainers are mostly installed by the farmers followed by 4, 12 and 8, respectively.

Farmers also like to install more strainers with the intention that if one or two of these become inoperational due to one or the other reasons, they can close those and operate the well with the remaining strainers without losing discharge significantly. The distance of the strainers from the well i.e. from the pump is also arbitrary and depends on the drillers advice and farmers desires. Some times, it also depends on the location of the pump installed. The farmers normally try to increase the distance with the concept that with greater distance, they can get more discharge for longer time. Three inch strainer is commonly used by the farmers. The reasons for this selection is the availability of materials, availability of equipment for installation and relatively easy installation. Selection of casing (blind pipe) is normally based on the water-table depth. Greater the water-table depth, the greater the length of casing. The prevailing water table in the area ranges from 15 ft to 25 ft. Therefore, 20 ft length blind pipe is commonly used in the area.

Based on the information collected, three skimming wells have been selected. Piezometers have been installed on these wells to find the effect of each strainer on the drawdown. Multi-level observation wells have also been installed to collect samples from various depths for salinity analysis. In addition, seven multi-level observation wells have also been installed in the area to collect water samples from various depths and to measure water-table depth which would help determine the fresh-saline water interface. At the selected skimming well sites, pumping tests will be conducted under different strainers configurations and operational strategies. Modifications in the selected skimming wells will be made if deemed necessary. All this information will help to refine the skimming well design and operational strategies.

Project Title: *Use of low quality groundwater for sustainable crop production.*

Principal Investigator: *Dr. Ashfaq Ahmad Sheikh*
Dy. Director

Location of Project: *Pakistan Council of Research in Water Resources, H# 3, St#17, F-6/2, Islamabad.*

Duration: 36(months)
Start Date: 5/5/2004
Project Status: On-going

Total Cost (million): 1.700
Funds Released (Rs): 826900
Funds Utilized (Rs): 736494
(Upto 30th June, 2005)

Objectives:

- To develop and test strategies for conjunctive use of surface and low quality groundwater using cyclic and mixing modes at the farm level.
- Estimate quality and status of groundwater use in the selected area.
- Design and test strategies for cyclic and mixing modes for saline and sodic groundwater respectively.
- Estimate the potential cropped area and cropping intensity under both strategies and water availability at the farm level.

Achievements/Progress:

The increasing scarcity of water is a well recognized problem in the world. At present, approximately 80 countries with 40% of the world population already suffer from serious water shortages. Agriculture sector is by far the largest user of water in the world and on a consumptive use basis, more than 60% of all the water is consumed in agriculture. The increasing demand for water in the world especially in the arid and semi-arid regions has forced the farmers to use low quality water for irrigation. Currently, in Pakistan the rainfall and canal water supplies are insufficient to meet the crop water requirement. Groundwater is another major source of irrigation available to farmers however most of these groundwater supplies are far inferior to canal water. For use of low quality irrigation water, sufficient information is available in literature on the importance of changes in land configuration, exchange phenomenon and salt leaching, gypsum usage and water requirement of its dissolutions, irrigation schedules, salinity/sodicity tolerance of the crop cultivars at various phenological stages, agro-techniques used etc. However, physical, chemical and biological methods alone may not be sufficient for the safe use of low quality water. A strategic combination of methods and proper cultural practices could nevertheless help use low quality water without the risk of salinity build up in the root zone.

The main theme of the current study is to design and test strategies for conjunctive use of low quality groundwater and estimate the potential cropped area and cropping intensity under evolved strategies and water availability at the farm level. In order to achieve the project objectives, a detailed survey of the study area (Sargodha District, Chaj Doab) has been carried out to assess the status of groundwater quality and utilization using participatory appraisal survey through a specially designed questionnaire covering various aspects of canal supplies, groundwater, soil, crop production, farmers' practices and perceptions about use of low quality water, etc. Further groundwater and soil samples from surveyed tubewells were also collected for

detailed quality analysis. The collected data were analyzed to identify the status, utilization and quality of groundwater being used for agriculture. On the basis of the survey results, four sites have been selected at farmers fields for experiments for productive use of low quality water of various compositions: i) one site with saline groundwater, ii) one with sodic, and iii) two sites with saline-sodic groundwater. The strategies have been developed to test at these sites on various cyclic and mixing modes of groundwater and canal supplies with the standpoint of sustainable crop production and land utilization to enhance potential cropped area and cropping intensity.

Project Title: *Testing and evaluation of low cost lining materials for water courses in drought endangered areas of Balochistan.*

Principal Investigator: *Mr. Nadeem Sadiq*
Scientific Officer

Location of Project: *Arid Zone Agri. Research Center, (PARC) Quetta*

Duration: 36(months)
Start Date: 1/9/2004
Project Status: On-going

Total Cost (million): 2.776
Funds Released (Rs): 1074500
Funds Utilized (Rs): 589000
(Upto 30th June, 2005)

Objectives:

- Devise mechanism to minimize the water coarse losses.
- To analyze Financial and Economic feasibility of various lining materials.

Achievements/Progress:

The conveyance efficiency of water is low due to earthen water channels in the farms. Average farm size in the areas is around 10 to 25 acres and the two sites covered under this project are below 10 acres. Apple, grapes and vegetables are the main crops in the farms. The farmers apply annually 18 to 22 irrigations to grapes and 20 to 25 irrigations to apple orchards. Soil of the area is silty loam to clay loam. The treatments constitute of PE film treatment, coaltar treatment and farmers practice (earthen channels). Polyethylene sheet treatment gave good results in terms of seepage control as compared to other two treatments. Area of orchard to be irrigated with the treatments is 9.2 acres and 8.5 acres for Pishin and Mastung districts respectively. Average discharge of tube wells in the area is around 0.4 to 0.6 cusecs. The irrigation method is flood irrigation through water pond in both Pishin and Mastung target areas. The pond in Pishin is lined where as the pond in Mastung is earthen.

Topographi maps of Pishin and Mastung target areas have been prepared showing slope gradient, farm size and topography. The two treatments (Polyethylene and Bitumen) have applied on newly constructed earthen channels where as third treatment Control is the farmers practice.

Project Title: *Nutrient Indexing and Integrated Nutrient Management for Sustaining Sugarcane Yields.*

Principal Investigator: *Dr. Sagheer Ahmed*
Senior Scientific Officer

Location of Project: *Sugar Crops Program, Institute of field & Horticultural crops, National Agricultural Research Centre, Islamabad*

Duration: 36(months)

Start Date: 25/3/2004

Project Status: On-going

Total Cost (million): 5.800

Funds Released (Rs): 2952000

Funds Utilized (Rs): 2063157
(Upto 30th June, 2005)

Objectives:

- To generate scientific information for balanced nutrient management, by integrating organic and inorganic sources, for increasing sugarcane productivity and quality.
- Diagnose the nature, extent and severity of nutritional disorders in sugarcane.
- Use press mud / filter cake as organic fertilizer for improving soil fertility, soil physical conditions, and sugarcane yields.
- Develop a package of technology for on-site integrated, balanced nutrient management, including micronutrients, to obtain maximum economic sugarcane yield and improved quality
- Reduce environmental pollution by recycling pressmud / filter cake in agriculture.

Achievements/Progress:

Nutrient Indexing Survey/Soil fertility monitoring

- Nutrient indexing survey of sugarcane fields of Sargodha and Jhang districts was carried out during September-October 2004 for collection of sugarcane plant tissues and associated soil samples. .
- Diagnostic sugarcane plant tissues (Leaf sheaths and leaf blades) and soils were sampled from 63 sites of district Jhang and 48 sites of district Sargodha.
- Farmers of the same sites were discussed about the management practices they followed at their farms, yield obtained and problems they faced.
- The position of each site was recorded with GPS.
- Plant samples were processed, i.e. dried, ground, sieved and stored for chemical analyses.
- Plant tissues were analyzed for nitrogen (N), phosphorus (P), potassium (K) and micronutrients.
- Composite soil samples from associated soils were collected at two depths (0-30 and 30-45 cm).
- Associated soil samples were processed, i.e. dried, ground, sieved and stored for physico-chemical analyses.
- Soil samples were analyzed for macro- and micro-nutrients, as well as for physico-chemical properties, i.e. soil texture, organic matter (OM), and lime contents etc.
- Thirty per cent farmers used optimum N fertilizers, 32 % farmers used optimum P fertilizers and only 11 % farmers used K fertilizers. Fifty six percent farmers applied farmyard manure (FYM).

- All the fields of Jhang district were low in AB-DTPA extractable NO₃-N, 97 % were low in P and 3 % in K. Sugarcane cultivated soils were also found deficient in Zn and B.
- Most of the fields had pH (1:1) more than 8.0. Soil OM ranged from 0.26 to 1.77 % and 41 % fields were low in OM.
- All the sampled fields of Sargodha district were low with respect to NO₃-N, 98 % fields were low in P while 4 % in K. Only 6 % fields were low while 70 % were adequate in terms of OM contents.
- Sixty seven percent sugarcane plants of Sargodha district were deficient in N, all in P but none in K. In case of Jhang District, 43 % sugarcane plants were deficient in N, none in P but 25 % in K. Zinc and B were also found deficient in plant tissues.

Pressmud sampling and Analyses

- Pressmud was collected from sugar mills of Sargodha and Jhang districts.
- Fresh pressmud samples were processed for chemical analyses, i.e. weighed, air dried sieved and stored for chemical analyses.
- These samples were analyzed for EC, pH, N, P, K and micronutrients.
- Pressmud is a rich source of nutrients. It had EC (1:10), 2.10 dS m⁻¹; pH (1:10), 5.32; N, 3.29 %; P, 1.42 %; K, 0.66 %; Fe, 718 mg kg⁻¹ and Zn, 106 mg kg⁻¹.

Field Experiments

- Planted medium term field experiments in the districts of Sargodha and Jhang for determining nutritional needs of sugarcane.
- Different fertilizer levels of N, P and K along with various doses of pressmud and/or micro nutrients (i.e. Zn, B) were used to determine the nutrients need of sugarcane in the project area.
- The experiments were planted at 4 locations in Sargodha and Jhang districts during the month of February-March, 2005 measuring 1 to 2 acres at each site.
- Data on agronomic parameters like germination, plant height, plant girth, plant weight and sugar contents will be recorded.
- Nutrient status of cane plants and nutrient uptake will be monitored in all fertilizer treatments through plant tissue analysis.

Project Title: *Field evaluation of vesicular arbuscular mycorrhizal fungi and their significance in wheat-maize cropping system under different soil series of NWFP.*

Principal Investigator: *Dr. Muhammad Sharif*
Assistant Professor

Location of Project: *Department of Soil and Environ., NWFP Agricultural University, Peshawar*

Duration: 36(months)

Start Date: 1/11/104

Project Status: On-going

Total Cost (million): 1.411

Funds Released (Rs): 505571

Funds Utilized (Rs): 359129
(Upto 30th June, 2005)

Objectives:

- Specification of soil series in different ecological zones of NWFP, which are commonly used for crop production.
- Identification and estimation of the status of VAM infection in wheat- maize cropping system in different series of different agro-ecological zones of NWFP.
- Complete characterization and population dynamics of VAM fungi both from crop roots and from the same soil.
- Complete investigation of the nutritional status of both crops as well as soils of the survey sites.
- To design preliminary pot experiments in marginal and fertile solid for study of the scope of inoculating the non-mycorrhizal crop identified during the field survey.

Achievements/Progress:

Arbuscular Mycorrhizal (AM) fungi are of considerable interest because of their archaic existence, ability to form symbiotic associations with 85% of plant taxa and their potential use as a biofertilizer to increase yield of crops and tree species.

This research project was initiated to conduct the comprehensive field survey in both nutrient deficient and fertile soils to evaluate AM fungal status and their significance in wheat-maize cropping system in different soil series of NWFP under different ecological zones.

Seventy important soil series extensively in use for the production of wheat and maize crops covering each district of NWFP were identified with the assistance of Peshawar Regional Office of the Directorate of Soil Survey of Pakistan. Rhizosphere soil and roots samples were collected from fertile and marginal soil of wheat and maize crops of 32 soil series of Kohat, Peshawar, Malakand and Hazara areas of NWFP during first year of the project and were analyzed.

Project Title: *Improving yields and nitrogen use efficiency in cereal based cropping system.*

Principal Investigator: *Dr. Amanullah Jan*
Associate Professor

Location of Project: *Department of Agronomy, NWFP Agricultural University, Peshawar*

Duration: 36(months)
Start Date: 17/5/2004
Project Status: On-going

Total Cost (million): 1.234
Funds Released (Rs): 582000
Funds Utilized (Rs): 493773
(Upto 30th June, 2005)

Objectives:

- To develop a sustainable nitrogen management system for cereals (maize and wheat) to utilize the N from crop residues and chemical fertilizers in the year of application and year to follow after application.
- To understand the influence of organic and inorganic-N source on the accumulation and partitioning of dry matter, nitrogen and yield of wheat and maize.
- To determine the cumulative effects of crop residue and fertilizer N on the availability of N to cereal crops.
- To assesses the economic analysis and requirement of N for wheat and maize production from crop residue and either should supplemented or not, with chemical fertilizer.
- To determine the effectiveness of KCl (MOP) as urease inhibitor for urea-N efficiency in continuous wheat-corn cropping system.

Achievements/Progress:

- Summer sowing for all experiments has been completed with maize.
- All the agronomic data on maize has been collected, compiled and statistically analyzed.
- Fall sowing for all experiments has been completed with wheat.

Conclusions and Recommendations:

The following conclusions are made from the said three field experiments.

- Types of fertilizer (NH₄ and NO₃) had similar effect on yield and other parameters.
- Three split dose of 130 kg NH₄ fertilizer ha⁻¹ proved superior in terms of grain yield.
- A sole application of 130 kg NO₃ fertilizer ha⁻¹ performed as good as three split application of the same level. Two split of 130 kg NO₃ ha⁻¹ improved yield to some extent.
- Two split of 130 kg NO₃ ha⁻¹ improved yield to some extent.
- Three nodes appearance proved better stage for single dose of N fertilizer.
- Half dose of 130 kg N ha⁻¹ at sowing and rest at pre tasselling stage improved grain yield.
- Cereal residue supplemented with N fertilizer at the time of residue application and rest at pre tasselling delivered good results.
- Legume residue performed well when supplemented with N fertilizer at pre tasselling.
- Cereal residue when supplemented with NH₄ fertilizer, increased yield.
- Legume residue when supplemented with NO₃ fertilizer, improved yield.

- Muriate of potash (MOP) increased urea N efficiency.
- Crop residue (cereal and legume) performed better than MOP in terms of urea N efficiency.

Project Title: *Improvement of groundnut production through Rhizobial inoculation in NWFP.*

Principal Investigator: *Dr. Sabir Hussain Shah*
Soil Microbiologist

Location of Project: *Soil and Plant Nutrition Directorate, Agricultural Research Institute
Tarnab, Peshawar*

Duration: 36(months)

Start Date: 22/5/2004

Project Status: On-going

Total Cost (million): 1.701

Funds Released (Rs): 954000

*Funds Utilized (Rs): 931481
(Upto 30th June, 2005)*

Objectives:

- To improve the production of groundnut crop through Rhizobium inoculation. To achieve this goal, the following objectives are being pursued.
- To determine the nodulation status of groundnut in different parts of NWFP
- To popularize groundnut Rhizobial inoculation among the farmers in NWFP
- To prepare and distribute groundnut Rhizobial inoculant, free of cost among the farmers for about 5000 acres.
- To supplement the use of N fertilizers through biological N fixation and thereby reduce cost on chemical fertilizers and minimize environmental pollution.

Achievements/Progress:

- Rhizobial inoculants for about 1500 acres of land were prepared and distributed among the farmers.
- Two local strains of groundnut Rhizobia were isolated as GNK₃, GNK₄ and preserved on yeast extract manifold agar media in the laboratory.
- Inoculation trials were laid out at two sites in Karak, district on farmer's fields in the month of May 2005. Local strain of Rhizobia was used for inoculating the groundnut seeds.
- Groundnut seeds were inoculated with two foreign strains (NC-92 & CIAT 1101) and one local strain (GNK1) of Rhizobia just before sowing in the month of May 2005. The groundnut cv SP-96 was used as test variety. A basal dose of N, P₂O₅ & K₂O @20, 75 & 20kg/ha was applied to all treatments @ 500 kg/ha in the month of June. Three plants from each treatment were uprooted at full flowering stage to record the nodulation data. The crop was harvested in the month of October and plant biomass & pod yield was recorded for each treatment.

SOCIAL SCIENCES

BACKGROUND

1st Batch:

ALP Secretariat received 39 preliminary proposals relating to social sciences for funding under the 1st batch. In process of preliminary appraisal 21 proposals were short listed for the invitation of detailed projects and 18 proposals which were not up to the standard were dropped. Finally, 7 projects costing Rs.14 million were approved by the Board of Director (BOD) of ALP for funding to conduct the research in different disciplines:

2nd Batch:

ALP Secretariat received 65 preliminary proposals relating to social sciences for funding under the 2nd batch. In process of preliminary appraisal 31 proposals were short listed for the invitation of detailed projects and 34 proposals which were not up to the standard were dropped. Finally, 22 projects costing Rs. 83 million were approved by the Board of Director (BOD) of ALP for funding to conduct the research in different disciplines:

For instance, there are projects on WTO Trade Liberalization to study the existing situation in domestic market & international arena and to pinpoint adverse effects of liberalization if any and suggest ways and means to minimize such effects. To recommend policy prescriptions in line with the WTO trade liberalization. There are also six projects on transfer of technology. The region wise details of the on-going projects is summarized as under:

<i>S.No</i>	<i>Region</i>	<i>No. of Projects</i>	
		<i>1st Batch</i>	<i>2nd Batch</i>
1	<i>PARC/NARC</i>	2	10
2	<i>PUNJAB</i>	2	7
3	<i>NWFP</i>	1	1
4	<i>SINDH</i>	2	3
5	<i>BALUCHISTAN</i>	-	1
<i>TOTAL</i>		<i>7</i>	<i>22</i>

IMPLEMENTAION STATUS

1st Batch:

Out of 7 approved projects, five projects have been completed and two are in operation.

2nd Batch:

Out of 22 approved projects, 18 projects are ongoing and four projects are in process of agreement so far.

FINANCIAL STATUS

1st Batch:

So far an amount of Rs. 9 million has been released against the overall total cost of Rs.14 million in respect of approved projects. Till 30th June 2005 overall expenditure of Rs.7 million has been incurred as reported by the PIs of the projects.

2nd Batch:

So far an amount of Rs.18 million has been released against the overall total cost of Rs.83 million in respect of approved projects. Till 30th June 2005 overall expenditure of Rs. 12 million has been incurred as reported by the PIs of the projects.

MONITORING & EVALUATION

ALP Secretariat with the active involvement of concerned Technical & Finance Divisions, PARC has completed on-site review of 6 projects. The recommendations of review teams have been conveyed to concern PIs for further guidance and planning.

Currently, most of the projects have completed first years of their life span. The annual progress reports of the projects shows that significant task has been completed and the outcomes are very encouraging /cheering. The salient achievements of these projects have been compiled in subsequent chapters of this annual report.

Project Title: *Determination of profitability and efficient production packages for various vegetables.*

Principal Investigator: *Dr. Bashir Ahmad*
Vice Chancellor

Location of Project: *University of Agriculture, Faisalabad*

Duration: 36(months)
Start Date: 3/4/2002
Project Status: Completed

Total Cost (million): 2.500
Funds Released (Rs): 1936500
Funds Utilized (Rs): 1423172
(Upto 30th June, 2005)

Objectives:

- To ascertain extent of adoption of various practices followed by the farmers in the production of various vegetables.
- To determine the cost structure gross income and profitability of cultivation of various vegetables.
- To identify and prioritize the major constraints in the cultivation of different vegetables.
- To identify the improved farm practices for obtaining high yield of various vegetables.

Achievements/Progress:

Under this project the studies on the following vegetables were carried out:

- i. Tinda gourd
- ii. Muskmelon
- iii. Bitter gourd
- iv. Carrot
- v. Radish
- vi. Potato
- vii. Onion
- viii. Watermelon

The results of the study carried on tinda gourd depicted that the estimated tinda yield per acre in Khanewal (1589.6 kg) was statistically lower as compared to ,that in Layyah (2692.8 kg). However, it was found that tinda growers of Khanewal received a higher price compared to those in Layyah. That's why gross income was reported higher in Khanewal and lower in Layyah. Total cost per acre was statistically higher in Layyah compared to that in Khanewal. Cost per kg was statistically low in Layyah and high in Khanewal. But net returns per 40 kg were estimated higher in Khanewal (Rs. 76) than those in Layyah (Rs.10.40).

The findings of the muskmelon study indicated that the yield per acre was statistically higher in Rahim Yar Khan compared to Bahawalpur. Gross income was estimated to be higher in R. Y. Khan than Bahawalpur. The respondents of R. Y. Khan applied more inputs to their crop compared to Bahawalpur. Therefore, total cost per acre was found higher in R. Y. Khan and lower in Bahawalpur. Application of fertilizer, irrigation number and use of pesticide were statistically different between the two districts. The respondents of R. Y. Khan obtained higher

net returns per kg than those of Bahawalpur while cost per 40 kg was almost the same in R. Y. Khan (Rs. 130.40) and Bahawalpur (Rs. 130.80).

The results of the study conducted on bitter gourd showed that the yield per acre of the respondents of R. Y. Khan (2974 kg) was statistically higher compared to that of Faisalabad (2763.6 kg). Gross income per acre was estimated to be higher in R. Y. Khan (Rs.21603.13) than that of Faisalabad (Rs.19537.27). The respondents of R. Y. Khan district applied more inputs to their crop as compared to Faisalabad district. Therefore, total cost per acre was found higher in R. Y. Khan (Rs.14802.91) and lower in Faisalabad (Rs.12541.01). Application of fertilizer, irrigation, use of pesticide and labor for weeding was statistically different between the two districts. Gross margin per 40 kg was significantly higher in Faisalabad (Rs. 140.56) compared to that in R.Y.Khan (Rs.132.23). The respondents of Faisalabad obtained higher net returns per 40 kg (Rs. 101.26) than those of R.Y.Khan (Rs.91.46) while cost per 40 kg was relatively less in Faisalabad (Rs.181.51) as compared to R.Y.Khan (Rs.199.09).

Data collected for carrot, radish, potato and onion were analyzed. The results of the study of carrot indicated that use of important inputs like tractor hours used for land preparation, quantity of seed, and phosphorus were significantly different between Sheikhpura and Kasur. The estimated carrot yield per acre in Sheikhpura was statistically higher as compared to that in Kasur. However, it was found that carrot growers of Kasur received a higher price compared to those in Sheikhpura. That's why gross income was reported higher in Kasur and lower in Sheikhpura. Total cost per acre was a little bit higher in Kasur compared to that in Sheikhpura. Cost per 40 kg was statistically low in Sheikhpura and high in Kasur. But net returns per 40 kg were estimated higher in Kasur than those in Sheikhpura. For radish, the results depicted that application of inputs was higher in Sheikhpura as compared to Sahiwal. The yield per acre was statistically higher in Sheikhpura as compared to that in Sahiwal. Cost per kg and per 40 kg was relatively less in Sheikhpura as compared to Sahiwal. The respondents of Sheikhpura obtained higher net returns than those of Sahiwal.

Results of Potato showed that variable and total costs were found higher in Kasur than those of Okara. This is mainly due to high cost of seed, fertilizer and irrigation. Cost per kg and per 40 kg was also higher in Kasur than those in Okara. Gross margins were significantly higher in Okara as compared to those of Kasur. Net returns, net returns per 40 kg and per kg were comparatively higher in Okara than those of Kasur. Significantly higher gross income per acre in Kasur was attributed to high price of onion per kg. Other important factors that contributed towards high yield were cost of farmyard manure, cost of nursery and labour used for weeding. Comparatively low gross income per acre was estimated for the respondents of Okara district. Low price of onion and disease and pest attacks decreased considerable gross returns in Okara. Total cost per acre and per kg was Rs. 4043.63 and 2.56 respectively in Kasur and the respective costs in Okara were Rs. 4374.62 and 3.30. Net returns per acre and per kg were negative in Okara and these returns were positive in Kasur. Data collected for watermelon were analyzed. The results indicated that use of important inputs like land preparation, plant protection measures, and labour used for weeding were significantly different between Rahim Yar Khan and Bahawalpur for watermelon crop. The estimated watermelon yield per acre was statistically insignificant between the selected districts. However, it was found that watermelon growers of Rahim Yar Khan received a higher price compared to those in Bahawalpur. That's why gross income was reported higher in Rahim Yar Khan and lower in Bahawalpur. Total cost per acre was statistically higher in Rahim Yar Khan compared to that in Bahawalpur. However, cost per 40 kg was statistically lower in Bahawalpur and higher in Rahim Yar Khan. But net returns per 40 kg were estimated

higher in Rahim Yar Khan than those in Bahawalpur. Low price of output, water shortage, transporting the production to the market, inadequate funds to purchase inputs and adulterated inputs were the most important constraints in watermelon cultivation.

The reports of bitter gourd, tinda gourd, muskmelon, radish, carrot, onion, potato and watermelon have been printed and sent to PARC. These reports provide useful information to the extension workers and farmers about the input use, farm practices, cost and profitability of these crops.

Conclusions:

On the basis of the above findings, it is suggested that the tinda growers could increase yield per acre by adopting better plant protection measures, application of sufficient quantity of farmyard manure and better land preparation. Timely sowing of tinda gourd and the efficient use of labour for weeding could further increase the yield of tinda gourd. Therefore, the respondents belonging to the low yield category of the sampled farmers could enhance yield per acre by following the practices of the high yielders.

The results of the study of bitter gourd showed that manure, fertilizer and labor used for controlling weeds and earthing up are important in increasing the yield of bitter gourd. The results of the study conducted on muskmelon depicted that the farmers should allocate more area to Chichawatni variety by applying optimum quantities of nitrogen, phosphorus, potassium, farmyard manure, irrigation and proper weeding. In this way, they could obtain higher yield of muskmelon.

It is concluded from the study that great potential exists in improving the carrot yield per acre in the selected districts. Farmers' access to certified seed, better land preparation, recommended dose of seed and fertilizer and availability of credit are the major factors that can enhance the carrot production.

The results of the study on radish concluded that quantity of seed, fertilizer, irrigation and labor used for controlling weeds played a significant role on the farms that experienced high radish yield.

It is concluded from the study of potato that farmers could enhance potato yield per acre if seed, farmyard manure and particularly fertilizer are applied according to the recommendations given by Department of Agriculture. Availability of funds, access to good quality seed, provision of cold storage and transportation facilities and stable potato price could, further, increase potato production in the province.

Thorough land preparation, balanced quantities of fertilizer, proper weed control and proper plant protection measures and discussing problems with extension field staff and experienced farmers could enhance onion yield and hence gross income per acre.

Better land preparation, proper plant protection measures, weed control and appropriate application of fertilizer could increase watermelon yield per acre to a great extent. On the other hand, Government should take appropriate steps to control prevailing malpractices in input and output markets.

Project Title: *Application of farm planning models to analyze the choice of oilseed crops at regional and national levels.*

Principal Investigator: *Dr. Khalid Mehmood Aujla*
Sr. Scientific Officer

Location of Project: *SSD, PARC, Islamabad.*

Duration: 36(months)
Start Date: 2/9/2002
Project Status: On-going

Total Cost (million): 3.000
Funds Released (Rs): 795000
Funds Utilized (Rs): 781730
(Upto 30th June, 2005)

Objectives:

- To establish farm typologies for the construction of representative farm models for different agro-ecological regions;
- To elicit the importance given to a range of objectives by a representative sample of farmers in the representative oilseed growing farming systems of Pakistan ;
- To explore the systems relations and resource allocation patterns among prevailing and alternative oilseed crops in the major cropping zones;
- To build linear programming and Multiple Criteria Decision Making Models (MCDM) to analyze the economic implications of the adjustments of alternative oilseed crops in different production systems of Pakistan;
- To analyze the impact of improved technologies of alternative oilseed crops on the allocation of farm resources for different systems at regional and national levels; and
- To draw implications from the study for research, extension and government policy with regard to the new oilseed crops.

Achievements/Progress:

Literature/ references collected from NARC, PARC, NODP, PODP and APCOM through personal visits and discussions with concerned scientists and reviewed for identifying and establishing farm typologies.

Data on acreage, production and yield of oilseed crops such as soybean, rapeseed and mustard, cottonseed, groundnut, sesame, sunflower, safflower, linseed and castor were collected for trend analysis and growth rates at national, provincial and district levels.

Potential growing areas for various oilseed crops were identified for primary data collection through data analysis.

Conclusions:

If the farmers of the selected areas be made realized about the comparative advantage of the oilseed production in these areas and production is promoted mainly by providing incentives to farmers in the identified districts supported by farmer-friendly government policies, the aggregate production of oilseed crops can be enhanced on sustainable basis. The primary focus of the research work so far accomplished under this project was to analyze historical trends in acreage, production and productivity in oilseed crops and to identify major oilseed producing

areas/ zones/ regions to initiate primary data collection tasks after designing and pre-testing field survey questionnaire. This data would be ultimately used to identify typical farm situations as well as constructing farm planning models.

Published data available on nine major oilseed crops such as soybean, rapeseed and mustard, cottonseed, groundnut, sunflower, safflower, sesame, linseed and castor seed was analyzed for:

- Data analysis methods and representative Multiple Criteria Decisions Making (MCDM) Farm Models;
- Specification of farm activities and constraints of the representative farm planning models; selection of target areas for conducting field surveys; and
- Designing field survey.

Project Title: *Farmers' capacity building through information technology in Pakistan.*

Principal Investigator: *Dr. Muhammad Zakria Zakar*
Chairman

Location of Project: *Department of Sociology, University of the Punjab, Lahore*

Duration: 36(months)

Start Date: 1/7/2004

Project Status: On-going

Total Cost (million): 2.201

Funds Released (Rs): 933500

Funds Utilized (Rs): 918795
(Upto 30th June, 2005)

Objectives:

- To study the Knowledge, Attitude and Practices (KAP) of farmers (peasant-proprietors, tenants) about farming in different regions of Pakistan
- To analyze the role of existing information system at institutional and grass root level in the provision of extension services by government line agencies especially agricultural extension, mass media, indigenous /traditional sources, any other source
- To review the effectiveness of sector specific information provision for the equitable and sustainable farming i.e. the capacity existing sources to meet farmers' needs, the bottlenecks and difficulties in the way of effective transmission of information
- To strengthen the local agricultural extension system through the establishment of community managed Information and Communication Centre (ICC).
- Assess the viability and sustainability of ICC as social institution for subsequent broad based replication.

Achievements/Progress:

- Village profile of the selected locations/ villages completed.
- Based on the sample-frame representative sample of the stakeholders was drawn.
- Identified contact persons/ social mobilizers from the selected locations/ villages.
- Identified sites for the establishment of Information and Communication Centers (ICC) in the selected villages/ localities.
- Selected members of the ICC management committees.
- Identified computer literate persons who could voluntarily donate time to assist the day-to-day functioning of ICC.
- Identified various stakeholder, intuitions and NGOs who were providing dissemination services to the farming community.
- Information needs of farmers were identified and their patterns of information seeking were mapped out.
- Two ICCs were established in both the selected districts (one in each district).
- Through ICC information dissemination services were started on trial basis.
- An extensive social mobilization was carried out to maximize community participations in the activities of ICC.
- Farmers were provided information free of cost and without discrimination.
- Farmers were encouraged to discuss and debate the information within the local cultural context so that they could translate the information into action.
- Farmers were educated how they could contribute to make an enabling environment where they could be capable of using the information for their socio-economic benefits.

Project Title: *Economic analysis of agroforestry plantations in Sindh province of Pakistan.*

Principal Investigator: *Dr. Heman Das Lohano*
Assistant Professor

Location of Project: *Department of Agri. Economics, Sindh Agriculture University, Tandojam*

Duration: 24(months)
Start Date: 28/10/2004
Project Status: On-going

Total Cost (million): 1.328
Funds Released (Rs): 339791
Funds Utilized (Rs): 115749
(Upto 30th June, 2005)

Objectives:

- To assess the current status of forestry development in Sindh and Pakistan.
- To conduct a benchmark survey of agro forestry plantations in selected districts of Sindh.
- To undertake economic analysis of major tree species grown in agroforestry plantations.
- To study the needs, availability, marketing, and export aspects of forestry with special reference to Sindh province.
- To recommend policy measures and program initiatives for the development of agro forestry in Sindh on a sustainable basis.

Achievements/Progress:

- Four different comprehensive questionnaire have been developed and designed to conduct survey from procedures, wood contractors/ traders/ industries and stakeholders.
- Forest cover including agro forestry plantation in Sindh is limited and shirking due to water shortages and arid climate. According to Forest Sector Master Plan, the forest area of Sindh is 14901 thousand hectares out of total area of 87980 thousand hectares of Pakistan including Azad Jamu and Kashmir and northern areas. Data show that the share of Sindh is only 11.59 percent in farmland tree plantations in Pakistan. Thus, there is a need of increasing the farmland tree planting in Sindh.
- The forest cover of Pakistan is almost spread on conifer (46 percent) and scrubs (28 percent), while the remaining 26 percent is devoted to farmland trees, mangroves, riverian and irrigated plantings. Forest types in Sindh, which shows that 51 percent of forest in Sindh is mangrove, while the irrigated plantations are 6 percent.

Conclusions:

Based on the given information and status of the forest sector it can be concluded that there is a great potential and need as well to increase agroforestry plantations in Sindh province of Pakistan. The growth of the agro forestry cover is constrained possibly due to number of issues which need to be investigated and addressed.

Project Title: *Strengthening of design and analysis capabilities in the National Agricultural Research System (NARS)*

Principal Investigator: *Dr. Muhammad Inayat Khan*
Professor/ Chairman

Location of Project: *Department of Mathematics & Statistics, University of Agriculture, Faisalabad*

Duration: 36(months)

Start Date: 28/8/2004

Project Status: On-going

Total Cost (million): 2.833

Funds Released (Rs): 540000

Funds Utilized (Rs): 343759

(Upto 30th June, 2005)

Objectives:

- To conduct experiments on improved experimental designs at PARS (university agricultural field experiments station), NARC Islamabad and at AARI to test the efficiency of the designs.
- To disseminate and introduce novel statistical methods and advance but statistically efficient experimental designs for agricultural experimentation, through trainings and workshops.
- To tutor statistical softwares (GENSTAT and SPSS) for the scientists of NARS to improve their data handling and analysis capabilities.

Achievements/Progress:

To examine the effectiveness of Alpha Lattice design in field, five experiments on wheat crop at different research stations were conducted. The objective of this study was to determine the efficiency of alpha lattice design as compared to randomized complete block design.

Data on different parameters were recorded during the seasons. Preliminary data analysis is done only for yield data using ALPHA program. The results of the experiments indicate that the error mean square (EMS) for Alpha Lattice design is smallest than RCB design in experiment No. 1, 2 and 4 while in experiment No. 3 there is slight difference between error mean square (EMS). This implies that blocking effective for these trials.

The coefficient of variation (CV) calculated for these trials are 9.1, 7.9, 10.10 and 9.2 for alpha lattice design and 10.68, 8.65, 10.06 and 9.88 for randomized complete block design (RCBD) respectively. The CV values for experiment No. 1, 2 and 4 under alpha lattice design indicated the degree of precision with which the treatments are compared and is a good index of the reliability of the experiments.

The relative efficiency calculated for the experiment No. 1, 2 and 4 are 1.36, 1.19 and 1.16 respectively. These values indicate that the use of alpha lattice design instead of randomized complete block design (RCDB) increase experimental precision by 36% 19% and 16% respectively.

For experiment No. 3 the CV value for alpha lattice design as compared to RCDB is high and the relative efficiency calculated for this experiment is 0.9925. This result indicated that the additional blocking in the alpha lattice did not increase the precision over the RCBD.

A workshop on “Advanced biometric Technique for Agricultural Research System in Pakistan” was organized from June 20-25, 2005 at Department of Mathematics & Statistics, University of Agriculture, Faisalabad. Twenty participants from different research institutes participated in the workshop. Statistical package “Statistical” was used to demonstrate different statistical analysis to the workshop participants.

Project Title: *Enhancing agricultural productivity through transfer of demand driven technologies to the farmers in the selected districts of Sindh.*

Principal Investigator: *Mr. Manzoor Ali Memon*
Senior Scientific Officer

Location of Project: *Technology Transfer Institute (PARC), Tandojam, Sindh*

Duration: 36(months)
Start Date: 18/8/2004
Project Status: On-going

Total Cost (million): 4.36
Funds Released (Rs): 2203000
Funds Utilized (Rs): 1649310
(Upto 30th June, 2005)

Objectives:

- To identify issues, constraints, and opportunities and prioritize farmer's needs of improved interventions through PRAs & other informal & multi-disciplinary approaches.
- To create Information Exchange Forum (IEF) at the village/community level through already formatted Community Based Organizations (CBOs).
- Establishment of database of research-based tested and proven technologies/interventions available with ARS located in the province.
- Creation of functional linkages with Extension, Research and other line departments to make IEF operational through two-way flow of information developing effect mechanisms of technology transfer to the end users.
- Organize and undertake capacity building programmes for farmers, activists, and extension workers of all cadres as well as district government functionaries on sustainable basis.
- To transfer the demand driven technologies to the farmers according.
- Institutionalize Participatory Monitoring & Evaluation (PME) system at CBO level for performance assessment and on-going monitoring and Evaluation.

Achievements/Progress:

- Based on the agro-ecological zones or major cropping system in the province four districts has been selected. From each district one taluka selected as project area. From Thatta taluka Sujawal, from Mirpurkhas taluka Kot Ghulam Muhammad, from Shikarpur taluka Khanpur and from Hyderabad taluka Tando Allahyar has been selected.
- A cluster of five village in each selected for project activities. From each village number of CBOs and Vos and their members has been listed to provide them support through the project for capacity building. Technology transfer activities through the project will be continuous process specially in the area of skill improvement, communication and adoption of new technologies.
- PRA has been carried out in collaboration with extension staff and other line department and CBO office bearers.
- A comprehensive questionnaire has been developed to collect the base line information form the target population.
- Questionnaire has been finalized to conduct the baseline survey in the selected village to document the existing situation.

- Technology transfer through latest technologies i.e. computer with other electronic media (TV & radio) will be used for transfer of required information to the farmers. Distribution of printed brochures etc. through IEF will be carried out.
- The collected information may also be useful even after completion of the project as it provides a basis for measurement/ evaluation of the impact of the projects. The purpose of the need assessment survey was to generate information regarding existing situation of the target area.
- The personal characteristics of the farmers and socioeconomic conditions related to their families and farmers are generally considered important influencing their innovations, decision making and productivity. These include farms age and education levels, family size and composition, family labor, on-farm and off-farm implements has been analyzed and farmers' irrigation source and location of on-farm water course has been identified.
- The most important intervention identified is lack of availability of certified seed of major crops and vegetables in the selected districts of Sindh. The main reason for this is that most farmers use their own seed for many years and do not appreciate the need for good seed. A seed purification and replacement program could help to overcome this problem. The Sindh Seed Corporation needs special attention, funds and resources to produce quality seed of major crops. There is need of more sales points, greater participation of private sector distributions, sale of certified seed in small lots of 5-10 kgs, and more widespread information dissemination through extension, radio and TV.
- Timely sowing is an important factor for its rapid and successful growth. Crop sown on proper time gave best germination. The sample farmers 82 percent reported that they do not practice timely planting. It is suggested that awareness among farmers in the target area is necessary to adopt timely planting of crops to enhance crop production.
- Good land preparation is an important component of the recommendations to obtain better crop yield. There are number of other advantages for good land preparation. Among its advantages are timely planting, improved crop stand and a substantially reduced cost of land preparation and sowing. It is suggested that farmers in the target areas are educated for good land preparation to enhance crop portability through promotion of land preparation.
- Water is an important input and plays an important role on crop production. Overall 62 percent farmers reported inadequate water availability in the study area. It is suggested that increase water availability in the study area is important to enhance crop productivity.
- Credit is an important instrument which enables farmers to acquire command over the use of working capital and consumption goods. In the study area most of the farmers found interest in obtaining institutional credit for investing in various activities of crop and livestock enterprise, it is suggested that institutional credit should be provided to the farmers on easy terms and conditions.
- Keeping in view the above priority intervention to enhance the crop productivity, the backstopping support will be provided for capacity building of selected CBOs members and extension workers in the selected districts of Sindh. A continuous process, especially in the area of capacity building and transfer of new technologies. The target population for human resources development: GBOs (male and female) members, extension workers. A future strategy has been outlined for enhancing crop productivity and poverty alleviation in the target area.