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Pakistan Agricultural
Research Council



Inauguration of the Tree plantation week
by the Chairman



The Minister for Food, Agriculture & Co-operatives Rear Admiral M. Fazil Janjua examining various varieties of wheat at N.A.R.C. On the right is Admiral K.R. Niazi

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**Pakistan Agricultural
Research Council**



A general view of Seminar on Soil Fertility and
Fertilizer Use held at Islamabad.



A view of the National Seminar on Wheat Research
and Production held at Islamabad

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

FOREWORD

The Pakistan Agricultural Research Council was re-organised and made a fully autonomous body in 1978 with the appointment of a research scientist as a whole-time Chairman. This measure was taken by the Government in recognition of the crucial importance of a well organised multi-disciplinary research in agriculture production.

In the past ARC was largely a funding agency with very little involvement in actual research programmes at national level. With the current crisis in various agricultural commodities which the country has been facing it became imperative that agricultural research should play a major role in the planning of a sound agricultural system of the country and by providing the vital input of package of technology for various agricultural commodities developed through inter-disciplinary research. For this purpose the PARC has to embark on short term programmes designed to achieve substantial increases in the production of various crops in the short term by using already available knowledge regarding various commodities, suitably adapted for local conditions. This purpose has been achieved through various coordinated research programmes where the available technology is condensed in definite packages of practices and communicated to the farmers through the extension system.

A more difficult but vital component of the agricultural research system is the solution of intricate problems of agriculture which requires well planned, high quality, inter-disciplinary research of medium term nature. Such activity has been almost completely lacking in the country. In several disciplines and commodities, there is not even a single qualified and capable scientist who could conduct research on any aspect of these commodities or disciplines. Besides, the country is generally short of trained scientific manpower for agricultural research as well as equipped research institutions for conducting research on various aspects of agriculture. Therefore, the Council immediately after re-organization laid special emphasis on the development of institutional structure and build up of trained scientific manpower. An elaborate programme has been chalked out for the training of young scientists both within the country and abroad.

Another major responsibility of the PARC is to co-ordinate on-going research in various institutions in the country. The research efforts in the country have been largely scattered and poorly coordinated in the past. Efforts have therefore, been made to develop a proper research coordination system by first identifying priorities for research in different areas and then assigning the priority research problems to various qualified research scientists alongwith the necessary financial support. The final step in the system is review and evaluation of the achievements made by various individuals and institutions and communication of the results of research to

the farming community. This system is currently being developed, although due to the non-availability of an adequate infra-structure for research management, it is not easy to operate a coordinated research system at full efficiency in the early stages.

The Council's main emphasis is on developing the institutional facilities for research specially in those disciplines which have been largely neglected in the past both at the provincial and federal level. Besides, the institutional facilities like reference library, data bank and germplasm introduction facilities, etc. have also been lacking. Therefore, the Council has given top priority to the development of the National Agricultural Research Centre in Islamabad where construction of various facilities has actually started. With the pace of development of various aspects of agricultural research, the donor agencies have also shown keen interest in supporting the Council's programme and it is hoped that the momentum will be kept up in the coming years and the Council will be able to establish a dynamic, properly coordinated agricultural research system in the country which is fully supportive of the production effort in all the sub-sectors of agriculture, under the rapidly changing socio-economic and agro-ecological situation in the country.



(Amir Muhammed)
Chairman

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THE COUNCIL*

President

**Rear Admiral M.F. Janjua
Minister for Food, Agriculture
and Cooperatives**

Chairman

Dr. Amir Muhammed

Whole Time Members

<i>Plant Sciences</i>	<i>Animal Sciences</i>	<i>Social Sciences</i>	<i>Finance</i>
Dr. C.M. Anwar Khan	Dr. H. Hasnain	Vacant	Mr. M. Mumtaz Abdullah

Part Time Members

Four scientists one from each province, to be nominated by the President viz. the minister for Food and Agriculture.

1. Dr. Mahbub Ali,
Managing Director,
Punjab Seed Corporation,
Lahore
2. Dr. I. M. Bhatti,
Director,
Rice Research Institute,
Dokri,
Larkana
3. Mr. M. H. Shah,
Director,
Agricultural Research Institute,
Tarnab, Peshawar
4. Dr. Abdul Hameed Khan,
Director,
Fruit Research Institute,
Quetta

Four Heads of Principal Institutions and Research Laboratories of the Council/ Federal Government.

1. Mr. G. M. Khattak,
Director General,
Pakistan Forest Institute,
Peshawar
2. Dr. Mujtaba Naqvi,
Director,
Nuclear Institute for Agriculture
and Biology,
Faisalabad
3. Dr. Ahmed Moheyuddin,
Vice Chancellor,
Quaid-i-Azam University,
Islamabad
4.

* Composition of the PARC as on 30th June, 1979.

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Four prominent and progressive farmers—one from each province to be nominated by the Provincial Governments

1. Dr. Wazir Agha,
58 Civil Lines,
Sargodha
2. Mian Obaidullah Jan,
Village Malka-Dher,
Tehsil Charsadda,
District Peshawar
3. Mr. Abdul Ghaffar Khan Achakzai,
3-3/24 Baldeva Road,
Quetta
4. Mr. Abdul Majid Khoso,
Farmer, P. O. Thal,
District Jacobabad

Four persons with interest in Agriculture or Industry connected with the Agriculture to be nominated by the Federal Government.

1. Dr. Z. A. Hashmi,
Chairman,
Pakistan Science Foundation/Advisor
to MLA Punjab on Education,
Science and Culture,
Lahore
2. Mr. G. Mueenuddin,
President,
Chamber of Agriculture,
1-Chamba Road,
Lahore
3. Mr. A. Jamil Nishtar,
Chairman,
Agriculture Development Bank of
Pakistan,
Islamabad
4. Haji Farid-ud-Din Siddiqui,
Chairman,
Sind Chamber of Agriculture,
Hyderabad

Four Scientists including two Vice Chancellors of Agricultural Universities, representing the Provincial Governments—two from the Punjab and two from Sind.

1. Dr. Ghulam Rasool Chaudhry,
Vice Chancellor,
Agricultural University,
Faisalabad
2. Dr. S. A. Qureshi,
Director General,
Punjab Agricultural Research Institute,
Faisalabad
3. Dr. Abdul Qadir Ansari,
Vice Chancellor,
Agricultural University,
Tandojam
4. Syed Ahmed Pasha Jagirdar,
Director,
Agricultural Research Institute,
Tandojam

Two representatives of the Agriculture Division.

1. Mian Mumtaz Ali,
Agriculture Development Commissioner,
Ministry of Food and Agriculture,
Islamabad
2. Dr. Abdus Salam Akhtar,
Animal Husbandry Commissioner,
Islamabad

Chief, Food and Agriculture Section, Planning Division, Government of Pakistan.

1. Dr. M. Sulaiman Kakli,
Chief
Food and Agriculture Section,
Planning Division,
Government of Pakistan,
Islamabad

ADMINISTRATIVE SETUP AND PROCEDURE OF WORK

ADMINISTRATIVE SETUP

Recently, the Pakistan Agricultural Research Council has attained the status of an autonomous body at federal level for closer coordination with the Ministry of Food and Agriculture, agricultural research institutes and the agricultural universities in the country.

The Council has a whole-time Chairman with the status of a Federal Secretary of the Government of Pakistan. The Chairman is the Chief Scientific and Administrative Executive. Adequate powers have been delegated to him and the Executive Board to manage the affairs of the Council in an effective manner. The Board undertakes regular review and evaluation of the accomplishments and progress of the research projects, the programmes and the constituent units of the Council. It also exercises control over the research activity, and with the concurrence of the Chairman has powers to approve, expand, diminish, re-direct or re-locate the research projects. The technical members of the Executive Board head their respective Research Divisions and plan, coordinate, supervise and guide the conduct of research in their Divisions. The Member Finance takes care of all matters concerned with budget, finance and accounts.

The administrative and technical activities of the PARC are reviewed at suitable intervals in a general meeting of the Council. The Federal Minister for Food, Agriculture and Cooperatives, who is the President of the Council, presides at such meetings. The Council formulates policy directives in accordance with the national policies and plans. The decisions arrived at in the general meeting are final and are communicated to the concerned agencies for their implementation.

PROCEDURE OF WORK

The Pakistan Agricultural Research Council has recently attained an autonomous status and the present procedure of working through Technical Committees has been modified. Currently, PARC has embarked on the introduction of a Coordinated Agricultural Research Planning System (CAREPLANS), which involves both the users of research and the doers of research in the identification of research and consequently formulation of sound research projects designed to solve these problems. The following steps are included in the system:

- 1. Identification of problems;*
- 2. According of priorities;*
- 3. Formulation of projects;*
- 4. Evaluation of research projects;*

5. *Approval of research projects;*
6. *Assigning of research projects to various institutions;*
7. *Implementation of research projects;*
8. *Accomplishment reporting; and*
9. *Accomplishment evaluation.*

1. *Identification of Problems:* The representatives from a broad base of interest in agriculture identify the problems after reviewing the current status of various agricultural commodities, resources, technologies and identifying all principal constraints limiting production. In this manner, a list of potential researchable opportunities is formulated.

2. *According of priorities:* An *ad hoc* committee designated as Status Review Committee (SRC) identifies the problems and accord priorities keeping in view the following criteria: -

- a. Urgency of the problem (threat of disease, etc.);
- b. Economic importance;
- c. Scope and size of the problem considering:—
 - i. people, land units affected;
 - ii. benefits of research in relation to cost; and
 - iii. likelihood of extensive and immediate adaption of results of research;
- d. Availability of adequate facilities;
- e. Feasibility of completion of proposed research within the stipulated time; and
- f. Avoidance of wasteful duplication of research effort.

3 (a). *Formulation of projects:* An *ad hoc* committee designated as Technical Planning Committee (TPC) formulates guidelines for the preparation of projects in the priority areas determined by the SRC. Each independent or coordinated project usually covers the following topics:

- a. Title,
- b. Objectives,
- c. Present and previous work,
- d. Methodology/approach,
- e. Resources needed,
- f. Personnel,
- g. Cooperator (s),
- h. Institutional units involved, and
- i. Any other information needed to evaluate the project.

3 (b). Projects are then formulated on P.C.1 proformas by the Principal Investigator designate working in a research institution, for seeking approval of the Government for funding.

4. *Evaluation of research projects:* The projects formulated by the Principal Investigator are reviewed by 2 specialists in the subject with particular reference to the

following:--

- a. The extent to which the research meets the national/provincial goals;
- b. Contribution to man's knowledge;
- c. Cost benefit ratio;
- d. Number of people likely to benefit;
- e. Feasibility of implementation and completion of proposed research within the stipulated time;
- f. Assurance that research on the same subject was not being conducted on the same lines and under the same set of conditions by another organization.
- g. Urgency of research, and
- h. likelihood that extensive and immediate use would be made of research findings.

5. *Approval of research projects:* The research projects together with the comments of the experts are carefully examined by a Technical Committee on the concerned subject/commodity or groups of subjects/commodities. A number of Technical Committees have been appointed for this purpose.

The recommendations of the Technical Committees are put up to the Executive Board of the Council as to whether the project should be:

- a. Approved as such;
- b. Approved with modifications considered necessary;
- c. Deferred;
- d. Dropped.

The Technical Committees carefully examine the Annual Accomplishment Reports. They also advise the Executive Board and the Chairman, PARC on the execution of projects.

6. *Assigning of research projects to various institutions:* The Directorate of Planning and Technical Services maintains a central record of all research institutes, experiment stations, research centres, universities, departments and other establishments engaged in agricultural research in respect of facilities in the form of scientific manpower, their qualifications and experience, land, buildings, equipment and other facilities. The projects are assigned to the institutions keeping in view the physical facilities and trained manpower and the requisite infra-structure.

7. *Implementation of research projects:* The research funds are placed at the disposal of the head of the concerned institution, who alongwith P.I. is responsible for the implementation of the project. The record of the projects is also maintained by the PARC in the Directorate of Planning and Technical Services. The PARC Directors and Coordinators also maintain the record of the projects supervised by them to provide technical guidance.

Year-wise work plans to implement the projects and the strategy for implementation is developed with a proper schedule. Every subsequent year work-plans and implementation strategies are revised on the basis of performance during the

previous year. This is done by the Principal Investigator and the head of the institution with the approval of PARC.

The accounts of the projects are maintained and pre-audited by the institutions concerned. The post-audit of the accounts is carried out by the PARC.

8. *Accomplishment reporting:* Six monthly fiscal and technical reports are submitted by the Principal Investigator through the head of the institution. Technical and fiscal reports are scrutinised by the PARC and the necessary instructions are given to the institutions/ Principal Investigators. The donor agencies are also kept informed about the progress of work.

9. *Accomplishment evaluation:* Annual accomplishment reports and expenditure reports are received in the PARC on prescribed proformas for critical evaluation against expected accomplishments and expenditure with particular reference to the following:

- a. Work accomplished against objectives;
- b. Soundness of methodology/approach adopted;
- c. Reliability of data collected;
- d. Statistical analysis of data;
- e. Interpretation of results and drawing of conclusions.

The above reports are examined by the Technical Committees and the Executive Board of PARC who issue necessary directions. The Final Technical and Fiscal Reports are submitted and the Principal Investigators on the completion of the Project.

1. CROPS

COORDINATED RESEARCH PROGRAMME ON WHEAT, BARLEY AND TRITICALE

This project is operating on all Pakistan basis to strengthen the research capabilities of the cooperating units through provision of technical staff, equipment, and training, so that the defined objectives of wheat, barley and triticale research are achieved. The present programme has been developed with the active participation of CIMMYT, FAO and Ford Foundation.

A. WHEAT

VARIETAL IMPROVEMENT FOR BETTER YIELD, QUALITY, DISEASE RESISTANCE AND SALT TOLERANCE

Thousands of fresh crosses were made in wheat at various cooperating units and studies were continued on the breeding material ranging from F0 to F7 which consisted of several thousand lines.

Selections on the basis of plant type and rust resistance were made from the segregating material and a number of lines in advance generation were bulked for their yield testing in the preliminary yield trials. All the breeding material was inoculated with rust inoculum on large scale with more emphasis on advanced lines for screening against rust attack. Resistant lines were identified and maintained for further testing. The facilities available at Kaghan were utilized in the wheat breeding programme by having an extra generation of advanced wheat breeding material during summer, in order to cut short the time required for the development of new wheat varieties and screening against rust. Out of 1935 wheat entries received from CIMMYT and ICARDA, 206 entries were selected on the basis of yield and screening against diseases. The yield of these selections ranged from 433 -- 1143 kg. per acre under rainfed conditions.

ENHANCING GENERATION OF BREEDING MATERIAL AND SCREENING FOR DISEASES AT KAGHAN

The promising wheat lines, developed at different research stations were planted in Kaghan in summer nursery for the screening against rusts and other diseases. The seed of promising lines was also increased in summer by planting in Kaghan to save time for varietal development.

NATIONAL UNIFORM WHEAT (NORMAL) YIELD TRIALS (NUWYT)

These trials are conducted at different locations and ecological zones of the country to test and select high yielding and disease resistant lines/varieties. Coded numbers are allotted to the various varieties, in order to have un-biased yield results. Replicated yield trials consisting of 20 varieties spread over 40 locations were conducted.

NATIONAL UNIFORM WHEAT (EARLY) YIELD TRIALS

To develop high yielding, disease resistant and early maturing wheat cultivars, 7 candidate wheat varieties of early duration were tested at 40 locations in a replicated National Uniform Wheat Yield Trial. Some of the advanced lines/varieties have been identified which are resistant to diseases and are early maturing.

AGRONOMIC STUDIES-CULTURAL PRACTICES AND USE OF FERTILIZER

To determine the optimum seed rate of high yielding commercial wheat varieties under rainfed conditions, replicated yield trial was conducted at National Agricultural Research Centre, Islamabad with four seed rates (25 kg., 50 kg., 75 kg. and 100 kg. per hectare) on Pavon, Nuri, Sandal, and Arz varieties. The varieties responded differently to various seed rates: Pavon and Arz gave highest grain yield at the highest seed rate, whereas, Sandal gave maximum grain yield at the seed rate of 75 kg. per hectare. However, the combined average grain yield of all the four varieties showed positive correlation.

WHEAT PLANT DESIGN FOR PAKISTAN AND BREEDING OF WHEAT FOR BARANI AREAS AND STRESS CONDITIONS

The project became operative in February, 1979 at a total cost of Rs. 0.25 million. It is an in-house research project but the laboratory facilities available at the Quaid-i-Azam University, Islamabad are also being utilized.

DEVELOPMENT AND USE OF NEW SOURCES OF DWARFING FOR BROADENING THE GENETIC BASE OF PAKISTANI WHEAT

Reduced height mutants in Pakistani wheat and those from Hungary and USA, have been obtained and planted in Kaghan for incorporation of these genes into wheat under commercial cultivation. Laboratory equipment has been improvised for mutagen treatment with effective chemical mutagens like Sodium Azide and N-methyl-N-nitrosourea.

GIBBERELLIN A3 RESPONSE AND SCREENING WHEAT GERM – PLASM OF LONG COLEOPTILE TYPES

Laboratory screening tests have been developed for identification of long coleoptile, GA3 sensitive genotypes for getting a true measure of coleoptile length potential. Indigenous and exotic germ-plasm is being screened for identifying genotypes with high emergence potential. Rht/Gai recombinant material is being grown in Kaghan for use in breeding.

SCREENING TESTS FOR IDENTIFICATION OF BETTER ROOT SYSTEMS

Equipment was improvised and a technique developed for characterization of root system of wheat genotypes at the seedling stage. Screening of local and exotic germ-plasm has been in progress and eight genotypes isolated for their better root system. This material has been planted in the Kaghan Summer Nursery for cross-breeding purposes.

B. BARLEY

One thousand and six hundred barley entries were received from CIMMYT and ICARDA. On the basis of yield, plant type, and disease reaction selections were made. The yield of the selected lines ranged from 232 to 1240 kg. per acre.

C. TRITICALE

Two hundred seventy entries were received from CIMMYT and ICARDA and 34 selections were made therefrom on the basis of yield, plant type and disease reaction. The yield of the selections ranged from 844.8 to 1135.2 kg. per acre under barani conditions.

To develop high yielding, disease resistant and comparatively drought tolerant triticales, 5 varieties were tested in a replicated yield trial at 40 locations in the country.

COMPARATIVE YIELD PERFORMANCE OF WHEAT, BARLEY AND TRITICALE UNDER RAINFED CONDITIONS

Yield potential of wheat, barley and triticale was compared under rainfed conditions. The triticale yielded 584.66 kg. per hectare which was higher than wheat and barley which yielded 541 kg. and 480 kg. per hectare, respectively.

COOPERATIVE RESEARCH PROGRAMME ON RICE

The project is in operation at the Rice Research Institute, Kala Shah Kaku; 9

Rice Research Institute, Dokri and Agricultural Research Institute, Tarnab.

COMMON OBJECTIVES

EVOLUTION OF HIGH YIELDING, MEDIUM GRAIN AND EARLY MATURING VARIETIES

Kala Shah Kaku

a) *Breeding for High Yield, Medium Grain and Fine Grain Basmati Varieties*

Two hundred and forty fresh crosses were made and 250 crosses were studied in F1. From advance generation 11,494 single panicle selections were made for further studies.

Eight yield trials comprising 176 medium grain lines were conducted and lines No. 34712, 44268, 44279, 45169, 44795, 42598, 45154, 45349, and 45270 were found not only high yielder than IR-6 but also possessed better grain quality than IR-6. Seven yield trials comprising 140 fine grain, early and medium maturing lines were conducted. All the lines yielded significantly higher than Basmati 370.

b) *Breeding for High Yield, Medium Grain and Early Maturing Varieties*

In the medium long non-scented group, two high yielding lines have been developed. An early maturing line IR-1561-288-8 (matures within 95 days after transplanting) with a yield potential of 5000-6000 kg/ha and suitable as first crop in the double cropping system has shown promise. The other line is IR-579-160-2 which is suitable for low-lying area, with yield potential equal to IR-6 but better in grain quality.

Similarly, in fine-scented group four lines, semi-dwarf, early maturing and capable of yielding 40-80 per cent higher than the local Sugdasi/Basmati have been developed.

SCREENING OF VARIETIES FOR RESISTANCE TO DISEASES AND PESTS

Kala Shah Kaku

a) *Effect of Transplanting Dates on the Incidence of Stem Borer*

Borer attack was low in all the experiments but the highest yield of 4671 kg/ha was obtained with the 1st July transplanting with PK 177 as test variety.

b) *Studies on Moth Population*

Study on comparative moth population of different rice stem borers was conducted. The peak period for white borer moth was the 3rd week of April while that of yellow borer moth it was the first week of October.

Dokri

a) *Granular Insecticides*

Rice stem borers were effectively controlled with insecticidal granules, Cytrolane 3G, Curater 3G, Padan 4G @ 1.0 kg a.i./ha, and Dyfonate 5G, Birlane 10G, Evisect 5G and Miral 5G @ 1.5 Kg a.i./ha by two applications each after 35 and 50 days after transplanting.

Brown spot, narrow brown leaf spot, glume discoloration and kernel smut were recorded in 40 different breeding lines. The observations on these diseases were taken by using 0-9 scale. Maximum disease incidence of kernel smut was observed in IR -28 and IR -30 with 9 and 7 scales, respectively, where other diseases viz; B.S. NPLS and GLD were in 1, 2, 3 and 1 scale in both the varieties tested under local field conditions.

BREEDING HIGH YIELDING VARIETIES WITH IMPROVED GRAIN MILLING AND COOKING QUALITY

Kala Shah Kaku

Effect of Date of Transplanting on Quality of Rice

First week of July was observed to be the optimum time of transplanting to get minimum bursting.

Dokri

Different Transplanting Dates and Milling Recovery

Six varieties i.e. Jajai-77, Dokri Basmati, Basmati-370, IR-8 x Dokri Basmati, Basmati-370, IR-8 x Dokri Bas: (A) and J-77 x Dokri Bas: (B) were sown at intervals of 15 days. The nursery sowing was started from 15th April to 15th July, 1977 and the transplanting was done after one month from the date of nursery sowing. After milling, the best recoveries were obtained when the varieties were transplanted on the dates shown against each:

J-77	1st July	D.B	1st June
B-370	15th July	IR-8 x D.B.	15th June
J-77xD.B.(B)	15th July	J-77xD.B.(A)	15th June

*DEVELOPMENT OF PRODUCTION TECHNOLOGY AND ITS TRANSFERENCE
AT FARMERS' LEVEL.*

Kala Shah Kaku

a) *Direct Seeding Experiment*

An experiment was conducted to study the feasibility of direct seeding of rice. The yield of IR-6 was quite comparable with that normally obtained with the conventional method. The major problem encountered in direct drilling was the weeds which were frequently controlled by hand weeding.

b) *Date of Transplanting x Varietal Trial*

Date of transplanting of three new lines PK 177, 35234 and PK 178 were compared with Basmati 370 and 3 medium grain varieties viz; IR24, IR1561 and IR579 were compared with IR6.

Three fine varieties PK177, PK178 and Basmati 370 gave the highest yields of 4734, 4619 and 1846 Kg./ha, respectively. The highest yield of all the fine varieties was given by 1st July transplanted except a new strain 35234 which gave the maximum yield of 5844 Kg/ha with 1st June transplanted. In case of coarse varieties, IR24 gave the highest yield of 7795 Kg/ha when transplanted in May whereas others IR1562, IR579, IR6 gave the highest yields of 6580, 6819, respectively, with July transplanted.

c) *Effect of Herbicides*

In a weedicide trial Saturn 10G gave the highest yield of 5115 Kg/ha, followed by Avirosan 4715 Kg/ha in case of transplanted rice.

d) *Studies on Nitrogen Efficiency*

The source of N viz; Urea and sulphur-coated-Urea and their time and method of application were compared. The results showed that in treatments where 30, 60 and 90 Kg N/ha was applied in mud-ball; 90 Kg/ha gave the highest yield of 5837 Kg/ha against 4850 Kg/ha given by control. When comparing SCU with splits, the split proved better with paddy yield of 5935 Kg/ha against 5646 Kg/ha of SCU.

e) *Effect of H_2SO_4 Application on the Productivity of Problem Soils*

Effect of H_2SO_4 application was studied on a salty land with pH 9.0 for the elimination of bad effects of Na_2CO_3 and $NaHCO_3$ on the growth and yield of PK 177 variety of rice. With the application of 200 litres of

H₂SO₄/ha the highest yield 4033 Kg/ha was recorded as against 3019 Kg/ha of control plot.

Dokri

Agronomy

On the basis of several experiments the following recommendations have been formulated:

- Seedling of the age of 25-30 days have been found to be the best for optimum yield.
- A spacing of 20 x 20 cm have been found to be optimum for IRRI coarse varieties, while 15 x 15 cm spacing for local tall sugdasi and fine varieties.
- Transplanting period from 15th June to 15th July has been found to be optimum for rice yield.
- Rice grown in rotation with peas and gram has yielded the best results.
- Nitrogen in combination with Phosphorus in the ratio of 2:1 is better.

Tarnab

Agronomic Investigations

a) *Varietal-cum-time of Planting Experiment*

The experiment was conducted on two varieties and six dates of sowing in Swat and three varieties and five dates of sowing in D.I. Khan.

In Swat, transplanting in the first week of June to 1st week of July for variety J.P.5. and 3rd week of June to 1st week of July for variety Y.R.L. has given good yields.

In D.I. Khan, June transplantings for all the three varieties have given good results. The experiment in Swat will be concluded while the experiment at D.I. Khan will be repeated for the third year.

b) *Varietal-cum-plant Population experiment*

Four population treatments and two varieties were tested in this experiment in Swat. Closer spacing have given good results for both the varieties.

c) *Varietal-cum-fertilizer Experiment*

The experiment was conducted on two varieties and six fertilizer doses of nitrogen in Swat. The experiment received a moisture stress in the

early days after transplanting due to breakage of water channels by floods causing general low yields by varieties. The treatments means were significantly different from one another.

d) Varietal-cum-irrigation Experiment

The experiment was conducted on varieties J.P.5 and Y.R.L. at four days intervals. The results were not significantly different from one another.

e) Varietal-cum-Method of Planting Experiment

The experiment was conducted on three varieties and two methods of sowing (i.e. direct seeding and transplanting). The data show that transplanting has given good results in case of all the varieties in the experiment. The experiment will be repeated next season.

SPECIFIC OBJECTIVES

Kala Shah Kaku

BREEDING FOR RESISTANCE TO ZINC DEFICIENCY

Three hundred and twentyeight lines were screened for their resistance to Zn deficiency. The results showed that only 9 strains viz; 245, 34315, 44067, 44664, 44811, 44935, 44937, 45286 and 49177 were resistant to Zn deficiency symptoms.

Dokri

Breeding for Heat Tolerance

From IYRN (L) five lines viz, CO 38, IET 5656, IET 2911, IR3454---80-2-1 and IR 4625-132-1-2 were selected. In addition to this, from a set of 491 early maturing lines, only two best ones named IR 8423-156-22 and IR 9447-12-1 were selected. These will be tried for heat tolerance and in double cropping programme.

Tarnab

Breeding for Cold Tolerance

Two hundred and thirtyeight plant selections have been made in the breeding generations and cold tolerance for further testing under Swat and D.I. Khan conditions.

Fortyfour homozygous and promising lines have been selected in the breeding material, observation lines and cold tolerance nursery for further

testing in the preliminary yield tests next season. Two A-Tests have been made with J.P.5. and Y.R.L. as checks.

Seventyfive F1 populations have been selected for testing as F2 next season.

OUT-REACH RICE RESEARCH PROGRAMME

The project is in operation in Punjab, Sind and NWFP since 1977, in collaboration with the International Rice Research Institute, Philippines.

DEVELOPMENT OF RICE VARIETIES FOR SALINE SOILS

Studies were carried out at NIAB, Faisalabad, with salt tolerant recombinants resulting from a cross between Jhona 349 x Mangolia. The characteristics of the saline fields were pH 8.7, ECe 7.5 mmhos per cm at 25°C and ESP 36.7. The characteristics of the control were : pH 7.9, ECe 2.9 and ESP 13.4. All the morphological characters decreased in the saline substrate. However, the decrease was different for various characters.

The progenies P-57-74-96 and P-57-74-108 were more salt-tolerant and indicated the possibility of breeding of rice varieties for saline soils.

SCREENING OF RICE GERMPLASM

Eighteen hundred lines were collected and preserved, these were screened at RRI, Kala Shah Kaku, RRI, Dokri and at Mingora Research Station, NWFP, for rice plant diseases, salinity and heat & cold tolerance, respectively.

DETERMINATION AND TRANSFER OF RICE PRODUCTION TECHNOLOGY

A total of 140 applied research trials were conducted in the rice growing districts of Punjab and Sind provinces to test important variables influencing rice yield. 53 trials were carried out in Punjab and 87 in Sind.

a) Nitrogen Placement

The results of nitrogen placement trials indicated that by applying nitrogen in dry soil and incorporating it before flooding would result in an increase of approximately one ton per hectare over the present practice of fertilizer application at puddling.

b) Sources of Nitrogen

Among ammonium sulphate, DAP+Urea, Urea+Nitrophos and CAN 15

(Calcium Ammonium Nitrate); DAP plus Urea produced the highest yield with an average of 7 tons per hectare, followed by Urea and Ammonium Sulphate.

c) *Fertilizer Response*

Yield increase of approximately 3 tons/ha over the control was obtained with 120 Kg/ha N applied using dry method. No response to phosphorus and potassium was observed.

d) *Zinc Response*

Results of 57 trials in Punjab and Sind indicated that there were only two locations where response to Zinc on IR-6 (a susceptible variety) was observed. This indicates that there are only isolated fields especially in the poorly drained areas where there was response to zinc.

e) *Methods of Stand Establishment*

The results of research on direct seeding to overcome the problem of less plant population, indicated that more than 6 tons of yield per hectare could be produced by broadcasting pregerminated seed on well-prepared puddled soil and by using the proper amount of seed with good water control on heavy clay soils.

f) *Double Cropping*

Results of double cropping trials on rice at 7 locations in Punjab indicated that the best yields could be obtained when both crops were transplanted. The highest yield of 14.2 tons paddy/ha was obtained from selection 36234.

g) *Insecticide Placement*

Results of the insecticides placement trials at two locations in Punjab indicated that the application of 33 Kg/ha of 3% Furadan granules (1Kg/ha a.i.) gave significantly better protection than the other insecticides with a yield difference of approximately 3 tons/ha between the treated and control on IR-6.

COOPERATIVE RESEARCH PROGRAMME ON MAIZE SORGHUM AND MILLET

The project was initiated in 1975 with the primary objective to enhance the production of maize, sorghum and millet crops in the country through strengthening of the research capabilities at national and provincial levels. The programme is under implementation at the National Agricultural Research Centre (NARC) Islamabad and at the provincial institutes. In 1978-79 the programme was also extended to Azad Kashmir.

COLLECTION AND TESTING OF GERMLASM

Five hundred and twentyone maize, 103 sorghum and 79 millet cultivars were arranged from various international agencies and distributed to cooperating units.

IMPROVEMENT AND EVALUATION OF VARIETIES

a) Maize

Farawan (BS. III Late) a full season yellow variety ranked first among 14 varieties and yielded 3889 Kg/ha. Soan white variety was early maturing than Sadaf and showed promise in rainfed areas. Santa Rosa (1) 7624 out-yielded all other varieties. Its seed will be procured from CIMMYT, Mexico, for large scale testing. The yield performance of national cooperative trial (Full season) was encouraging and the yields of varieties ranged from 3111 to 4081 kg/ha at Pirsabak and 6517 to 8404 kg/ha in Swat. On overall average, Sarhad, Obregon 7446 and Akbar varieties produced higher yields per hectare. In short season group, Soan, Agaiti-72 and Pachaiti Sufaid showed superiority over the varieties developed at Pirsabak.

The overall average performance of national cooperative yield trials conducted at 5 locations revealed that in case of full season varieties Sarhad (Yellow), Pirsabak-7442 and Mansehra composite yielded higher than the other varieties included in the national trial. In short season group, Soan out yielded all the entries and was followed by Syn-551. In hybrid maize yield trials Sarhad 'Yellow' out-yielded all other entries tested at five locations.

b) Sorghum

A medium tall variety 1747 out-yielded the existing approved varieties and was recommended for its approval for general cultivation.

c) Millet

In national cooperative pearl millet trials variety Hairy Dwarf attained first position. Its seed will be increased in the coming season for large scale testing.

DEVELOPMENT OF PRODUCTION TECHNOLOGY

In water-logged soils at Mona Reclamation Experimental Station, Bhalwal, planting of maize on broad beds produced 900 kg/ha more as compared to planting on flat beds.

In herbicidal trial on maize conducted at Yousafwala yield of 5457 kg/ha was obtained which was 83% more than the control, by use of Primaxtra (500 F.W.).

EFFICIENCY OF DIFFERENT INSECTICIDES

Eleven different insecticides were tested at Yousafwala during the year, out of which Sumicidin 20 EC gave the maximum yield (3813 Kg/ha).

COOPERATIVE RESEARCH PROGRAMME ON OILSEED CROPS

Research is being conducted at the National Agricultural Research Centre, Islamabad, and the four Provincial Agricultural Research Institutes on established oilseed crops namely, rape and mustard, groundnut, sesamum and castor as well as on new oilseed crops such as sunflower, soyabean and safflower.

INTRODUCTION AND DEVELOPMENT OF IMPROVED VARIETIES OF ESTABLISHED CROPS

a) Rape and Mustard

Rape and mustard germplasm with wide genetic diversity was collected and maintained at National Agricultural research Centre, Islamabad for breeding purposes. The number of entries presently available are : Brassica campestris -- 98, Brassica napus -- 17, Brassica tournifortii -- 165 and Eruca sativa -- 98. A total of 310 different rape and mustard entries were evaluated for early maturity, disease resistance and high yield. The promising entries with a yield between 336--784 kg/acre were further tested in the preliminary yield trials. One hundred and forty exotic and local strains of different cruciferous species were tested and 12 entries were found most promising with a yield potential ranging between 560 -970 kg/acre. A new variety of raya (Poorbi Raya) with yield potential of about 1300 kg/acre under irrigated conditions was developed at the Ayub Agricultural Research Institute, Faisalabad. Popularization of this variety among the farmers would increase the average yield by 448 -500 kg/acre. PRL 34 -E showed outstanding performance at Faisalabad and PRL 9--E at Bahawalpur. Their yield ranged between 755--860 kg per acre. RL--18 gave maximum yield of 1300 -1400 kg per acre. Its main drawback was its tallness and susceptibility to insect pests. PR -7 variety of toria evolved at Agricultural Research Institute, Tarnab, yielded 40 per cent higher than local varieties. Lines K -655 and K -1033 gave higher yield than Poorbi Raya.

Research was undertaken to evolve rape and mustard varieties free from erucic acid and glucosinolates. A line, K -190 was identified which contained zero erucic acid. It was further crossed with high yielding varieties. The seed of low erucic acid varieties Midas, Tower, Regent, Span, Torch and Candle was multiplied at the Ayub Agricultural Research Institute, Faisalabad for further testing.

b) Groundnut

Yield trials were conducted at Rawalpindi on erect Spanish varieties.

Among the erect varieties, LICN and Banki gave the highest per acre yield of 482 kg pod, while HSU-JI and Spanlioma (Spanish Type) gave the highest yield of 320 and 310 kg, respectively. The spreading variety Panghu No. 2 gave the highest yield of 623 kg per acre pods and 440 kg kernel. The Nigerian bunch type variety (Nigeria No. 10) yielded 554 kg pods per acre. A semi-erect variety A-1-2 was evolved at the Agricultural Research Institute, Tarnab, for large scale cultivation in groundnut growing areas of Swabi. Its yield potential was 1420 kg per acre. A semi-erect Chinese groundnut variety "Shi-Tou-Chi" performed well at D.I.Khan.

c) Sesame

Evaluation of available collection was undertaken to evolve high yielding variety of sesame coupled with resistance to disease and shattering behaviour. Sesame varieties S-17, S-30-10 and progeny 19-9 were identified at the Agricultural Research Institute, Tandojam as suitable genetic resource for Sind. Their yield varied between 187 to 746 kg/acre.

d) Castor

A gene pool of the castor germplasm was maintained at the National Agricultural Research Centre, Islamabad. Annual type castor hybrid varieties C-3 and U-S I were identified as high yielding under rainfed conditions.

INTRODUCTION AND EVALUATION OF NEW OILSEED CROPS

a) Sunflower

Eighty different hybrid open pollinated sunflower varieties were tested and evaluated at the National Agricultural Research Centre, Islamabad. The varieties with yield potential of above 930 kg/acre were: IS-9841, IS-8944, Sunbred 212, Romsun-90, French variety C-77 and Big Top. In addition, these varieties were uniform in height and maturity with head diameter varying from 12-20 cm and seed set at 90-95 per cent. Two biotypes, "Noor and Shams" were developed at the Ayub Agricultural Research Institute, Faisalabad.

b) Soyabean

The Soyabean varieties Bragg, William, Forrest Mitchell, Lee, Davis and Pickett-71 were identified as high yielding varieties. Their yield was 597-970 kg/acre at the National Agricultural Research Centre, Islamabad. Loopa, Columbus, T-15 and Improved Pelican gave high yields under Sind conditions. Hampton 260-A was the best variety for that area. Chinese variety Erotu No. 2 was found resistant to yellow mosaic disease.

c) Safflower

Forty eight safflower varieties were evaluated at National Agricultural 19

Research Centre, Islamabad, under rainfed conditions. US-10 and Gila were found high yielding and resistant to Alternaria leaf blight. Safflower variety S-208 yielded 591 kg/acre at Ayub Agricultural Research Institute, Faisalabad and a spineless variety Thori-78 between 225 to 500 kg/acre depending on soil fertility and moisture conditions in Sind.

Safflower was crossed with a wild species 'Pohli' (*Carthamus oxycantha*) at NARC. F2 segregating population was planted and desirable plants selected.

IMPROVED PRODUCTION PRACTICES INCLUDING SOIL AND WATER MANAGEMENT

a) Rape and Mustard

Poorbi Raya yielded between 750-800 kg/acre with sowing between 10th and 19th September, applying two irrigations, fertilizing at the rate of 45 : 45 NP kg/acre and harvesting the crop 110 days after emergence.

b) Groundnut

Best pod yields were obtained at Ayub Agricultural Research Institute, Faisalabad, when one plant per hill was planted at row spacing of 1.5 ft. and plant spacing of 6 inches.

c) Sunflower

An obtaining plant stand of 12,000 - 15,000 plants per acre was established for obtaining high yield under rainfed conditions. The best fertilizer dose was 68 : 23 lbs NP. The difficulty of obtaining the required plant stand of sunflower was overcome, after 3 years of experimentation at the National Agricultural Research Centre, Islamabad by dibbling 2 seeds per hill on ridges and later on thinning to one plant per hill. Yield trials were conducted at Faisalabad on long duration (100-110 days) and short duration (80-90 days) sunflower varieties. The highest yielding long duration varieties were SUN-HI 410, Hybrid 204, IS8944 and Shams while Sun Hi 301, Noor 248 and Armvirsky were the highest yielding among short duration varieties. The yield of both the long and short duration varieties, ranged between 600-795 kg per acre. Under out-reach tests conducted at Faisalabad and Khanpur, Sun Hi and Sunbred-212 gave the highest yield of 924-949 kg at Faisalabad, while Noor yielded 549 kg at Khanpur.

d) Soyabean

The NWFP and Sind were found to be the most suitable regions for growing soyabean. The yield in these areas varied between 933 to 1568 kg/acre at Ayub Agricultural Research Institute Faisalabad. The bio-types

Ford, Wayne and Sue Hsine, Monkey Hair showed promise in spring and Kharif, respectively. In the autumn, the best types were Pelican (improved), Loopa and Bragg. In large scale yield trials at Faisalabad under irrigated conditions, Wayne gave the highest yield of 243 kg/acre. Best yields were obtained with seed rate of 30 kg/acre with 1 ft. row spacing. The best sowing time was from the first week of July to mid July.

SCREENING OF GERMPLASM OF POTATO SPECIES (4n) FOR ADAPTATION TO ENVIRONMENTAL STRESSES IN PAKISTAN

SCREENING AND EVALUATION OF POTATO VARIETIES

The local and exotic potato varieties procured from USA, West Germany, Holland, Scotland and India were subjected to screening studies under different ecological zones, to test their disease reaction, resistance to pests and tolerance to hot and cold weather, and yield potential. The variety Atlantic and clones number B0093- 2 and B8500-A/1 showed promise in comparison to standard varieties in Punjab. Similarly, varieties Cosima, Atica, Cardinal, Prima, Bounty, Abnaki exhibited promising performance in the provinces of NWFP, Baluchistan and Sind.

One hundred thousand potato seedlings comprising segregating material in F1 generation were procured from USA and are under trials in different agro-ecological zones in Pakistan, for subsequent selection and varietal development.

IMPROVEMENT OF PRODUCTION PRACTICES

Fertilizer and water requirement studies revealed that the application of 125 Kg N, 125 Kg P₂O₅ and 60 Kg K per hectare with watering at seven (7) days interval were more conducive to increase yield in the provinces of Sind and Punjab.

Better crop stand, early maturity by 7-10 days and higher yields were obtained when sowing was done with pre-sprouted potato seed in comparison to un-sprouted seed.

IDENTIFICATION AND CONTROL OF VIRUS AND FUNGAL DISEASES

The viral and fungal diseases cause potato crop losses ranging from 3 to 36 per cent in various region of the country. Mosaic, PVX, PVY, PLRV and Fusarium wilt, early blight, black leg, were observed to be prevalent in plains of Sind and Punjab provinces. The incidence of these diseases was low at higher altitudes, however, late blight was abserved in hilly areas of Kaghan valley. The disease attack was of much higher magnitude in spring season and resulted in degeneration of seed stock. Extensive studies are in hand in different agro-climatic regions to sift out suitable resistant varieties.

DEVELOPMENT OF APPROPRIATE SEED PRODUCTION TECHNOLOGY

In the absence of a system for certified seed, potatoes are imported from Holland involving expenditure in valuable foreign exchange. The imported stock hardly meets 5–10% requirements of the potato crop. This seed when further multiplied during the spring season gets quickly de-generated due to heavy incidence of virus diseases in the plains. To overcome this difficulty to develop an appropriate seed production technology suitable sites at higher altitudes with low aphid population, the main agent for spreading virus were tested in the hills of NWFP and Baluchistan. The seed production trials conducted in Kaghan valley (NWFP) and in Kan Mihtar Zai (Baluchistan) showed that basic seed could be produced at higher elevations ranging from 2300–2600 metres, through single plant selection technique and roguing of diseased plants at appropriate time. The dynamics of aphid population areas were also studied to develop standard cultural practices for virus control.

Possibilities of raising early summer crop in the lower hills were also studied for seed purposes. The crop planted at Mansehra and in Loralai districts indicated that potato tubers could be harvested during June-July, and used as a seed for the ensuing autumn crop.

The above studies are indicative of development of a seed production cycle in the country to locally meet the requirements of certified and healthy seed.

Determination of Nutritional Qualities of Selected Varieties

Food technological studies were undertaken to determine the nutritional quality of selected varieties. The glyco alkaloid contents of various varieties were also determined.

Highest dry matter contents were found in USA variety Atlantica and Clones B91210–2. The varieties Patrones and B8500–A1 showed good chipping quality.

Varieties Bintji, Redbad, Atica, and Prima, possessed desirable character of colour, taste and easy softening at boiling.

The glyco-alkaloides in selected varieties were found within safe level for human consumption.

COORDINATED SCHEME FOR SUGARBEET BREEDING AND SEED PRODUCTION IN NWFP

Exotic material was procured from beet growing countries and tried for the development of inbred lines. Seventyseven lines have been developed from S2 to S4 stage. Twelve lines were planted for the development of synthetic varieties.

induce bolting in sugarbeet. At Beet Seed Farm, Swat, upto 50 tons per annum of seed could be produced, sufficient to meet 40--50 per cent requirement of three sugarmills in the area. The imported and local seed were at par in root yield, sugar content and resistance to pests and diseases. However, the advanced generations of sugarbeet seed gave comparatively less root yield and also declined in sugar contents.

VARIETAL TESTING, NUTRITIONAL INVESTIGATIONS AND NUCLEUS SEED PRODUCTION OF VEGETABLES IN D.I. KHAN

Out of 10 pea varieties the variety Wando gave the highest yield of 5.38 tons/ha. In turnips, the variety Purple Top gave the highest yield of 14.4 tons/ha. Radish variety Japanese White gave the highest yield of 16.45 tons/ha. out of seven varieties. Fertilizer trial on Okra for seed production showed that treatment $N_{90}P_{90}K_{30}$ gave the highest seed yield of 1.55 tons/ha followed by $N_{60}P_{90}K_{30}$ treatment with a yield of 1.0 ton/ha.

GINGER CULTURE AND ITS FIELD PLOT DEMONSTRATION, SIND.

Ginger sowing was done under partial and complete shade. Field planting was also done on two different dates. Sowing was also done in pots on different soils.

GINGER AND VEGETABLE CROPS IN SOAN VALLEY AND OTHER SUB-MOUNTAINOUS AREAS OF PUNJAB

In experimental plots laid out at the selected sites of Shakargarh, Bajwat, Soan Valley, Kahuta and Murree, germination of ginger remained higher at Murree as compared to other sites. Very poor germination in ginger was recorded in a trial where farm yard manure, poultry manure and castor oil cake were used and covered with plastic tunnels. In a mulching trial on Ginger sown in field and in tins, very poor germination was obtained in tins and there was no germination in the field. High germination was recorded in "Date of planting-cum-shading trial" on Ginger when it was sown on 16th March and shaded in May and June. More than 80 per cent Ginger tubers germinated when sown in 2,000 polythene bags on different dates. However the sprouted ginger totally failed on transplanting in the field.

In manurial trial germination percentage in case of M9 where gypsum was included was higher than in the ordinary soil.

IMPROVEMENT OF VEGETABLE SEED PRODUCTION IN BALUCHISTAN, QUETTA

Date of transplanting trials on turnip and beet seed production and sowing method trials on radish and cabbage seed production were carried out. Turnips and beet roots transplanted on 15th September, produced more seed as compared to those transplanted in November. The yield of radish and cabbage seed was increased when roots and heads were transplanted, respectively, as compared to direct seed

sowing method.

BANANA CULTIVATION IN HYDERABAD REGION (MIRPUR-KHAS)

The banana suckers of Basrai and William's Hybrid were got radiated from Atomic Energy Centre, Tandojam. The irradiated banana suckers of Basrai variety were planted on 6.5.1977 and William's Hybrid suckers on 24.5.1977. Since the size of the suckers was too small and temperature was also high at the time of planting, most of the suckers died. William's Hybrid Banana sucker treated with KR-1 completely died. The suckers produced by the treated suckers of both the varieties were removed and planted during March, 1978 and are under observation.

SAFFRON CULTIVATION IN QUETTA AND KALAT DIVISION

Seventy two thousand corms of saffron were distributed to the farmers for planting. Reports indicated that saffron could be cultivated successfully in the districts of Zohb, Kalat, Chagi and Pishin. The Spanish variety gave higher yield than the other two varieties. There was no difference in the yield of saffron due to variation in the number of irrigations.

COLD STORAGE OF FRUITS AND VEGETABLES IN PESHAWAR REGION

- In oranges, it was observed that among all the fungicides tried, Tecto-40 exhibited an effective control against mould rots during a storage period of 15 weeks.
- In pears, variety 'Kieffer' was found to be most suitable for cold storage during a storage period of 18 weeks. Fungicides 'Zerlate' was most effective against rot and grey mould.
- In plums, variety, 'Fazle Manani' was the suitable variety for table purpose even after 6 weeks of storage when picked at medium ripe stage.
- Studies on Apricots revealed that under-ripe apricots when packed for cold storage the fruit retained original colour and texture during 4 weeks period of storage.
- In persimons, preliminary cold storage studies revealed that room temperature storage resulted in partial ripening of the fruit with no significant change in sugar/acid ratio.
- In pea, no sprouting was observed when treated with 'Zerlate' during 6 weeks storage period at $32 \pm 2^{\circ}\text{F}$. It was also observed that SO_2 fumes exhibited effective control against sprouting during 6 weeks of storage

but at the same time discolouration and softening of pea pods were recorded.

— In potatoes the variety Desiree followed by Patrones performed well during the period of 15 weeks of storage at $40 \pm 2^{\circ}\text{F}$, having 80 -90% R.H. after having been treated with fungicide, Potassium hypochlorite.

— It was observed that cold storage charges, application of fungicides, cost of packing materials though involved additional expenditure but helped in prolonging marketing season which gave higher returns to growers as compared to fresh marketing prices during peak harvest season.

PLANT INTRODUCTION CENTRE, KARACHI

Banana suckers of varieties, Valery muso ssp. and Nancio ssp. planted at Landhi Farm are growing successfully and more plants have been obtained through suckers. Coffee plants in the open field have perished but those planted under shade are growing well. The seedlings of Jojoba raised and transplanted are growing at a very slow rate. Germination of ginger in the open field was very poor and the plants died due to sun burn. Leucaena plants raised from seed were further propagated through cuttings and their number has increased to 50. Out of 100 seedlings of tamarind, about 25 per cent have survived and are growing successfully.

The Centre is providing material of great genetic diversity to the provincial research institutions.

EXPLORATION, COLLECTION, PRESERVATION, CONSERVATION AND EVALUATION OF PLANT GENETIC RESOURCES

The project is operating as a component of the regional project 'Exploration and Conservation of Germplasm in Near East', financed by the Swedish International Development Authority. The activities under the project are:

a) *Collection of Germplasm*

The germplasm material of various crops including Rice, Wheat, Barley, Triticale, Oilseeds, Pulses, Chickpea consisting of about 3500 accessions is available with the Pakistan Agricultural Research Council.

b) *Evaluation/Screening of Local and Exotic Germplasm Material*

International chickpea nurseries from ICRISAT, India, consisting of 120 accessions were evaluated for various agronomic and disease resistance characters.

c) *Establishment of a Cold Storage and Laboratory*

The construction of cold storage and seed cleaning room, seed drying room and a laboratory is nearing completion at the NARC, Islamabad

INTRODUCTION OF TEA AND COFFEE CROPS IN PAKISTAN

The experimental work on the introduction of tea in Pakistan was started during the year 1973-74, by importing seeds from Sri Lanka, Bangladesh, Japan, China and Russia. Trials were laid out at four locations in the Northern part of the country. Encouraging results have been obtained at Baffa (Distt. Mansehra-NWFP) and a demonstration tea garden on an area of 5 acres has been established. The irrigation to the plantation is being provided through sprinkler irrigation system.

Work on introduction of coffee was started during 1975 by importing coffee seeds from Nigeria, Uganda, Kenya, Indonesia and Mexico. The preliminary work has shown that the Mundo Novo Progeny-3 of Mexico gave better results in respect of its germination and plant growth. The plants raised from the coffee seeds of Mundo Novo Progeny-3 were distributed in various locations in the country. The preliminary results have shown that coffee can be grown in southern parts of Sind.

IMPROVEMENT OF YIELD AND QUALITY OF JUTE IN PAKISTAN

Experimental work on the introduction of jute in Pakistan was initiated a few years ago to meet the fibre requirements of the existing jute mills, which amounts to about 70,000 tons. Different varieties of jute were tried in the provinces. In Punjab, the variety JRO 878 and JRO 7835 out-yielded the other varieties. In Sind, the variety D-154 out-yielded rest of the varieties while in NWFP the variety Nepal-1 gave promising performance. As a result of the studies conducted so far it has become possible to grow jute locally in Pakistan and feed the local jute mills by increasing area and through improvement in the production technology.

FODDER AND FORAGES

FODDER AND FORAGE COOPERATIVE RESEARCH PROGRAM

The research programme is operating at 12 cooperating units/institutes throughout the country.

SUPERIOR FORAGE & FODDER VARIETIES THROUGH SELECTION & BREEDING WITH SPECIAL EMPHASIS ON BERSEEM, LUCERN AND SORGHUM

a) Sorghum

In a yield trial conducted at NARC, Islamabad, under rainfed condition the sorghum varieties Pak. SS-II, D.G. Pearl, Sarokartuho, Roma and Perdue yielded 22.00, 22.05, 19.38, 18.48 and 16.44 tons of green fodder per hectare, respectively, compared to the local variety which yielded only 8.41 tons per hectare. Thirtytwo different cultivars of sorghum were introduced from ICRISAT, India, at the University of Agriculture, Faisalabad, for evaluating quality and quantity of fodder. Fifteen sorghum sudan grass crosses were made at the University of Agriculture, Faisalabad and six crosses were selected on the basis of yield and quality tests. Germplasm nursery of sorghum cultivars numbering more than 100 was maintained at the University. Varietal trial on sorghum conducted at the Ayub Agricultural Research Institute, Faisalabad, and other government farms in the Punjab, revealed that variety J.S. 100 gave the highest yield of 42 tons of green fodder per hectare. The other varieties tested were J.S.I., J.S. 263 and D.G. Pearl. Sorghum varieties Turi and selection H-4-2 were found at Tandojam as high yielders of green fodder per hectare. The green fodder yield of the above two varieties ranged from 42 to 45 tons per hectare. A sorghum x sudan grass hybrid named 'Lajawab' was developed at Livestock Production Research Institute, Bahadurnagar.

b) Berseem

Forty bio-types of berseem were tested at the AARI, Faisalabad and some of those had the potential of double green fodder yield than the local varieties. Varieties 3/73, multifoliate and Lyallpur Late showed promise with an average yield of 97 tons of green fodder per hectare from 4 to 5 cuttings as compared to standard variety 4/11.

c) Lucern

In a varietal trial on lucern conducted at the NARC, Islamabad, under barani conditions, variety Elunico produced highest green fodder yield of 40.3 tons per hectare. The other varieties W.L. 303, Florida 66 and Sonora (USA) produced 37.5, 37.0 and 36.5 tons, respectively. In lucern varietal trials conducted at the Ayub Agricultural Research Institute, Faisalabad, the variety (8 + 9) out-yielded all the local, as well as exotic varieties. At Agricultural Research Institute a variety Kandhari yielded 62.4 tons of green fodder per hectare as compared to local variety which yielded only 54.4 tons per hectare.

d) Bajra

Varietal trial on bajra conducted at the NARC, Islamabad, showed that varieties Lyallpur. 154, DB-2, NC III and Y-72 produced 22.95, 22.06, 20.78 and 19.25 tons of green fodder per hectare, respectively, as compared to local one which yielded only 14.79 tons per hectare.

e) Bajra-Napier

Bajra Napier hybrid, a cross between bajra and Napier grass was successfully introduced at the NARC, Islamabad under barani conditions yielding 85 tons of green fodder per hectare. This hybrid has a potential of 130 tons of green fodder per hectare in five cuttings under irrigated conditions.

f) Medics

Medics cultivars Jemalong, Harbinger and Snails were well-adapted to rainfed conditions at NARC and yielded about 16.37 tons of green fodder per hectare

g) Oats

A variety D.N. 8 yielded 54 tons green fodder per hectare at NARC, against the local variety yielding 43.6 tons per hectare. At AARI, Faisalabad, oat varieties Full grain, Avon, Algerian and Sargodha Selection yielded between 60-70 tons of green fodder per hectare. At Agricultural Research Institute, Sariab, Quetta, variety Full-grain gave maximum green fodder yield of 25 tons per hectare. At Agricultural Research Institute, Tandojam the variety Algerian gave maximum green fodder yield of 40 tons per hectare.

FERTILIZER & OTHER AGRONOMICAL PRACTICES TO MAXIMIZE FORAGE AND FODDER PRODUCTION

districts of the Punjab revealed that application of NPK at the rate of 120 -60 -60 kgs. per hectare was the best fertilizer dose. Fertilizer requirement studies on barley conducted at D.I. Khan revealed that a dose of 40 -40 -0 kgs. gave the highest green fodder yield. A fertilizer dose of 90 -60 -0 kgs. per hectare was found optimum for higher green fodder yield of oats at Agricultural Research Institute, Quetta.

Application of NPK at the rate of 50 -100 -50 kg per hectare was found to be the best economical dose for obtaining maximum fodder yield of lucern.

Fertilizer trials on berseem conducted at AARI, Faisalabad and other places in Punjab showed that 40 -100 -0 kg. per hectare was the optimum dose.

At Agricultural Research Institute, Tandojam, seed rate of 125 kg. + 100 kg. N per hectare gave maximum green fodder yield in maize. In sorghum, 100 kg of seed + 100 kg of N per hectare were optimum for high fodder yields. In a similar trial on bajra, 25 kg. seed + 100 kg. N gave maximum fodder yield. Fertilizer studies on forage sorghum and bajra conducted at D.I. Khan showed that 60 kgs. N and 40 kgs. N per hectare were the most economical fertilizer doses for sorghum and bajra, respectively. In B.N hybrid maximum yield of 132 tons green fodder per hectare was obtained by the application 120 -120 -0 kg per hectare, at Livestock Production Research Institute, Bahadurnagar.

INTRODUCTION, TESTING AND SELECTION OF GRASSES, LEGUMES, SHRUBS AND TREES OF FORAGE IMPORTANCE IN VARIOUS ECOLOGICAL ZONES OF PAKISTAN

Introduction and observation nurseries of the grasses and legumes were maintained at each cooperating unit /institute and were strengthened/extended during the current year. Three Buffel grass cultivars viz RMF No. 18, 225 and 527 were selected on the basis of air dry matter yield per hectare. These cultivars yielded more than 10 tons of air dry matter per hectare. An Australian legume siratro was successfully introduced at the NARC, Islamabad, with outstanding green fodder yield of 20 tons per hectare.

Forage grass Panicum antidotale, a local strain, out-yielded exotic strains with regard to air dry matter yield per hectare. Superior strains of Cenchrus ciliaris, Cenchrus setigeris and Elionurus hirsutus were selected at the Forest Department, Thall, Punjab for large scale reseeded. A forage grass Echinochloa colonum gave green forage yield of 10 tons per hectare after 69 day of planting at Sind Agriculture University, Tandojam. This grass was also suitable for water logged areas. Another forage grass Panicum mihacum gave 20 tons of green forage per hectare.

Among the shrubs Atriplex species viz Halimum and Nummularia were found better adapted under the conditions of Dhabeji, Sind. Fourspineless cactus species were also selected for large scale planting as fodder shrubs. As a result of studies conducted at the Pakistan Forest Institute, Peshawar, Jaba Sheep Farm Manshra, Kala Chitta and Kohat areas following forage grasses and legumes were

selected for large scale re-seeding programme. Cenchrus ciliaris, Chrysopogon aucheri, Medicago sativa, Panicum antidotale, Panicum maximum, Panicum turgidum, Potarium sanguisorba, Trifolium paratens, Vicia sativa and hybrid bajra. About 100 kg. seed of these species has been provided to various agencies engaged in Range Management work, throughout the country.

Range ecological studies are in progress at Raya Sari hut Jaba Sheep Farm, Baz Khan and Banda Doud Shah in NWFP province. The local grass species known as 'Barshung' was tried which gave remarkable performance in Quetta range areas.

In Azad Kashmir, four species of Lolium, four species of Festuca one species each of Phalaris and Panicum antidotale gave outstanding forage yield.

RANGE MANAGEMENT AND FORESTRY

MANAGEMENT STUDY OF EUCALYPTUS CAMALDULENSIS

Seventeen thousand four hundred and eighty plants were planted over 8.5 hectares each at Changa Manga, Chichawatni, Pirawala, Bahawalpur, and Miani; following standard planting methods. Trench and flood irrigation was employed with three spacings : 1.5 x 1.5, 2.25 x 2.25 and 3.0 x 3.0 ms. replicated four times, in plot size of 0.3 hectare.

ESTABLISHMENT OF FIELD RESEARCH STATION FOR JUNIPER FORESTS OF BALUCHISTAN

PRESERVATION AND IMPROVEMENT OF JUNIPER FORESTS

Seven hundred thousand (700,000) seeds were sown to raise nursery and a large number of six-month old juniper seedlings raised in polythene tubes were successfully planted in the forest.

Eighty seven per cent of mature juniper trees were found attacked by heart rot, which destroyed 32% of the volume of wood.

Dwarf mistletoe was detected over 47% of the sampled area with 36% of the trees attacked in Sasnamana forests. The elevation range of 2900—3000 m, and south-eastern aspects were found most favourable for its development and spread. The parasite was also recorded to be extending in the contiguous Chasnak Forest.

INTRODUCTION OF OTHER SPECIES FROM SIMILAR ECOLOGICAL ZONES

Gledischia triacanthos and Cupressus arizonica planted in 1976 are surviving so far. Ulmus pinastramosa imported from USSR was planted in July, 1977 and showed 95% survival till June, 1978. This year 50,000 plants of Fraxinus anthoxyloides and Pistacia khinjak, the associates of Juniper and of Ephedra have been raised for planting in the area in July, 1979. In addition, 2500 plants of Ulmus pinastramosa have also been raised.

STUDIES TO DETERMINE THE EFFECT OF GRAZING

Forage production inside the fenced area was found to be 584 kg. per hectare in contrast to 83 kg. for the unfenced. Vegetation in the fenced area predominantly comprised grasses and in the unfenced area herbs and shrubs. Intermediate and

desirable species were present in the fenced area and undesirable species in the unfenced area. Infiltration rate, moisture at water saturation point and porosity was also significantly higher in the fenced area.

Species of grasses of the dry temperate zones of USA have been imported and sown in the nursery for seed propagation before testing in the area.

COMPARATIVE GROWTH STUDY OF EUCALYPTUS CAMALDULENSIS, SALMALIA MALABARICA, ACACIA ARABICA/MORUS ALBA

An experiment consisting of 6 treatments, 5 replications in factorial design has been started at two places: Chichawatni plantation and Sarhad plantation (Mirpur Mathelo). 11,520 plants have been planted over an area of 6.6 hectare at each of the two sites at a spacing of 2 x 2m.

At Sarhad, Acacia arabica was planted to compare with E. camaldulensis and Salmalia malabarica where as Morus alba was planted at Chichawatni in place of Acacia arabica because of the suitability of climatic conditions for the species.

NATIONAL RESEARCH PROGRAMME FOR TREE (FOREST, FRUIT AND ORNAMENTAL) INTRODUCTION, IMPROVEMENT AND PROPAGATION TECHNIQUES

ESTABLISHMENT OF INTRODUCTION AND TREE IMPROVEMENT NURSERIES IN IMPORTANT ECOLOGICAL ZONES OF PAKISTAN

Nurseries were established at the following places during 1977 and 1978 to raise planting stock of locally superior selected tree material and from imported seed of exotic tree species:—

- (a) Pakistan Forest Institute, Peshawar.
- (b) Nawanshehr (Abbottabad).
- (c) Bhurban (Murree).
- (d) Jallo (Lahore).
- (e) Muzaffarabad (Azad Kashmir).
- (f) Miani (Hyderabad).

The planting stock raised in the nurseries was subsequently used for establishment of seed stands, seed orchards and test plantations in various ecozones in the country.

COLLECTION AND MULTIPLICATION OF SUPERIOR PLANT MATERIAL, OF LOCAL AND EXOTIC SPECIES, AND ESTABLISHMENT OF SEED STANDS, SEED ORCHARDS AND TEST PLANTATIONS IN VARIOUS ECOZONES FOR

PRODUCTION OF GENETICALLY SUPERIOR PLANTING MATERIAL

More than 1500 candidate plus trees of different timber and ornamental species have been selected throughout Pakistan for the establishment of progeny tests and seed orchards. The principal species are kail (Pinus Wallichiana), deodar (Cedrus deodara), fir (Abies pindrow), walnut (Juglans regia), Chir Pine (Pinus roxburghii), Quetta pine (Pinus elderica), Shisham (Dalbergia Sissoo), Eucalyptus camaldulensis, Eucalyptus tereticornis, and Eucalyptus melanopholia,

Seed stands of Chir pine, fir, deodar and kikar have been selected and marked in different Forest Divisions of NWFP, Punjab and Azad Kashmir over an aggregate area of about 90 hectares.

Seed orchards of Shisham, Bakin, Simal, Mulberry, Eucalyptus spp., Acacia spp., Chir pine and Blue pine have been established over 35 hectares. These seed orchards will also serve as progeny tests for determination of heritability of different tree characteristics.

A number of test plantations have been raised during, 1977 and 1978 to test the suitability of different exotic species under various ecological conditions. Acacias, Eucalyptus, Leucaena, Albizzia species have been tried under both irrigated and non-irrigated conditions in the plains. Eucalyptus species under both irrigated and non-irrigated conditions, and leucaena leucocephala under irrigated conditions have proved promising in the tests. A number of species of exotic pines e.g. Pinus canariensis, Pinus radiata, P. caribaea and P. pseudostrobus, were tried in sub-tropical Chir pine and temperate blue pine zones in Galis, Muzaffarabad and Murree Hills Forest Divisions. Pinus pseudostrobus appears to be promising so far. Test plantations for testing of the exotic species have been established over about 25 hectares in different parts of the country.

TESTING, IMPROVING, DEVELOPING STANDARDIZING AND DEMONSTRATING NURSERY AND PLANTATION TECHNIQUES

Demonstration nurseries were established using standard nursery techniques. More than 100,000 plants raised from superior selected parent stock were provided to the field officers for planting. Seed of selected trees was also provided to them. About 250,000 plants were provided during spring, 1979.

STIMULATION OF FLOW OF RESIN IN PINUS ROXBURGHII WITH CHEMICALS

Five hundred trees of Pinus roxburghii (Chir-pine), 27.5 to 40 cm. in diameter, were selected at Batrasi and Baz Khan in Hazara. In 1974 all the trees were worked under the French system of tapping for calibration of yield. At the end of the tapping season, progressive increase in yield was indicated with increase in diameter.

In 1975, the use of chemicals was introduced. Forty per cent sulphuric acid solution and 60% sulphuric acid paste and solutions, were used in conjunction with American bark chipping method, while for sodium chloride solution and control French blazes were used. Highest yield was produced with 40% sulphuric acid solution. The average yield per tree being 3.7 Kg. as compared to 1.5 Kg. in Control through the use of this technique economic benefits calculated for 1000 trees, were three-fold as compared to the conventional method.

EFFECT OF FERTILIZER ON THE RATE OF GROWTH OF FOREST TREES

Fertilizer experiments were laid out on shisham (Dalbergia sissoo), hybrid poplar, Eucalyptus camaldulensis and chir-pine (Pinus roxburghii)

a. Shisham

Three year old shisham crop at PFI over 0.48 ha. was treated with N P K and their combinations in a factorial experiment in July, 1978 replicated 3 times, sub plots of 18.3 x 11.1 m size with 40 trees. The doses employed were: Nitrogen (Urea) 300 kg/ha, Phosphorous (SSP) 150 kg/ha and Potassium (Potassium sulphate) 150 kg/ha.

b. Hybrid Poplar

Four year old poplar crop grown at 5 x 5 m in compartment 74 Changa Manga plantation was given 8 fertilizer treatments viz., N, P, K, NP, NK, PK, NPK and control with 4 replication of each; 16 trees constituted a plot. The doses employed per plot of size 20 x 20 m are: Nitrogen (Urea) 22.27 kg., Phosphorous (SSP) 25.05 kg. Before the application of fertilizers soil samples were taken at 0-15, 15-45 and 45-90 cm depths for analysis.

c. Chir Pines

Two year old chir pine plants planted at a spacing of 2 x 2 m at PFI were given 8 fertilizer treatments N, P, K, NPK, NP, NK and control, 7 replications, 4 tree plots. Fertilizer doses employed per plant were Urea 20 gm, SSP 15 gm, and Potassium sulphate 25 gm. Heights of all the plants were recorded.

MANAGEMENT STUDY OF HYBRID POPLARS

Seventeen thousand six hundred and forty well grown, one year old poplar plants of uniform size and of the same clone were planted in February, 1976. Failures were restocked in February, 1977. Manual hoeing in closer spacing (1.8 x 1.8, 2.4 x 2.4, and 3.0 x 3.0 m) and soil cultivation with tractor in the remaining 4 spacing was completed in March, 1977. Annual measurements of diameter and height were recorded in January, 1977 and 1978.

January, 1977 measurements indicated that the closest spacing (1.8 x 1.8 m) gave significantly higher height (0.1 level) as compared to the other treatments.

INVESTIGATIONS ON RED RIND ROT OF CONIFERS IN PAKISTAN

Two hundred and ninety three blue pine, 135 chir pine, 169 deodar, 61 juniper, 125 fir, 20 chilghoza pine and 41 spruce trees have so far been studied in 41 localities. The incidence of red-rind-rot was 9.8% among all the sample trees. It was 80% in Chilghoza pine, 11.5% in blue pine, 8.4% in deodar, 4.2% in fir, 2.4% in spruce and 1.8% in chir pine. The overall loss of timber due to disease was found to be 5.8% by volume. The decay losses were 48.8% in chilghoza pine, 13% in blue pine, 3.5% in fir, 1.8% in spruce and 1% in chir pine and deodar.

Tree age was the factor found closely associated with the production of decay. The decay volume generally increased with advancing age, losses becoming high in trees over 100 years of age. Incidence of decay was higher in trees growing on southern aspects as compared to those on the northern. Dead branch stubs were the major infection courts for the pathogen.

EFFECT OF NATURAL ENEMIES AND SILVICULTURAL PRACTICES ON POPLAR BORER POPULATIONS

Studies on the biology of natural enemies of poplar and their extent of parasitism have been initiated. Infested logs of poplar trees from different localities were caged in the laboratory to record emergence of natural enemies of various borers. It was found that Ostomids and Elatrids (Coleoptera) were predaceous on larvae of Aeolesthes sarta; and Apriona cinerea; Apanteles, Brachymeria and Rhyssa sp. were recorded as parasites on larvae of Melanophila picta. An unidentified mite was found predaceous on larvae of Apriona cinerea. Boavaria sp. a fungal disease was recorded on Indarbela quardrinotata. 20 to 32% of the larvae of I. Quardrinotata collected at regular intervals from poplars died due to the infestation of the fungus of Boavaria sp. Under field conditions 26 to 57% larval galleries contained dead dried larvae due to this attack.

GENETIC IMPROVEMENT AND BREEDING OF THREE POPLAR SPECIES

<u>Species</u>	<u>No. of trees selected</u>	<u>Location</u>
<u>Populus alba</u>	35	Murree, Jhelum Valley and Poonch, Abbottabad.
<u>P. Ciliata</u>	108	Murree, Galis, Kiran, Sharda,

The criteria for selection were diameter and height growth as well as stem form on comparison basis. Wood samples from selected trees were also collected for the determination of wood specific gravity in the laboratory. The final grading of the selected trees would be determined by growth rate, stem form and wood specific gravity.

Cuttings and seeds were collected during 1977 and 1978 from both selected candidate plus trees as well as ordinary trees for subsequent progeny tests. The nursery stock of seedling clonal origin is being raised at Nawanshehr (Abbottabad), Bhurban (Murree) and Pakistan Forest Institute, Peshawar.

**COLLECTION OF SEED OF DIFFERENT SEED SOURCES AND
ESTABLISHMENT OF PROVENANCE TRIALS OF HIMALAYAN
BLUE PINE (Pinus Wallichiana A. B. JACKS. Syn. P. griffithii)**

In 1978, seed was collected from 11 localities in the district of Dir, Swat and Chitral. Ten representative trees were selected in each of these localities and seed was collected from them for establishment of nursery provenance study using seed of previous years collection as well. The field provenance study was also established in Kalabagh Forest of Galis Forest Division during 1978. Laboratory studies on seedling characteristics and anatomical properties of needles of different seed sources have confirmed earlier findings that considerable genetic diversity exists in blue pine within its natural range in Pakistan and Azad Kashmir. Distinct differences of morphological and anatomical characteristics of needles, seed and branching habit have been observed in natural stands of blue pine growing in xeric and mesic habitats. These were confirmed through nursery provenance study of a number of seed sources from both habitat types.

**SELECTION OF SUITABLE POPLAR CLONES FOR LARGE SCALE
POPLAR PLANTATION IN THE PUNJAB**

Out of the forty clones under trial, at Jallo and Changa Manga, four clones i.e., 1 116/60, A -61/186, A -65/27 and 1-BL, have given better performance so far in Punjab.

CULTIVATION OF SISAL

Sisal nursery was established over an area of 0.3 hectare at Jallo. A field trial in six plots was also laid over an area of 1.5 hectare. Two plots were kept as control with 2.5 x 1 meter spacing with no watering whereas in the remaining two plots planting has been done along two parallel lines, one meter apart, having a distance of 4 meters from the next double line.

lala Bye-pass Road, in three equal size plots were also conducted. Field trials were also carried out in the territorial divisions of Jhelum, Rawalpindi and Attock by planting 9000 sisal plants.

GROWTH AND MANAGEMENT OF FAST GROWING TREE SPECIES IN SIND

Nurseries and clonal archive were established and management study on Eucalyptus selected poplar clones and Albizzia procera in different sub-selected poplar clones and A. procera in different sub-centres of the province were carried out. Rotational studies on A. procera, Hybrid poplar and Salmalia malabaricum are in the process of establishment.

THE BIOLOGICAL BEHAVIOURAL AND HABITATS STUDIES OF URIAL, CHINKARA DEER AND NILGAI IN THE PUNJAB

Census of Urial was carried-out in Chiltan and a thorough survey of its population and its trend was carried out in Taraki, Barali, Domeli and Diljaba parts of Salt Range first in 1976 and again in 1978. Reconnaissance survey on the distribution of Urial was carried out in Lal Sohanra National Park.

SOIL & IRRIGATION

COORDINATED RESEARCH PROJECT ON "ESTIMATION OF CONSUMPTIVE USE OF WATER FOR MAJOR CROPS UNDER OPTIMUM MANAGEMENT CONDITIONS IN PAKISTAN"

The project is in operation since 1975 on a national basis at five cooperating units / institutions. The research work at most of the locations has shown that consumptive use of water by crops can be substantially reduced with negligible, if any, loss in yield. The results of research studies on maize, cotton and wheat are given below.

a) Cotton

The results obtained at Tandojam, Mona and Bhakkar indicated that cotton crop can be grown successfully with far less irrigation water than is normally applied and appreciable increase in yield was obtained under moisture stress conditions. The consumptive use for cotton equals to approximately 812, 858 and 926 mm of actual water use at Tandojam, Bhakkar and Bhalwal, respectively and the yields obtained were 2.04, 1.59 and 2.02 tons/ha., respectively. The higher yield at Tandojam and Bhakkar was due to fairly dry season whereas monsoon rains at Mona disturbed the stress conditions at critical stages of crop growth. The crop yield was reduced to 1.8 tons/ha at Tandojam and Bhakkar under high moisture conditions where 700 mm of water was used by the crop. The growing season average crop coefficient (E_t/E_{tp}) for cotton at 1,3 and 5 bar stress treatment comes to 0.75, 0.71 and 0.83, respectively, whereas growing season crop coefficient using pan evaporation was 0.68, 0.66 and 0.69 from 1, 3 and 5 bar stress treatments at Mona and Bhalwal. Appreciable increase in yield was obtained with high fertility level i.e. $N_{100}P_{50}K_{30}$ Kg/ha. The yield was reduced to 1.8 tons/ha with low fertility level i.e. $N_{50}P_{20}K_{30}$ Kg/ha.

b) Sugarcane

The results indicated that the consumptive use of water for sugarcane was 142 mm at Bhakkar when the crop was irrigated at 50% soil moisture depletion level. The consumptive use of water was reduced to 1284 mm of water when the crop was irrigated at 95% soil moisture depletion level. The highest yield of 142 tons/ha was obtained with high fertility dose of $N_{135}P_{60}K_{50}$ Kg/ha, when 1422 mm of water was used during the growing season. Significant decrease in yield was obtained at moisture

conditions under high fertility level whereas with low fertility conditions yield was not affected significantly.

c) **Maize**

The results obtained at Faisalabad, Peshawar, Tandojam, Mona and Bhakkar indicated that the consumptive use of water was 340, 350, 360 and 620 mm, respectively. The yield obtained was 2.82, 2.04 4.56, 2.29 and 5.59 tons/ha, respectively. The crop was sown in February and harvested in June. Appreciable increase in yield was obtained where irrigations were applied at 75% soil moisture depletion at various growth stages. Significant decrease in yield was also obtained under high moisture (wet) conditions. The yield was reduced under high moisture stress conditions.

d) **Wheat**

The consumptive use of water for wheat was 346, 505, 400, 459 and 596 mm at Faisalabad, Tandojam, Mona Bhakkar and Mianchannu, respectively. The yield at these locations varied from 2.8 to 4.94 tons/ha, respectively. The crop coefficient varied from 0.5 to 1 at various growth stages during crop growing season.

MICRONUTRIENT STATUS OF BALUCHISTAN SOILS AND THEIR EFFECT ON FRUIT TREES AND OTHER CROPS IN GENERAL

Survey of crop land of some districts of Baluchistan was conducted to study the effect of calcium carbonate contents on the availability of micronutrients in the soil. Six soil series, namely Baleli, Chilton, Karbala, Pishin, Quetta and Sariab were selected. These soils are calcareous in nature and the CaCO_3 content ranged from 5 to 31%. Crops growing on these soils were subjected to moderate to severe chlorosis. 200 soil samples and 96 leaf samples were collected for analysis from different parts of Baluchistan soils. Seven field trials were conducted for application of different micronutrients which significantly increased the yield of potato, tomato and other crops.

IMPROVEMENT OF SOIL PRODUCTIVITY THROUGH THE USE OF ORGANIC MATTER

The major sources of organic matter, including crops, forests and industrial wastes and wild plantation were surveyed in Punjab.

**COOPERATIVE RESEARCH PROGRAMME ON IMPROVING
WATER MEASUREMENT AND CONTROL SYSTEM DEVELOP-
MENT FOR THE AGRICULTURAL RESEARCH INSTITUTES IN
PAKISTAN**

The project has been started from January 1979 with the main objective to determine yield decrements of major crops and specific varieties as a function of water stress levels.

PEST MANAGEMENT

PEST MANAGEMENT STUDIES AND RESEARCH FOR THE DEVELOPMENT OF INTEGRATED PEST CONTROL PROGRAMME FOR MAJOR CROPS- PADDY, MAIZE, COTTON AND SUGARCANE

PRIORITY PESTS

An outbreak of Gurdaspur borer occurred in the Punjab. Its phenology, population and control were investigated at Mandi Bahauddin. Preliminary studies revealed that about 40% larvae die during winter.

Brown leaf spot, kernel bunt and blast were the important diseases of paddy. Bacterial blight of cotton infected 5.9% on the early and 10.3% on the late-sown crop in Multan area. Its degree of attack was similar at different fertilizer levels. This was the most prevalent disease in Multan and its economic significance needs to be worked out in detail.

The incidence of sugarcane diseases had been on increase possibly due to the cultivation of susceptible varieties or more favourable climatic conditions.

Trienthera monogyna, Cyperus spp. and Digera arvensis were important weeds of cotton in Multan. Cynodon dactylon was the important weed of sugarcane at Mardan.

Paralongidorus was recorded for the first time on maize crop in Pakistan. Other nematodes were as abundant in winter as in the fall, thus showing no adverse effect of lower temperatures.

Of the 11 species of nematodes recorded in association with sugarcane crop, Tylenchorhynchus spp., Helicotylenchus spp. and paratylenchus spp. seemed important. Ratooning possibly had no effect on the nematode population. Test varieties of sugarcane at Murree harboured lesser numbers of nematodes.

SIGNIFICANCE AND IMPORTANCE OF DIFFERENT CONTROL COMPONENTS

The microbial pesticide, Bactospeine was tested against maize stem borer, Chilo partellus, both in the field and laboratory. It proved effective against young larvae. Its application in the field was done on the basis of pest scouting.

Populations of cotton pests and their predators were slightly higher at high fertilizer rate than at the low level. Thrips and bollworms were more numerous on the late than on the early-sown crop, whereas whitefly, aphid and mites occurred almost in equal numbers. Bollworms were recorded on Abutilon, Althaea and Hibiscus, apart from cotton. Mortality of diapause larvae of Pink bollworm was higher in the top layer and gradually declined toward the bottom layer of the stacks. Larval mortality was also higher in the heaps stacked in the sun than those kept in the shade.

Of the 10 species of predators recorded in cotton fields, Orius albidipennis, Paederus fuscipes and spiders seemed important. These predators had higher population in such cotton fields which received lesser amount of pesticides. They were also encountered on alternate host plants of cotton pests as well as in the shed material during winter.

Light-trap catches during September 77 — June 78 showed that Earias vittella was the dominant bollworm.

Field trials of Bactospeine against sugarcane stem borers gave satisfactory control. Of all the recorded natural enemies of Pyrilla, Epipyron and Ooencyrtus seemed important as biotic agents in the NWFP. The population of the former was same in the chemically treated and untreated fields. However, Ooencyrtus occurred in lower numbers, in the sprayed area.

Of the 26 test varieties of sugarcane grown at Mardan, 13 seemed to be resistant to Whip Smut and Red Rot, one highly susceptible to both and four highly susceptible to Whip Smut only.

HONEYBEE MANAGEMENT

RESEARCH ON HONEYBEE MANAGEMENT IN PAKISTAN

The project has been operating at Islamabad, Faisalabad and Peshawar.

DEVELOPMENT OF HONEYBEE STRAINS

Colonies of the hill bee Apis cerana were procured from Swat, Hazara, Azad Kashmir and Marghala and studied for evolving better strains having high honey production potential. Three strains namely Marghala, Swat and PARC selected in the PARC phase were promising. The first had slightly longer tongue and was more suitable for the foothills and possibly plains of the Punjab. The second had a fairly high honey production potential and expected to be suitable for the hilly areas. The third produced fairly high honey yield in the plains, foot-hills and hills, being suitable for the beekeepers who migrate their colonies in these areas.

DEVELOPMENT OF HONEYBEE QUEEN BANK

The hill bee (A. cerana) occurs in some Asian countries and little research work has been done on this species. In Pakistan, about 4200 colonies of this bee were maintained in modern hives. The queens of this bee were reared in hills and foot-hills of the Punjab and NWFP during February-April and in the hills in some parts of Hazara and Swat during September. These queens were either individually used for queenless colonies or placed in nucleus colonies like that of the European honeybee (Apis mellifera) in the western countries. The nucleus colonies of A. cerana were heavily attacked by wax moth and most of them absconded. The apiaries suffered heavy losses due to queenlessness occurring in colonies almost throughout the year. Maintenance of double queen colonies of this bee had been reported to be unsuccessful unlike that of the European bee (A. mellifera) usually practised in the western countries. Keeping in view these difficulties, some trials were conducted on storing the queens of the hill bee. It was found that two or more new queens, owing to fight among them, failed to live together in a colony. However, 10 one-year-old queens when stored in one colony survived for 2-24 weeks and some of those were used for queenless colonies. This method was successfully tested again by placing 35 queens in one colony. Storing of one-year-old queens in this way would solve the problem of queenlessness and would definitely reduce the heavy losses occurring to beekeeping industry in Pakistan and elsewhere.

BROOD DEVELOPMENT OF HILL HONEYBEE

Studies were conducted on brood development in the Marghala and Swat 43

strains (A. cerana), effect of diet (Multi-vitamins, yeast, hen egg mixed with sugar syrup), cannibalism and foraging activities of bees in relation to colony development. Swat strain was found better for brood development than Marghala train. Feeding of sugar syrup mixed with multi-vitamins, yeast and hen egg induced oviposition in the queen during dearth period when all the queens stopped egg-laying

INTRODUCTION AND ACCLIMITIZATION OF EUROPEAN HONEYBEE

The Caucasian and Italian strains of A. mellifera were imported from Russia in July 1977 and Australia in February 1979, and now there are 75 colonies of this species in the PARC phase and 48 colonies with private beekeepers. It could not be possible to establish this species in Pakistan inspite of the several efforts made during the last 6 decades. Present studies revealed that failure in establishing this species was owing to presence of toxic sugars in some honey plants, non-fertilisation of queens in the plains and foot-hills due to high temperature and heavy attack of hornets.

PROPAGATION OF EUROPEAN BEE IN HILL BEE COLONIES

The European honeybee had been genetically improved in the western countries. The Italian strain of this species produces very high honey yield but the cost of their colonies was very high. Therefore, most of the beekeepers could not afford to buy them. Keeping this difficulty in view the PARC staff has conducted various trials for mass multiplication of this bee. It was found that the newly sealed queen cell of Italian bees grafted in a very gentle local bee colony was accepted and the queen, after emergence, normally worked in the local bee droneless colony. This colony was surrounded by the Italian bee colonies having drones and was provided with empty comb of Italian bees. The queen started egg-laying within a few days after mating flight. Introduction of Italian bee queen into the local bee colonies consequently transformed the local bee colony into the Italian one in about 3-4 months, and in this way the cost of producing the Italian bee colonies was reduced to a very low level. This method is, at present, being tested by some progressive beekeepers.

VERTEBRATE PEST CONTROL CENTRE

A. PILOT CONTROL STUDIES

1. *Rodent Control in Paddy Fields*

Newly developed acute and chronic rodenticides were tested to compare their effect on rice yields, near Gharo, district Thatta. The 'Vacor' and Brodifacum proved highly effective against rats as compared to Racumin and Zinc Phosphide (Registered in Pakistan). These materials were cheap and involved less labour in their application; and also the phenomenon of bait shyness was lacking in 'Vacor'.

2. *Bird Control in Maize, Wheat and Sunflower.*

Maize: Methiocarb at the rate of 2 kg (50% wettable power) per hectare, was sprayed in maize fields in Multan area, to study its repellent effect against Parakeets. After two days of spraying, the parakeets completely avoided the treated areas which resulted in less damage as compared to the untreated fields, where upto 20% of the cobs were severely damaged by these birds.

Wheat: For control of house sparrow damage in wheat crop, modified Australian crow trap and nest destruction technique were evaluated against toxic chemicals including Methiocarb, Avitrol and Fenthion, near Multan. Spraying with Methiocarb resulted in reduced feeding pressure, which reduced to 40% on the 2nd day of spraying, while no significant results were obtained with Avitrol and Fenthion. Success was poor in case of traps but nest destruction proved very successful.

Sunflower: Modified Australian Crow Trap (MACT), Methiocarb and Avitrol were used as controlling agents, against parakeets damaging sunflower in Multan District. Methiocarb when sprayed on heads reduced the damage considerably (upto 50%) as compared to untreated plots. Similar results were obtained in case of Avitrol. However, trapping with MACT did not result in major reduction in pest attack.

3. *Pika Control in Apple.*

Different poison baits were tested in Oct. 1978, to study their effectiveness against Pika damaging apple trees in upland valleys of Baluchistan. Prebaiting with rolled oats, broken rice and chopped apples was done along the stone wall embankments of nine orchards, to assess the pre-treatment activity. This was followed by baits of 2% zinc phosphide, 1% Vacor and 0.005% Brodifacum in chopped apples and rolled oats, respectively. It was estimated that zinc phosphide bait had low acceptability but the Brodifacum showed more than 90% reduction in the estimated

population. Vacor reduced activity to about 75–80%. More than 150 apple trees were banded with "Ostico" paste. The sites were inspected in April, 1979 and none of the treated trees were found damaged by the Pika.

4. Rodent Control in Grain Storages

High percentage of rat mortality was obtained, in small rice godowns in Karachi, with the use of Vacor, zinc phosphide and Racumin dusts and sodium warfair liquid baits.

5. Wildboar Control

To control wildboar trials were conducted in Piranwala Forest Plantation and baiting was done with zinc phosphide, sodium monofluoroacetate (1080) and endrin. The 1080 and endrin were filled in small gelatine capsules and inserted in pieces of fish meal or meat, whereas, zinc phosphide was mixed at 2% with broken rice, dried milk and molasses. The pigs accepted these baits except zinc phosphide and 40–50 animals were recorded dead.

B. ASSESSMENT OF LOSSES

Sugarcane

Analysis of data, based on samples drawn from 200 sugarcane farms in Punjab and Sind provinces, showed that rodents reduced sugar production by an average of 10.7 per cent.

Wheat

Survey of wheat crop, conducted just before harvest during 1979, led to estimates that at least 2–3 percent of the yield was lost to rodents. Most seriously affected areas were Gujrat, Gujranwala, Sheikhpura and Faisalabad districts in Punjab, Larkana district in Sind and certain localities in NWFP.

Apple Orchards

Apple Orchards in Loralai, Ziarat and Quetta were surveyed for Pika damage. In Muslim Bagh, Loralai and Quetta, about 1000 apple trees surveyed showed nil damage, which may be due to heavy snow and low Pika population during the year 1979 (winter months). However, in Ziarat two orchards suffered severe attack. Five hundred trees were banded to test Ostico which was found highly effective.

C. RODENT BORNE DISEASES SURVEY

The Medical Zoology Division continued bi-monthly surveys of rodent population in Lasbela district (Uthal, Baluchistan) to obtain data on the incidence of cutaneous Leishmaniasis. The occurrence of this disease is wide spread among the labourers working in the two industrial units in Uthal. The local population, however, seems to be immune to this disease and only the persons from outside this area get infested. So far 275 houses have been surveyed to collect data on the prevalence of this disease.

D. TRAINING AND EXTENSION

1. Long Term Training

Three courses were held to provide in-depth training to senior Plant Protection and Extension Officials from each Province. Forty four persons (10 from Sind and 34 from Punjab) received 6 days intensive training in the principles and practices of rodent and bird control.

2. Short Term Training

A series of one day training courses for bait preparation and demonstrations were arranged during November in the Northern Punjab. Meetings were organized at Rawalpindi, Jhelum, Kharian, Fateh Jhang and Murree in which over 550 farmers and Agricultural Extension workers participated. One day training sessions were also held at Faisalabad and Loralai in which sixty five persons participated. At Faisalabad instructions were given to graduate students in Irrigation Department for the control of mole rats. A 2 day session was organized at the Cotton Research Institute, Multan to demonstrate the control of mole rats on the farms. Two one-day sessions were held at Quetta, in which 20 extension workers and 18 research scientists participated.

3. Teaching Aids.

Instructional leaflets were prepared, in Urdu, on the control of rodents and birds, pests under various situations and distributed to Agricultural Extension Services and to farmers throughout the country.

ANIMAL SCIENCES

A. ANIMAL PRODUCTION

CROSS-BREEDING OF AUSTRALIAN ILLAWARA SHORTHORN (A.I.S.) WITH THE SAHIWAL BREED AND COMPARATIVE STUDIES ON PRODUCTION PERFORMANCE AND ADAPTABILITY OF PROGENY.

One hundred cows of A.I.S. breed were imported from Australia for cross-breeding with local Sahiwal cattle at the Livestock Experiment Station, Islamabad. It was observed that the average birth weight among 10 A.I.S. and 21 cross-bred was 23.90 ± 0.93 and 24.77 ± 0.70 kg., respectively. The crossbreds weighed 217.13 Kg. at 14 months of age and the weight gain per month varied from 8.52 to 18.42 Kg. The pure A.I.S. had an average age at first calving of 875 ± 24 days, whereas it was approximately one and a half month less in the crossbred animals. Average daily milk yield for the first 12 weeks of lactation was 8.42 and 18.40 litres for A.I.S. and cross-breds, respectively.

STUDIES ON THE PRODUCTION PERFORMANCE AND ADAPTABILITY OF THE CROSS-BRED COWS UNDER SUB-TROPICAL ENVIRONMENTAL CONDITIONS OF THE PUNJAB.

The imported Jersey & Holstein Friesian were cross-bred with Sahiwal cattle at the Livestock Production Research Institute, Bahadur Nagar. Preliminary results indicated that there was hardly any difference in the birth weight of F1 and F2 animals but an interesting point to note was that F1 females were heavier at birth than males but this trend reversed in F2 calf population. However, the fact that Friesian crossbred calves were heavier at birth than Jersey cross-bred calves in F1 generation was maintained in F2 generation as well, and this superiority of F1 over F2 calves was also maintained in their weaning weights. The F2, F x S and J x S calves weaned lighter by 8 to 12 kg. on the average than their F1 counter-parts. The F2 heifers, although lighter in body weight by 30 Kg. and 38 Kg. on the average in F x S and J x S, respectively, yet there was no difference in age at maturity in the formers but the F2, J x S matured earlier by fortnight than their F1 counterparts.

It was determined that under extension area the average 305 days 1st lactation milk production as estimated from a partial lactation yield of 112 days of recorded information was found to be 2674.9 Kg. for Sheikhpura animals whereas it was 2097 Kg. for F x S and 1938.8 Kg. for J x S animals at Bahadurnagar.

the desired potential of a commercial dairy cow in terms of early maturity, enhanced productive life by calving early and producing more milk.

STUDIES ON TEDDY GOAT FOR MUTTON PRODUCTION

Reproduction

Two hundred and thirtyseven, 190 and 78 goats gave birth to 370,301 and 115 kids during 1975-76, 1976-77 and 1977-78, respectively. The twinning and triplet percentage for the entire period was 41.4 and 6.1%, respectively. Fifty-nine per cent of kidding took place during January-March, 21% during June-August and only 15% in the remaining six months. The goats mated during August to October and January to March gave births to kids of higher weight most probably due to greater availability to good quality green fodder during these months.

Birth Weight

It was observed that the average birth weight of male and female kids was 3.2 and 2.7 lbs., respectively.

Growth Rate

A daily weight gain of 0.03 and 0.05 lbs. was recorded in male and female, respectively upto the age of two months.

Age at Maturity

Average age at maturity (age at first oestrus) was recorded to be 209 days.

Dressing Percentage

Five male young stock were randomly selected, slaughtered and their dressing percentage was calculated. It was found to be 41.1%. This was the percentage of hot carcass whereas by including pluck, head and trotter this percentage rose to 53.2.

Grazing Trial

In order to assess the requirement of the animals and grazing condition of the range, 5 goats were daily selected at random and weighed in the evening after grazing. The difference was calculated so as to estimate the daily intake of fodder. The daily average consumption was estimated to be 2.2 kg per animal.

STUDIES ON MILCH GOAT

Studies were conducted on the various economic traits of Nachi, Dera Din 49

Panah (DDP) and Beetal goats for better milk production:

Breeding Behaviour

It was observed that maximum frequency of breeding occurred during the period March to June followed by the period July to October and November to February. It was observed that the goats usually breed during the period of the year when the days are longer and the frequency was lowest in winter months.

Birth Rate

Observations were made for two years on 76 Nachi, 60DDP and 64 Beetal goats. The fertility calculated on the basis of total kids born against goats kidded was 126% and 129% in Nachi, 129 and 116% in DDP and 115 and 138% in Beetal, During the years 1975-76 and 1976-77, respectively. The twinning rate was 26 and 29% in Nachi, 29 and 16% in DDP and 15 and 37% in Beetal breeds, respectively, during the same years. However, only in DDP both birth rate and twinning percentage decreased which seemed to be due to high mortality in breeding goats.

Kidding Interval, Service Period and Dry Period

The kidding interval, service period and dry period, respectively, was 296, 146 and 171 days in Nachi, 312, 162 and 187 days in DDP and 352, 202 and 239 days in Beetal. Apparently the performance of Nachi breed was better and it possessed higher production capacity.

Age and Body Weight at First Kidding and Conception

Nachi breed has shown early maturity and conceived for their 1st kidding at an average age of 403 days. Beetal conceived at the age of 520 days and DDP at 579 days.

Milk Production

Milk production was higher in Nachi than in DDP and Beetal.

Birth Weight

It was noticed that both the male and female kids of DDP breed were heavier at birth than Nachi and Beetal. In Beetal the birth weight was lowest.

Growth Rate of Kids

The average daily weight gain showed that during the first three months the kids (male and female) of Nachi breed gained more than those of DDP and Beetal kids. There was positive correlation between birth weight and growth rates.

TWICE A YEAR LAMBING IN LOHI SHEEP

The data indicated that the effect of early weaning of lambs (30--40 days after birth) had marked effect on the oestrus cycle of sheep. The findings of the study also revealed that concentrate feeding had excellent effect on the health of sheep, as well as on the birth weight of lambs and twinning percentage. Milk substitute ration feeding to lambs have also good effect on the growth rate of lambs and weaning weight.

B. ANIMAL HEALTH

CONTAGIOUS OVINE AND CAPRINE PLEURO-PNEUMONIA IN NWFP

Contagious Ovine and Caprine Pleuro-Pneumonia is one of the greatest causes of mortality in goats in NWFP. Concrete steps have been taken to evolve effective vaccine to deal with the problem. Since the commencement of the scheme 4428 goats were vaccinated with formalinized autovaccine and 151 goats treated with Oxytetracycline against the disease. A sample survey in connection with the quinquennial assessment of incidence and losses amongst sheep and goats due to the disease was carried out.

C. ANIMAL NUTRITION

UTILIZATION OF AGRO-INDUSTRIAL BY-PRODUCTS FOR BEEF PRODUCTION

A number of feeding trials with various agro-industrial by-products were conducted on old bullocks for fattening them economically. Observations were recorded on various traits and average quantity of feed required to gain 100 lbs. of weight was worked out.

UTILIZATION OF AGRICULTURAL AND INDUSTRIAL BY-PRODUCTS AND WASTES IN POULTRY FEEDS

Almond cake contained a higher percentage of protein but contained a chick-growth inhibitory factor. It could only be incorporated in broiler rations upto a level of 5% without impairing the growth rate and feed utilization of the chicks. The chick-growth depression by feeding of almond cake might be due to the presence of higher level of cyanophoric compounds in the indigenous almond cake.

Autoclaving and lysine supplementation improved the nutritive value of indigenous almond cake which was reflected in better growth response and feed utilization of the chicks. This indicated that the indigenous cake might be deficient in the essential amino acid lysine.

Indigenous poppyseed cake as a sole source of vegetable protein in broiler rations was inferior in quality as compared to sesamum cake. Autoclaving was ineffective, whereas supplementation of lysine and methionine significantly improved the nutritive value of indigenous poppyseed cake. This indicated that lysine and methionine might be the limiting essential amino acids in poppyseed cake.

Guar meal was an inferior source of vegetable protein as compared to sesamum cake in broiler rations. Indigenous guar meal contained a chick-growth inhibitory factor. It could only be used upto 5 per cent level without causing any significant chick-growth inhibition.

D. FISHERIES

REARING TECHNIQUES OF FRESH WATER PRAWN FOR COMMERCIAL UTILITY

Adult specimens of *M. malcolmsonii* measuring 112-225 mm. were brought to the laboratory from fresh water for taxonomic study. Preliminary rearing study from hatching to juvenile stage revealed that commercial species of fresh water prawns could be grown successfully in laboratory. A piece of 5 acres of land at Husri near Hyderabad is being acquired for making experimental ponds.

STUDIES ON THE KEEPING QUALITY OF SOME COMMERCIALY IMPORTANT FISH/SHRIMPS OF PAKISTAN

The pigmentation defect known as 'melanosis or black spots', frequently appear on shrimps harvested from tropical and semi-tropical waters, thus creating a pronounced marketing problem. These black spots readily develop on dead prawns, specially when they are held under dried refrigeration. Experiments were conducted to find out the effect of metabisulphite on reducing black spot formation. The results indicated that when deheaded shrimps (washed with clear sea water) were dipped in 4 to 5% metabisulphite solution for 10 minutes and then preserved in ice the spots did not develop till the 10th day.

CRUSTACEA (DECAPODE & STOMATOPODA) OF PAKISTAN

A total of 300 specimens including juveniles of prawns have so far been collected. They pertain to 50 species belonging to the families: Penaeidae, Alpheidae, Hippolytidae, Processidae, Callianassidae, Diogenidae, Dromiidae, Dorrippidae, Philyrinae, Leucosiinae, Calappidae, Matutinae, Majidae, Portunidae, Ocypodidae, Xanthidae, Squillidae. At least three species referable to *Ogyrides*, *Pontophilus* and *Calcinus* were collected for the first time from the northern Arabia Sea.

A few samples of a small planktonic shrimps (*Acetes*), not known in Pakistani waters were also collected.

LIFE HISTORY AND FISHERY RESOURCES OF LOBSTERS OF PAKISTAN

Distribution of lobster larvae in time and space in the northern Arabian Sea has been studied through the Norwegian research vessel 'Dr. Fridtjof F. Nansen'. Breeding season and fecundity of *P. polyphagus* have also been studied in detail. Some success in hatching and rearing of lobsters under laboratory conditions has

been achieved.

A conservation study indicated that undersized lobsters (less than 150 mm total length), berried females and newly moulted lobsters should be banned from being caught and landed. Accordingly, the Directorate of Marine Fisheries has initiated action on formulating suitable regulations for this purpose.

In addition to the previously known three species (i.e. Panulirus polyghaqu Herbst, P. homarus linnaeus and Thenus orientalis Lund), three more species viz Panulirus versicolour latreille, Puerulus sewelli Ramadan and Scyllarides tridac-nophaqa Holthuis have been recorded. P. versicolour and P. sewelli may possibly provide good fishery in future.

AGRICULTURAL ECONOMICS

COOPERATIVE RESEARCH PROGRAMME ON THE STUDY OF CROPPING PATTERN IN VARIOUS ECOLOGICAL REGIONS OF PAKISTAN

In the Universities at Faisalabad, Karachi, Peshawar and at the Agriculture Research Institute, Quetta research work has been initiated recently, Basic statistics are being collected for the full implementation of the Project.

COLLECTION OF DATA REGARDING EXISTING CROPPING PATTERN THROUGH FIELD SURVEYS AND SECONDARY SOURCES

The study of cropping pattern presents the results of econometric analyses of the historical perspective. Data on it also furnishes basic information regarding the geographical conditions of the area, growth of irrigation system, pattern of land use, cropping intensity, changes in production, availability of inputs, effect of the size of holding and yield of major crops, and different cropping patterns. The province-wise results of study are reported below.

PUNJAB

The study revealed aggregate picture of cropping pattern in the province of Punjab during the last 28 years (1947-48 to 1975-76). There were only minor changes despite considerable upsurge in the supply of inputs considered to be instrumental in changing cropping pattern of an area. The canals were designed for the cropping intensities of 13 to 48 per cent in Kharif (Summer) and 25 to 85 per cent in Rabi (Winter) for different perennial canals and 24 per cent to 66.6 per cent in Kharif season for non-perennial canals. The designed supply of canal water was three cusecs for every 1000 acres of cultivable land. Thus it was the inadequate supply of water which allowed the cropping intensities to increase very slowly.

Fertilizer supply in the Punjab was 60,900 nutrient tons during 1964-65 which reached 281,000 nutrient tons during 1974-75. The cropping intensity during 1947-48 was 89.25 per cent which rose to 103 percent in 1974-75 with an exception of 1972-73 and 1973-74 when it reached 105.9 per cent and 110.57 per cent, respectively. This trend shows a negligible increase of about 0.5 per cent per annum in cropping intensity. During the last 28 years the only thing on which cropping intensity depended in the Punjab was double cropped area. The double cropped area increased three times during the period 1947-48 to 1974-75. It was 1.31 million acres in 1947-48 and reached 3.80 million acres during 1974-75 with the exception of 1972-73 and 1973-74 when it was 5.00 and 5.57 million acres, respectively.

The crop acreage as a percentage of the total cultivated area also showed some fluctuating trend. All the major food and cash crops, except gram, showed increasing trend.

SIND

The results of the econometric analysis revealed that greater availability of water and fertilizer in the province led to an increase in the area of wheat and rice crops and thus helped in increasing the cropping intensity by lowering the volume of current fallow land. In other words with greater availability of water from 13,35,700 cusecs during 1947-48 to 20,46,200 cusecs during 1975-76 and fertilizer use from 37,660 nutrient tons during 1964-65 which rose markedly to 104,260 nutrient tons during 1974-75, an increase of 277 per cent, the farmers are likely to increase the acreage and not the per acre use of such inputs. The cropping intensity in Sind during 1947-48 was only 55.5 per cent which increased to 70.30 per cent during 1975-76. Due to competition for area between wheat and cotton crops during the months of October and November, acreage under both the crops was inversely related to the acreage under cotton, sugarcane and wheat crops, respectively. Bajra and Jowar crops showed high degree of complementarity for each other in terms of area.

NWFP

The fertilizer availability in the present years was effective in determining the land allocation to major crops. In case of maize and tobacco which are cash crops in NWFP, it showed a positive effect, though not very significantly in case of tobacco but very significantly in case of maize crop. On the other side it had a negative effect on sugarcane and wheat crops and this effect was statistically significant.

The water availability was also found effective in determining the land allocation to major crops. In case of maize and tobacco it again showed a positive effect, whereas it showed negative effect on wheat and sugarcane. However, these negative effects cannot be regarded as statistically significant in determining land allocation to these crops.

Prices seem largely ineffective in determining land use allocations. However, it showed that in case of wheat which dominated in area, its absolute price in previous year determined its land allocation positively though not very significantly. In case of sugarcane, its relative prices in the previous year in relation to maize price showed a positive effect but it was statistically non-significant. In case of maize its absolute price in the previous year showed a negative effect on the use of land for major crops. In case of tobacco the absolute price in the previous year was totally insignificant, in determining the land allocation to tobacco crop.

RESEARCH INSTITUTES

NATIONAL AGRICULTURAL RESEARCH CENTRE, ISLAMABAD

The Pakistan Agricultural Research Council has embarked on the establishment of a National Agricultural Research Centre, at Islamabad, particularly to undertake research in selected problem areas of national importance, for which research capability does not exist at the provincial research establishments. The in-house research capability and the basic support for research will be provided to the PARC scientists to undertake research on various crops, livestock, fisheries, range management and forestry. At present the cooperative research programmes on which work is in progress at the Centre include: 1. Wheat, Barley & Triticale; 2. Maize, Sorghum & Millet; 3. Oilseed; 4. Fodder and Forage; 5. Rice; 6. Sugarcane; 7. Legume Pulses. In addition, livestock experiment station has also been established at the Centre and the work on animal breeding and livestock improvement has been undertaken.

The achievements under the above mentioned programmes have been reported under individual commodity programmes in the current report.

PHYSICAL PROGRESS

The first phase of the development work at the Centre has been completed and 250 acres of land out of 1395 acres have been micro-levelled and developed where research work is in progress. Four field sheds in the experimental area have been constructed where implements, other materials and the field staff are located for research work.

Detailed contour survey and survey of the area from the engineering viewpoint, where the main NARC Complex comprising of laboratories, auditorium, library, etc. along with the staff colony and other construction is to be undertaken, has been completed. The completion of the Master Plan is in its final stages. Work on the construction of irrigation and drainage systems and roads is to start soon.

CEREAL DISEASES RESEARCH INSTITUTE

The Cereal Diseases Research Institute is located at the Pakistan Agricultural Research Council, Islamabad with its sub-stations at Murree and Karachi. The Institute conducts research on cereal diseases. The work carried out during the year is summarised as under:--

A. WHEAT

DISEASE SITUATION

The development of stripe and leaf rust remained restricted to 'hot spots' with variable intensities from field to field and variety to variety. Stripe rust was recorded in low intensities in northern foot hill districts of the Punjab and NWFP while it varied in the central plains of Punjab and uplands of Baluchistan. Stem rust development was recorded in low intensities near the maturity of the crop.

i) **Stripe Rust**

It was first recorded on 10th January 1979, from Amankot (Pabbi) on variety Khushal-69. The varieties S.A.75, Chenab-70, Yecora-70, Lyallpur-73, Nuri-70 and imported varieties HD-2009, WL-711 and Pavon were found moderately susceptible to susceptible. Known resistant varieties Blue Silver, Sonalika, PARI-73 and Sandal were found moderately susceptible in low intensities showing break-down in resistance.

ii) **Leaf Rust**

This rust was first recorded on 4th February around Rawalpindi, Jhelum and Gujrat on local varieties. Varieties Pak-70, S.A.-75, Chenab-70, Khushal-69 were found susceptible; Lyallpur-73 moderately susceptible while Sandal, Nuri, Yecora, Sonalika and HD-2009 were intermediate. However, the varieties PARI-73, L.U. 26, Pavon and W.L. 711 were found resistant to moderately resistant.

iii) **Stem Rust**

Varieties C-271, C-273, C-591, Dirk, Sandal, Yecora, HD-2009 and W.L. 711 were found susceptible.

iv) **Loose Smut**

Imported varieties Pavon, Sonalika, HD-2009 and W.L. 711 developed traces to 3 per cent infection at various locations. At Attock and Mingora, its incidence was alarming on varieties C-591 and Mexi-Pak with 10 and 7 per cent infection, respectively.

v) **Flag Smut**

Flag smut was recorded in traces on varieties Chenab-70, Sandal, Nuri-70, S.A.-75, Arz, Sonalika, HD-2009, Mexi Pak, L.U.-26 and Pavon in the rain-fed areas of Punjab and NWFP. However, on Lyallpur-73 upto 2 per cent incidence was recorded at Attock.

vi) Complete Bunt

Complete bunt was recorded in traces on locally cultivated wheat in the uplands of Baluchistan and Swat valley but near Shergarh upto 2 per cent incidence was recorded on Arz.

vii) Powdery Mildew

Moderate to heavy infection of powdery mildew was recorded in the northern foot hill areas of Punjab and NWFP. Most of the varieties were found moderately susceptible to susceptible except Lyallpur -73 which was intermediate.

SAMPLE COLLECTION

A total of 529 samples were collected from 243 localities of 84 varieties.

RUSTINOCULUM COLLECTION, PRESERVATION AND SUPPLY

Five hundred and eightythree grams of stripe rust inoculum were collected during 1978, out of this 200 grams were supplied to breeding centres at Tarnab, Faisalabad and Kaghan. Likewise 439 grams of leaf and Stem rust inoculum were collected during 1978. Out of this 260 grams was supplied to all breeding centres for creation of artificial rust epidemics.

One hundred and twentysix grams of stripe rust and 559 grams of leaf and stem rust inoculum was collected during 1979.

RACE ANALYSIS

One hundred and fifteen samples of leaf rust were analysed during summer 1978 to determine the physiologic races in the rust pathogen populations prevalent in the country. Physiologic races 77,57, 149 and 12 were identified in order of their frequencies. Like-wise analysis of 59 isolates of stem rust indicated the presence of races 40, 17, 21, 15, 34, 117 and 11 in order of their frequency.

VARIETAL SCREENING

i) Seedling

A total of 59 entries including elite lines from CIMMYT, Mexico and NUWYT material were tested against the mixture of stripe, leaf and stem rust races. Out of these 39 were resistant to stripe rust, 42 to leaf rust and 46 to stem rust, respectively, and 32 varieties/lines were resistant to all the three rusts. Similarly, screening of breeders material comprising 502 entries

showed that 360 varieties/lines were resistant to stripe rust. In addition 439 varieties/lines from breeders were screened against leaf and stem rust. Out of these 287 and 343 were found resistant to leaf and stem rust respectively.

ii) Adult

(a) Breeding material comprising 891 varieties/lines was screened against three rusts at Islamabad and Karachi. Out of these, 493 entries were resistant to stripe, leaf and stem rust.

(b) In the National Wheat Disease Screening Nursery, 526 varieties/lines were screened against the three rusts, flag smut, complete bunt and powdery mildew.

(c) A total of 5100 varieties/lines in the regional nurseries (Bread wheat, durum, triticales and barley) from ICARDA were screened at five locations against the three rusts. Of these, 578 entries were resistant to the three rusts.

At the NARC, Islamabad 1671 varieties/lines in international nurseries from CIMMYT/ICARDA/USDA, planted by the Coordinator (wheat) were screened against stripe and leaf rust. Out of these 1321 and 1193 entries were found resistant to stripe and leaf rust, respectively.

SUMMER NURSERY, KAGHAN

Breeders material and Regional trap Nursery from ICARDA totalling 870 varieties/lines were planted during fall 1978 for screening against rusts and powdery mildew at summer Nursery, Kaghan. In addition, 878 varieties/lines have been planted in June, 1979 for screening against rusts, smuts, mildew, leaf spot and head scab.

WHEAT RUSTS EPIDEMIOLOGY TRAP PLOTS

The wheat rust trap plots measuring 100 sqm. were planted at 39 locations through-out the country at district level to monitor the first natural appearance of three rusts. Data analysed indicated that leaf rust appeared as early as 4th February, 1979, in Punjab and 13th February in Sind. However, stripe rust was recorded first on farmer field in NWFP on 10th January in 1979. These preliminary results have their value in formulating future guidelines for rust epidemiological studies in Pakistan.

B. SORGHUM

VARIETAL SCREENING

Forty six varieties/lines from different breeding centres were screened 61

at six locations against foliar and ear diseases. Twentyone varieties/lines were found resistant against foliar diseases like red leaf spot, leaf blight, rough leaf spot and chainspot disease

From 48 entries tested against grain smut at Karachi, Bahawalpur and D.I.Khan, 21 varieties/lines were resistant. Similarly at Dadu, 38 varieties/lines out of 48 were found resistant to long smut.

C. MAIZE

VARIETAL SCREENING

A maize screening nursery against leaf blights (*H. maydis* and *Alternaria*) comprising 18 entries was planted at six locations in Sind, Punjab and NWFP. Of these, 5 and 15 were found resistant to moderately resistant against the two blights, respectively.

D. PEARL MILLET

A total of 18 varieties/lines were screened against leaf spots at 6 locations. Out of these 13 were found moderately resistant while 5 were moderately susceptible.

ARID ZONE RESEARCH INSTITUTE, QUETTA

Arid Zone Research Institute of the Pakistan Agricultural Research Council, is conducting research on crops, forages and grasses on a national basis to increase their yield under arid conditions. In additions, research on livestock production and development of range lands has also been initiated. The Institute has been established with its headquarters at Quetta, (Baluchistan) and three sub-stations at Bahawalpur, D.I. Khan and Umarmkot. Physical progress and research achievements are summarised below:—

PHYSICAL PROGRESS

Fifty acres of land have been developed into a research farm at the main Institute at Quetta. The ground floor of the Laboratories and Administration block and plant physiology laboratory have been completed. The land and water use division laboratories have been equipped and are operational. Similarly, 120 acres and 100 acres of land have been developed into a research farm at D.I. Khan and Bahawalpur sub-stations, respectively. At Umarmkot 200 acres have been recently acquired.

RESEARCH ACTIVITY

Wheat Production

(1) W.B-8, (2) B-189, (3) 4293, (4) 141, (5) Barani 70 and (6) Local White by sowing at 5 cm and 10 cm depth was undertaken under arid conditions. W.B-8 performed better at 10 cm depth in water stress conditions by giving higher yield than the rest of the varieties.

At D.I. Khan seven varieties of wheat including Lyallpur-73, Najah, SA-75, Inia, Arz, Chenab-70 and Sannain were tested for their yield performance. Maximum yield of 22 maund per acre was obtained from Lyallpur-73; followed by the varieties Najah and Arz which yielded 20 maunds per acre.

Forage Production

Comparative studies on the forage production of important perennial grasses including Buffel and Rhodes showed that Buffel grass survived for three months more under arid conditions in comparison to the other grasses.

Legumes

The Tall Fescue and Master phalloris performed better than other legumes in the trial.

Local Grasses and Herbs

Comparative study of local grasses and herbs on un-consolidated deposits caused by erosion on barren lands was carried out. Kaj (Crysopogen archri) and Hadden (Stipa pennata) survived on these lands and were also found capable of checking erosional soil losses.

Castor

In a varietal trial conducted with Hybrid 72, Baker Hybrid 415, Lynn dwarf and CS 30 tall, it was observed that Hybrid 415 gave higher yield by 2 maunds per acre over the other varieties in natural precipitation in Quetta imate.

Zeera (Cumin)

Zeera is an important crop in the economy of Baluchistan farmer. Presently, the white species is being grown and the black species which is more costly and in greater demand does not grow successfully. Experiments were initiated last year and it is gratifying to mention here that black zeera can be successfully grown under arid conditions in the Quetta valley through the adoption of improved production technology. Among the varieties tested Olic lead gave about one maund higher yield than the rest of the varieties. Under arid conditions this variety gave 2½ mds per acre in Quetta climate.

Safflower

Safflower was tried both at Quetta and Bahawalpur. At Quetta, the variety 63

Gilla yielded about 8 maunds per acre, while at Bahawalpur a yield of 10 maunds per acre was obtained.

Live Herbarium

Plant material including crops and grasses belonging to different species has been collected from different ecological regions of Baluchistan for maintenance in the live herbarium at the Farm. An area of 10 acres has been earmarked for this purpose.

AGRICULTURAL ENGINEERING

IRRI-PAK AGRICULTURAL MACHINERY PROGRAMME

The project is in operation since 1976, in collaboration with the International Rice Research Institute, Los Banos, Philippines.

IRRI-PAK STANDARD & MINI AXIAL FLOW THRESHERS

Both the standard and mini axial flow threshers were demonstrated at farmers fields in most of the area of Punjab and NWFP on wheat, soyabean and paddy crops. The design of the standard axial flow thresher was finalized and drawings were prepared. The design of mini thresher has been finalized and drawings are being prepared.

Since most of the agricultural machinery manufacturing firms have difficulty in accurately fabricating machines from drawings, much time was spent by the Programme staff in assisting the cooperating manufacturers in fabricating and improving their machines. A total of 20 standard threshers and 2 mini threshers were fabricated by our cooperating manufacturers.

The design of portable thresher has been prepared and prototype unit is being tested on wheat crop.

KOREAN PADDY TRANSPLANTER

Efforts were made for improving the performance of the power operated Korean paddy transplanters under a cooperative research project. The modified Korean paddy transplanter was demonstrated on large scale at 48 different locations in the Punjab. During these demonstration trials, it was found that 3 men were required to operate the machine and an average of 12 man/hour/acre were required for the transplanting operations. Field data is being collected from the cooperating farmers to evaluate the effect of mechanical transplanting on paddy fields.

LOW COST SEEDER

A simple seed metering mechanism was developed with no moving parts. A low-cost Seeder is now being developed for mounting on a three tyne bullock drawn cultivator.

PTO THRESHER

Work is underway on the development of a tractor PTO driven axial flow

thresher. This new thresher is being developed for threshing wheat and paddy varieties popularly grown in Pakistan. This PTO thresher has an axial flow threshing drum like the other IRRI threshers, however, it has a screen and air aspiration system for grain separation and cleaning. The design is rather simple and compact. It is being developed for a 1.5 to 2 ton per hour threshing capacity. The prototype unit was tried on Basmati paddy at Mardan.

FOUR WHEEL THAI TRACTOR

A simple 4-wheel tractor was imported from Thailand. This is a simple tractor which is locally produced in Thailand by many small metal working shops. It has a 16 hp. diesel engine. Power is transmitted from the engine to the transmission box with a triple V-belt and an idler clutch arrangement. The transmission box has a combination of automotive truck gears and chain sprockets which are generally available in most developing countries. The tractor has a tool bar with a simple mechanical lift for hitching implements. Appropriate implements are now being developed for this tractor to suit local farming requirements.

NIAM

Efforts were continued in improving the organization and the capabilities of the Agricultural Engineering Cell of PARC. A project was prepared for the establishment of the National Institute of Agricultural Mechanization (NIAM) at Islamabad.

RESEARCH INFORMATION

Pakistan Agricultural Research Council is in the process of developing a Division of Research Information to cater for information needs of the scientists in the country working in the fields of agriculture: crops, animal husbandry, fisheries and forestry. A Documentation Centre is already in operation and is the liaison centre for the FAO International Information System for Agricultural Sciences and Technology (AGRIS). Under this system the documentation centre is regularly supplying in-put of literature generated in the country for inclusion in the international AGRIS bibliography — AGRINDEX. Recently, the bibliographies on magnetic tapes have been obtained from FAO and are being de-coded on hardware available with the Pakistan Computer Bureau, Islamabad. After de-coding, the centre will undertake Selective Dissemination of Information (S.D.I.) service and would be regularly despatching the bibliographic material matching the interests of individual scientists to keep them abreast of the latest developments in the world. The centre is also meeting the bibliographic demands under AGRIS received from various liaison centres in different countries.

Compilation of the Directory of Current Research Projects in Agriculture was initiated last year in collaboration with the National Science Council of Pakistan. This directory has already been published.

The centre also under-takes work relating to publications of PARC including publication of scientific and popular journals, news-letter, proceedings of the seminars, symposia and conferences, leaf-lets and bulletins on various subjects of agriculture. Research journal entitled 'Agriculture Pakistan' (re-named as the Pakistan Journal of Agricultural Research) is regularly being brought out. A specimen issue of a popular journal of PARC 'Progressive Farming' has also been published and arrangements are in hand to make it a regular publication. In addition, a popular journal in Urdu will be also brought out.

A new activity introduced during the year under review relates to out-reach services. Although, agricultural extension is a provincial subject but a sound coordination and streamlining of this service for meeting out-reach requirement on national level has been planned. In this connection, Radio and T.V. programmes have been initiated alongwith the publication and distribution of extension bulletins among the farming community. A Central Coordination Committee for Farm Broadcasting headed by the Chairman, PARC has been formed. Radio Farm Programmes are currently being broadcast daily from seven radio stations in Pakistan. A large number of slogans on various aspects of wheat growing were released by PARC to all

Radio and T.V. stations. It has also been decided to publish selected talks broadcast from various radio stations on crop-wise basis. Similar action is being taken in respect of rice, maize, oilseeds and other crops.

SEMINARS, CONFERENCES AND MEETINGS

A. SEMINARS AND CONFERENCES

1. *Wheat* Research and Production Seminar, Islamabad, August 12–13, 1978.
2. *Rice* Research and Production Seminar, Islamabad, January 15–16, 1979.
3. Workshop on *Maize, Millet and Sorghum*, Pirsabak (Nowshera), April 10–12, 1979.
4. Seminar on *Potato* Post-harvest Technology, Islamabad, October 1–7, 1978.
5. Conference on *Potato* Research, Tarnab (Peshawar), March 13–14, 1979.
6. Workshop on *Soil Fertility and Fertilizers' Use*, Islamabad, January 27–28, 1979.

B. MEETINGS

PLANT SCIENCES

1. **Wheat**
 - i. Meeting on Measures for increasing wheat production, Islamabad, January 7, 1979.
 - ii. Wheat breeders meeting for varietal zoning, Islamabad, May 16, 1979.
2. **Maize & Millet**
 - i. Meeting to review and plan the research programme on maize, millet sorghum, Islamabad, November 15, 1978.
 - ii. Meeting of the specialists on maize, millet and Sorghum, Islamabad, January 15–16, 1979.
3. **Oilseeds**
 - i. Annual review meeting of cooperating scientists on cooperative research programme on oilseed crops, Islamabad, February 14–15, 1979.

4. Fodder and Forage
 - i. Meeting of the provincial fodder and forage cooperating scientists, Islamabad, February 26, 1979.

5. Honeybee/Plant Protection
 - i. Meeting of the provincial and federal staff to discuss honeybee production, Islamabad, October 1978.
 - ii. Meeting of the provincial and federal staff to discuss honeybee production, Islamabad, January 1979.
 - iii. Meeting of the specialists to discuss sugarcane pest control. Islamabad, April 18, 1979.
 - iv. Meeting of the technical committee to discuss progress report and new schemes of Cess Fund/PL-480 Projects Islamabad, April 23, 1979.

6. Vegetable Crops
 - i. Meeting of the horticulturists, Islamabad, November 29, 1978.
 - ii. Meeting of the sugarcane subject specialists, Islamabad, July 26, 1978.

7. Soil & Irrigation
 - i. Meeting of Principal Investigators of two newly sanctioned projects i) Micro-nutrient Status of Pakistani Soils and ii) Improvement of Soil Productivity Through the use of Organic Matter, Islamabad, Sept. 23-24, 1978.
 - ii. Meeting on Water Management Research, Islamabad, November 7, 1978.
 - iii. Meeting of Water Users Association, Islamabad November 26, 1978.
 - iv. Meeting of Water Users Association, Islamabad, December 13-14, 1978.
 - v. Annual Meeting of Soil & Irrigation Technical Committee, Islamabad, January 29-30, 1979.
 - vi. Meeting of Sub-Technical Committee on development of standards and specifications regarding proper management at farm level,

Lahore, March 14--15, 1979.

- vii. Meeting of Sub-Technical Committee to develop coordinated research programme on salinity and fertilizers, Islamabad, March 28, 1979.
- viii. Meeting of Principal Investigators of Coordinated Research Project on Micro-nutrients, Islamabad, May 2, 1979.
- ix. Meeting of Principal Investigators of Coordinated Research Project on Soil Productivity Through Biological Control, Islamabad, May 3, 1979.

ANIMAL SCIENCES

- i. Meeting of Technical Committee on Fisheries, Islamabad, March 12, 1979.
- ii. Meeting of the Technical Committee on Animal Health and Production, Karachi, October 7-8, 1978.
- iii. Meeting on Dairy Cattle Cross-breeding project, Karachi, May 15, 1979.

SOCIAL SCIENCES

- i. Meeting of the expert group on Marketing of farm Product, Islamabad, January 21-23, 1979.
- ii. Meeting of Executive Sub-committee on Agricultural Economics, Islamabad, January 24, 1979.
- iii. Meeting of Project leaders for cropping pattern project, Islamabad, January 25-26, 1979.
- iv. Meeting of Technical Committee on Agricultural Economics, Islamabad, May 26-27, 1979.
- v. Meeting of expert group on statistics, Islamabad, June, 25-26, 1979.

MISCELLANEOUS

- i. Meeting of Technical Committee on Agricultural Policy Study Cell, Islamabad, January 24, 1979.
- ii. Meeting on the Control of Wild Boars, Islamabad, November 29, 1978.

- iii. Meeting on Agro-ecological system, Islamabad, December 13, 1978.
- iv. Meeting of sub-committee on agro-ecological zones, Islamabad, January 17, 1979.
- v. Meeting on farm broadcasting, Islamabad, December 18, 1978.

SCIENTIFIC PERSONNEL

<u>S.No.</u>	<u>Name</u>	<u>Designation</u>	<u>Pay Scale</u>
1.	Dr. Amir Muhammed	Chairman	22
PLANT SCIENCES			
2.	Dr. C.M. Anwar Khan	Officer on special Duty	20
3.	Dr. Baz Mohammad Khan	Director of Research(Soil & Irrig.)	19
4.	Dr. Mohammad Tahir	Principal Research Officer	19
5.	Dr. Noor Ullah	Coordinator (Wheat)	19
6.	Dr. Mohammad Akbar	Coordinator (Rice)	19
7.	Dr. M. Qasim Chatha	Coordinator (Maize)	19
8.	Syed Mahfooz Ali Shah	Coordinator (Potato)	19
9.	Dr. Abdur Rehman Khan	Coordinator (Oilseed)	19
10.	Dr. Zahur Alam	Coordinator (Vegetable)	19
11.	Mr. Afzal Husain Qureshi	Coordinator (Fodder & Forages)	19
12.	Dr. Rafiq Ahmed	Coordinator (Honeybee)	19
13.	Dr. M.N. Beg	Director (Pest Management Project)	19
14.	Ch. Zafaruddin	Dy. Director of Research (Range Management & Forestry)	18
15.	Dr. N.I. Hashmi	Geneticist	19
16.	Dr. A.A. Basit	Sr. Plant Pathologist	18
17.	Mr. Mohammad Ashraf	Senior Production Agronomist	18
18.	Mr. Rashid Ahmed Shad	Production Agronomist	18
19.	Mr. M. Sharif Zia	Production Agronomist	18
20.	Mr. Ghulam Hussain	Production Agronomist	18
21.	Mr. Saeed Ahmed	Production Agronomist	18
22.	Mr. Mohammad Munsif	Production Agronomist	18
23.	Mr. Ghulam Mustafa Avesi	Production Agronomist	18
24.	Mr. Abdul Ahad Qureshi	Production Agronomist	18
25.	Mr. Abdul Razzaq Saleemi	Production Agronomist	18
26.	Mr. Badruddin Abro	Production Agronomist	18
27.	Mr. Abdul Shakoor	Senior Research Officer	18
28.	Mr. Rashid Anwar	Plant Breeder	18
29.	Mr. Bakht Roidar Khan	Agronomist	18
30.	Mr. Nasir Alam Khan	Economist-cum-Statistician	18
31.	Mr. M. Banaras Bhatti	Senior Research Officer	18
32.	Dr. Salahuddin Sulaiman	Oilseed Technologist	18
33.	Qazi Tauqir Azam	Agricultural Economist	18
34.	Mr. Naazar Ali	Senior Research Officer	18
35.	Mr. Mohammad Sharif	Oilseed Agronomist	18
36.	Mr. Mohammad Aslam	Oilseed Agronomist	18
37.	Mr. M. Salim	Entomologist	18
38.	Mrs. Kausar Perveen	Agricultural Economist	18
39.	Mr. Shaukat Khan	Assistant Coordinator	18

<u>S.No.</u>	<u>Name</u>	<u>Designation</u>	<u>Pay Scale</u>
40.	Mr. M. Afzal Akhtar	Plant Pathologist	17
41.	Mr. Shamsuddin Soomro	Research Officer	17
42.	Mr. Habib-ur-Rehman	Research Officer	17
43.	Mr. Masood Amjad Rana	Research Officer	17
44.	Mr. Abdul Majid	Assistant Agronomist	17
45.	Mr. Shahryar Khan	Research Officer	17
46.	Mr. Abdul Qayyum Malik	Assistant Entomologist	17
47.	Miss Elazabeth Camphor	Assistant Entomologist	17
48.	Mr. M. Irshad	Assistant Entomologist	17
49.	Mr. Rafiq Masih	Assistant Entomologist	17
50.	Mr. Ali Mardan Khan	Asstt. Plant Pathologist	17
51.	Mr. S.A. Masud	Assistant Entomologist	17
52.	Mr. M. Siddiq Mirza	Assistant Plant Pathologist	17
53.	Mr. Ahmad Ali Hakro	Assistant Plant Pathologist	17
54.	Mr. Yar Mohammad Memon	Asstt. Director of Research (S&I)	17

ANIMAL SCIENCES

55.	Dr. Haleem-ul-Hasnain	Member	20
56.	Mr. M. Rafiq Raja	Director (L.E.S.)	19
57.	Mr. Imtiaz A. Qureshi	Senior Research Officer (Nutrition)	18
58.	Mr. M. Iqbal Barula	Farm Superintendent	18
59.	Mr. Mukhtar Ahmed Naqvi	Asstt. Director of Research(A.H.)	17

SOCIAL SCIENCES

60.	Mr. M. Toaha Qureshi	Director of Research (Agri. Eco.)	19
61.	Mr. Sakhi Mohammad	Dy. Director of Research(AE)	18
62.	Mr. Abdul Ghani Channa	Asstt. Director of Research(AE)	17
63.	Mr. Tazeem-ur-Rehman	Assistant Director	17

RESEARCH INSTITUTES & UNITS

64.	Dr. Mohammad Sharif	Director, National Agricultural Research Centre, Islamabad.	19	
65.	Mr. G.H. Siddiqi	Superintending Engineer	19	
66.	Dr. S.F. Hasan	Director, Cereals Diseases Research Institute, Islamabad	19	
67.	Syed Salahuddin Ahmad	Director, Arid Zone Research Institute, Quetta	19	
68.	Mr. Bashir Ahmed Malik	Dy. Director of Research	18	
69.	Mr. M.A.S. Kirmani	Senior Research Officer, (CDRI)	18	
70.	Dr. Hafeez Ahmed	Radio Entomologist	18	
71.	Mr. M.M.H. Baig	Senior Chemist	18	
72.	Dr. M. Allah Dad Khan	Entomologist	18	
73.	Mr. K.N. Babar	Deputy Director (AZRI)	18	
74.	Mr. Rafiq Zaheer	Deputy Director (")	18	
75.	Mr. S. Hasan Raza	Deputy Director (")	18	
76.	Mian Mohammad Shafi	Project Director (VPCC)	18	
77.	Mr. Abdul Samad Khan	Assistant Director of Research	17	
78.	Mr. Amir Nawaz Khan	Assistant Director of Research	17	
79.	Mr. Liaquat Husain	Assistant Director (Procurement)	17	
74	80.	Mrs. Shahzaman Yousuf	Entomologist	17

<u>S.No.</u>	<u>Name</u>	<u>Designation</u>	<u>Pay Scale</u>
81.	Mr. Ali Hussain Siddiqi	Deputy Entomologist	17
82.	Dr. Zafar Mahmood	Chemist	17
83.	Mr. Jamil Usmani	Chemist	17
84.	Mr. Munawar Hussain	Plant Pathologist(CDRI)	17
85.	Mr. S.A. Rizvi	Plant Pathologist(CDRI)	17
86.	Mr. S.A. Jamil Khan	Plant Pathologist(CDRI)	17
87.	Mr. Mohammad Naycemullah	Plant Pathologist(CDRI)	17
88.	Mr. Lal Khan	Plant Pathologist (CDRI)	17
89.	Dr. A.K. Khanzada	Plant Pathologist (CDRI)	17
90.	Mr. M. Asghar	Range Management Officer	17
91.	Mr. A. Aziz Khan	Vertebrate Pest Control Officer	17
92.	Mr. A. Rauf Khokhar	Vertebrate Pest Control Officer	17
93.	Mrs. Ismat Perveen	Vertebrate Pest Control Officer	17

FINANCE DIVISION

94.	Mian Mumtaz Abdullah	Member (Finance)	20
95.	Mr. M.R. Qureshi	Deputy Director (Finance)	18
96.	Mr. Sher Mohammad	Accounts Officer	17
97.	Mr. Bashir Ahmed	Accounts Officer	17
98.	Mr. Javed Ahmed	Accounts Officer	17

DIRECTORATE OF RESEARCH COORDINATION

99.	Mr. M. Ikramul Huque	Director (Research Coordination)	20
100.	Miss Shahida Akhtar	Assistant Director (Coordination)	17
101.	Mr. S. Wasi A. Maulai	Assistant Secretary	17

DIRECTORATE OF RESEARCH INFORMATION

102.	Malik Mushtaq Ahmed	Senior Documentation Officer	18
103.	Mr. Azmat Ali Siddiqi	Dy. Director (Lib. & Publications)	18
104.	Mr. Shafiq Ahmed	Reprographic Officer	17

AGRICULTURAL ENGINEERING

105.	Mr. Abdul Shakoor Khan	Deputy Agricultural Engineer	18
106.	Mr. Javed Akhtar	Deputy Agricultural Engineer	18
107.	Sahibzada Anwar Ahmad	Assistant Agricultural Engineer	17
108.	Kazi Munawar Ali	Assistant Agricultural Engineer	17
109.	Mr. Arshad Pervajz	Assistant Agricultural Engineer	17

SECRETARIATE

110.	Mr. M. Amjad Virk	Secretary	18
111.	Mr. M.A.H. Rizvi	Deputy Secretary (Admn.)	18
112.	Mr. Mohammad Yasin	Assistant Secretary	17
113.	Mr. S.N. Ghani	Assistant Secretary	17

TRAINING SPONSORED BY PARC

<u>S.No.</u>	<u>Name and Designation</u>	<u>Field of Training</u>	<u>Date of Departure</u>	<u>Institution and Country of Study</u>
1.	Mr. Abdul Wadud, Assistant Agronomist, Agri. Res. Inst. Tarnab.	Maize Agronomy (Ph.D)	14th May, 1979	University of Kentucky, U.S.A.
2.	Mr. Abdul Sattar, Agricultural Research Officer, Punjab Agri. Res. Inst. Faisalabad	Wheat Breeding (Ph.D)	27th April, 1979	University of Nebraska, U.S.A.
3.	Mr. Abdul Majid Assistant Agronomist, Pakistan Agri. Res. Council, Islamabad	Crop Agronomy (Ph.D)	3rd February 1979	Lincoln College, New Zealand
4.	Mr. Ghulam Mustafa Avesi, Production Agronomist, Pakistan Agri. Res. Council Islamabad	Rice Technology— Breeding (Ph.D)	2nd November, 1978	Philippines University, Philippines
5.	Mr. Mohammad Aqil Khan, Assistant Botanist (Wheat) Punjab Agri. Res. Inst. Faisalabad	Plant Breeding Wheat (M.Sc.)	29th December, 1978	Montana State University, U.S.A.
6.	Mr. Habib-ur-Rahman, Agriculture Engineer, Rice Res. Inst. Kala Shah Kaku	Agricultural Engineering (M.Sc.)	20th June, 1979	Philippines University, Philippines
7.	Mr. Abdul Shakoor, Senior Research Officer, Pakistan Agri. Res. Council, Islamabad	Fodder Research (M.Sc.)	6th January, 1979	Colorado State University U.S.A.
8.	Mr. Mohammad Ashfaq, Reader in Forestry, Pakistan Forest Institute, Peshawar	Range Management, (Short course)	26th May, 1979	CIMMYT, Mexico
9.	Mr. A.R.Khokher, Assistant Vertebrate Pest Control, Officer, PARC, Karachi	Zoology—Rodent Ecology (Short Course)	15th January, 1979	Philippines

- | | | | | |
|-----|--|-----------------------------------|--------------------|---|
| 10. | Mr. Mohammad Rafi,
Research Officer,
Punjab Agri. Res. Inst.
Faisalabad | Wheat Agronomy,
(Short course) | 13th April, 1979 | CIMMYT, Mexico |
| 11. | Mr. Mohammad Hashim Khan,
Assistant Agronomist(Rice)
Agri. Department,
Peshawar | Rice Production
(Short course) | 3rd February, 1979 | International Rice
Res. Inst. Manila,
Philippines |
| 12. | Mr. Fazal Elahi,
Rice Botanist,
Agri. Department,
Peshawar | -do- | -do- | do- |

ANNUAL BUDGET 1978-79

The Pakistan Agricultural Research Council derives its income from the levy of cess collected under the following four acts:-

Agriculture Produce Cess Act 1940.
Oilseed Committee Act, 1946.
Coconut Committee Act, 1944.
Lac Cess Act, 1930.

The major portion of income of the Council comes from the cesses levied under the Agricultural Produce Cess Act 1940. Negligible income was received from cess levied under the Oilseed Committee Act, 1946. No income was received during the year under report from oilseed Cess because collection arrangements were withdrawn by the Central Board of Revenue. However, the arrear accumulated for the past few years with the Accountant General, Sind was received during 1978-79. No income was received under the other two acts.

CESS FUND

Under Cess Fund the cash balance as on 1st July, 1978 was Rs. 92,38,600/-. Actual receipts during the year 1978-79 under Cess Fund amounted to Rs. 90,57,800/- which were added to the balance of the preceding year. Thus the total receipts rose to Rs. 1,82,96,400/-. From this fund a sum of Rs. 48,32,900/- was incurred during 1978-79 on various research projects in the field of Agriculture, Forestry, Plant Protection, Soil and Irrigation, Animal Husbandry and Fisheries, executed by various agencies including Federal and Provincial Governments. In addition to the expenditure under regular head of Cess Fund such as payment of salary of research staff, T.A. to non-official members, entertainment, expenditure on meeting and leave salary and pension contribution, etc. A sum of Rs. 1,34,63,500/- was left as balance as on 1st July 1979.

US-AID FUND

In the agreement executed between USAID authorities and the Government of Pakistan the USAID authorities provided funds during the year 1971-72 and 1972-73 amounting to Rs. 31,39,000/- and 26,00,000/-, respectively. Against the above grants a sum of Rs. 27,70,000/- was available on 1st July, 1978 which was utilized during the year 1978-79.

3. FORD FOUNDATION FUND

In term of an agreement with Ford Foundation authorities it was agreed to provide fund to Pakistan Agricultural Research Council for Research on Rice, Wheat, Maize and Training, etc. Actual cash balance against this grant as on 1.7.78 was Rs.7,04,800/-. Against this amount the expenditure of Rs. 3,88,800/- was incurred during the period under report leaving with us a balance of Rs. 3,16,000/- as on 1.7.1979.

4. USDA FUND FOR PL-480 PROJECT

During the year 1978-79 a sum of Rs. 1,70,62,900/- was received from the USDA authorities for on-going projects under Federal, Provincial Government, Universities and various Institutions, etc. According to the existing procedure whatever amount is received from USDA, is required to be placed at the disposal of the respective Government/Institutions, etc. and this was done.

5. DOCUMENTATION CENTRE

As per agreement the USAID authorities provided Rs. 10,00,000/- as grant for Documentation Centre of Pakistan Agricultural Research Council during 1976 - 77. Against this grant a balance of Rs. 9,61,500/- was available as on 1.7.1978. During the year 1978-79 an expenditure of Rs. 2,28,200/- was incurred leaving a balance of Rs. 7,33,300/- as on 1.7.1979.

The details of income and expenditure for 1978-79 is given as under:-

<u>INCOME</u>		<u>EXPENDITURE</u>	
Actual Cash balance as on 1.7.1978 (cess)	92,38,600	Actual expenditure under Cess Fund during 1978-79	48,32,900
Actual income under Cess Fund 1978-79.	90,57,800	Actual expenditure under USAID during 1978-79	27,70,000
Cash under USAID	27,70,000	Actual expenditure under Ford Foundation	3,88,800
Cash balance under Ford Foundation	7,04,800	Actual expenditure during 1978-79 under USDA	1,70,62,900
Cash fund received under Ford Foundation during 1978-79	—		
Fund received under USDA during 1978-79	1,70,62,900		

Documentation Centre balance 1.7.78	9,61,500	Actual expenditure under Documentation Centre upto 30.6.79	2,28,200
	3,97,95,600		
Total:			
INCOME		EXPENDITURE	
B/F	3,97,95,600	B/F	2,52,82,800
		Balance as on 1.7.79	
		Cess Fund	1,34,63,500
		USAID Fund	—
		Ford Foundation	3,16,000
		USDA Fund	—
		Documentation Centre	7,33,300
	3,97,95,600		3,97,95,600
Total:			

In addition to the above Pakistan Agricultural Research Council received the following allocations for the year 1978–79 from the Government out of General Revenues for different development and non-development research programmes which include the Main Secretariat of the Pakistan Agricultural Research Council and its Research Units.

NON-DEVELOPMENT	1978--79
1. Pakistan Agricultural Research Council (Main)	16,55,200
2. Research Scheme of Pakistan Agricultural Research Council.	20,95,800
3. ADERI (Livestock Division of Pakistan Agricultural Research Council).	13,32,600
	50,83,600
Total (a)	
DEVELOPMENT	
1. Arid Zone Research Institute	33,80,000
2. Jute Programme	6,60,000
3. Tea Programme	60,000
4. Vertebrate Pest Control Centre	28,00,000
5. Strengthening of Agricultural Research Capabilities.	2,87,00,000
6. Exploration of Plant Genetic Resources	50,000
7. Viral	90,000
	3,57,40,000
Total (b)	
	4,08,23,600
Total (a) and (b)	

PUBLICATIONS

A. PERIODIC PUBLICATIONS

- 1) 'Agriculture Pakistan' quarterly Research Journal (English)
- 2) 'Progressive Farming' quarterly Popular Journal (English)
- 3) 'PARC News' monthly bulletin (English)
- 4) Annual Report of PARC

B. GENERAL PUBLICATIONS

- 1) Wheat Production in Pakistan (Keynote Address) by Dr. Amir Muhammed, Chairman, PARC. pp. 19.
- 2) Wheat Production Manual pp. 179.
- 3) Activities and Achievements of Agricultural Research Council of Pakistan. pp. 74.
- 4) Position paper on Oilseeds in Pakistan. pp. 10.
- 5) Position paper on Gram in Pakistan. pp. 10.
- 6) Potato Research in Pakistan. pp. 63.
- 7) Wheat Production—Recommendations for 1978-79. pp. 16 (Urdu)
- 8) Maize Production—Recommendations for 1979. pp. 11 (Urdu)
- 9) Rice Production—Recommendations for 1979. pp. 12 (Urdu)
- 10) First All-Pakistan Farmers Conference. pp. 27 (Urdu)
- 11) Sunflower Production in Barani Areas. pp. 20 (Urdu)

LIST OF PL -480 AND CESS FUND PROJECT

S.No.	Project	Duration	Principal Investigator and Performing Institution
PL-480			
CROPS			
1.	<i>A survey of occurrence and structure of root-nodules in non-leguminous angiosperms of Pakistan and their ecological and economic significance in reforestation and soil/plant conservation as providers of atmospheric nitrogen.</i>	Jan. 1974 – Dec. 1979	<i>Dr. Ashraf H. Chaudhary, Dept. of Biological Sciences, Quaid-e-Azam Univ., Islamabad</i>
2.	<i>Screening of germplasm of potato species (4n) for adaptation to environmental stresses in Pakistan.</i>	Sep. 1974 – Sep. 1980	<i>S. Mahfooz Ali Shah (Coordinator) Pakistan Agricultural Research Council, Islamabad. Mr. M. Atlas Khan, Quetta; Mr. Hamid Hassan Rizvi, Tandojam; Ch. Altaf Hussain, Faisalabad and Mr. Said Kamal Khan, Tarnab.</i>
3.	<i>Improvement of pome and nut fruits in northern areas of N.W.F.P.</i>	Aug. 1974 – Nov. 1979	<i>Mr. M.S. Roghani, Agricultural Research Inst., Tarnab, Peshawar</i>
4.	<i>Screening of germplasm for bolting resistance, disease and insect resistance and developing improved varieties and their seed production at higher elevations.</i>	Nov. 1974 – Nov. 1979	<i>Dr. Akhtar Baig, Agricultural Research Inst., Tarnab, Peshawar.</i>
5.	<i>Development of varieties of berseem, Persian clover and lucerne for increased production.</i>	Mar. 1975 – Mar. 1980	<i>Dr. M.H. Chaudhry, Ayub Agricultural Research Inst., Faisalabad.</i>
5.	<i>a) Survey of glycoalkaloid content in potato tubers growing in Pakistan and study of environmental factors causing their synthesis. b) Physiological investigations on feeding high glycoalkaloid greenish potatoes to experimental animals.</i>	Oct. 1976 – Sep. 1981	<i>Dr. Raftiq Ahmad, Professor of Botany, Univ. of Karachi, Karachi</i>
7.	<i>Further taxonomic studies of economically important families in the Flora of Pakistan.</i>	June 1976 – May 1981	<i>Prof. Eugene Nasir, National Herbarium, Pakistan Agricultural Research Council, Islamabad.</i>
8.	<i>Brief resume of research on saffron cultivation in N.W.F.P.</i>	June 1976 – June 1981	<i>Mr. Habib ullah Khan, Agricultural Research Inst., Tarnab, Peshawar.</i>
9.	<i>Evaluation of domestic and introduced scion and root-stock cultivar selection for expansion of stone fruits in N.W.F.P.</i>	Aug. 1976 – July 1981	<i>Mr. Habib ullah Khan, Agricultural Research Inst., Tarnab, Peshawar</i>

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| 10. | <i>Research and development of safflower as an alternate oilseed crop.</i> | Aug. 1976 –
Aug. 1981 | Shamshad Akhtar,
Director (Oilseeds) Punjab Agricultural
Research Inst., Faisalabad |
| 11. | <i>Development of early maturing, short statured varieties of rice through the use of induced mutations.</i> | Aug. 1976 –
Aug. 1981 | Mr. Afsar Awan,
Nuclear Inst. for Agriculture and Biology,
Faisalabad. |
| 12. | <i>Improvement of triticale for yield and yield components.</i> | Apr. 1977 –
Apr. 1982 | Dr. A. Shakoar,
Nuclear Inst. for Agriculture and Biology,
Faisalabad. |
| 13. | <i>Screening of germplasm of oleiferous Brassica for resistance to aphids.</i> | Aug. 1977 –
Aug. 1982 | Mr. Nasrullah Chatha,
Nuclear Inst. for Agriculture and Biology,
Faisalabad. |
| 14. | <i>Inter specific transfer of genes from napiergrass (Pennisetum purpureum schum) to bajra (Pennisetum americanum) (L.) R. Schum</i> | June 1977 –
May 1980 | Dr. K.M. Khan,
Sind Univ., Jamshoro.
Dr. M. Aslam Rajput
(Co-Principal Investigator)
Sind Univ., Jamshoro. |
| 15. | <i>Development of erucic acid and glucosinolate free rape seeds (crucifers) in Pakistan.</i> | Sep. 1977 –
Sep. 1982 | Dr. S.A. Khan,
Dr. Pervez Aziz,
(Co-Principal Investigator),
PCSIR Laboratories, Lahore |
| 16. | <i>Development of sugarcane varieties for frost tolerance.</i> | Oct. 1977 –
Oct. 1982 | Mr. Wali Mohammad Khan,
Agricultural Research Inst., Tarnab,
Peshawar. |
| 17. | <i>Cooperative research programme on Guar.</i> | Nov. 1977 –
Nov. 1982 | Dr. M.H. Chaudhry,
Ayub Agricultural Research Inst., Faisalabad |
| 18. | <i>Experimental cultivations of condiments and spice crops.</i> | Jan. 1978 –
Jan. 1983 | Dr. Asghar Jalis,
Ayub Agricultural Research Inst.,
Faisalabad. |
| 19. | <i>Sugarcane breeding with special reference to frost, salt and drought tolerance.</i> | Oct. 1977 –
Oct. 1982 | Mr. Shahabuddin Fasihi,
Ayub Agricultural Research Inst.,
Faisalabad. |
| 20. | <i>Shelf-life extension of citrus fruits by refrigeration and controlled atmosphere storage.</i> | Nov. 1977 –
Nov. 1981 | Mr. Wasim Ahmad Farooqui,
Nuclear Inst. for Agriculture and Biology,
Faisalabad. |

RANGE MANAGEMENT AND FORESTRY

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|----|--|--------------------------|--|
| 1. | <i>Research studies on wild and exotic mushrooms in Pakistan.</i> | Apr. 1975 –
Apr. 1980 | Dr. A.G. Kausar
Professor of Horticulture, Univ. of Agriculture,
Faisalabad. |
| 2. | <i>Selection of suitable poplar clones for large scale poplar plantations in the Punjab.</i> | Jan. 1976 –
Dec. 1980 | Mr. M. Hafeez,
Silvicultural Research Forest Division,
Lahore. |
| 3. | <i>Management study of hybrid poplars.</i> | Sep. 1975 –
Aug. 1980 | Mr. Mahmood Iqbal Sheikh,
Director, Forestry Research Division,
Pakistan Forest Inst., Peshawar. |

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| 4. | <i>Research on cultivation of sisal.</i> | Apr. 1977 –
Apr. 1982 | Mr. M. Hafeez,
Silvicultural Research Forest Division,
Lahore. |
| 5. | <i>Collection of seed from different seed sources and establishment of provenance and trials of Himalayan Blue Pine (Pinus wallichiana A.B. Jacks. syn. Pinus griffithii)</i> | July 1976 –
July 1980 | Dr. K.M. Siddiqui,
Forest Geneticist, Pakistan Forest Inst.,
Peshawar. |
| 6. | <i>Genetic improvement and breeding of three poplar species.</i> | Feb. 1977 –
Feb. 1982 | Dr. K.M. Siddiqui,
Pakistan Forest Institute, Peshawar. |
| 7. | <i>Growth and management of fast growing tree species in Sind.</i> | Nov. 1977 –
Nov. 1982 | Mr. Afaque Mohammad Khan,
Silviculture Research Division, Hyderabad |
| 8. | <i>Effect of fertilizer on the rate of growth of forest trees</i> | May 1978 –
May 1983 | Mr. Muhammad Iqbal Sheikh,
Pakistan Forest Inst., Peshawar. |
| 9. | <i>Effect of natural enemies and silvicultural practices on poplar borer population.</i> | Feb. 1978 –
Feb. 1983 | Mr. M. Ismail Chaudhry,
Pakistan Forest Inst., Peshawar. |
| 10. | <i>To develop techniques for utilizing Arid and semi-arid lands through planting under dry conditions.</i> | Aug. 1978 –
Aug. 1983 | Mr. M. Iqbal Sheikh,
Pakistan Forest Inst., Peshawar. |
| 11. | <i>Utilization of poor quality woods growing in Pakistan for the management of panel products.</i> | Mar. 1979 –
Mar. 1982 | Dr. K.M. Siddiqui,
Pakistan Forest Inst., Peshawar. |
| 12. | <i>Investigation of anatomical, physical and mechanical properties of exotic and indigenous poplars grown in Pakistan.</i> | Mar. 1979 –
Mar. 1982 | Dr. K.M. Siddiqui,
Pakistan Forest Inst., Peshawar. |
| 13. | <i>Stimulation of flow of resin in Pinus roxburghii with chemicals (Extension project)</i> | Feb. 1979 –
Feb. 1983 | Mr. Muhammad Iqbal Sheikh,
Pakistan Forest Inst., Peshawar. |
| 14. | <i>Study of size, placement and composition of wind breaks for optimum production of annual crops and woods.</i> | Mar. 1979 –
Mar. 1984 | Dr. G.M. Khattak,
Pakistan Forest Inst., Peshawar. |
| 15. | <i>Survey and control of mistletoes in Pakistan.</i> | Mar. 1979 –
Mar. 1984 | Mr. Zakauallah,
Pakistan Forest Inst., Peshawar. |

SOIL AND IRRIGATION

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|----|--|--------------------------|---|
| 1. | <i>Management of high bicarbonate irrigation waters.</i> | July 1973 –
Aug. 1980 | Dr. Shah Mohammad,
Dept. of Soil Science, Univ. of Agriculture,
Faisalabad. |
| 2. | <i>Availability status of micro-nutrients in the soils of Pakistan and the role and behaviour of selected micro-nutrients in the nutrition of crops.</i> | July 1973 –
July 1980 | Dr. Muhammad Tahir,
Senior Scientific Officer,
Nuclear Inst. for Agriculture and Biology,
Faisalabad. |
| 3. | <i>Taxonomy of cellulolytic fungi isolated from saline and sodic soils.</i> | July 1974 –
July 1980 | Dr. K.A. Malik,
Nuclear Inst. for Agriculture and Biology,
Faisalabad. |
| 4. | <i>Estimation of consumptive use of water for major crops under optimum management condition for Pakistan.</i> | Jan. 1975 –
Jan. 1980 | Dr. Baz Mohammad Khan, (Coordinator),
Mr. Shahid Ahmad, (Asstt. Coordinator),
Pakistan Agricultural Research Council,
Islamabad. |

Ch. Hayat Mohammad Bhatti, Faisalabad;
 Mr. Abdul Hamid, Tarnab, Peshawar;
 Mr. G.N. Kalwar, Tandojam;
 Dr. Ghulam Haider, Mona; and
 Ch. A Rehman, Lahore.

5. Quantity of water of different qualities to grow successful arable crops keeping healthy salt balance in soil. July 1976 – June 1981
 Ch. Hayat Mohammad Bhatti,
 Ayub Agricultural Research Inst., Faisalabad
6. Development of sugarbeet equipment for small farm holdings in Pakistan and study of consumptive use of water for improvement of sugarbeet. Nov. 1976 – Oct. 1981
 Mr. Arshad Aziz,
 Associate Professor,
 Engineering College, Peshawar.
7. Isolation and identification of effective root nodules bacteria for important grain legumes of Pakistan. June, 1978 – June 1983
 Dr. Altaf Hussain,
 Agricultural Univ., Faisalabad.

HONEY BEE MANAGEMENT

1. Research on honey bee management. July 1976 – Oct. 1979
 Dr. Rafiq Ahmed, (Coordinator),
 Pakistan Agricultural Research Council,
 Islamabad.
 Mr. M.A. Makhdomi,
 Ayub Agricultural Research Inst., Faisalabad.
 Mr. Sharfud-Din Khan,
 Agricultural Research Inst., Tarnab.

PLANT PROTECTION

1. Survey of grasshoppers in arid and semi-arid regions of Pakistan. Sep. 1974 – Mar. 1980
 Mr. Fariduddin Ahmed,
 Dept. of Plant Protection, Jinnah Avenue,
 Malir Halt, Karachi.
2. A revision of leafhopper (Cicadellidae) of Pakistan and adjoining countries of oriental region. June 1974 – May 1980
 Dr. S. Hamid Mahmood,
 Dept. of Zoology, Univ. of Karachi,
 Karachi.
3. Insect enemies attacking tamarisk *Tamarix spp.* in Pakistan. June 1975 – June 1980
 Dr. M.A. Ghani,
 Commonwealth Inst. for Biological Control,
 Rawalpindi.
4. Fungal spoilage of stored wheat, rice, maize and sorghum grains and their products. July 1974 – July 1980
 Mr. Masoud Ahmad Nasir,
 Nuclear Inst. for Agriculture and Biology,
 Faisalabad.
5. A revision of superfamily Membracoidea of Pakistan. Nov. 1974 – Nov. 1979
 Dr. Imtiaz Ahmad,
 Dr. Miss Nighat Yasin,
 (Co-Principal Investigator),
 Dept. of Zoology, Univ. of Karachi, Karachi
6. Pest management studies and research for the development of integrated control programme for major field paddy, maize, cotton and sugarcane crops. Oct. 1974 – Sep. 1979
 Dr. M.N. Baig,
 Pakistan Agricultural Research Council,
 Islamabad.
7. Biology and ecology of principal natural enemies Apr. 1976 –
 Dr. M.A. Ghani,

- of some flies that breed in dung and vegetable refuse in Pakistan. Mar. 1981 Commonwealth Inst. for Biological Control, Islamabad.
8. Investigations on the natural enemies of *Abutilon*, *Amaranthus*, *Rumex*, and *Sorghum* in Pakistan. Sep. 1975 – Sep. 1980 Dr. M.A. Ghani, Commonwealth Inst. for Biological Control, Rawalpindi.
9. Studies on the long term effects of gamma rays on some important pests of store cereals. June 1975 – May 1980 Dr. Hafiz Ahmad, Radio-isotope and Radiation Lab., Plant Protection Research Station, Malir Halt, Karachi.
10. Investigation on the insect enemies of *Chenopodium* species. Mar. 1978 – Mar. 1983 Dr. M.A. Ghani, Commonwealth Inst. for Biological Control, Rawalpindi.
11. Investigations on the biological control of *Rhizoctonia solani* and *Fusarium oxysporum* f. *lini* causing root rot and wilt diseases in cotton and linseed crops, respectively. May 1976 – May 1981 Dr. M. Akhtar, Ayub Agricultural Research Inst., Faisalabad.
12. Investigation on the natural enemies of selected lepidoptercus pests of crucifers and feasibility studies of mass rearing and releases of promising species for the control of these pests. Mar. 1978 – Mar. 1983 Dr. M.A. Ghani, Commonwealth Inst. for Biological Control, Rawalpindi.
13. Studies on the biology, phenology and field behaviour of natural enemies of the pink bollworm *Pectinophora gossypiella* (Saund.) in Pakistan. June 1976 – June 1981 Dr. M.A. Ghani, Commonwealth Inst. for Biological Control, Rawalpindi.
14. Investigations on nematodes parasitic on insect pests. Jan. 1977 – Dec. 1981 Dr. M.A. Ghani, Commonwealth Inst. for Biological Control, Rawalpindi.
15. Melon fruit fly and its control in N.W.F.P. Feb. 1977 – Feb. 1982 Mr. Sharifuddin, Agricultural Research Inst., Tarnab, Peshawar.
16. Insect pests on stored cereal grains and their control in Pakistan. Apr. 1977 – Apr. 1982 Hafiz Abdul Qayyum, Agricultural Univ., Faisalabad.
17. Ecological studies on cereal fruits nematodes of Pakistan. Aug. 1977 – Aug. 1982 Dr. Nazarul Hussain, Dept. of Biochemistry, Univ. of Karachi, Karachi.
18. Studies on the storage stability of pesticides and their residues on crops in Pakistan. July 1978 – July 1983 Mr. M.M.H. Baig, Dept. of Plant Protection, Pakistan Agricultural Research Council, Karachi.
19. Investigation on genetical, pathological and agronomic aspects of improvement of grain legumes in Pakistan. Oct. 1977 – Oct. 1982 Dr. Mohammad Aslam, Univ. of Agriculture, Faisalabad.
20. Studies on the rice insects of Pakistan with reference to their systematics and pheromone glands. Dec. 1977 – Dec. 1980 Dr. Imtiaz Ahmad, Univ. of Karachi, Karachi.
21. Bionomics and control of Coccids in Baluchistan. Jan. 1978 – Mr. Badarul Haq Qureshi,

- Jan. 1981 Agriculture Research Ins.
Sariab, Quetta.
22. *Investigations on new strains of Bacillus thuringiensis effecting lepidopterous crop pests.* Sep. 1978 –
Sep. 1983 Dr. Rafi Sheikh,
Univ. of Karachi, Karachi.
 23. *Ecology and control (Microbial and hormonal) of termites of Pakistan.* Oct. 1978 –
Sep. 1983 Dr. Muzaffar Ahmad,
Dept. of Zoology, Punjab Univ., Lahore.
 24. *Ecology of leafhopper pests of vegetables and fruit plants of Pakistan.* Oct. 1978 –
Nov. 1983 Dr. Manzur Ahmad,
Karachi Univ., Karachi.
 25. *Studies on the integrated control of Sclerotial Fungi.* Oct. 1978 –
Oct. 1983 Dr. Abdul Ghaffar,
Dept. of Botany, Karachi Univ., Karachi.
 26. *Studies on Bio-systematics and control of mites of field crops, vegetables and fruit plants in Pakistan.* Nov. 1978 –
Nov. 1983 Dr. Wali Ahmad Chaudhry,
Univ. of Agriculture,
Faisalabad.

ANIMAL HUSBANDRY

1. *Breeding adapted strains of dairy cattle through crossing Sahiwal Jersey and Holstein Friesian.* July 1973 –
July 1980 Dr. Manzur-ud-Din Ahmad,
Dept. of Animal Breeding and Genetics,
Univ. of Agriculture, Faisalabad.
2. *Schemic for evolving well adapted synthetic strains of dairy cattle with superior production by crossing indigenous, milch breed, with suitable improved exotic breeds.* Mar. 1975 –
Mar. 1980 Mr. S.M. Athar,
Officer Incharge,
Livestock Experiment Station, Korangi,
Karachi.
3. *Studies on relative merits of three breeds of sheep and their crosses for high gaining ability.* Dec. 1974 –
Dec. 1979 Dr. M.D. Ahmed,
Mr. Ivaheed Ahmed,
Dept. of Animal Reproduction,
Univ. of Agriculture, Faisalabad.
4. *Utilization of cellulosic wastes for the production of easily digestible feed for the ruminants containing single cell protein.* June 1975 –
June 1980 Dr. F.H. Shzh,
PCSIR Laboratories,
Ferozepur Road, Lahore - 16.
5. *Ectoparasites of livestock of Sind.* July 1976 –
July 1980 S. Ishfaq Hussain,
Dept. of Zoology,
Univ. of Sind, Jamshoro, Sind.
6. *Control of aquatic weeds.* Apr. 1976 –
Apr. 1981 Dr. Badaruddin,
Inst. of Chemistry,
Univ. of the Punjab, Lahore.
7. *Studies on Newcastle disease vaccines.* June 1976 –
June 1981 Dr. Y.M. Eissa
Poultry Research Inst., Korangi,
Karachi.
8. *Studies in climatic physiology of cattle and buffaloes.* July, 1976 –
Dec. 1979 Dr. M.A. Saji,
Livestock Production and Research Station,
Bahadarnagar.
9. *Control and eradication of aquatic weeds in lakes and impounded waters.* Jan. 1977 –
Jan. 1982 Mr. Moin-ud-Din,
Dept. of Fisheries, Karachi.

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|-----|--|--------------------------|---|
| 10. | <i>Salmonellae in poultry, poultry products, poultry feed and feed ingredients.</i> | Dec. 1976 –
Nov. 1981 | Dr. Y.M. Eissa,
Poultry Research Inst., Korangi,
Karachi. |
| 11. | <i>Use of urea as a substitute for protein supplement in ruminants.</i> | Dec. 1976 –
Dec. 1979 | Mr. M.A. Saji,
Univ. of Agriculture, Faisalabad. |
| 12. | <i>Studies on 'Deg Nela' disease in cattle and buffaloes.</i> | July 1977 –
June 1980 | Dr. M. Ifsan,
Dr. J.H. Mirza,
College of Animal Husbandry, Lahore/
Univ. of Agriculture, Faisalabad. |
| 13. | <i>Studies on incidence, epizootiology and development of effective vaccines for control of contagious caprine pleuropneumonia and contagious agalactia in sheep and goats in Baluchistan.</i> | Nov. 1977 –
Oct. 1982 | Mr. Munir Ahmad Tariq,
Livestock Dept.,
Government of Baluchistan, Quetta. |
| 14. | <i>Studies on rinder pest like diseases relevant in livestock.</i> | Mar. 1978 –
Feb. 1983 | Mr. S.M. Athar,
Poultry Research Inst.,
Karachi. |
| 15. | <i>Investigation of the resistance of indigenous (desi) fowls to leukosis and determination of the relative resistance to Marek's disease of crosses and reciprocal crosses of desi and exotic breeds of chickens.</i> | Nov. 1979 –
Nov. 1981 | Mr. S.M. Athar,
Poultry Research Inst.,
Karachi. |
| 16. | <i>Bioecology of Avian Fauna in the Sind province of Pakistan.</i> | June 1979 –
June 1983 | Mr. Pervaiz A. Siddiqui,
Univ. of Karachi, Karachi. |

AGRICULTURAL ECONOMICS

- | | | | |
|----|--|---------------------------|--|
| 1. | <i>Socio-economic characteristics of migratory farm labour in Sind province of Pakistan.</i> | Dec. 1972 –
Dec. 1979 | Mr. Sharif Ahmad Siddiqui,
Sind Agricultural Univ., Tandojam. |
| 2. | <i>To determine efficacy of various machines towards increased agricultural production in Sind province.</i> | Dec. 1973 –
June, 1982 | Mr. B.T. Devrajani,
Sind Agricultural Univ., Tandojam. |
| 3. | <i>To study marketing infra-structure, margins and seasonal price variation of selected agricultural commodities in Sind province of Pakistan.</i> | Jan. 1974 –
Apr. 1980 | Mr. Rajab Ali Memon,
Sind Agricultural Univ., Tandojam. |
| 4. | <i>A survey of socio-economic conditions of manpower engaged in forest and wood-based industry in Pakistan.</i> | Mar. 1977 –
Feb. 1980 | Dr. G.M. Khattak,
Pakistan Forest Inst.,
Peshawar. |

S.No.	Project	Duration	Principal Investigator and Performing Institution
CESS FUND			
CROPS			
1.	Research on ginger cultivation in Soan valley	--	Ch. Altaf Hussain, Vegetable Research Inst., Faisalabad.
2.	Scheme for variety testing nutritional investigation and production of vegetable in D. I. Khan.	Feb. 1973 – Dec. 1979	Mohammad Atta Shuja, Agricultural Research Station, D.I. Khan.
3.	Uniformity trials on various crops in N.W.F.P.	Mar. 1977 – Mar. 1982	Fazli Subhan, Agricultural Research Inst., Tarnab.
4.	Cold Storage of fruit and vegetable in Peshawar	May 1973 – Apr. 1976	Mushtaq Ahmed, Agricultural Research Inst., Tarnab.
5.	Research on ginger cultivation, Sind.	Nov. 1977 – Nov. 1982	Mohammad Ramzan Punhewar, Sind Horticulture Inst., Mirpurkhas.
6.	Research on banana cultivation, Sind.	Jan. 1977 – Jan. 1982	Syed Ahmed Pasha, Sind Horticulture Inst., Mirpurkhas.
7.	Research on coconut cultivation, Sind.	--	Inayat Ali Rizvi, Horticulture Research Station, Landi, Karachi.
8.	Scheme for research on saffron cultivation in Quetta and Kalat regions.	June 1972 – June 1982	Mohammad Aslam, Agricultural Research Inst., Sariab, Quetta.
9.	Plant introduction centre, Karachi.	Feb. 1975 – Dec. 1981	Syed Majid Ali, Plant Introduction Centre, Karachi.
10.	Extension of national wheat programme under PARC to Azad Kashmir.	--	Director of Agriculture, Singrichambal, District Mirpur
11.	Extension of national rice programme under PARC to Azad Kashmir.	--	Production Agronomist, (Rice), Karoli, District Muzaffarabad.
12.	Extension of national maize programme under PARC to Azad Kashmir	June 1972 – June 1982	Syed Sharif-ud-Din, Department of Agriculture, Muzaffarabad.
RANGE MANAGEMENT AND FORESTRY			
1.	National Research Programme for Trees (forests, fruit and ornamental trees) introduction, improvement and propagations techniques.	Dec. 1976 – Nov. 1981	Dr. K.M. Siddiqui, Pakistan Forest Inst., Peshawar.

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|----|--|--------------------------|--|
| 2. | <i>Cooperative growth study of Eucalyptus under different quantity of water.</i> | Jan. 1977 –
Jan. 1981 | <i>Mohammad Iqbal Sheikh,
Pakistan Forest Inst., Peshawar.</i> |
| 3. | <i>Management study of Eucalyptus camaldules.</i> | Apr. 1975 –
Apr. 1979 | <i>Mohammad Iqbal Sheikh,
Pakistan Forest Inst., Peshawar.</i> |
| 4. | <i>Establishment of field research station for juniper forests of Baluchistan.</i> | Apr. 1975 –
Apr. 1980 | <i>Raja Mohammad Zarif,
Forest Dept., Ziarat, (Baluchistan).</i> |

SOIL AND IRRIGATION

- | | | | |
|----|--|---------------------------|---|
| 1. | <i>Scheme for micro-element status of central region of Punjab area.</i> | July 1973 –
June 1979 | <i>Hayat Mohammad Bhatti,
Ayub Agricultural Research Inst., Faisalabad</i> |
| 2. | <i>Scheme for micro-element study of soils of Baluchistan.</i> | Apr. 1977 --
Mar. 1982 | <i>Mumtaz Ahmed,
Agricultural Research Inst., Sariwah (Quetta).</i> |
| 3. | <i>Improvement of soil fertility through the use of organic matter.</i> | July 1977 –
June 1982 | <i>Mohammad Ibrahim Azad,
Ayub Agricultural Research Inst., Faisalabad</i> |
| 4. | <i>Cooperative Research Programme for Improvement in soil productivity through the biological means</i> | -- | <i>Dr. Baz Mohammad Khan,
Islamabad/Faisalabad/Tandojam/
Peshawar/Quetta.</i> |
| 5. | <i>Cooperative Research Programme on micro nutrients status of Pakistan soils and their use for obtaining increase crop yield.</i> | -- | <i>Dr. Baz Mohammad,
Islamabad/Tarnab(Peshawar)/
Peshawar Univ./Tandojam.</i> |

HONEY BEE MANAGEMENT

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|----|---|----|--|
| 1. | <i>Contribution to Honey Bee Management scheme.</i> | -- | <i>Dr. Rafiq Ahmed,
Pakistan Agricultural Research Council,
Islamabad.</i> |
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PLANT PROTECTION

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|----|--|------------------------|---|
| 1. | <i>Facilities for work on shisham bark beetle</i> | May 1977 –
May 1980 | <i>M. Ismail Chaudhry,
Peshawar.</i> |
| 2. | <i>Investigation on grape diseases in N.W.F.P.</i> | May 1972 –
May 1982 | <i>Dr. Mohammad Aslam,
Agricultural Research Inst., Tarnab,
Peshawar.</i> |
| 3. | <i>Scheme for malformation of mango inflorescence.</i> | -- | <i>Dr. Niaz Ali,
Univ. of Agriculture, Faisalabad.</i> |

ANIMAL HUSBANDRY

- | | | | |
|----|--|--------------------------|--|
| 1. | <i>Studies on the production and performance and adaptability of cross breed dairy cows under tropical environmental conditions of the Punjab.</i> | July 1974 –
July 1979 | <i>Dr. Karam Shah,
Livestock Experimental Station,
Bahadurnagar, (Okara).</i> |
| 2. | <i>Utilization of agricultural and industrial by-products and wastes in poultry feeds.</i> | Jan. 1975 –
Jan. 1980 | <i>Dr. M. Yaqoob Malik,
Animal Nutrition Section,
College of Animal Husbandry, Lahore.</i> |
| 3. | <i>Cross breeding of the Australian Illawarra short horns (A.I.S.) with the Sahiwal breed.</i> | Jan. 1978 –
Jan. 1983 | <i>Dr. M. Iqbal Brula,
Livestock Experimental Station,</i> |

*National Agricultural Research Centre,
Islamabad.*

4. *Studies on lohri sheep twice a year lambing.* Jan. 1978 – Jan. 1981
*Mohammad Sharif,
Livestock Experimental Station,
Bahadurnagar, (Okara).*

FISHERIES

1. *Scheme for studies of life history of fisheries resources of lobsters of Pakistan.* Aug. 1973 – Aug. 1980
*S. A. Jalil,
Marine Fisheries Dept., Karachi.*
2. *Study on keeping quality of commercially important marine fisheries and shrimps of Pakistan.* Apr. 1975 – Mar. 1979
*S. A. Jalil,
Marine Fisheries Dept., Karachi.*
3. *Induced spawning of major carps with a special emphasis of *Labeo rohita* in N.W.F.P.* Nov. 1977 – Nov. 1980
*Shan Ahmed Naved,
Directorate of Fisheries, Peshawar, N.W.F.P.*
4. *Scheme for rearing technique of fresh water prawn for commercial utility.* Jan. 1977 – Dec. 1981
*Moinuddin,
Directorate of Fisheries, Karachi.*
5. *Study of Trout fish at Maydan, Trout Hatchery in Sawat.* July 1978 – June 1982
*Shan Ahmed Naved,
Madyan, District Swat.*
6. *Crustacea (Decapoda and Stomatopods) of Pakistan.* --
*Dr. Nasima M. Tirmizi,
Karachi Univ., Karachi.*

AGRICULTURE ECONOMIC

1. *Cooperative Research Programme on the study of cropping pattern in various ecological regions of Pakistan, under PARC.* --
*Qazi Taquir Azam,
PARC, Islamabad,
Univ. of Karachi, Univ. of Agriculture,
Faisalabad/Univ. of Peshawar,
Agricultural Research Inst., Quetta.*

AGRICULTURE ENGINEERING

1. *Agricultural Engineering cell under PARC.* --
*Dr. A. U. Khan,
73/A, Satellite Town, Rawalpindi.*



A general view of the 15th General Meeting of PARC

NATIONAL WORKSHOP ON MAIZE, SORGHUM & MILLET
APRIL * 9-12, 1979
AT
MAIZE & MILLET RESEARCH INSTITUTE
PIRSABAK (NOWSHERA)
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Nation Workshop on Maize:Sorghum and Millet held
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