THE MART/AZR PROJECT

HIGH ELEVATION RESEARCH IN PAKISTAN

Pakistan Agricultural Research Council

ARID ZONE RESEARCH INSTITUTE

Brewery Road, Quetta, Pakistan.

No. 62

AZRI RESEARCH PLANS FOR 1990-91.

BY

AZRI/PARC AND ICARDA/AZRI STAFF.

by

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MART/AZR PROJECT RESEARCH REPORTS

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This Institute has responsibility for undertaking dryland agricultural research in all provinces in Pakistan through its headquarters in Quetta, Baluchistan and its sub-stations at D.I. Khan (NWFP), Umerkot (Sind) and Bahawalpur (Punjab)

This series of research reports outlines the joint research findings of the MART/AZR Project and AZRI. It will encompass a broad range of subjects within the sphere of dryland agricultural research and is aimed at researchers, extension workers and agricultural policy-makers concerned with the development of the resource-poor, arid areas of West Asia and North Africa.

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AZRI RESEARCH PLANS FOR SEASON 1990-91

INTRODUCTION

The Arid Zone Research Institute of The Pakistan Agricultural research Council (PARC) was set up to take responsibility for three major areas of PARC's national research mandate, namely:

a) to identify and address the problems associated with the agricultural development of the arid areas of Pakistan, where the potential for irrigation is either non-existent or undeveloped, by creating an effective research capability;

b) to investigate and quantify the present technical constraints to agricultural productivity in these dry areas, in order to develop and test appropriate innovations designed to overcome these constraints;

c) to consider the economic and social acceptability of possible technological improvements, and to develop suitable methods for rapid and effective dissemination of new agricultural information.

The attainment of these objectives should be pursued within the context of maintaining the self-sustainability of biological systems, and should not increase the risks of further degradation of fragile environments.

The MART/AZR project was established by PARC at AZRI in late 1985 under funding by USAID and has been implemented by ICARDA, with the involvement of Colorado State University. The objectives of the project are to assist in the development and strengthening of the research capacity of AZRI, and to help in the initiation and execution of a research program in dryland agriculture.

Technical results of the previous four seasons work in upland Balochistan have been published in Research Reports Nos. 1-61. A full list is attached in Appendix 3. Individual reports can also be requested from the AZRI/ICARDA office, PO Box 362, Quetta.

This research plan for the 1990-91 season is the joint product of AZRI and ICARDA scientists, and is the fifth annual workplan document since the start of MART/AZR's assistance to AZRI.

AZRI is currently organised into five main groups, which have each contributed separate sections to this report. However, it must be emphasised that the research is carried out in a multidisciplinary fashion, and thus the three expatriate advisers as well as most local scientists are involved in more than one group, as shown in Table 1.

TABLE 1

DISCIPLINARY GROUPS, AND CONTRIBUTING SCIENTISTS AND THEIR ORGANIZATIONS IN 1990/91.

DISCIPLINARY GROUPS	CONTRIBUTING SCIENTISTS	ORGANISATIONS
Range Management	Ghulam Akbar	AZRI/PARC
	E.F. Thomson	ICARDA
	A.Y. Allan	ICARDA
Livestock research	Shahid Rafiq	AZRI/PARC
	E.F. Thomson	ICARDA
Germplasm evaluation	B. Roidar Khan	AZRI/PARC
	Asghar Ali	AZRI/PARC
	J.D.H. Keatinge	ICARDA
	A.Y. Allan	ICARDA
Agronomy research	Hassan Raza	AZRI/PARC
	A.Y. Allan	ICARDA
Agricultural econs/ Farming systems	Farid Sabir	AZRI/PARC
	A. Rodriguez	ICARDA
AZRI Exptl. Station, Umerkot, Sind	Yar Mohammad Memon	AZRI/PARC
AZRI Exptl. Station, D.I. Khan, NWFP	Ruhal Amin	AZRI/PARC
AZRI Exptl. Station, Bahawalpur, Punjab	Mushtaq Ahmad	AZRI/PARC

Since 1985, AZRI has implemented its research program in an interdisciplinary, integrated manner, using an overall systems approach, and this policy will continue in the 1990-91 experimental year with all AZRI research groups operating in a collaborative manner. However, in this document, for purposes of clarity of presentation, the institute's research program has been subdivided into its four principal disciplinary sub-divisions: Range-livestock management, germplasm evaluation, agronomy and agricultural economics. In contrast to previous years, owing to acute senior staff shortages, the responsibilities of the agricultural extension and communication research group have had to be absorbed by the four other major research groups. This development is to be regretted at a time when AZRI technological interventions are starting to come on stream.

The experimental program described is in accordance with the strategic research emphasis outlined in AZRI's strategic research plan which has been published as MART/AZR Research Report 23 (1988). A summary of the proposed experimental program is shown in Appendix 1.

RANGE-LIVESTOCK MANAGEMENT RESEARCH GROUP

RANGE RESEARCH

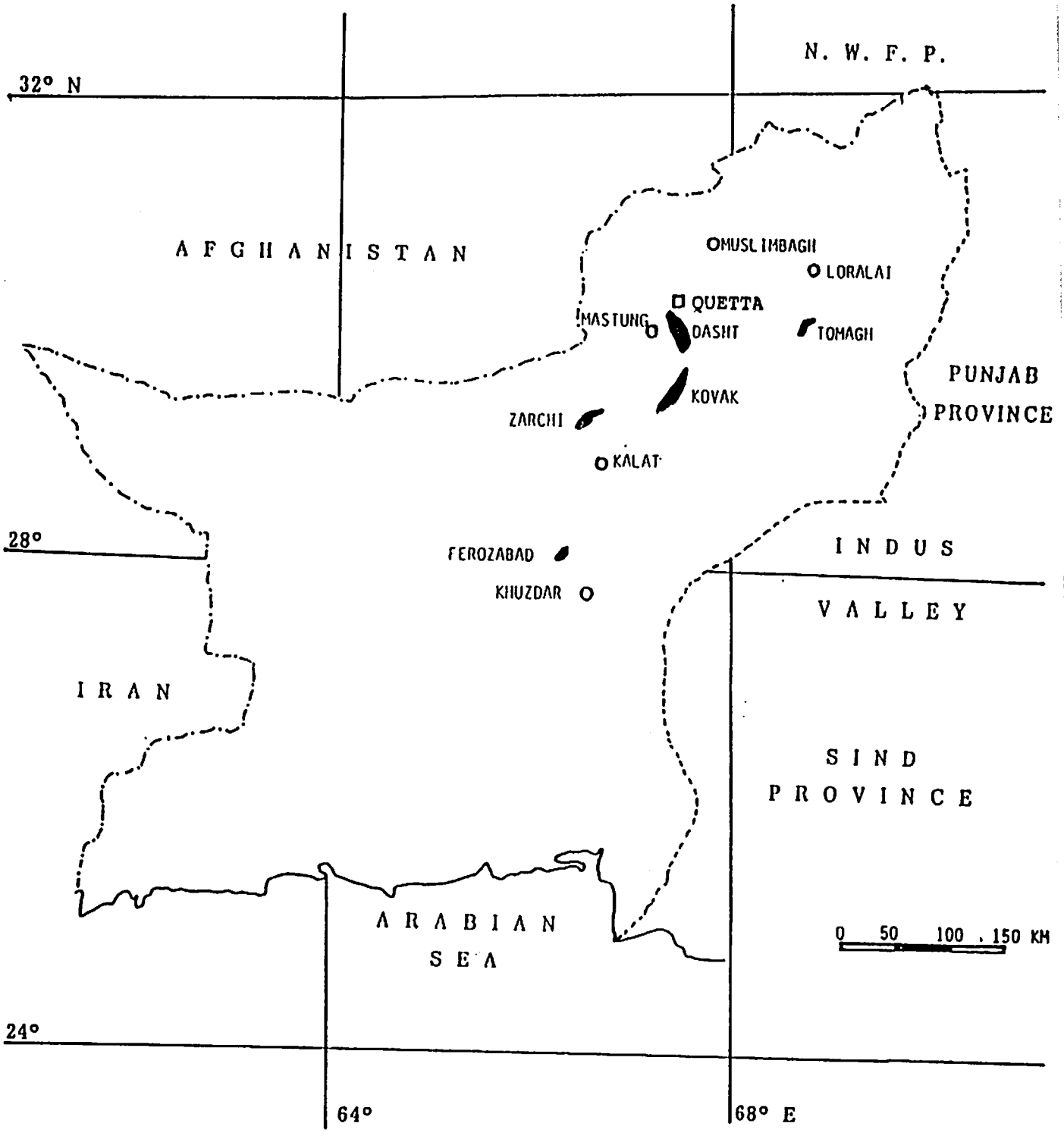
Introduction

The Range Research Group of the Arid Zone Research Institute was created in late 1985. Since that time the Range Research Group has established two research stations; one at Tomagh in Loralai district and one at Zarchi in Kalat district to study the responses of range vegetation and animal performance to different grazing and livestock management practices. Each site was chosen as being representative of one of the principal range vegetation types in highland Balochistan. Research activities included:

- -Determining range grazing potentials.
- -Identification and introduction of potential species of grass, legumes and shrubs for establishing forage reserves.
- -Improvement of range areas through soil and water conservation practices and through improved range rehabilitation techniques.

Previous results from these experiments have been reported in MART/AZR Research Reports Nos. 22 and 44, in and ICARDA Research Reports 127, 138 and 158. The locations of Tomagh, Zarchi and other experimental sites are shown in Figure 1.

FIGURE 1. MART/AZR PROJECT EXPERIMENTAL SITES IN BALUCHISTAN PROVINCE, PAKISTAN



Experimental plans

1. Range Vegetation Survey Priority Rating 1

Problem statement: Very little quantified information is available on the current status and historical changes in plant population, composition and forage production of the rangelands of Balochistan. This information is a pre-requisite for the design of range and livestock management experimental trials.

The line intercept method is being used to record various parameters such as plant cover, composition, density and frequency. Aspect and topographic factors are also being taken into consideration. The study is being carried out over three seasons of the year autumn, spring and summer and is currently two-thirds completed. The study is being performed at both Zarchi and Tomagh.

2. Establishment of fourwing saltbush (Atriplex canescens) on rangelands with land treatments to improve moisture storage (Priority Rating 1).

Problem statement: Fourwing saltbush is a new introduction to Balochistan, as such can small scale water harvesting land treatments help in its establishment and persistency? The species was planted into range grassland at Tomagh in 1987. Fifty percent of the seedlings were found to be surviving at the end of first year, while in 1990 ninety percent of those surviving plants are persisting. Can water harvesting techniques improve the percentage of initial survivors and their persistency?

Four land treatments are being tested at three sites: Tomagh, Zarchi and Mastung. All treatments employ "micro-catchment" practices because they are designed to trap runoff in small areas widely distributed over rangeland surfaces. Two treatments are applied with hand tools: saucer-shaped catchments two meters in diameter, and v-shaped catchments with two meter wings set at right angles. The other two treatments are applied by tractor power: contour furrows made with plows, and contour ripping.

Each treatment covers an area of approximately 1/8 ha at each site. Ninety six seedlings have been planted in each treatment and a total of 384 seedlings in the entire study. The study has been laid out in a randomized complete block design with four replications. Seedlings of uniform size and age have been planted in the study according to following spacing scheme:

(a) Saucer catchments	Center of saucer
(b) V-shaped catchments	Center of V, inside, 50 cm from intersection of wings
(c) Furrows	Bottom of furrow, 2 m apart
(d) Ripping	In ripped line, 2 m apart

Only one irrigation was provided at the time of planting with 15 liters of water per plant. Data on survival and growth rate are being recorded on a monthly basis while biomass of plants in different treatment will be recorded on annual basis. The experiment is expected to last for three years until 1992.

3. The Effects of fertilizer, spacing and land treatment on the growth of fourwing saltbush under rainfed conditions. **(Priority Rating 2).**

Problem statement: No quantitative information exists for the basic agronomic management of fourwing saltbush in Balochistan. Plant density and possible benefits of responses to fertilizer, particularly animal manure, requires investigation if growth of forage reserve blocks of this shrub are to be as productive as possible.

The study will be laid out in a randomized complete block design with 12 treatments and two replications. These treatments are based on the interactions of three fertilizer levels, two spacings and two land treatments:

Fertilizer : Manure, N and P fertilizer, No fertilizer
Plant spacings : 2.5 m, 2 m
Land Treatments: Saucer-shape, V-shape

Each replication will cover an area of 1564 m^2 and each treatment an area of 100 m^2 leaving 2 m distance in between each treatment. One year old seedlings of uniform size of Fourwing saltbush will be planted in the study. A total number of 316 seedlings will be required for each replication and 632 plants for the entire study area at each site. In treatments having 2.5 m plant to plant spacing, 25 seedlings per treatment will be planted while in treatments having 2 m distance 36 plants will be planted.

Considering one bag of Nitrophos fertilizer (23-23-0) weighing 50 kg will be applied to one hectare, 31 g of fertilizer per plant will be used in those treatments which will have a plant to plant spacing of 2.5 m. While 20 g of fertilizer per plant will be used for treatments having a plant to plant spacing of 2 m. In case of sheep manure, using 1 t/ha as a standard dressing, 0.63 kg/plant of sheep manure will be used for treatments having plant to plant

spacing of 2.5 m while 0.4 kg/plant will be used for treatments having 2 m plant spacing. Fertilizer will be applied only at the time of planting by mixing it thoroughly in the planting hole. Similarly only one irrigation (15 liters/plant) will be provided at the time of planting.

Data on plant height and crown diameter will be recorded on a monthly basis, while the biomass of plants in each treatment will be recorded at the end of the study. The experiment will be planted at three locations AZRI farm, Zarchi and Tomagh and is expected to last three years till 1992.

4. Evaluation of Different Cool Season Grass Species **(Priority Rating 3)**.

Problem Statement: The productivity of the natural range vegetation, especially in the drier shrub dominated ranges such as at Zarchi, is very low. One possible option for increasing the productivity of these rangelands is to identify new grass species for possible introduction on a large scale. Finding suitably adapted species requires an initial evaluation of available germplasm. This experiment, which was started in 1989, continues the evaluation of a wide range of introduced grasses over a range of environments.

Ten cool season grass species of exotic origin were sown at two different locations: Mastung and Tomagh during February, 1989. The study was laid out in a randomized complete block design with four replications. Seed of each species was sown in 13 m long lines with a line to line spacing of 30 cm. A total of five lines of each species/variety was sown in each replication. Data regarding forage production of all these species were collected during Fall, 1989. The experiment was repeated in 1990 at three locations: Quetta, Mastung and Tomagh The species/varieties included in the study are:

1. Western wheatgrass cv Arriba
2. Crested wheatgrass cv Ephrain
3. Crested wheatgrass cv Hycrest
4. Russian wildrye cv VNS
5. Thickspike wheatgrass cv Critona
6. Indian ricegrass cv Paloma
7. Crested wheatgrass cv Nordon
8. Siberian wheatgrass
9. Intermediate wheatgrass
10. Tall wheatgrass (Jose)

It is planned to investigate the comparative evaluation of these species on the basis of first year forage yield, second year forage yield and third year forage yield. Continuous observation over a three year period will enable us to assess the vigor and regrowth potential of the introduced species under natural conditions.

Conclusions

With the current level of staffing in the research group - 1 SSO and 1 SO, it is likely that only experiments with priority ratings 1 and 2 will be achieved. As this implies abandonment of grass introduction trials after two years research investment, the need for further strengthening of the numbers of staff in this group is manifest. The further possibility that the SSO group leader will be leaving for longterm training makes further staff recruitment to the range group an AZRI priority.

LIVESTOCK RESEARCH

Introduction

The production of small ruminants is the major dryland agricultural activity in Balochistan. Numbers have increased substantially since 1955, at a rate of approximately 7% a year, to give a present estimate of around 18 M head. This represents 40-50% of all the small ruminants in Pakistan and is thus potentially a major contributor to the gross agricultural product of Pakistan. However, offtake from the small ruminants in Balochistan is only a fraction of its potential as most animals are badly undernourished and parasitized. AZRI's research program which has been operating over the last five years has demonstrated that improvements in productivity from prophylactic health care and periodic winter feed supplementation can have a substantial impact on animal productivity. Progress in this experimental work has been documented in MART/AZR Research Reports Nos. 13, 16, 18, 27, 37, 58 and 59.

Germplasm plans

1. The impact of protein and energy feed supplementation on the performance of range-fed sheep and goats **(Priority Rating 1)**.

Problem Statement: The research programme on winter supplementation of sheep has been underway for the last 2-3 years and has shown very encouraging results. Significant improvements in productivity have resulted with this nutritional management during winter. One important objective of the study planned for 1990-91 is to have an additional year's data from both the stations to allow

comparisons to be made across locations. Another important objective is the refinement of the type and amounts of supplements to be fed during forage deficit periods to enable the development of cost effective technology. Additionally, goats will be involved in the study to broaden the scope of research findings to both the major small ruminant species.

The study will be conducted at the Zarchi and Tomagh Range-Livestock Research Stations during winter 1990 and will start in the autumn to coincide with the breeding season for sheep and goats. Six groups of sheep and goats (three groups of each species) will be involved in the study and two kinds of supplemental feeds will be provided during the breeding and lambing periods only. Last years results have shown that continuation of supplementation after breeding is of little advantage. The first group of each species will be maintained on range grazing alone. The second group will be fed a supplemental ration composed of mainly cottonseed cake, barley and wheat bran when the animals return from grazing in the afternoon. Whereas the third group will be provided urea-molasses block licks in addition to grazing.

The performance of each group in terms of body weight changes, conception & lambing rates, wool production, lamb birth & weaning weights, lamb growth rate and, abortions & mortality will be monitored.

2. Nutritive evaluation of fourwing saltbush in growth, digestibility, nitrogen & energy metabolism studies on sheep **(Priority Rating 1)**.

Problem Statement: Research work on the nutritive evaluation of fourwing saltbush has shown that this shrub has potential as a winter forage and the proposed study is a further in depth investigation of this question. It will determine what additional nutrient supplements are required to make fourwing saltbush a better livestock ration for use in winter. Research work at AZRI and Tomagh on the nutritive evaluation of fourwing saltbush has shown that the animals can survive on this shrub and that the protein digestibility of this forage is comparable to other conventional feeds. However its fiber is less digestible.

Twenty four lambs of 4-5 months of age will be used to study three experimental rations at the animal nutrition unit at Quetta. Ration A will be composed of pure fourwing saltbush. Ration B will be comprised of fourwing saltbush and barley grain and ration C will be a mixture of fourwing saltbush and cottonseed cake. Fourwing saltbush is being harvested for this purpose from Mastung, Tomagh and AZRI Quetta.

3. Nutritive evaluation of cultivated forages (Vicia and Barley species) in sheep under pen-fed conditions (**Priority Rating 2**).

Problem Statement: AZRI researchers are currently looking for cereal and leguminous dryland forage crops with promising yields and nutritive value. In 1988-89 a grazing trial with sheep was conducted at AZRI that involved exotic and native Vicia and barley species. The animals grazing these forages were able to maintain their body weights and indicated good intake levels after adaptation to these forages. In 1990-91 the proposed study is planned to determine palatability, intake, digestibility and nitrogen balance of lambs under pen-fed conditions at AZRI Quetta.

Eight plots (4 x 30 m) of each of the three forage species (Vicia dasycarpa, Arabic Abiad and local barley) were grown in 1989-90 at AZRI farm, Quetta. Fifty percent of each plot was harvested in late March at the flowering/heading stage and 50% will be harvested at the maturity stage. Air dried forage/hay will be fed to six groups of sheep to study and compare the nutritive value of these forages at two stages of maturity.

4. In vivo digestibility of native and exotic grasses, shrubs and other range forage plants (**Priority Rating 3**).

Problem Statement: Range and crop forages vary not only in their nutritive value, as measured by chemical analysis in the lab, but also in their intake and digestibility values by animals. This study is proposes to examine the digestibility of range forages as well as field grown forages either commonly or experimentally grown in Balochistan (lucerne, sorghum, barley and vetch hay).

Forage samples will be digested by sheep and then collected through use of the nylon bag technique in rumen-fistulated sheep at the Animal Nutrition Research Unit, AZRI, Quetta.

5. Effect of parasites and diseases on offal from sheep and Goats marketed in Quetta and its environs (**Priority Rating 4**).

Problem Statement: Parasitic, bacterial and viral diseases are a big threat to the productivity of sheep and goats in Balochistan. Research at AZRI has shown that more than 80% of sheep in flocks in highland Balochistan were infected with internal parasites. This study would be a follow up to this survey work to determine the impact of parasitism and disease on directly marketable products.

Liver, lung, heart, kidney, spleen, intestine and blood samples will be collected from the Quetta slaughter house for examination. Tissue slides will be prepared in the lab and damage to the organs will be assessed by visual and microscopic examination.

Conclusions

Manpower is likely to be a major constraint to the work of the livestock section at AZRI in 1990-91. With the likely departure of Mr. Atiq for longterm training this will leave only one SSO and one SO in the group. Towards the end of the year Dr. Wahid will be expected to return from longterm training at Oregon State University. However, only priority rating one experiments can be guaranteed to be completed. Experiments with priority ratings 2 and 3 can probably be achieved if extra scientific manpower is recruited. Experiments with priority rating 4 require the recruitment of a scientific officer with veterinary qualifications. Though this experimental rating is low, the absence of good veterinary support at AZRI currently undermines the entire range and livestock group experimental program. Action in recruitment in now urgently required.

GERMPLASM EVALUATION GROUP

Introduction

The Germplasm Evaluation Group at AZRI has been working in conjunction with ICARDA on cereals since 1980 and on legumes since 1984-85. However, only since 1985 has this collaboration received priority attention from ICARDA. Progress to date is reported in the following MART/AZR Research Reports 17, 21, 29, 32, 36, 46, 49 and 56. Of necessity, germplasm evaluation needs to be a continuous process attempting to "keep ahead" of biotic stresses and to reduce production risks in the face of the prevailing, harsh environmental conditions.

The research group has two broad objectives:

1. To select improved, disease resistant crop genotypes suitable for growth under non-irrigated conditions in order to diversify the wheat mono-cropping system currently being practiced in highland Balochistan;

2. To investigate and evaluate the potential for increased livestock feed production from the introduction of forage crops, and from additional crop residues from food or dual-purpose crops.

Experimental plans

A) Annual Sown Forage Legumes
Problem Statement: In Balochistan supplies of animal feed fall far short of demand owing to excessive animal numbers and severe overgrazing of natural range vegetation. Thus, the potential productivity of small ruminants is severely constrained. AZRI research has demonstrated that small amounts of balanced feed supplement can improve potential animal offtake considerably. As there is at present no forage legume species grown in highland Balochistan under dryland conditions the introduction of adapted annual sown forage legumes could be of considerable importance to local farming systems.

Current program output:

At the end of the current season (1989-90) promotions from the V. villosa and V. sativa yield trials are being put forward to the agronomy group. Depending on seed availability, this will consist of 4-8 lines.

Core Program (Priority Rating 1): **FLYT - HG 1990/91.**

Ongoing forage legume yield trials (FLYT - HG 90/91) with approximately 40 entries will be planted at three locations Mehtar, Kan Mehtarzai and Agric. Res. Instit. (ARI) Sariab in late autumn. The trials will consist principally of selections from the previous two years multiple site yield trials and promotions from observation nurseries. The dominant species will be Vicia villosa but some sativa material will also be included. The current improved check V. villosa ssp. dasycarpa Acc. 683 will be replaced by the outstanding line in the 1987-90 V. villosa yield trial series. Trials will employ standard RCB designs with three replications.

Some promising lines (less than 10) with enhanced cold tolerance are requested from ICARDA PFLP for this trial to try to provide further species diversification. This could include villosa lines with improved seed setting characteristics. If seed is available for non-shattering vetch and V. amphicarpa this would be appreciated. If insufficient seed for yield trials can be spared these lines could be included in the FLON 1990-91.

Core Program (Priority Rating 2): **FLON - HG**

A forage legume observation nursery (FLON - HG 90/91) will be planted, this will consist largely of lines in the 1989-90 trial which have not yet been fully exposed to cold conditions owing to the relative mildness of the 1989 winter. Some additional lines (10-20) could be included at the discretion of PFLP.

Additional Program (Priority Rating 3): FLSSYT - HG

To date (1985-89) results of the spring sowing of forage legumes have been disappointing. Yields of forage are generally low, and seed yields consistently poor. However, as spring planting continues to be the only option for farmers a continuing search for short maturity forage material is needed.

A new series of short maturity lines and species is requested from PFLP. These should have cold tolerance at the seedling stage and an ability to set seed rapidly in a terminal drought. Perhaps a wider range of species than previously could be considered by ICARDA, incorporating unimproved GRU material, as the yield potential does not have to be very high.

B) Lentil

Problem Statement: AZRI surveys have indicated that although only very small areas of lentil are actually grown in Balochistan, consumption is widespread and quite sustained. A possible reason for this low level of production is the ultra-small seed size of the local landrace, which attracts little market demand: as consumers prefer larger grains which make cleaning in the kitchen a less time-consuming process. Urban demand in Quetta is currently being met by imports from Turkey. An opportunity thus exists for AZRI to satisfy a local demand by providing an adapted, cold tolerant lentil cultivar with large seeds.

Current program output:

Following seed bulking this season, sufficient seed supplies of recommended lines ILL 5865 and ILL 5677 are available for agronomic testing. These lines will also supercede the local landrace as the improved control lines in subsequent nurseries and yield trials. The seed size of these two selected lines, though twice that of the local landrace, remain in the microsperma class. Efforts to find further adapted macrosperma lines will be emphasized.

Core program (Priority Rating 2): LYT - HG 90/91

This trial will be winter planted at three locations Loralai, Kan Mehtarzai and Sariab as RCB designs with three replications. It will consist of approximately 20-25 entries.

One additional yield trial will be planted at Sariab only, subject to seed availability, consisting of FLIP selected large-seeded lines with genetic backgrounds from the highlands. This should not exceed twenty entries.

Additional program (Priority Rating 3): LYT - LR 90/91

Little progress to date has been made in the search for a short season, drought tolerant lentil suitable for spring planting. ICARDA is requested to supply two sets of a yield trial specifically of short duration material. This will be planted at Kan Mehtarzai and Sariab. This trial should not include more than 24 entries.

Observation nursery material of lentil will not be planted as these produce insufficient seed for rapid promotion to yield trials.

C) Barley

Problem Statement: The dry environment of highland Balochistan would seem to favour the production of barley over wheat. However, farmers continue to grow wheat almost exclusively for food security reasons. With the major deficit in animal feed currently being experienced by ruminant producers in Balochistan, greater barley production would enable farmers to supplement the diets of their flocks and thus increase animal productivity by a considerable amount. What is required is a cold tolerant barley variety which is at least 25% more productive than wheat especially in dry years, with resistance to yellow rust; and as we have observed this season some resistance to barley yellow dwarf virus is also needed.

Current program output:

Promotions were made in the previous season and their effectiveness in agronomy trials needs assessment prior to further promotions which are expected for the 1991-92 season.

Core Program (Priority Rating 1): BYT - HG 90/91

The ICARDA barley yield trial for high altitude areas (BYT - HA 1990/91) will be planted with AZRI selected material from previous seasons in a winter planted yield trial at Sariab, Kan Mehtarzai and Loralai. This will consist of 40-50 entries and will form AZRI's BYT- HG 90/91 nursery. It will be planted in an RCB design with three replications. Disease resistant, cold tolerant, long duration material is the desired ecotype from these trials. A range of material is requested to include both landraces and "improved" lines with an emphasis on their ability to withstand cold and to avoid premature heading when planted in late autumn.

Core program (Priority Rating 2): BON - HG 90/91

ICARDA is requested to send their BON - HA 1990/91 which will be amalgamated with AZRI selections and planted at the three locations in which the yield trial will be planted. This will form AZRI's nursery BON- HG 90/91.

Additional program (Priority Rating 3): BYT - LR

There is a need for alternative barley material of short duration with enhanced drought tolerance and resistance to yellow rust. Several promotions have been made in previous seasons but this research needs to continue as drought tolerance needs to be improved. This yield trial is requested from ICARDA and will be planted at two locations in spring (Sariab and Kalat). Some AZRI selections may be added to provide 30-40 entries. No observation nursery will be planted.

D) Breadwheat

Problem statement: Breadwheat is the principal crop grown under dryland conditions in Balochistan. It is largely grown under a low input subsistence system. The only well adapted variety is the local landrace which is a winter type of long maturity. Under normal conditions this cultivar is quite productive of both grain and straw and has sufficient flexibility to make grain in most seasons in which sufficient summer rainfall occurs to allow pre-winter crop emergence. This variety has two major problems: it is extremely sensitive to rust diseases which in wet years are capable of devastating the crop; and its long maturity period is unsuitable for spring sowing conditions. As a result AZRI's research efforts are geared towards finding an improved breadwheat cultivar that would be suitable for winter planting and which is resistant to the local strain of yellow rust. In addition, it is looking for suitable cultivars for use in spring planting that have short maturity periods, and improved resistance to heat and drought stresses dur ing grain filling.

Current Program Output:

It is likely that there will be one promotion to agronomy trials from the winter wheat maturity group and several lines from the spring wheat group (maximum 5). This remains dependent on the final disease sensitivity scoring which will not be completed until closer to harvest.

The 1989-90 season is the first since 1982-83 in which rust diseases have been observed and thus will be extremely important for screening purposes.

Core Program (Priority Rating 1): BWYT - HG and BWON - HG

ICARDA is requested to supply three sets of their BWYT - HA and BWON - HA 90/91, these will be amalgamated with AZRI winter planted selections from yield trials and observation nurseries to give a yield trial with approximately 30 entries and an expanded observation nursery. These will then form AZRI's BWYT -HG and BWON -HG. These trials will be planted in late autumn at Sariab, Kan Mehtarzai and Loralai in randomized complete blocks with three replications.

Additional program (Priority Rating 3): BWYT - LR

AZRI has presently quite a large number of lines potentially suitable for spring planting. As such the search for new material has a lower priority rating than it would otherwise merit. ICARDA is requested to send two copies of its BWYT-LR 90/91. This will be amalgamated with AZRI selections from previous years but the final yield trial will be restricted to not more than 30 lines. They will be planted in two locations Sariab and Kalat in late winter or early spring (snow conditions permitting).

Conclusions

Numbers of supervisory staff in the AZRI germplasm group are presently uncertain. If two scientific officers are available throughout the 1990-91 season all priority 1 and 2 core program activities will be undertaken. If extra resources become available the additional program will be carried out. If Mr. Asghar Ali leaves for longterm training in autumn 1990 and is not immediately replaced then only priority one aspects of the program will be covered.

Work on segregating populations of wheat and barley which have reached the F4 and F5 stages will be shelved until the position on additional staff is clarified.

AGRONOMY RESEARCH GROUP

Introduction

The agronomy group at AZRI has been collaborating with ICARDA since 1985, and the main aims of the agronomy programme have been:

- to characterise the agro-climatic variables for crop growth under rainfed conditions in Balochistan.

- to obtain data from on-farm trials investigating the effects of such interventions as water-harvesting; new varieties of wheat, barley, forage and food legumes; fertilizers and farm yard manure; tillage practices and soil amendments; herbicides, fungicides and inoculums.

- to assess, in conjunction with other AZRI groups, the agronomic, economic and social implications of potentially advantageous interventions.

Field trials have shown that moisture shortages severely limit yields, that water harvesting can significantly alleviate this constraint, and that other interventions tended to have little or no effect when moisture was limiting. There were indications that some of the other interventions such as fertilizers could be beneficial when increased moisture was made available by water harvesting.

Experimental plans

Water harvesting trials (WHTs)

Problem statement: The next series of WHTs will have to take into consideration the following important issues and problems:

- enlarging the catchment area to infiltration area ratio, to ensure that even in dry years there is a better likelihood of harvesting adequate water for a crop.

- avoiding waterlogging on the infiltration area, by levelling it carefully, and by making provision for draining off excessive water when necessary, using slightly raised beds, shallow furrows, a small ditch at the bottom side, and a spillway.

- avoiding the wastage of that drained off water, by using it on a second, lower infiltration plot, which would thus act as a buffer or reserve infiltration zone, to mop up surplus runoff in wet years.

- improving the infiltration on the cropped areas.

- utilising land outside and above currently cropped fields for catchment; these areas are frequently unproductive.

- intergrating food and forage crops, by growing forages on the lower infiltration zone.

- utilising local labour rather than outside machinery.

Core program (Priority Rating 1): WHT - HG 1990/91

The WHTs will have 2 infiltration plots, an upper one immediately below the catchment areas, and a lower one just below the upper one. These two infiltration plots will be separated by a small bund, which will incorporate a spillway designed to let surplus water overflow from the upper plot into the lower one, under control. This is intended to minimise the risk of waterlogging in the upper plot, and use any excess water productively on the lower plot.

The ratio of catchment area to infiltration areas will be 2:(1+1) or 3:(1+1). This means that there will be 2 main plots, plus a control without water harvesting, ie. 3 main treatments.

The crops on the upper infiltration plot will be wheat and barley, and the crops will be split for presence and absence of fertilizer. On the lower plot, the 2 forage crops will be V. villosa ssp, dasycarpa and Atriplex, also split for some appropriate agronomic treatments, such as inoculation or fertilizer.

One replication of the 3 WH treatments will be grown in each farmers field, and 10 neighbouring farmers will be selected at each site area, ie. 10 at Kolpur, Dasht, Mian Ghundi and Mastung, giving a total of c. 40 of these on-farm trials. The economics and extension groups would be intimately involved in the establishment, running, monitoring, evaluation and development of these trials.

Barley production

Problem Statement: Previous trials have consistently shown that barley outyields wheat by around 27% and also gives better hay and straw production. Better new varieties should be coming through from the germ-plasm group, and hence the on-going Barley Variety Trials (BVTs) will be continued.

Core program (Priority rating 2): BYTs - HG 1990/91
These barley variety trials will be carried out on Sailaba plots at Loralai, Kolpur and Mian Ghundi, and no Kushkaba, 2:1 Water Harvesting plots at Kolpur, Dasht, and Mian Ghundi. The intention is that the results from these trials can be related to those in the WHTs. They will be laid down as RCBs, with 4 reps per site.

Forage legume production

Problem statement: Increased supplies of forage for the ever-multiplying sheep and goats of Balochistan are urgently needed, and the most promising materials are new lines of Vicia spp, notably subspecies dasycarpa.

Core program (**Priority Rating 2**): **FLT - HG 1990/91**

4-8 new lines should be coming forward from the germplasm group, and these will be tested in factorial trials, at the same sites and with the same moisture regimes as the Barley Variety Trials. They will also incorporate the best treatments from the Vicia agronomy trials in 1989/90. If considered useful, a few of the best treatment combinations from the barley/vicia intercropping trial in 1989/90 could be included in this trial.

Agro-meteorology

Problem statement: The agro-meteorology of upland Balochistan has now been described, particularly the rainfed aspects. Reliable conclusions can be drawn from the analyses of the 1880 to 1946 data, but the rainfall data from 1946 from 1946 to 1989 have not yet been processed.

Core Program (**Priority rating 3**): **Agro-meteorology**
The data for the period 1946-1990 should be obtained from the Met Dept. for compilation and verification. A detailed analysis of the temperature climatology of Balochistan remains to be carried out. The data collection and initial stages of the processing can be handled by AZRI staff who have been trained and are experienced in this field, but the final, more advanced steps in the analyses will need help from an outside consultant.

Conclusions

The major constraint in fulfilling the proposed research plan, as in the other groups, is the lack of senior staff. Shortly, there will be only 3 senior officers instead of the former 6. Off the former staff, 2 have gone, or will be going, for further training and 1 has left for personal reasons. 2 - 3 suitable new additions to the group are urgently needed before the next season begins.

AGRICULTURAL ECONOMICS/FARMING SYSTEMS GROUP

Introduction

The agricultural economics/farming systems research group at AZRI was initiated in 1985 and has subsequently extensively described the farming systems of highland Balochistan. This has been reported in MART/AZR Research Reports 3, 5, 7, 10, 11, 20, 26, 28, 35, 43, 45, 47, 50, 54 and 55. These reports provide a first class foundation for AZRI's research

program and are furthermore now used extensively by other governmental agencies. However, this descriptive role has now reached a stage at which technology evaluation and impact assessment can become the principal roles of the research group. This change in emphasis is reflected in the plans proposed for the coming season.

Experimental plans

TECHNOLOGY EVALUATION

1. Catchment basin water harvesting **(Priority Rating 1).**

The AZRI agronomy group has been conducting water harvesting trials since 1986 at 3 selected sites in highland Balochistan (Mastung, Dasht and Kovak). In 1989-90 a new site was added in the Kolpur area.

According to the results of the crude economic analysis of the trails to date, the cost of catchment setup is low, after the establishment year costs are reduced by 34% due to reduced need for seed and cultivation inputs (animal draft and labour). Net benefits were 33% higher than the control for 1:1 treatments but 27% lower for the 2:1 treatment (ICARDA Res. Rep. 158).

Now, there is a need to investigate whether in the presence of improved methods of water harvesting, agronomic improvement such as fertilizer addition or the introduction of a new crop variety will be economically profitable, and can assist in ensuring a better, and more stable return to investment for farmers than is possible under the current subsistence system.

The research group in the 1990-91 season will concentrate on collecting a wider set of data on the establishment and maintenance costs of a catchment basin system to determine whether or not the return to farmers is both higher and more consistent over a ten year period. In addition, it will attempt to determine the social acceptability of the innovation proposed and the likely uptake by farmers in the next 5-10 year period.

This data set will include:

The costs and feasibility of bundmaking, run-off area preparation and spillway costs, and their social acceptability, for both farmers with and without access to mechanical traction.

The costs of alternate cropping strategies and their likely productivity in the presence of highly variable climatic conditions.

The economic and social impact of achieving a grain crop in dry years, and possibly reduced yields in wet years due to waterlogging.

The size of the recommendation domain for which the type of small scale catchment basin water harvesting is applicable in highland Balochistan, and the potential uptake of the technology and its subsequent impact.

2. Fourwing saltbush forage reserves (**Priority Rating 1**).

Introduction of the browse shrub Atriplex canescens, fourwing saltbush, has been shown by the range/livestock research group to be technically feasible, and when grown in forage reserves it can be much more productive than local range vegetation. Furthermore, the value of this shrub as a feed supplement has been demonstrated, as it has potential for either maintaining ewe body weights in winter - thus precluding the need for migration to the Indus valley - or in potentially improving lambing percentages and reducing ewe mortality.

This innovation seems to have promise. However, at this early stage in the research process it is necessary to start collecting and evaluating economic information on the cost of establishment, the social likelihood of providing adequate protection, its productivity over a range of years, the profitability of its use in animal offtake, in preservation of vital breeding stock in dry years, its potential ability to reduce the need for migration, its use as a fuel supply, etc. With this information attempts at assessing its impact, and that of other similar shrubs and perennial grasses now being tested by AZRI, can be undertaken. Such studies would be a vital pre-requisite prior to making recommendations about forage reserve interventions to the provincial forestry and livestock departments extension services.

3) Farmer Managed Trials (FMT) performed in the 1989-90 growing season (**Priority Rating 3**).

Some new technologies were investigated in the 1989-90 season in farmer-managed trials at Kolpur, Mehtar and Kovak. These studies require the collection of follow up data on the costs and profitability of proposed interventions. In addition, knowledge of the farmer's subsequent attitudes to the new technology, particularly of its risk attributes are of vital concern to AZRI. Follow-up surveys will be undertaken in all FMT locations to gather this information. This will also act as a basis for subsequent impact assessment once the technology intervention has been more fully proven.

The success with which such technological interventions fit into the farming system currently being practised has to be assessed. One technique by which this can conveniently be considered in both time and space is the use of a whole farm model. The information gathered in association with the FMT's will act as the basis for model development and the use of linear program techniques. This approach allows the analysis of cross effects from changes in prices, resources and technology interventions and helps to assess the opportunity costs of farmer resources. This will be vital in the assessment of adoption rates and the scope for potential impact. In the context of dryland cropping systems this approach could be used to evaluate choice of production methods, factor substitution effects, input/output response relations, differences in quality of resources, ecological and market seasonality, and credit and cash flow constraints.

A similar approach will be adopted in studying the small ruminant production system of Balochistan. A considerable quantity of basic information will be collected in association with the range-livestock group's experimental program. This will permit the simulation of animal population dynamics, forage availability and consumption, and liveweight gains under different environmental and managerial conditions. Furthermore, it will help to assess the impact of improved marketing techniques for policy change recommendations such as the cessation of meatless days or improved export strategies to the federal and provincial governments.

Descriptive and diagnostic studies

1) Feed use and economic parameters of village sheep flocks in highland Balochistan **(Priority Rating 2)**.

In conjunction with data on small ruminant production gathered from range-livestock group experiments, there is an additional need for a detailed survey of economic performance of village flocks with particular reference to their current level of feed supplementation. This will assist the proposed linear programming effort and the survey will be designed to give information that is currently missing from AZRI's livestock survey record.

Three flocks owned by private farmers in the Tomagh area will be involved in the study. All the sheep and goats in each flock will be tagged. One flock from Tomagh Range-Livestock Research Station of AZRI will be included in the study as an improved control treatment. The farmer's flocks will not be provided any managemental treatment. All the traditional management practices/activities carried out throughout the year will be recorded over a three year period. The flock maintained at the Tomagh Range-Livestock

Research Station will be given full prophylactic health cover. The study will enable AZRI to collect hard data on traditional methods of sheep management and their productivity and to assess the effect of veterinary cover on production rates.

2) Agricultural-livestock production systems survey of the highland areas of D.I.Khan District (NWFP) **(Priority Rating 4)**.

The descriptive and diagnostics studies started in the first phase of MART/AZR project were mostly undertaken in the highland areas of Balochistan. In the future, such information will be required for the target areas at sub-station locations. These studies will be started in the highland areas of D.I. Khan district which is in accordance with AZRI's strategic planning priorities. AZRI's previous household production systems survey will be used as a role model.

COOPERATION WITH PROVINCIAL GOVERNMENT AGENCIES

In common with other AZRI research groups, the Econ/FS group will strive to foster active communication links with provincial research and extension agencies. In particular, this will encompass further joint work with the Agric. Econ. Res. Unit (AERU) at ARI Sariab and the fostering of a more active farming systems approach in crop, livestock and range research in provincial departments.

Conclusions

With the current staffing level of four scientists in the group all of the proposed program can be maintained. However, if Mr. Khalid leaves for longterm training without replacement, items of priority levels 3 and 4 will be at risk. In addition, it is likely that without a senior counterpart at SSO level in this group, linear programming efforts will take much longer to produce effective results.

UMERKOT SUB-STATION, SIND

Introduction

In contrast to the continental Mediterranean environmental conditions experienced in highland Balochistan, the AZRI Sub-station at Umerkot has an arid sub-tropical climate. The level of aridity is too great to support consistent rainfed crop production and Umerkot's environs, the greater Tharparkar desert area, is principally used for livestock raising on native range vegetation.

Experimental plan

1. Establishment and productivity of multi-purpose tree species (**Priority Rating 1**).

Problem statement: Little knowledge exists on the potential productivity of local and introduced browse and fuel wood tree species. This needs to be assessed to determine the potential for range rehabilitation.

In this experiment, ongoing since 1988, seven species of Acacia are being evaluated. A. senegal and A. jaquomontii are the most promising species to date. Further plantings of these two species will be undertaken this season in larger forage reserve blocks.

2. Evaluation trials of propagation, establishment and persistency of range grasses (**Priority rating 1**).

Problem statement: The severely overgrazed nature of the Tharparkar area suggests the need for range re-seeding. Should this prove to be feasible which grass seeding method would be appropriate?

In an ongoing experiment since 1988, 22 grass species are being compared in their capacity to become established, and be persistent, within the native desert vegetation with a range of seeding methods: aerial, drilling, transplanting of seedlings, and transplanting of root and stem clumps. Two species Lasirus sindicus and Cenchrus setigerus seem to be the best adapted in establishment terms to the environment. However, they were not the highest yielding species. Further years are required before this experiment can be formally evaluated. Further seeding methodology trials will be undertaken this season.

3. Establishment of a living herbarium of Thar vegetation **(Priority rating 2).**

Problem statement: To assess the likely validity of introducing new species to improve the productivity of the Thar desert, it is necessary to have an improved understanding of the range and growth characteristics of the native Thar vegetation.

One manner in which this is being assessed is by the collection and establishment at the AZRI sub-station of a living collection of species found in the Thar desert. To date this includes 73 species but further efforts are required to complete the collection of commonly occurring species.

4. Crop germplasm evaluation **(Priority rating 3).**

Problem statement: In some years sufficient rain is experienced in the Thar desert to justify opportunistic crop production. What species should be used to maximize the likelihood of a productive return?

If sufficient rain is experienced in summer, germplasm evaluation trials of millet, sorghum, mash, mung, guar and teppary beans may be planted.

Conclusions

Staff resources at Umerkot are limited (3 scientists). Experiments of priority ratings 1 and 2 will be achieved with current resources. Lower priority rating activities are unlikely to be achieved without further staff or financial support.

DERA ISMAEL KHAN SUB-STATION, NWFP

Introduction

This sub-station currently concentrates its experimental resources on evaluation of crop germplasm and agronomic interventions for the rainfed agricultural belt running NE from DI Khan.

Experimental plan

1. Ascochyta blight resistance screening for lentil and chickpea (Priority rating 1).

Problem statement: Severe blight epidemics have been experienced in this area in the early eighties. These could occur again, at any time, and current varieties are not yet adequately resistant.

ICARDA nurseries of chickpea and lentil are being screened for their potential resistance to Ascochyta blight. Lentil is not widely grown and the possibility that this crop could act as a substitute for chickpea is also being considered.

2. Agronomy of chickpeas (Priority rating 1).

Problem statement: The interaction between responses to inoculation and N and P fertilizer addition and planting method have not yet been clarified for this environment.

Inoculation x fertilizer x planting method trials have been conducted for one year and need to be continued for at least two further years to consolidate current findings which indicate small positive increases in yield with inoculation and addition of fertilizer.

3. Wheat agronomy trials (Priority rating 2).

Problem statement: Responses to ridge furrow moisture conservation techniques and fertilizer addition are undetermined.

Experiments to evaluate N and P fertilizer responses with and without adopting a ridge/furrow planting system has been investigated since 1988. These experiments are being continued.

4. Sorghum, Maize, Mung and Millet variety x fertilizer addition trials (priority rating 3).

Problem statement: The agronomy of dryland kharif crops is not well understood in this environment.

Experiments to clarify basic understanding of the potential of new varieties and the need for fertilizer addition are being assessed.

Conclusions

If Mr. Rashed S.O. is deputed for training in 1990-91 only priority rating 1 experiments can be assured, priority two experiments are likely and priority three experiments are unlikely to be achieved.

BAHAWALPUR SUB-STATION, PUNJAB

Introduction

This sub-station concentrates its activities on developing agronomic techniques suitable for the use of saline irrigation water and restricted irrigation water supply. Some effort is also made in determining suitable species for sand dune stabilization and in evaluating the potential for multi-purpose fodder/fuel wood trees.

Experimental plan

1. Crop germplasm evaluation for salt and drought tolerance **(Priority rating 1)**.

Problem statement: Much of the potential irrigation water available at Bahawalpur is saline. Clarification of which are the best crops and cultivars to be grown under these conditions requires assessment.

Experiments to evaluate tolerance to saline irrigation of germplasm of the following crops - Brassica sp., Taramira (Eruca sativa), chickpea, wheat, barley oats, guar, sorghum and millet has been evaluated since 1988. This is an ongoing activity and selections and new material will be evaluated in 1990-91.

2. Irrigation timing and technique experiments **(Priority rating 2)**.

Problem statement: Appropriate techniques for the use of saline water for irrigation have not yet been assessed under local soil conditions.

Experiments investigating irrigation techniques such as skip row, broad bed and ridge furrow have been examined in relation to the most appropriate timing of saline irrigation water. These experiments will continue in 1990-91.

3. Tillage, moisture conservation, mulching, water use efficiency, and FYM/fertilizer addition experiments **(Priority rating 3)**.

Problem statement: Can traditional agronomic interventions such as mulching, improved tillage, and fertilizer/FYM addition improve yields and water use efficiency under saline water irrigated conditions?

Experiments in 1988 have shown that traditional agronomic interventions, particularly mulching did provide a substantial effect on crop yields. Further experiments are planned to clarify the biological, water efficiency and economic effects of these interventions.

4. Germplasm evaluation of trees and grasses **(Priority rating 3)**.

Problem statement: The Cholistan desert is currently severely overgrazed and shifting sands threaten currently productive agricultural land, roads etc. There is a need to evaluate the suitability of grass and multi-purpose tree species in the roles of potential agents for sand dune stabilization and for providing alternative sources of fodder and fuel wood.

Germplasm evaluation experiments of a number of grass and tree species are ongoing at the Cholistan experimental location. Further years growth are required before these experiments can be properly evaluated.

Conclusions

Staff numbers at Bahawalpur, currently 2, are uncertain with the transfer of Mr. Sultani to Islamabad. Only priority rating 1 experiments can be guaranteed in 1990-91 unless further staff is available.

APPENDIX 1

SUMMARY OF PROPOSED EXPERIMENTAL PROGRAM, AZRI. 1990-91

GROUP	EXPERIMENT	DESIGN. NO OF:- TNTS	REPS	YEARS TO BE RUN	SITES	PRIOR-ITY	STAFF SITUATION
Range	1.Range vegn survey	-	-	Thro' the year 1990	Tomagh Zarchi	1	Present Staff-
	2.Atriplex establish -ment	4	4	1987-92	Mastung Tomagh Zarchi	1	1 SSO * 1 SO
	3.Atriplex fert, FYM, Spacing	12	2	1990-92	AZRI, Tomagh Zarchi	2	Additnl. staff needed-
	4.Grass species evaluatn	10	4	1989-92	AZRI Mastung Tomagh	3	
Live-stock	1.Protein & energy feed supplements	3x2	1	1990-91	Tomagh Zarchi	1	Present Staff- 1 SSO *
	2.Atriplex nutritive evaluation	3	8	1990-91	AZRI, Quetta	1	1 SSO 1 SO
	3.Vicia, Barley nutritv evaluation	3x2	1	1990-91	AZRI, Quetta	2	Additnl. Staff needed-
	4.Forages - digestibilities invivo			1990-91	AZRI, Quetta	3	1 SSO 1 SO 1 Govt
	5.Parasites, diseases - offal survey			1990-91	Quetta. abbatt-oir	4	

* - scientist due to go away for training.

-A2-

GROUP	EXPERIMENT	DESIGN. NO OF:- TNTS	REPS	YEARS TO BE RUN	SITES	PRIOR-ITY	STAFF SITUATION
Germ-plasm	A.ANNLFORAGE				Kan Met		Present
	A1.ForLeguae Yield Trial	40	3	1990-91	Mehtar Sariab	1	Staff
							1 SSO *
	A2.ForLeguae Obsvn Nursy		1	1990-91	Kan Met Mehtar Sariab	2	1 SO -------
	B.LENTIL						Additnl.
	B1.Lentil Yield Trial	20	3	1990-91	Kan Met Loralai Sariab	2	Staff needed -
							1 SSO
	B2.Lentil spring type	24	3	1990-91	Kan Met Sariab	3	1 SO
	C.BARLEY						
	C1-Bar.Yield Trial	50	3	1990-91	Kan Met Loralai Sariab	1	
	C2-B.Observn Nursery		1	1990-91	Kan Met Loralai Sariab	2	
	C3-B.Spring Yield Trl.	40	3	1990-91	Sariab Kalat	3	
	D.BREADWHEAT				Kan Met		
	D1.BW Yld T. & Obsv.Nur	30	3	1990-91	Loralai Sariab	1	
	D2.BW Spring Yield Trl.	30	3	1990-91	Sariab Kalat	3	

* - scientist due to go away for training.

-A3-

GROUP	EXPERIMENT	DESIGN. NO OF:- TRTS	REPS	YEARS TO BE RUN	SITES	PRIORITY	STAFF SITUATION
Agronomy	1.Water Harvesting Trials	3	1	1990-91	Dasht Kolpur MianGun Mastung	1	Present Staff-
		(10 trials at each of these 4 sites.)					1 SSO 2 SO
	2.Barley Variety Trials	? &	4	1990-91	Dasht Kolpur Loralai MianGun	2	------ Additnl. Staff needed-
	3.Forage Legume Trials	4-8	4	1990-91	Dasht Kolpur Loralai MianGun	2	3 SO
	4.Agrometeor -ology.			1990-92	AZRI	3	
Agric. Econs. & Farmng Systems	1.Water Harvesting Trials - Costs and returns	3	1	1990-91	Dasht Kolpur MianGun Mastung		Present Staff - 1 SSO * 1 SSO 2 SO *
		(10 trials at each of these 4 sites.)					
	2.Atriplex Forage reser -ves study			1990-91	Several areas	1	------ Additnl. Staff needed
	3.Farmer-managed trls			1989-90	Several areas	3	1 SSO
	4.Feed use-villagesheep			1990-93	Tonagh	2	1 SO
	5.Agric/live -stock prodn syste.survey			1990	DI Khan NWFP	4	

* - scientist due to go away for training.

APPENDIX 2

ATTENDANCE LIST
AZRI PLANNING MEETING 1990

NAME	DESIGNATION	ORGANIZATION
Dr. R. Aro	Consultant	SAZDA
Dr. D. Keatinge	Coordinator	ICARDA
Qazi Abdul Ali	Div. Forest Officer	Bal. Forest Dept.
Mirza M. Ashraf	Dir. (F&E)	PARC
Ume Kulsoom	Dir. (Coord & Plan)/ Proj. Dir. RDS Proj.	SAZDA
Bill C. Wright	Chief of Party	WINROCK/MART
Zulfiqar Ali Khan	DG Agric. BLN Quetta	Agric. Dept. GOB
Rod Bailey	Team Leader	AGRODEV SAZDA
M. Saeed	Prog. Specialist	USAID MART Proj.
Faqir Muhammad	Dir. Res.	Livestock Dept.
Byrd C. Curtis	Liaison & Breeder	CIMMYT/ICARDA
Euan F. Thomson	COP MART/AZR	ICARDA
Muhammad Rafiq	Mem. (NR)	PARC
B. Roidar Khan	Director	AZRI
Mumtaz Ahmad	Proj. Dir.	BARD
Alister Allan	Agronomist MART/AZR	ICARDA
Abelardo Rodriguez	Agric. Econ. MART/AZR	ICARDA
Jim Barnett	PROS/MART Project	
Abdul Hameed Bajoi	Director	ARI Sariab
Syed Hassan Raza	SSO	AZRI
Yar Mohammad Memon	SSO	AZRSS Umerkot
Shahid Rafiq	SSO	AZRI
M. Ikram-ul-Haq	Economic Botanist	ARI

Ghulam Akbar	SSO	AZRI
Mohammad Ismair	Agr. Chemist	ARI
Bashir Ahmad	P/I AERU	ARI
Atiq-ur-Rehman	SO Livestock	AZRI
Khalid Mahmood	SO Agri. Econ.	AZRI
Sarfraz Ahmad	SO Germplasm	AZRI
Nisar Ali Shah	ASO Agri. Econ.	AZRI
Abid Hussain	SO Agri. Ext.	AZRI
Sher Mahmood Shah	SO Soil & Agron.	AZRI
Asghar Ali	SO Germplasm	AZRI
Farid Sabir	SO Agri. Econ/FS	AZRI
Shahid Mahmood	Sc. Photographer Ext.	AZRI

June, 1990

APPENDIX 3

MART/AZR RESEARCH REPORT SERIES

Annual Reports published as ICARDA 110 (1985-86), 127 (1986-1987), 138 (1987-88) and 158 (1988-89).

Research Report No.

1. KEATINGE, J.D.H. The Systems Approach in Project Planning and Implementation - Advantages, Disadvantages and Lessons Learned by ICARDA in the MART Project at the Arid Zone Research Institute., MART/AZR, FSP/ICARDA, BARD Workshop, April 1986.

2. NAGY, J.G. The Production Function and Productivity Index Approaches to Estimating Returns of Agricultural Research. Proceedings of the Economic Research Policy Workshop, Faisalabad, 12 March 1987.

3. NAGY, J.G. Range-Livestock Production Constraint Diagnosis and Potential Research Opportunities in Baluchistan: A Farming Systems Perspective. Proceedings of the Workshop on Livestock in Farming Systems, Islamabad 8-15 April, 1987.

4. TALUG, C. What Makes an Extension Worker Successful. Proceedings of the First National Training Course on Technology Transfer for Agricultural Extension Staff. NARC, Islamabad, 4 February 1987.

5. REES, D.J., J.G.NAGY, S. H. RAZA, K. M. MAHMOOD, B. A. CHOWDRY, and J. D. H. KEATINGE. The Dryland Arable Farming System of Upland Baluchistan: A Case Study. Proceedings of the International Symposium on Problems and Prospects of Winter Cereals and Food Legumes Production in High-Elevation Areas of West and South-East Asia and North Africa. Ankara, Turkey 6-10 July 1987.

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8. NAGY, J.G. and J.H. SANDERS. Agricultural Technology Development and Dissemination Within a Farming Systems Perspective. Paper presented at the Joint International Association of Agricultural Economists Symposium on Rural Development Strategies, Beijing, China. 25-29th October 1987.

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10. FARID SABIR, G. and J. G. NAGY. Women's Household Agricultural Production Systems Survey Results. January, 1988.

11. DEL CASTILLO, C. Community Profiles: A Set of Cultural Sketches of Five Regions in Baluchistan. 1987.

12. TALUG, C., ARSHAD ALI, G. FARID SABIR, D.J. REES, H. RAZA, J.G. NAGY, M.B.A. CHOWDRY and M. ASLAM. Farmer-Managed Trials in the Kovak Valley, Baluchistan: The Effect of Variety and Addition of Fertilizer on Wheat Production. 1988.

13. KHAN, K.N.M., ATIQ-UR-REHMAN and M.B.A. CHOWDRY. Incidence of Internal and External Parasites in Sheep in Kovak Valley (Kalat District) Upland Baluchistan. 1988. Submitted for publication in Journal of Animal Health and Production (Pakistan).

14. AZRI and MART/AZR Research Plans for 1988-89 by AZRI and MART/AZR, June, 1988.

15. KEATINGE, J.D.H., D.J. REES, R.S. ARO, J.G. NAGY and C. TALUG. Guiding AZRI into the 21st Century - Strategic Planning Options for the Next Decade. June 1988.

16. ATIQ-UR-REHMAN, K. N. M. KHAN, M. ASGHAR and M.I. SULTANI. Fourwing Saltbush Forage Compared with Conventional Feeds for Yearling Sheep. 1988.

17. ASGHAR ALI, B. ROIDAR KHAN and J.D.H. KEATINGE. The Effects of Inoculation and Phosphate Fertilizer Addition on the Productivity of Lentils under Rainfed Conditions in Upland Baluchistan, Pakistan. June 1988. Accepted for publication in Lens.

18. KHAN, K. N. M., ATIQ-UR-REHMAN, B. ROIDAR KHAN and M. MUNIR. Incidence of Internal Parasites of Sheep in Upland Baluchistan (Pakistan), presented at the SAARC Conference, 22-25 May 1988, Islamabad.

19. KIDD, C. H. R., D.J. REES, J.D.H. KEATINGE, F. REHMAN, A. SAMIULLAH, and S.H. RAZA. Meteorological Data Analysis of Baluchistan. April 1988.

20. ASIF M.M., M. AFZAL, J.G. NAGY and S.M. KHAN. Agricultural and Related Statistics of Upland Baluchistan. 1988.

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22. ARO, R. S., M.I. SULTANI and M. ASGHAR. Introduction of Fourwing Saltbush (Atriplex canescens) into Degraded Rangelands in Upland Baluchistan. 1988.

23. KEATINGE, J. D. H., B. ROIDAR KHAN, D. J. REES, R. S. ARO and C. TALUG. A Strategic Plan for the PARC Arid Zone Research Institute 1990-2000. November 1988.

24. REES, D.J., F. REHMAN, A. SAMIULLAH, J.G. NAGY, G.F. SABIR, J.D.H. KEATINGE and S.H. RAZA. Barley Production under Suboptimal Conditions in Upland Baluchistan: Agronomic and Socio-Economic Considerations. 1989.

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