THE MART/AZR PROJECT

HIGH ELEVATION RESEARCH IN PAKISTAN

Pakistan Agricultural Research Council

ARID ZONE RESEARCH INSTITUTE

Brewery Road, Quetta, Pakistan.

No. 70

AZRI RESEARCH PLANS FOR 1991/92
(prepared by AZRI/PARC and ICARDA/AZRI staff)

by

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May 1991

CONTENTS

Introduction 1

Table 1 - Disciplinary groups at AZRI 3

Figure 1 - Locations of experimental sites 4

Figure 2 - Staffing situation at AZRI 5

Descriptions of research objectives for each group, with protocols describing individual experiments or studies.

Germplasm group 6

Livestock 16

Agronomy 25

Agricultural economics 34

Range 43

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. The MART/AZR project, which is being executed by ICARDA, was extended in December 1989 and is expected to continue until August 1994.

A change in the format of this document has been introduced this year, in an attempt to give a clearer picture of the proposed research. Both on-going and new research is presented as separate protocols. However, this document for the 1991/92 season continues to be the joint product of efforts by AZRI and ICARDA scientists, and is the sixth annual workplan document since the start of MART/AZR's assistance to AZRI. Technical results of the previous four seasons work in upland Balochistan have been published in Research Reports Nos 1-66. A full list can be obtained from the AZRI/ICARDA office, PO BOX 362, Quetta, from where individual reports can also be requested.

The locations of the experimental sites are shown in Figure 1.

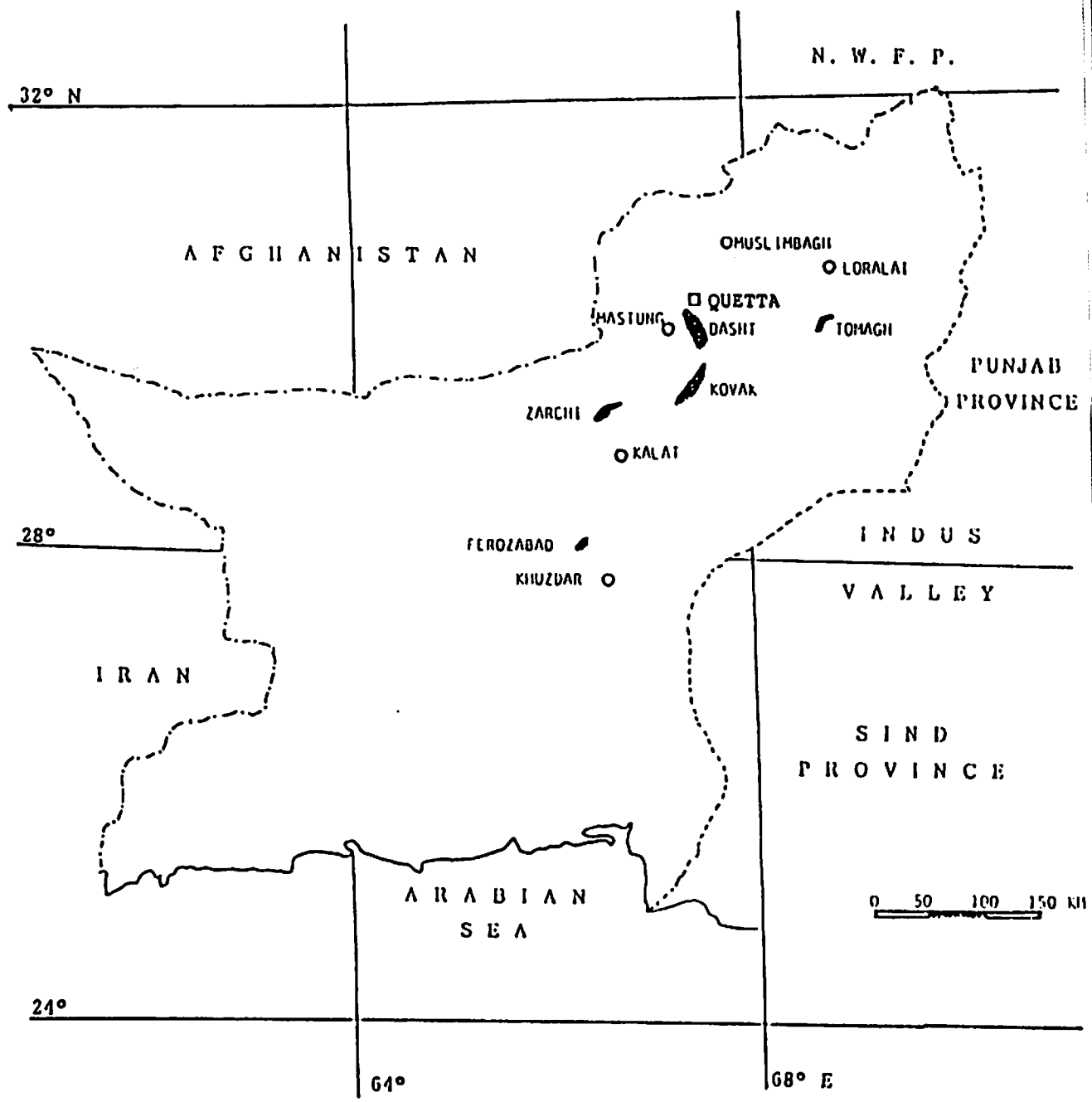
AZRI is currently organised into five main disciplinary groups, which have each contributed separate sections to this report (Table 1). In addition, sections from the three AZRI sub-stations are included. However, the scope of the research activities at AZRI is slightly narrower than last year because of the heavily reduced number of scientists in each group. This is because of the large number of vacancies, and also because several

longterm trainees are away doing higher degrees in the USA (Figure 2). In addition, a steadily diminishing AZRI operating budget is having a negative impact on its research activities. Indeed, adjusted for inflation, this budget is today about 10 percent of what it was ten years ago.

Table 1. Disciplinary groups at AZRI, and contributing scientists and their organizations in 1991/92.

Discipline	Scientist	Organisation
Range Management	Abdul Wahid Jasra	AZRI/PARC
	E.F. Thomson	ICARDA
Livestock research	Shahid Rafiq	AZRI/PARC
	E.F. Thomson	ICARDA
Germplasm evaluation	B. Roidar Khan	AZRI/PARC
	Safraz Ahmed	AZRI/PARC
	A.Y. Allan	ICARDA
Agronomy research	B. Roidar Khan	AZRI/PARC
	Sher Mahmood Shah	AZRI/PARC
	A.Y. Allan	ICARDA
Agricultural economics	Muhammad Afzal	AZRI/PARC
	A. Rodríguez	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.	Ghulam Akbar	AZRI/PARC

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



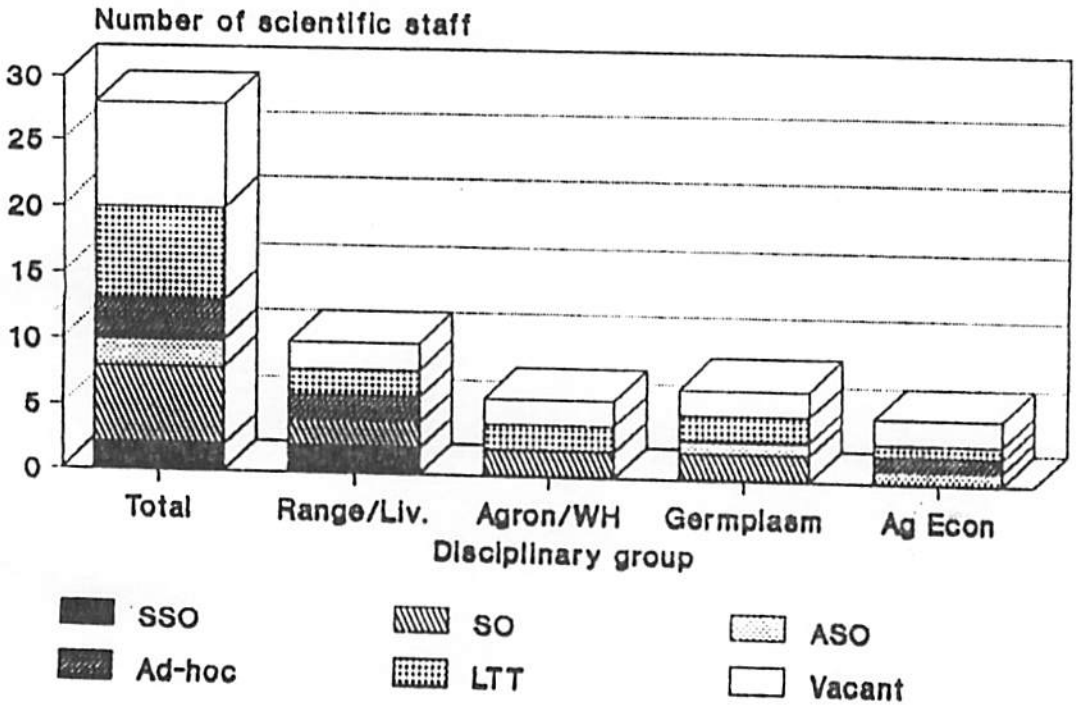


Figure 2. Distribution of AZRI scientific staff by disciplinary group and seniority (SSO = senior scientific officer, SO = scientific officer, ASO = assistant scientific officer, Ad-hoc = ad-hoc appointee, LTT = longterm trainee, Vacant = vacant post).

GERMPLASM EVALUATION SECTION

Introduction. In highland Balochistan winter crops are grown under dryland conditions, with supplementation in some areas from moisture conserved from monsoonal rains. The major constraints on production are limited water, uncertain rainfall, extremely low temperatures in winter and rust pathogens in the few wet years. The most productive way to reduce the effects of environmental stresses is through the development and evaluation of improved crop genotypes, which have resistance to biotic and abiotic stresses. Considerable forethought is thus required to plan an appropriate strategy to identify appropriate crop genotypes which can give better and more consistent yields of both food and forage crops in this highly variable environment. To address these problems, the Arid Zone Research Institute (AZRI) has been collaborating with the International Center for Agricultural Research in the Dry Areas (ICARDA) in a bread wheat, barley, lentil and forage legume germplasm improvement program, using materials which are collected from all over the world, on the basis of their adaptability to such harsh arid conditions. Progress to date is reported in the following MART/AZR Research Reports: 17, 21, 29 32, 36, 46, 56, 57, 60, 63 and 64.

Objectives. The objectives of the AZRI germplasm program are:

1. To select superior, disease-free/resistant crop species/lines /genotypes suitable for growth under non-irrigated conditions. Better genotypes of crops other than wheat would help farmers to diversify away from the wheat monocropping system which most cultivators in highland Baluchistan currently follow.

2. To investigate the potential for additional livestock feed production in the highlands from the introduction of forage crops, or from additional crop residues from food crops grown under rainfed conditions.

Overview of the 1989/90 Trials

Climatic Conditions. 1989/90 was a favourable cropping season for both winter and spring planted crops. More than 300 mm and 250 mm rainfall was received during the crop growth period of winter and spring crops respectively. No severe cold damage was experienced at Quetta and Kan Mehtarzai but dessicating winds at Quetta during the grain formation stage severely affected the grain setting of wheat, barley, lentils and forage crops.

Bread Wheat. In the 1989/90 season, two experiments were completed, and the results are presented in the following reports:- "Selection for abiotic and biotic stresses: the example of F2 bread wheat selection in highland Balochistan", MART/AZR Research Report No. 64, and "Screening of bread wheat genotypes for spring sowing in the arid highlands of Balochistan", MART/AZR Research Report in preparation.

In the first experiment, after nine years of testing, genotype ICW81. 1471 was selected for wide-scale agronomic testing. Although the yield potential of this genotype was not significantly higher than of the local check, it had the important advantage over local material of possessing good resistance to yellow rust (*Puccinia striiformis*).

In the second experiment 104 exotic lines were screened down to nine superior genotypes which had higher yield potential, early maturity, drought and heat tolerance and resistance to yellow rust. All these improved selected genotypes will be multiplied up and then handed over the Agronomy Group for testing.

Barley. One experiment was completed and a report prepared on "Selection of barley lines suitable for spring sowing in the arid highlands of Balochistan", MART/AZR Research Report No. 60.

Barley genotype W12291/W12269 was selected after three years of testing; it was more tolerant to environmental stresses and gave higher grain yields than the local barley landrace under dry conditions.

Lentils. One series of trials was completed and reported as "Germplasm evaluation of lentil lines for the arid highlands of West Asia", MART/AZR Research Report No. 56.

Two ICARDA lentil lines ILL 5865 and ILL 5677 have shown some promise over a wide range of environmenatal conditions in highland Balochistan. These lines have adequate cold tolerance and are suitable for winter sowing. They have seed sizes approximately double that of the local landrace.

Forage Legumes. A series of experiments was carried out with various vetches, and the results will be reported as "Selection of vetch genotypes under rainfed conditions in highland Balochistan", MART/AZR Research Report in preparation.

After multiple location and year testing in winter and spring planting, *Vicia sativa* Acc. 713 has been selected for winter planting due to its better productivity across trial locations, yield stability under different environments and adequate level of winter hardiness.

AZRI Research Protocol

Protocol code: G1 (ongoing) **Priority:** 1

Title of project: selection of bread wheat genotypes for winter sowing in the arid highlands of Balochistan

Collaborating institutions: ICARDA Cereal Program, Aleppo

Principal AZRI investigator: Mrs. Irshad Begum (SO)

Collaborating AZRI scientific staff: Sarfraz Ahmad (SO)
Syed Abdul Jaleel (ASO)

Collaborating non-AZRI scientific staff: Dr M. Tahir, ICARDA, Aleppo

Date of commencement: 1989/90

Date of completion: 1995

Site of project: ARI Sariab Quetta, Loralai and Kan Mehtarzai

1. Objectives

To select cold and drought tolerant, disease resistant and high yielding genotypes suitable for winter planting.

2. Experimental details

Total Entries	: 450 (In different trials)
Design	: RCB
No of Replication	: 3
Plot area	: 7.5 m^2
Fertilizer rate	: NPK 60:60:0 kg/ha
Irrigation	: Pre-soaking (if needed)
Sowing Time	: Autumn

Variables to be measured:
1. Growth habit
2. Cold tolerance
3. Drought tolerance/resistance
4. Heading date
5. Maturity period
6. Disease resistance
7. Total dry matter production
8. Grain yield
9. Chemical analysis (for selected lines)

3. Publication:

MART/AZR Research Report and refereed publication.

AZRI Research Protocol

Protocol code: G2 (ongoing) **Priority:** 2

Title of project: selection of bread wheat lines suitable for spring sowing in the arid highlands of Balochistan

Collaborating institutions: ICARDA Cereal Program, Aleppo

Principal AZRI investigator: Mrs. Irshad Begum (SO)

Collaborating AZRI scientific staff: Sarfraz Ahmad (SO)
Syed Abdul Jaleel (ASO)

Collaborating non-AZRI scientific staff: Dr. M. Tahir, ICARDA, Aleppo

Date of commencement: 1989/90

Date of completion: 1995

Site of project: ARI Sariab Quetta and Kalat

1. Objectives

To select short duration, heat and drought tolerant, disease free and high yielding genotypes.

2. Experimental details

Total Entries	: 50 (approximately, in different trials)
Design	: RCB
No. of Replication	: 3
Plot area	: 7.5 m^2
Fertilizer rate	: NPK 60:60:0 kg/ha
Irrigation	: Pre-soaking, if needed
Sowing Time	: Spring

Variables to be measured:

1. Growth habit
2. Drought and heat tolerance
3. Maturity period
4. Tillering ability
5. 1000 kernel weight
6. Disease resistance
7. Total dry matter production
8. Grain yield
9. Chemical analysis (for selected lines)

3. Publication: MART/AZR Research Report and refereed publication.

AZRI Research Protocol

Protocol code: G3 (ongoing) **Priority:** 1

Title of project: evaluation and selection of winter-sown barley lines for the arid highlands of Balochistan

Collaborating Institutions: ICARDA Cereal Program, Aleppo

Principal AZRI investigator: Sarfraz Ahmad (SO)

Collaborating AZRI scientific staff: Mrs Irshad Begum (SO)
Syed Addul Jaleel (ASO)

Collaborating non-AZRI scientific staff: Dr M. Tahir, ICARDA, Aleppo.

Date of commencement: 1989/90

Date of completion: 1995

Site of project: ARI Sariab Quetta, Kan Mehtarzai and Loralai

1. **Objectives:** To evaluate and select desirable genotypes for winter planting.

2. **Experimental details**

Total Entries	: 350 (approximately, in different trials)
Design	: RCB
No. of Replication	: 3
Plot area	: 7.5 m^2
Fertilizer rate	: NPK 60:60:0 kg/ha
Irrigation	: Pre-soaking (if needed)
Sowing Time	: Autumn

Variables to be measured:
1. Growth habit
2. Cold tolerance
3. Drought tolerance/resistance
4. Heading date
5. Maturity period
6. Disease resistance
7. Total dry matter production
8. Grain yield
9. Chemical analysis (for selected lines)

3. **Publication:** MART/AZR Research Report and refereed publication.

AZRI Research Protocol

Protocol code: G4 (ongoing) **Priority:** 2

Title of project: evaluation and selection of barley lines for spring sowing in the arid highlands of Balochistan

Collaborating institutions: ICARDA Cereal Program, Aleppo

Principal AZRI investigator: Sarfraz Ahmad (SO)

Collaborating AZRI scientific staff: Mrs.Irshad Begum (SO)
Syed Abdul Jaleel (ASO)

Collaborating non-AZRI scientific staff: Dr. M. Tahir, ICARDA, Aleppo

Date of commencement: 1989/90

Date of completion: 1995

Site of project: ARI Sariab Quetta, Kan Mehtarzai and Loralai

1. Objectives

To evaluate and select short duration, heat and drought tolerant, disease free and high yielding barley lines.

2. Experimental details

Total Entries	: 50 (approximately, in different trials)
Design	: RCB
No. of Replication	: 3
Plot area	: 7.5 m^2
Fertilizer rate	: NPK 60:60:0 kg/ha
Irrigation	: Pre-sowing (If necessary)
Sowing Time	: Spring

Variables to be measured:

1. Growth habit
2. Heat and drought tolerance
3. Maturity period
4. Disease resistance
5. Tillering ability
6. 1000 kernel weight
7. Total dry matter production
8. Grain yield
9. Chemical analysis (for selected lines)

3. Publication: MART/AZR Research Report and refereed publication.

AZRI Research Protocol

Protocol code: G5 (ongoing) **Priority:** 1

Title of project: selection of winter-type, bold-seeded lentil lines for dry highlands of Balochistan.

Collaborating Institutions: ICARDA Legume Program, Aleppo

Principal AZRI investigator: Sarfraz Ahmad (SO)

Collaborating AZRI scientific staff: Sayed Abdul Jallel (ASO)

Collaborating non-AZRI scientific staff: Dr. W. Erskine, ICARDA, Aleppo

Date of commencement: 1989/90

Date of completion: 1995

Site of project: ARI Sariab Quetta, Kan Mehtarzai and Loralai

1. Objectives

To select cold and drought tolerant, disease free, high yielding and bold-seeded lentil lines.

2. Experimental details

Total Entries	: 50 (approximately, in different Trials)
Design	: RCB
No. of Replication	: 3
Plot area	: 7.5 m2
Fertilizer rate	: NPK 60:60:0 kg/ha + Inoculum
Irrigation	: Pre-soaking, (if needed)
Sowing Time	: Autumn

Variables to be measured:

1. Cold and drought tolerance
2. Flowering date
3. Disease resistance
4. Maturity period
5. 1000 seed weight
6. Total dry matter production
7. Seed yield
8. Chemical analysis (for selected lines)

3. Publication: MART/AZR Research Report and refereed publication.

AZRI Research Protocol

Protocol code: G6 (ongoing) **Priority:** 1

Title of project: screening of lentil lines for spring sowing in the arid highlands of Balochistan.

Collaborating institutions: ICARDA Legume Program, Aleppo

Principal AZRI investigator: Sarfraz Ahmad (SO)

Collaborating AZRI scientific staff: Syed Abdul Jaleel (ASO)

Collaborating non-AZRI scientific staff: Dr. W. Erskine, ICARDA, Aleppo

Date of commencement: 1989/90

Date of completion: 1995

Site of project: ARI Sariab Quetta, Kan Mehtarzai and Loralai

1. Objectives

To evaluate and select short duration, heat and drought tolerant, disease free, high yielding lentil lines.

2. Experimental details

Total Entries	: (approximately 30, in different trials)
Design	: RCB
No. of Replication	: 3
Plot area	: 7.5 m^2
Fertilizer rate	: NPK 0:60:0 kg/ha + Inoculum
Irrigation	: Pre-sowing (if needed)
Sowing Time	: Spring

Variables to be measured:

1. Heat and drought tolerance
2. Maturity period
3. Disease resistance
4. 1000 seed weight
5. Total dry matter production
6. Seed yield
7. Chemical analysis (for selected lines)

3. Publication: MART/AZR Research Report and refereed publication.

AZRI Research Protocol

Protocol code: G7 (ongoing) **Priority:** 1

Title of project: introduction, evaluation and selection of forage legumes for winter-planting in the arid highlands of Balochistan

Collaborating institutions: ICARDA Legume Program, Aleppo

Principal AZRI investigator: Sarfraz Ahmad (SO)

Collaborating AZRI scientific staff: Syed Abdul Jaleel (ASO)

Collaborating non-AZRI scientific staff: Dr El Moneim, ICARDA, Aleppo

Date of commencement: 1989/90

Date of completion: 1995

Site of project: ARI Sariab Quetta, Kan Mehtarzai and Loralai

1. Objectives

To introduce palatable, cold and drought tolerant forage legume species suitable for winter-planting under non-irrigated conditions.

2. Experimental details

Total Entries	: 70 (approximately, in different trials)
Design	: RCB
No. of Replication	: 3
Plot area	: 7.5 m^2
Fertilizer rate	: NPK 0:60:0 kg/ha + Inoculum
Irrigation	: Pre-soaking (if needed)
Sowing Time	: Autumn

Variables to be measured:

1. Cold and drought tolerance
2. Early growth vigour
3. Flowering date
4. Maturity period
5. Disease resistance
6. Total dry matter production
7. Seed yield
8. Chemical analysis (for selected lines)

3. Publication: MART/AZR Research Report and refereed publication.

AZRI Research Protocol

Protocol code: G8 (ongoing) **Priority:** 1

Title of project: selection of forage legume species suitable for spring sowing in the arid highlands of Balochistan

Collaborating institutions: ICARDA Legume Program, Aleppo

Principal AZRI investigator: Sarfraz Ahmad (SO)

Collaborating AZRI scientific staff: Syed Abdul Jaleel (ASO)

Collaborating non-AZRI scientific staff: Dr. El Moneim, ICARDA, Aleppo

Date of commencement: 1989/90

Date of completion: 1995

Site of project: ARI Sariab Quetta, Kan Mehtarzai and Loralai

1. Objective

To select short duration, heat and drought tolerant, disease free, palatable, high yielding forage legumes for spring planting.

2. Experimental details

Total Entries	: 40 (approximately, in different trials)
Design	: RCB
No. of Replication	: 3
Plot area	: 7.5 m^2
Fertilizer rate	: NPK 0:60:0 kg/ha + Inoculum
Irrigation	: Pre-soaking, if needed.
Sowing Time	: Spring

Variables to be measured:

1. Heat and drought tolerance
2. Maturity period
3. Disease resistance
4. 1000 seed weight
5. Total dry matter production
6. Seed yield
8. Chemical analysis (for selected lines)

3. Publication: MART/AZR Research Report and refereed publication.

LIVESTOCK SECTION

Arresting range degradation is arguably the greatest challenge facing researchers and developers in Balochistan. Textbook solutions to this problem are repeated with monotonous regularity; these include reseeding with promising cool season exotic grass species and cold and drought tolerant shrubs; deferment or protection from grazing in early spring; controlling stocking densities; establishment of winter forage reserves, etc. (Nour 1989; Rafique and Akbar 1991). The chances of implementing these solutions on a large enough area to arrest further degradation seem as remote as ever. This *does not* mean that our efforts to do so should diminish, but that maybe some fresh thinking is needed. Other solutions to the problem, such as provision of alternative feeds, raise questions concerning the source of the feeds and the inherent dangers that providing additional feed will increase still further the population of small ruminants.

In view of the dangers indicated above, what is AZRI's strategy for livestock research? It is, *inter alia*, the investigation of low-technology solutions which will reduce year-to-year variations in farm incomes, mainly by increasing the off-take from production systems based on small ruminants in highland Balochistan, without accelerating the degradation of an increasingly fragile ecosystem. Furthermore, this increased off-take will help the attainment of one important national objective - increasing the domestic supply of red meat and skins.

Starting in 1991/92, research in the livestock section will attempt to quantify the extent to which offtake can be increased by improving the management systems of local sheep breeds. Particular attention will be given to ensuring that the fertility of ewes (Protocol L1) and the growth rate of their lambs (Protocol L2) reaches the genetic potential of the breeds; and that strategically aimed feeding of pregnant and lactating ewes enhances ewe and lamb survival (Protocol L4).

In addition, a gradual shift of the livestock research towards more careful definition of biological relationships will be initiated in 1991. For example, body condition scoring is being assessed as a potentially more accurate predictor of the nutritional status of ewes than liveweight. If it is found to be useful, then it should be possible to define the feeding of female animals more accurately so that their productive potential is reached.

References

Nour M. 1989. Rangeland Management in Pakistan. ICIDMOD Fellowship Series No. 1. ICIMOD, Kathmandu, Nepal.

Rafique, S. and Akbar, G. (Editors) 1991. Range-Livestock in Pakistan. Proceedings of an AZRI Seminar held on December 21-23, 1988, Quetta, Pakistan. In press.

AZRI Research Protocol

Protocol code: L1 (new) **Priority:** 1

Title of project: fertility of Balochi and Harnai ewes as influenced by differences in their liveweight and body condition scores in highland Balochistan

Collaborating institutions: none

Principal AZRI investigator: Dr. Shahid Rafique (SSO)

Collaborating AZRI scientific staff: Dr. Muhammad Munir (SO)

Collaborating non-AZRI scientific staff: none

Date of commencement: October, 1991

Date of completion: March, 1993

Site of project: Zarchi (Kalat) and Tomagh (Loralai)

1. Introduction

Previous studies at AZRI have verified that additional feeding of ewes prior to breeding enhances lambing rate. What is now needed is a better understanding of the factors which determine ewe fertility, rather than just recommending that farmers should feed (flush) ewes before breeding. This understanding will allow development of more precise management recommendations which should increase the probability that ewes will become pregnant. Body condition is known to be an important determinant of ewe fertility; the body condition can be assessed easily and given a numerical value, the body condition score, BCS. The proposed trial will study the value of BCS as a predictor of ewe fertility. The study will use 70-80 ewes grazing degraded ranges at both Tomagh and Zarchi. Starting four months before breeding takes place, ewes will be fed one of four levels of supplement that maintains them at a constant BCS until two months after conception. Four BCS categories will be used, ranging from very thin to fat. The study will last two or three years.

2. Objectives

1) To determine the relationship between fertility, liveweight and body condition score of Balochi and Harnai ewes grazing two types of degraded native rangelands of highland Balochistan.

3. Experimental Methods and Procedures

Seventy-to-eighty ewes of both the Balochi (at Zarchi in Kalat district) and Harnai (at Tomagh in Loralai district) breeds, and 2-5 years of age, will be used in a completely randomized design. The ewes will be divided into groups according to four body condition score categories: 0.5-1.0 (very thin), 1.5-2.0, 2.5-3.0 and 3.5-4.0 (fat) and balanced for age and weight. Four supplemental feeding levels will be applied to these four groups: the tentative feeding levels will be 300 (200 + 100), 600 (400 + 200), 900 (600 + 300) and 1200 (800 + 400) g/h/d of barley and cottonseed cake (2:1). However, the levels will adjusted in an effort to maintain the differences in the body condition scores of the four groups. Feeding will start from September 1, 1991 i.e., two months prior to breeding, and continue for two months after conception has occurred. The breeding will start from November 1 and last for two months. Feeding will be terminated on February 29. Group feeding will be applied to sub-groups of 4-5 ewes so that each sub-group will be considered as one experimental unit. The ewes will graze the native range and will be fed the supplemental ration in the afternoon when they return from grazing. If possible, vasectomized rams will be introduced to ewes on July 1 so the start of the breeding season can be defined from the initiation of cycling activity in ewes. Four intact rams will be introduced into flocks on November 1 and stay with the ewes for two months (random mating with multiple sires). Records of the exact mating dates and individual ram activity on specific ewes will be maintained by using color markers on rams. Colors of crayons will be changed at 17 days intervals and rams will be rotated between different ewe groups every 17 days. All the animals will be drenched with levamisol for internal parasite control before the experiment starts and vaccinated against the prevalent bacterial and viral diseases. Complete health records will be kept. Ewes will be weighed and body condition scored once every 15 days. The study will last at least two breeding seasons.

4. Experimental design

Completely randomized design.

5. Publication

MART/AZR Research Report will be published after completion of the experiment and later on, after gathering two to three years data, the research findings will be published in national or international refereed a journal.

6. References None

AZRI Research Protocol

Protocol code: L2 (new) **Priority:** 1

Title of project: assessing the fattening potential of Balochi lambs under intensive feedlot conditions

Collaborating institutions: none

Principal AZRI investigator: Dr. Shahid Rafique (SSO)

Collaborating AZRI scientific staff: Dr. Muhammad Munir (SO)

Collaborating non-AZRI scientific staff:

Date of commencement: September, 1991

Date of completion: December, 1991

Site of project: AZRI, Quetta

1. Introduction

One way to reduce the grazing pressure on the heavily degraded rangelands in highland Balochistan is to wean lambs when they reach 3-4 months of age and fatten them intensively. The weaned lambs could be either fattened by the farmers themselves, or sent to commercial feedlots at other locations. Inevitably, many questions concerning feedlot fattening arise, such as the source of feeds, the genetically determined growth and fattening potential of local breeds, and the optimal feed formulation for the prevailing prices of inputs and outputs. The latter two of these questions will be addressed in a pilot study using Balochi male lambs. Diets with different formulations will be used to derive a response curve between diet energy concentration and growth rate of the lambs. This pilot study will provide experience concerning the problems associated with such trials, for example diet palatability and intake levels.

2. Objective

1) To assess the fattening potential of male Balochi lambs under intensive feedlot conditions.

3. Experimental Methods and Procedures

Forty-to-fifty, three-to-four month old Balochi male lambs will be used in a randomized complete block design with two replicates. The study will last three-four months. The lambs will be randomly divided into groups and allotted one of the three treatments at random. The treatments will be three diets formulated to give different energy concentrations but equal in protein content. Diets will be offered *ad-libitum*, and composed from locally available ingredients such as barley grain, cottonseed cake, wheat bran, urea, and wheat straw. Lambs will be fed in subgroups of 5-6 lambs per pen and these subgroups will serve as replicates. A mineral-vitamin mix and water will be available in pens. Lambs will be weighed on two consecutive days at the start and finish of trial after an overnight fast, and every 15 days during the intervening period. Feed intakes of subgroups will be measured each day.

4. Experimental design

Completely randomised design

5. Publication

MART/AZR Research Report and a paper in a refereed national journal.

6. References None

AZRI Research Protocol

Protocol code: L3 (carried over from 90/91) **Priority:** 1

Title of project: nutritive evaluation of woollypod vetch and barley at the hay and mature stage and grown under dryland conditions in highland Balochistan

Collaborating institutions: Balochistan Livestock Department

Principal AZRI investigator: Dr. Muhammad Munir (SO)

Collaborating AZRI scientific staff: Mr. Sher Mahmood Shah (SO)
Dr. Shahid Rafique (SSO)

Collaborating non-AZRI scientific staff: Dr. M. Alam Maingal, Vet. Officer, Government Dairy Farm, Balochistan Livestock Department, Quetta.

Date of commencement: July, 1991

Date of completion: September, 1991

Site of project: AZRI

1. Introduction

The rangelands of highland Balochistan are showing severe symptoms of overgrazing because of the excessive population of small ruminants. One potential solution to this problem is to use a part of the cultivated land to grow forage crops which can be conserved and used during periods of shortage. Research at AZRI over the last few years has identified woollypod vetch (*Vicia villosa* subsp. *dasycarpa*) as an annual legume with high yield potential, even when annual rainfall is below 300 mm. The Syrian barley landrace Arabi Abiad has also shown good yield potential under local conditions. The trial described here aims to determine the nutritive value of these two forages, compared with the local barley landrace, at harvested at the hay and mature stages of crop maturity.

2. Objectives

1) To study the palatability, intake and digestibility of woollypod vetch and barley harvested at the hay and mature stages of maturity and grown under rainfed conditions in highland Balochistan

3. Experimental Methods and Procedures

Two lines of barley, one Pakistani and one the Syrian landrace Arabi Abiad, and one vetch (woolly pod vetch - *Vicia villosa* ssp. *dasycarpa*), were grown under rainfed conditions in 1990 at AZRI Farm, Quetta. Six 10 x 4.5 m plots of each species were sown in a completely randomized design during winter and were ready for grazing in spring 1990. Three of the six plots of each species were harvested at the flowering stage and dried as hay. The other three plots of each species were harvested at the seed hardening stage and sun-dried. All the hay and straw was threshed to pass through a 2.5 cm screen and stored at room temperature for later use in a digestibility study.

Eighteen Balochi lambs, four-to-five months of age, will be used in a completely randomized design with a 3 x 2 factorial arrangement of treatments (three forages at two maturity stages) and divided randomly into six groups of three animals each. The six treatments will be allotted to the six groups at random. The forages will be fed *ad libitum* individually to each lamb penned in metabolism crates at the Animal Nutrition Research Unit (ANRU), AZRI, Quetta. Records of daily feed offered and refusals will be maintained and representative samples saved. Water will be available free choice. Seven days will be given as the adaptation period and three to five days will be the collection period. Feces voided daily by each lamb will be collected in fecal collection bags and weighed. Ten percent of the total feces will be dried in a hot air oven at 60°C for 48 hours. Ten percent representative samples of feed, orts and dry feces for each lamb will be pooled across days and stored at room temperature for later analysis. Dry matter and nitrogen contents will be determined by standard methods, ADF and NDF analyzed the procedures of Goering and Van Soest, and digestibility calculated.

4. Experimental design

Completely randomised design with factorial arrangement of treatments.

5. Publication

MART/AZR Research Report and paper in national refereed journal.

AZRI Research Protocol

Protocol code: L4 (new) **Priority:** 2

Title of project: performance of lambs from ewes with different body condition scores, given two levels of supplementary feed in late pregnancy and early lactation, and grazing two rangeland types in highland Balochistan

Collaborating institutions: none

Principal AZRI investigator: Dr. Shahid Rafique (SSO)

Collaborating AZRI scientific staff: Dr. Muhammad Munir (SO)

Collaborating non-AZRI scientific staff: none

Date of commencement: March, 1992

Date of completion: August, 1992

Site of project: Zarchi and Tomagh

1. Introduction

Previous studies at AZRI confirm other studies that supplementary feeding of ewes in late pregnancy and early lactation improves lamb growth rate and reduces ewe and lamb mortality. However, even though supplementation appears to be an attractive option, few farmers use them other than wheat straw. Indeed, it may be undesirable to encourage farmers to feed supplements since they might try to own more animals which would put even more pressure on the already heavily degraded rangeland. Supplementation should therefore be kept to a minimum. This study will attempt to establish that minimum, but at the same time investigate higher levels of supplementation so that biological response curves can be determined. Different market prices of inputs and outputs can then be applied so that a feeding level can be determined that maximizes returns to the farmer facing a changing price environment. Possible interactions between body condition scores of ewes and level of supplementation will also be studied.

2. Objectives

1) To monitor the performance of lambs from ewes of the Balochi and Harnai breeds with different body condition score, fed two levels of supplementary feed during late pregnancy and early lactation, and grazing two rangeland types in highland Balochistan

3. Experimental Methods and Procedures

Seventy-to-eighty pregnant ewes of the Balochi (at Zarchi in Kalat district) and Harnai (at Tomagh in Loralai district) breeds from the fertility trial L10 will be used in a completely randomized design with a factorial arrangement of treatments (two supplement levels x four body condition scores). The ewes will be maintained in the same four body condition score groups i.e., 0.5-1.0 (very thin), 1.5-2.0, 2.5-3.0 and over 3.0 (fat) and each group will be further divided into two sub-groups. Different supplemental feeding levels will be applied to the sub-groups: no supplement (control) and a modest level of supplement covering 50-75% of metabolizable energy requirements. The supplement will contain a ratio of barley grain, cottonseed cake and wheat bran to give 11% crude protein. During pregnancy levels of feeding will be adjusted once every 15 days according to the expected date of lambing, then again at lambing and at 15 days intervals thereafter. The feeding will start from March 1, 1992 and continue for approximately 90 days after lambing has taken place. The lambing is expected to start from April 1 and should be over in 60 days. Group feeding (4-5 ewes per group) will be practised and each group will serve as an experimental unit. The ewes will graze the native range and will be fed the supplement in the afternoon after returning from grazing. Urea-treated wheat straw will be fed as maintenance ration to the control ewes if they cannot be supported by range grazing alone. Records of the exact lambing dates, sex of lamb, lamb birth and weaning weights and mortality will be maintained. All the animals will be drenched with levamisol for internal parasitic control and treated for external parasites. Ewes will be vaccinated against the prevalent bacterial and viral diseases. Ewes and lambs will be weighed and ewes body condition scored fortnightly.

4. Experimental design

Completely randomised design with factorial arrangement of treatments.

5. Publication

MART/AZR Research Report and paper in a national/international refereed journal.

References None

AGRONOMY SECTION

The agronomy group started operations under the present grant agreement in 1985, with a staff level of six local scientists, along with one ICARDA adviser. Exploratory agronomy trials were carried out in the first two years into the four main crops (wheat, barley, lentils and forage legumes), tillage, water harvesting, fertilizers, and weeding. These trials indicated that modest improvements in farmers yields could be obtained from some of the improved practices in good years, but rarely in average or poor years in this arid environment. The work on the more promising of these lines was continued in subsequent years, and trials were laid down at more sites. Results are given in several MART/AZR Research Reports, as shown in the attached list of AZRI Research Reports, and have been published in various scientific journals.

At the planning meeting last year, the results from the previous year, and the plans for the 1989-90 season then in progress, were presented and discussed. This year, the results from 1989-90 will be given, and the trials in progress at the moment will be described and discussed; there will also be a chance to see some of these trials on the ground during the field visit.

Staff. The AZRI staff numbers in the Agronomy group went down from six to three during the previous year due to departures for overseas training and for marriage. During the current year, numbers have declined even more, with the former team leader (SSO) having been promoted and transferred, and no replacement appointed. The agronomy programme for 1990-91 has therefore had to be pruned, with some work being stopped, and several of the previous separate aspects being put together into the single large, multi-factorial water-harvesting trial laid down at several sites.

Objectives. The main objectives in 1989/90 were to:-

- continue the catchment basin water harvesting trials (CBWHTs) started in 1986/87 at existing and additional sites.
- evaluate the yields of the promising woollypod vetch, *Vicia villosa* ssp. *dasycarpa*, under different seed rate, inoculation and fertilizer treatments, and
- measure the effects of other interventions such as manure, fertilizers and intercropping on the yields of wheat, barley and vetch.

Climatic Conditions. The low rainfall from July to December 1989 was insufficient for planting crops in winter. It was only after good rain in late December and early January that the agronomy trials could be planted. There was heavy rains from then until March but it stopped abruptly towards the end of that month. The rainfall season was therefore rather short but quite copious which caused some waterlogging during February. The favourable rainfall conditions in several districts led to an epidemic of yellow rust (*Puccinia striiformis*) which devastated wheat yields; wheat in the agronomy trials at Loralai was virtually wiped out. There were no serious late frosts to damage these spring plantings but very dry desiccating winds in April caused some shrivelling of grain during maturation.

Agronomy Trials. The agronomy trials are all purely rainfed. The local name for such rainfed cropping is "khushkaba" where no run-on from outside flows on to the cropped area; where there is some run-on from flood water in higher areas

the term "sailaba" is used. All the trials were khushkaba except at Kolpur; *there* all the trials except the water harvesting one were sailaba. The trials were sited on gently-sloping or almost flat valley bottoms, in Kolpur, Dasht, Kovak, Miangundi and Mehtar, near Loralai. Most soils were silty clay loams or silt loams, which when wetted tend to seal very quickly, and form a hard crust on drying.

i) Catchment basin water harvesting trials were started in 1986/87, and went on with small changes into 1989/90. The catchments were set up by ploughing with a tractor-mounted mouldboard plough, then the soil was pulverised and levelled with a heavy tractor-mounted wooden plank. Once made, catchments should remain effective for many years with only minor upkeep. The three treatments in 1989/90 were a control, where the whole area was cropped, a 1:1 catchment-to-crop area where the upper half was a smoothed catchment, and a 2:1 catchment-to-crop area with the top two-thirds smoothed. Wheat, barley and woollypod vetch were grown.

Water harvesting increased the TDM produced by all three crops, with the 2:1 treatment exceeding the 1:1, which surpassed the control. Grain yields were affected differently; the 1:1 treatment surpassed the control for all three crops but the 2:1 plots of wheat and vetch did not exceed the control, and were poorer than 1:1 plots. Waterlogging lasted for slightly longer in the 2:1 than in the 1:1 and control, and this affected grain production in the wheat and vetch more than in the barley, which was more tolerant of the temporary waterlogging. These findings confirmed that CBWH has a modest potential for increasing yields and reducing risks of crop failure where there is very erratic, variable rainfall. One problem is the waterlogging in the 2:1 treatment, and efforts will be made in the 1990/91 trials to overcome this.

ii) Trials on woollypod vetch were conducted to measure both forage and seed yields from five seed rates - 30, 60, 90, 120 and 150 kg seed/ha - with and without inoculum, and with and without phosphate. The 30 and 60 kg/ha seed rates were best for seed production, and for forage production 60 kg/ha was best. Both seed and TDM yields declined at the higher seed rates. Inoculum increased yields significantly, but phosphate gave only small increases.

iii) Factorial trials were laid down at Kolpur, Mastung and Miangundi to measure the effects of 10 t/ha of FYM, and fertilizers (40 kg N/ha and 60 kg P_2O_5/ha), on Pak 81 wheat and Arabi Abiad barley. Yields at Kolpur were higher due to an appreciable amount of sailaba run-on. There, both FYM and fertilizer gave significant grain and TDM yield increases, while barley outyielded wheat by 51%. At the other two kushkaba sites yields were lower and significant responses fewer.

iv) A fertilizer trial with four rates of N and P was laid down as a 4 x 4 *factorial* with three replications. The rates were 0, 20, 40 and 80 kg N/ha As ammonium nitrate, and phosphate at 0, 30, 60 and 120 kg P_2O_5 /ha as triple superphosphate at planting. No significant N or P responses were obtained.

v) To find out if intercrops of cereals and vetch could increase production and make harvesting easier, intercropping trials have been conducted for some years. In 1989/90 the four treatments were: monocropped wheat, monocropped woollypod vetch, a single row of vetch sown between 2 rows of wheat and a single row of

wheat sown between 2 rows of vetch. At the Kolpur sallaba site, intercropping reduced total grain yield compared with pure wheat, but having one row of wheat between two rows of vetch increased overall forage yields.

AZRI Research Protocol

Protocol code: A1 (ongoing) **Priority:** 1

Title of project: catchment basin water harvesting

Collaborating institutions: none

Principal AZRI investigator: Syed Sher Mahmood Shah (SO)

Collaborating AZRI scientific staff: 1. Mr. Mohammad Islam (SO)
2. Mr. Mohmmad Aslam (SO)
3. Mr. M. Afzal (ASO)
4. Mr. S. Ali Shah (SA)

Collaborating non-AZRI scientific staff: none

Date of commencement: July, 1990

Date of completion: Continuing for several years

Site of project: Mastung, Kolpur, Spezand, Dasht and Loralai.

1. Introduction

Catchment basin water harvesting is being studied at AZRI to improve crop yields on valley bottom soils, which have very poor permeability. Low earth banks are constructed around plots measuring c. 60 x 20 m. The soil on the upper proportion of the plots is sealed to allow the water to run off on to the lower remaining infiltration area where crops are grown. The crops being tried are wheat, barley, lentils and woollypod vetch, an annual forage legume, and also fourwing saltbush, a forage shrub (*Atriplex canescens*). Aspects to be studied include: the effects of the water-harvesting treatments on crop yields and on responses to fertilizer and manure;techniques for preparing the run-off areas and prolonging their life-spans; use of spill-over water for Atriplex forage production; and the income stabilizing and risk reduction benefits associated with the use of water harvesting.

2. Objectives

In general, to enhance the supply of food and feed crops in upland Balochistan, using sustainable water harvesting techniques to increase the frequency of economic crop yields and reduce risks of crop failures.

More specifically, to establish catchment basin water harvesting trial sites at additional locations in Balochistan;
-to quantify the improvement in yields and water-use-efficiencies obtained from better water-harvesting treatments;
-to measure the effects of fertilizer and manure when these are used along with water-harvesting;
-to determine the life-span of the run-off areas, and develop techniques to prolong that life-span.

-using promising water-catchment designs, to establish salt-bush fodder reserves using spilt-over water from infiltration areas.
-to estimate the reduction in the risks of crop failures achieved by the applied water harvesting practices.
-to involve farmers in the use of water-harvesting as a technology for increasing crop yields.

3. Methods

Field trials will be conducted at four sites around Quetta, in upland Balochistan. Each trial consists of three replicates.

The four main water-harvesting treatments are:- a control, with no water harvesting applied. and three treatments with different ratios between the catchment and cropped areas, namely 1:1, 2:1 and 3:1. Yhe last two treatments also have a buffer zone below the crop area, where excess water is to be used to grow Atriplex.

Each main treatment is split into 12 subplots, where there are four crops - locally available or AZRI improved varieties of wheat, barley, lentils and woolly-pod vetch (*Vicia Villosa* subsp.*dasycarpara*). The crops are grown with or without manure, and in addition the wheat and barley are grown with and without NP fertilizer. The 12 treatments are:-

{(W or B) x 2F x 2M} + {(L or V) x 2M}

Soil samples were taken for gravimetric moisture determination at all sites, while neutron probe access tubes were installed only at the Mastung site.

Crops observations will be made at different phenological stages, and when mature, crop samples will be taken for measuring straw and grain yield. Water-use-efficiencies of crops will be calculated.

Simple economic analysis will be done to estimate benefit: cost ratios and variability in profit margins over time. This variability will make it possible to estimate the risk of applying the technology, in comparison with traditional methods.

4. Experimental design

Each trial site has 3 reps of the 4 main treatments and each main treatment is split into 12 sub-plots.

5. Publication. MART/AZR Research Report and national refereed journal.

AZRI Research Protocol

Protocol code: A2 (new) Priority: 1

Title of project: seed multiplication of improved lines/varieties

Collaborating institutions: none

Principal AZRI investigator: Syed Sher Mehmood Shah (SO)

Collaborating AZRI scientific staff: 1. Mr. Mohammad Islam (SO)
2. Mr. Mohmmad Aslam (SO)

Collaborating non-AZRI scientific staff: none

Date of commencement: July, 1991

Date of completion: July, 1992

Site of project: Mastung, Kolpur, Dasht and AZRI, Quetta

1. Introduction

Seeds of genotypes which have performed well in trials need to be multiplied up for further, more extensive trials, including on-farm testing, and also for larger-scale seed multiplication and distribution later.

2. Objectives

3. Methods

Seeds of promising cereals, lentils and forage legumes were planted in sailaba and khushkaba conditions in upland Balochistan on farmers land at Kolpur, and at AZRI, Quetta and Mastung, as shown below:-

No:	Crop	Variety	Location	Area planted(sq.m.)
1.	Wheat	Sonalika	Kolpur	140
2.	"	Zamindar	"	140
3.	"	Local wheat	"	5200
4.	"	No: 603	"	20
5.	"	NO: 613	"	20
6.	"	No: 620	"	20
7.	"	No: 923	"	20
8.	"	No: 1003	"	20
9.	"	NO: 1007	"	20
10.	"	No: 913	"	20
11.	"	Kahani	"	20
12.	"	Soreviki	"	20
13.	"	Punjab-85	"	5400
14.	Barley	Arabic Aswad	"	600
15.	"	Wadi Hassa	"	600
16.	"	w-12291/w12269	"	150

17.	"	Arabic Abiad	"	5400
18.	"	" "	AZRI	500
19.	Vicia	Dasycarpa	"	1000
20.	"	"	Mastung	1000
21.	"	"	Kolpur	1360

4. Experimental design — Not applicable.
5. Publication — Not applicable.

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AZRI Research Protocol

Protocol code: A3 (on going) Priority: 1

Title of project: agrometeorological recording

Collaborating institutions: none

Principal AZRI investigator: Syed Sher Mehmood Shah (SO)

Collaborating AZRI scientific staff: 1. Mr. Mohammad Islam (SO)
2. Mr. Mohmmad Aslam (SO)

Collaborating non-AZRI scientific staff: none

Date of commencement: 1985

Date of completion: This is a continuous activity

Site of project: AZRI; ARI; Mastung; Tomagh; Kolpur and Loralai

1. Introduction

Accurate agromet data is essential for the evaluation and interpretation of agricultural research data, especially in an area like Balochistan, which is characterised by a very variable and inhospitable climate. Good data enables the risks of crop failures to be assessed more exactly, and can assist in evaluating whether new technology is likely to
decrease risks, or involve major changas in farmers' practices.

In addition to rainfall, 16 other parameters, such as max/min air and soil temperatures, humidity, sunshine hours and wind speeds are recorded in detail; evapo-transpiration is automatically calculated. The data are collected regularly and stored in AZRI's computers for future research use.

2. Objectives

To collect Agromet. data from AZRI trial sites, so that experimental results can be related to the prevailing climatic conditions during growth and to build up a

data bank of agro-met data, for use in AZRI's research; the data-base is also a valuable resource for other organisations.

AZRI Research Protocol

Protocol code: A4 (on going) **Priority:** 1

Title of project: routine analyses of soil, water and plants materials

Principal AZRI investigator: Syed Sher Mehmood Shah (SO)

Collaborating AZRI scientific staff: Mr. Mohammad Islam (SO)

Date of commencement: This is a continuous activity

Site of project: Laboratories at AZRI, Quetta

1. Introduction and objectives:

A laboratory for the analyses of soil, water and plant materials was set up at AZRI several years ago, and is equipped for carrying out analyses of samples of soil, water and plants materials from experiments on a routine basis.

AZRI Research Protocol

Protocol code: AE1 (on going) **Priority:** 1

Title of project: on-farm evaluation of 3-row camel seed drill

Collaborating institutions: none

Principal AZRI investigator: Mr. Bilal Chaudry (SO)

Collaborating AZRI scientific staff: Syed Sher Mehmood Shah (SO)
Mr. Mohammad Islam (SO)
Mr. Mohmmad Aslam (SO)
Mr. M. Afzal (ASO)

Collecting non-AZRI staff: none

Date of commencement: July, 1990

Date of completion: July, 1992

Site of project: Spezand, Kolpur, Mastung.

1. Introduction

Over the last three years, a 3-row camel-drawn seed drill has been developed by a Faisalabad farm machinery company in collaboration with the agronomy group, and several prototypes were procured for on-farm trials.

The extension group laid down some plots in Spezand and Mastung in Jan 1991, to compare the performance of the planter with the conventional method of planting, where farmers use the traditional camel plough. These preliminary efforts will be extended to more farmers in 1991-92.

2. Objectives

To compare the 3-row seed drill with the traditional planting method.
To obtain data on labour inputs and results of the two methods.
To evaluate the potential benefits of using the 3-row planter.

3. Methods

In 1991, plots of local wheat and Arabic Abiad barley each measuring 30 x 10 m. were planted with the 3-row planter, side by side with similar sized plots planted with a traditional one-furrow plough by the farmers normal method. Similar treatments will be used in the second year.

Farmers will be asked to evaluate the performances and potential benefits of the drills under their conditions, and indicate whether they would be prepared to purchase such machines themselves, for local use and possibly contract-hire.

Experimental design

The two treatments will be compared over a number of on-farm sites, which will act as simple replications.

5. Publication

MART/AZR Research Report, and a local refereed journal.

AGRICULTURAL ECONOMICS

The four research protocols presented below are the detailed version of the future activities of the Agricultural Economics group outlined in the 1990 Annual Report (AZRI and ICARDA/AZR, 1991). They emphasize the need to develop linkages with the emerging private sector of Balochistan, which will enable the identification of bottlenecks in production and marketing of AZRI commodities, and suggest alternatives to these bottlenecks. The "Marketing and Processing of Small Ruminants products in Highland Balochistan" (Mahmood and Rodríguez, 1991) is a good example of the steps in this direction.

The first two research protocols ("Pricing of Small Ruminants by Producers, Wholesalers and Commission Agents in Highland Balochistan" and "Skins Marketing Survey in Highland Balochistan") are a continuation of research guidelines generated in previous studies on livestock development. If AZRI human resources improve, a study on the sociological aspects of livestock transactions could be initiated to complement our knowledge of pastoralists' view points towards the improvement of livestock quality. This kind of study will permit a more holistic approach toward livestock development in highland Balochistan.

The last two research protocols ("Seasonal Price Indices of Agricultural and Livestock Commodities of Quetta and Karachi Markets" and "Risk Analysis of Cereal Crops Grown Under Water Harvesting Techniques in Highland Balochistan") represent blocks of knowledge which are tremendously important for AZRI's future research. Development of production and marketing strategies of the agricultural and livestock products in highland Balochistan will take advantage of the seasonal price indices of major consumption centers such as Quetta and Karachi. The adoption potential of water harvesting techniques for cereal production is possibly one of the most exciting topics of sustainable low-input rainfed agriculture in highland Balochistan. As mentioned below, a by-product of the risk analysis study will be the crop module of the AZRI model (see AZRI and ICARDA/AZR, 1991).

References

Arid Zone Research Institute (AZRI) and International Institute for Agricultural Research in the Dry Areas/Arid Zone Research (ICARDA/AZR). 1991. 1990 Annual Report. MART/AZR Project Research Report No. 65, ICARDA Quetta.

Mahmood, K. and A. Rodríguez. 1991. Marketing and Processing of Small Ruminants in Highland Balochistan. MART/AZR Project Research Report No. 68, ICARDA Quetta.

AZRI Research Protocol

Protocol code: E1 (new) **Priority:** 1

Title of project: pricing of small ruminants by producers, wholesalers and commission agents in highland Balochistan

Collaborating institutions: none

Principal AZRI investigator: Mr Nisar Ali Shah (SA)

Collaborating AZRI scientific staff: Mr Muhammad Afzal (ASO)
Mr Jamil Ahmad (SO)
Mr Mohammad Rafique (ASO)

Collaborating non-AZRI scientific staff: Mr Imran Ali (ICARDA consultant)

Date of commencement: January, 1991

Date of completion: December, 1992

Site of project: Quetta

1. Introduction

The objective of this study is to quantify the factors that determine the pricing of small ruminants by producers, wholesalers and commission agents. The underlying hypothesis is that the pricing mechanism of different market agents can provide valuable information about the potential to extend the knowledge on animal husbandry practices and marketing strategies to producers. This study was started in January 1991 and will continue for a period of two years in the Quetta livestock market. Quantification of the seasonal changes in livestock prices will allow the estimation of the strength of the relationship between weather variables and forage production with price dynamics. The lags between shortages of forage availability and livestock prices can be used to develop livestock production and market planning.

2. Objectives

1) To quantify pricing mechanisms of producers, wholesalers and traders on the basis of body condition, sex, breed, age, live weight and time of the year.
2) To test the homogeneity of the pricing models and the interaction of variables as a way (mechanism) to assess the impact of extension services.
3) To quantify the relationship between the changes in prices and the changes in forage availability.

3. Experimental Methods and Procedures

Each month of the two year study, the team made up of agricultural economists and livestock scientists will visit the Quetta Livestock Market and weigh 50 sheep and 50 goats of producers, and the same number of sheep and goats will be weighed from wholesalers and/or commission agents. These producers, wholesalers and commission agents will be asked to give a selling price for each of their animals. An electronic balance will be used to weigh the animals and the team will determine their body condition, breed, sex and age. Data will be analyzed with SPSS. Econometric models will be developed using linear, log linear and double-log price models for the different market agents, type of animal (sheep or goat), sex and season. The homogeneity of models and interaction of variables will be tested using analysis of covariance (Johnston, 1972). Precipitation will be used as a proxy for forage availability and will be entered as another variable to determine its relation with price seasonality.

4. Experimental design Econometric models, using analysis of covariance.

5. Publications

A MART/AZR Research Report will be prepared based on the preliminary analysis of the first year's data (February 1992). A manuscript will be sent for consideration by an international refereed journal (**Agricultural Economics**) towards the end of 1992.

References

Johnston, J. 1972. Econometric Methods. McGraw Hill, New York.

AZRI Research Protocol

Protocol code: E2 (new) **Priority:** 1

Title of project: skins marketing survey in highland Balochistan

Collaborating institutions: none

Principal AZRI investigator: Mr Imran Ali (ICARDA consultant)

Collaborating AZRI scientific staff: Mr Nisar Ali Shah (SA)
Mr Mohammad Afzal (ASO)
Mr Mohammad Rafique (SA)

Collaborating non-AZRI scientific staff: none

Date of commencement: December, 1990

Date of completion: January, 1992

Site of project: Loralai, Sanjavi, Kuchlak, Almo Chowk, Kalat, Mustung and Quetta

1. Introduction

Skins and other inedible and edible offal contributed 16% to the butcher's gross revenues (Mahmood and Rodriguez, 1991). There are beoparies (traders) and commission agents in the slaughter houses who arrange the purchase of these skins for further processing. Processed skins, treated with salt for preservation are then sold locally or exported to other provinces.

Quantification of skin processing and marketing is necessary to determine if there are opportunities to increase producers' and other market agents' income. Results from this survey will be used to promote livestock quality awareness on the producer side, to attract entrepreneurs to take advantage of the market opportunities and to encourage the provincial government to have a more prominent role in livestock development.

2. Objectives

1) To identify potential opportunities to improve the marketing efficiency of skins in highland Balochistan.
2) To identify the problems faced by different market agents.
3) To evaluate the potential of developing tanneries in highland Balochistan and/or improving export channels.

3. Experimental Methods and Procedures

An informal survey was conducted in December 1990 to prepare a questionnaire for different market agents: managers of slaughter houses, commission agents, beoparies (traders) and butchers. Questionnaires will be filled out in Loralai, Sanjavi, Kuchlak, Kalat, Mastung, Zhob, Kachi and Quetta. This questionnaire was pretested in January 1991 and a formal questionnaire has been finalized.

Butchers who operate with the registered slaughter houses and in those who slaughter by themselves will be interviewed to obtain information about grading, storage, sale price to commission agents or beoparies, tools used in skinning the animals. Other market agents will be interviewed in the slaughter houses. The following information will be obtained from the managers of the slaughter houses: facilities in the slaughter house, origin of the animals, seasonality of processing rates, and grading and standardization of skins. The commission agents will be interviewed about the commission paid per skin, grading of skins, storage, transportation costs, credit availability, etc. Beoparies will provide information with regard to grading, pricing and disposal of skins, as well as export channels, costs and returns.

Data will be analyzed with SPSS and simple descriptive statistics will be used to prepare a final report. Results from this survey will be presented for consideration of interested parties (government and entrepreneurs).

4. Experimental design. Simple descriptive statistics.

5. Publications

MART/AZR Research Report will be prepared and a paper will be submitted to an international refereed journal (**Small Ruminants Research**).

References

Mahmood, K. and A. Rodríguez. 1991. Marketing and Processing of Small Ruminants in Highland Balochistan. MART/AZR Project Research Report No. 68, ICARDA Quetta.

AZRI Research Protocol

Protocol code: E3 (new) **Priority:** 2

Title of project: seasonal price indices of agricultural and livestock commodities of Quetta and Karachi markets

Collaborating institutions: agricultural and livestock products marketing and grading department, Government of Pakistan (ALPMGD) and ICARDA.

Principal AZRI investigator: Mr Muhammad Afzal (ASO)

Collaborating AZRI scientific staff: Mr Jamil Ahmad (SO)

Collaborating non-AZRI scientific staff: Mr Malik Muhammad Yousaf, Marketing and Grading Inspector (ALPMGD)

Date of commencement: July, 1990

Date of completion: July, 1992

Site of project: Quetta and Karachi

1. Introduction

Seasonal price indices of agricultural and livestock commodities are useful for planning production and marketing strategies. If AZRI is to develop technological packages to improve food and fiber production by farmers and pastoralists of highland Balochistan, it is important to determine the opportunity costs of consuming or selling these commodities. Because Balochistan is not isolated from other provinces it is important to know how integrated are the markets of the major cities. The seasonal price indices of major consumption centers such as Karachi and Quetta can suggest the trade patterns between Balochistan and Sindh. The usefulness of these indices for whole farm modelling and regional planning are extremely valuable.

2. Objectives

1) To compare the prices of agricultural commodities of the Quetta and Karachi market.
2) To find out the price fluctuations in different seasons.
3) To develop seasonal price indices for agricultural and livestock commodities.
4) To train the AZRI agricultural economists in time series analysis.

3. Experimental Methods and Procedures

The following data sets are being assembled/updated:

1) Quetta market monthly prices data from July 1985 to April 1991 has been collected for 24 agricultural commodities from the Agricultural and Livestock Products Marketing and Grading Department. These are: wheat flour, rice, pulses (gram, mung, masoor, mash) chillies, turmeric, potato, onion, tomato, garlic, ginger, maize, maida, suji, sugar, poultry,meat and livestock products (milk, cheese, mutton, beef, poultry meat and eggs).

2) Weekly data from the Karachi market has been gathered since July 1990 and it will continue for two years. The commodities are: wheat, barley, sorghum, maize, lentil, fodder supplement (cotton seed, oil cake) and eggs.

3) A third data set needs to be gathered from Karachi Marketing Division for the monthly prices from July 1985 to April 1991 for the same 24 commodities included in data set 1.

Data sets 1 and 3 will be used for developing seasonal price indices and to determine the degree of integration of the Quetta and Karachi markets. Data set 2 will be used for training of AZRI and Provincial Government scientists in time series analysis.

4. Experimental design

5. Publications

A MART/AZR Research Report will be prepared and a paper will be submitted to a domestic refereed journal (e.g., Pakistan Journal of Agricultural Social Sciences).

AZRI Research Protocol

Protocol code: E4 (new) **Priority:** 2

Title of project: risk analysis of cereal crops grown under water harvesting techniques in Highland Balochistan

Collaborating institutions: none

Principal AZRI investigator: Mr Nisar Ali Shah (SA)

Collaborating AZRI scientific staff: Mr Muhammad Afzal (ASO)
Mr Sher Mahmood (SO)

Collaborating non-AZRI scientific staff: Mr Imran Ali (ICARDA consultant)

Date of commencement: January, 1991

Date of completion: September, 1992

Site of project: Quetta

1. Introduction

Because of low and erratic rainfall conditions of highland Balochistan, water harvesting techniques have potential to increase yields and reduce long-term variability of crop production. Four years of data for wheat and two years for barley will be analyzed to determine the net benefits of two treatments (1:1 and 2:1 proportions of catchment to crop area) compared to the control (no catchment area, traditionally managed). The net benefits of four years of data for wheat and two for barley are scattered points in the probability distributions of net benefits. In situations where weather variability is extremely influential on crop performance, it is necessary to incorporate the probabilities of different rainfall intensities in the economic analysis. Thus, simulation techniques will be used to find distributions of net benefits of these cereal crops. Stochastic dominance analysis will be used to find farmer's preferences for different water harvesting techniques. Once that the adoption potential of water harvesting techniques is known, the optimal land allocation for different crops and other managerial aspects, can be further assessed. As a by-product of this research, the basic structure of the crop module of the AZRI model (AZRI and ICARDA/AZR, 1991) will be developed.

2. Objectives

1) To asses the adoption potential of water harvesting techniques for cereal crops grown in highland Balochistan.
2) To find out if water harvesting practices (1:1 or 2:1 catchment to crop area treatments) are preferred by farmers over the traditional management practice.
3) To compare farmers' preferences between alternative water harvesting practices.
4) To provide guidelines for on-farm optimal land, labor and capital allocation.

3. Experimental Methods and Procedures

Four seasons of wheat trials (1986/1987 to 1989/1990) and two seasons of barley trials (1988/1989 and 1989/1990) at Mastung, Kolpur and Dasht will be analyzed with enterprise budgets specifically developed to reflect the costs and revenues of a particular season in a given location. Historical rainfall data will be read with BELINDA (Kidd et al. 1987). Simulations of water run-off of different treatments of water harvesting will be done with CARE (model developed by Dr. E. Perrier) following the guidelines provided by Rees (1990). Water-use-efficiency coefficients estimated by the agronomy group will be incorporated into a simulation model that will include enterprise budgets for one growing season. The net returns from fifty growing seasons for different treatments will be analyzed with a generalized stochastic dominance analysis package (Cochran and Raskin, 1988) to assess the farmers' preferences for different water harvesting techniques. Based on the results of the stochastic analysis of cereals grown under water harvesting techniques, some guidelines will be provided to assess on-farm optimal land, labor and capital allocation.

4. Experimental design Stochastic dominance analysis.

5. Publications

A MART/AZR Research Report will be prepared and a paper will be submitted to an international refereed journal (**Agricultural Systems**).

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Range Section

Research on fourwing saltbush (FWSB) will be given particular attention during the coming year. As well as continuing the research started during 1990/91, new studies will investigate plant spacing (Protocol R4), season of transplanting (Protocol R5) and establishment of fodder reserves on farm land (Protocol R6).

Attention has turned to having either close or wide plant spacing of FWSB. Close spacing, that is 1 m^2 per plant, may make better use of rainfall but may also increase competition effects between plants. However, if the plant height is restricted by grazing, a high plant density may be less detrimental to plant longevity. Indeed, short, compact plants may have a more appropriate geometry for grazing by sheep but for goats, which have a different grazing behaviour, taller plants are unlikely to hinder grazing.

In the case of wide plant spacing, such as 3 m^2 per plant, larger plants may be supported but they may make less efficient use of rainfall as more is last by evaporation. However, close placing of FWSB in 2-3 m rows to produce a "fodder hedge" would allow growing of crops between the rows. This form of alley-farming deserves more attention at AZRI in the future.

AZRI has worked for several years on FWSB and it is now time to initiate on-farm trials which given researchers experience of the shrub under farmer conditions and feed-back on the attitudes of farmers towards it. This will be pioneering research and give AZRI researchers the opportunity to work with farmers. In the 1990's this is an essential aspect of the progressive researchers' portfolio, not just the domain of extension officers.

AZRI Research Protocol

Protocol Code: R1 (terminated August 1990) **Priority:** 1

Title of project: range vegetation survey at Tomagh and Zarchi

Collaborating institutions: none

Principal AZRI investigator: Mr. Ghulam Akbar (SSO) (transferred Aug 1990)

Collaborating AZRI scientific staff: Mr. Rana Asghar (transferred Sep 1990)

Collaborating non-AZRI scientific staff: none

Date of commencement: August, 1988

Date of completion: August, 1990

Site of project: Tomagh and Zarchi

1. Introduction

There is little quantitative information on the current status and historical changes in the plant population, composition and forage production of the rangelands of Balochistan. This information is a pre-requisite for the design of trials aiming to study sustainable range and livestock management systems for these areas.

This study was planned to continue for three years but was terminated after two years when the principal investigator was transferred to the AZRI sub-station at Bahawalpur.

2. Objectives

1) To study the seasonal changes in plant cover, composition, density and frequency on two rangeland types in highland Balochistan.

3. Experimental Methods and Procedures

The line intercept method was used and aspect and topographic factors at the two range sites were taken into consideration. Sampling took place in autumn, winter and spring.

4. Experimental design

Line intercept sampling.

5. Publication

MART/AZR Research Report and national refereed journal.

AZRI Research Protocol

Protocol Code: R2 (ongoing) **Priority:** 2

Title of project: plant spacing, fertilization and water catchment effects on survival and productivity of fourwing saltbush *(Atriplex canescens)*

Collaborating institutions:

Principal AZRI investigator: Mr. Ghulam Akbar (SSO) (until August 1990)
Dr. A. Wahid Jasra (SSO) (since January 1991)

Collaborating AZRI scientific staff: Mr. Javed Afzal (SO)
Mr. Abid Hussain (SO)

Collaborating non-AZRI scientific staff:

Date of commencement: June, 1990

Date of completion: June, 1993

Site of project: AZRI HQ, Tomagh, Zarchi

1. Introduction

Very little quantitative information exists on the basic agronomic management of fourwing saltbush (FWSB) in Balochistan. The effects of different plant densities and the possible benefits from fertilizer, particularly manure, require investigation if growth of this shrub for forage reserves is to be as productive as possible. The effects of water harvesting on these other treatments also need to be measured.

2. Objectives

1) To determine the effects of fertilization, plant spacing and water catchment method on the growth of fourwing saltbush (A. canescens)

3. Experimental Methods and Procedures

The trial is being conducted at Tomagh, Zarchi and AZRI HQ. One year-old seedlings of uniform size were transplanted into plots in June 1990.

3.1. Treatments: three factors will be investigated:

- fertilizer: manure, N plus P, and no fertilizer
- plant spacings: 2.5 and 2 m
- water catchment system: saucer-shaped, V shaped

These three factors combine to give 12 treatments, each applied on 100 m^2 plots.

3.2. Procedures: the plants in the fertilizer treatments received a single dose of 31 g and 20 g Nitrophos (23-23-0) for the 2 and 2.5 m spacing treatments, respectively. This is equivalent to 50 kg/ha. In the case of sheep manure, amounts applied were based on a 1 t/ha dressing: 400 g/plant and 630 g/plant for the 2 and 2.5 m spacing treatments, respectively. A single irrigation of 15 l/plant was applied at the time of planting.

3.3. Observations: measurements of plant survival, height and crown diamenter will be made every two months during the growing season for three years. At the end of the study the biomass of plants will be determined.

4. Experimental design

RCB with factorial arrangement of treatments (3 x 2 x 2), and two replications at each site.

5. Publication

AZRI Research Report, and national/international refereed journal.

AZRI Research Protocol

Protocol Code: R3 (ongoing) **Priority:** 1

Title of project: establishment of fourwing saltbush (*Atriplex canescens*) on rangelands with land treatments to improve water catchment

Collaborating institutions: none

Principal AZRI investigator: Mr. G. Akbar (SSO) (until August 1990)
Dr. A. Wahid Jasra (SSO) (since Jan 1991)

Collaborating AZRI scientific staff: Mr. Javed Afzal (SO)
Mr. Abid Hussain (SO)

Collaborating non-AZRI scientific staff: none

Date of commencement: May, 1990

Date of completion: May, 1993

Site of project: Mastung, Zarchi and Tomagh

1. Introduction

Fourwing saltbush (*A. canescens*) is a new introduction to Balochistan. Its success is largely dependent on establishing a good stand of bushes. This trial is therefore intended to measure how small-scale water harvesting treatments may help in the establishment and persistency of fourwing saltbush. Four different methods of capturing run-off water are being compared, namely saucer-shaped or V-shaped basins, and furrows or ripped lines.

2. Objectives

1) To study the effects of four micro-basin water harvesting methods on the establishment and survival of fourwing saltbush (*A. canescens*)

3. Methods

The trials are being conducted at Mastung, Zarchi and Tomagh. The four different micro-basin water harvesting techniques are designed to collect the run-off from rangeland and thereby enhance the water supply to the salt bushes.

3.1. Treatments: the four micro-basin water catchment treatments are:

a. saucer catchments; each saucer has a 2 m diameter
b. V-shaped catchments: these have 2 arms at 90° to each other, with each arm being 2 m. long.
c. Contour furrows: at 2 m. spacing
d. Ripping: at 2 m. spacing

Treatments a. and b. were applied by hand and c. and d. by a tractor-drawn plough.

3.2. Procedures: six month old seedlings were transplanted in spring, 1990 and a single irrigation of 15 l. water was given to each plant.

4. Experimental design

RCB with four replications.

5. Publication

MART/AZR Research Report and paper in national/international refereed journal.

AZRI Research Protocol

Protocol code: R4 (new) **Priority:** 1

Title of project: plant spacing and survival, production, and utilization of fourwing saltbush (*A. canescens*) in highland Balochistan

Collaborating institutions: none

Principal AZRI investigator: Dr. Abdul Wahid Jasra (SSO)

Collaborating AZRI scientific staff: Mr. Javed Afzal (SO)
Mr. Abid Hussain (SO)

Collaborating non-AZRI scientific staff:

Date of commencement: February, 1991

Date of completion: February, 1996

Site of project: AZRI, Quetta and Karkhasa National Forest

1. Introduction

A. canescens, fourwing saltbush (FWSB), is a promising plant species for revegetating the depleted range areas of upland Balochistan. It could also be used to establish forage reserves on farm land close to villages. Our experience with FWSB forage reserves established by AZRI has shown that if stands become too dense and woody, they are poorly used by sheep and goats. The purpose of this study is to find the plant density that maximizes sustainable off-take of FWSB in Balochistan. It is anticipated that the higher plant spacing will make better use of the scarce rainfall although the life-span of closely spaced plants may be shorter because of competition effects.

2. Objectives

1) To study the effect of plant spacing on productivity and survival rate of saltbush (*A. canescens*) established on marginal lands of highland Balochistan.
2) To determine the optimum plant spacing for efficient utilization and grazing management of fourwing saltbush stands.

3. Experimental Methods and Procedures

This study will be conducted at two locations; AZRI station, Quetta, and Karkhasa National Park near Quetta (Forest Department, Govt. of Balochistan). At each location, two blocks (replicates) of 3000 m^2 each and differing in their soil types, will be planted with fourwing saltbush (*A. canescens*). The three plant spacing treatments will be applied within each block.

3.1. Treatments: the three treatments are:

T1 = 1 x 1 m spacing (10,000 plants/ha)
T2 = 2 x 2 m spacing (2,500 plants/ha)
T3 = 3 x 3 m spacing (1,111 plants/ha)

Six month old seedlings of uniform size i.e. about 20-25 cm high, and grown at the AZRI Nursery, will be transplanted into plots during the first week of February, 1991.

3.2. Data Collection: data will be collected as follows:

Years I and II: a) establishment or survival rate, b) recording every two months of plant height and crown diameter of 15 randomly selected plants/treatment.

Year III: a) forage production in May and October, representing the two growing seasons of the area. The weight estimate method (Pieper, 1978) will be used to assess forage production. It involves sampling 15 randomly selected plants/treatment. b) plant height and crown diameter of 15 randomly selected plants/treatment every two months.

Year IV and V: a) forage production as previously. b) grazing by sheep. Stocking rates will be adjusted according to forage production in each treatment. c) Plant utilization by sheep will be estimated by using the before and after method (Pieper 1978).

The soils at each site will be sampled for chemical composition. Estimated water use efficiency of plants will be estimated from kg DM/mm rainfall/ha.

4. Experimental design

A RCB design will be used, with two locations and two replicates at each location. The results will be analyzed using MSTATC to find statistical differences between treatments.

5. Publication

AZRI Research Report and national/international refereed journal.

AZRI Research Protocol

Protocol code: R5 (new) **Priority:** 1

Title of project: establishment of fourwing saltbush (*Atriplex canescens*) transplanted in the four different seasons of the year on a rangeland in Balochistan

Collaborating institutions: none

Principal AZRI investigator: Dr. Abdul Wahid Jasra (SSO)

Collaborating AZRI scientific staff: Mr. Javed Afzal (SO)
Mr. Abid Hussain (SO)

Collaborating non-AZRI scientific staff:

Date of commencement: February, 1991

Date of completion: February, 1996

Site of project: Karkhasa National Park, Quetta

1. Introduction

The most critical stage in the planting of fourwing saltbush (*A. canescens*) is the initial seedling establishment. The general procedure for planting FWSB at AZRI is to grow the seedlings in a nursery for 4-6 months and to transplant them in late winter/early spring (Feb-March) when they are roughly 20-25 cm high. Low seedling survival has resulted in the past when no additional water was applied at transplanting, presumably because the seedling was weakened by the lack of soil moisture. In this study FWSB will be transplanted on four different dates, representing the four seasons of the year, so that the most appropriate season can be found in Balochistan when maximum seedling establishment is achieved with minimal or no additional watering.

2. Objectives

1. To determine the survival rate, crown diameter, plant height and produc -tivity of fourwing saltbush (*A. canescens*) transplanted during the four different seasons of the year.

3. Experimental Methods and Procedures

This study will be conducted at the Karkhasa National Park (Forest Department, Government of Balochistan), Quetta.

3.1.Treatments

The four transplanting treatments are:

a) February, 1991 (traditional spring transplanting)
b) July/August, 1991 ("monsoon" transplanting)
c) October, 1991 (late fall transplanting)
d) Mid-December 1991 (winter transplanting)

A range area, with relatively homogeneous vegetation cover, soil type and topography, has been fenced in Karkhasa National Park. The area has been divided into four blocks (replicates) and each block subdivided into four plots. In each plot there are 15 trenches measuring approximately 2.0(L) x 0.25(D) x 0.75(W) m, already dug out by the Forest Department some years ago. Two FWSB seedlings per trench were transplanted in February and March 1991, with one seedling at each end.

3.2. Biological Observations

The following observations will be recorded once every two months for at least five years:

a) survival rate,
b) crown diameter and plant height of 20 randomly selected plants per treatment (or within 10% of population mean.)
c) forage production, estimated from crown diameter and growth rate (growth rate patterns to be established)
d) Grazing productivity (method to be determined)

The soil will be analysed at the start of the experiment.

4. Experimental design

Completely randomized design, with four replications. The results will be analysed using MSTATC, and treatment differences compared using the LSD test.

5. Publication

AZRI Research Report and national/international refereed journal.

AZRI Research Protocol

Protocol code: R6 (new) **Priority:** 1

Title of project: establishment and management of fourwing saltbush reserves on farmers fields, and assessment of farmer attitudes to the technology

Collaborating institutions: none

Principal AZRI investigator: Dr. Abdel Wahid Jasra (SSO)

Collaborating AZRI scientific staff: Mr. Javed Afzal (SO)
Mr. Abid Hussein (SO)

Collaborating non-AZRI scientific staff: none

Date of commencement: June, 1991 **Date of completion:** June, 1995

Site of project: farmers' fields near Tomagh, Zarchi, Mastung

1. Introduction

For several years now AZRI has been studying the use of fourwing saltbush (FWSB) as a feed reserve for periods of deficit in the highlands of Balochistan. The studies have been conducted on experimental stations. The most difficult task is to test the FWSB in on-farm trials which involve the farmer. This makes it possible to assess the reactions of farmers to the technology, and therefore the chances of the technology being adopted them. This project aims to assess the technology under farmer conditions. The fodder reserves will be established close the farmers' houses so that they can keep a close watch on them, and so that the technology gets maximum exposure to other farmers in the village.

2. Objectives

1) To establish and manage fodder reserves of fourwing saltbush on farms in highland Balochistan
2) Assess farmer perceptions about fodder reserves

3. Experimental Methods and Procedures

Reserves of fourwing saltbush will be established in a number of villages close to the AZRI research sites at Tomagh, Zarchi and Mastung. The size of each reserve will be at least 1000 m^2, divided between plants spaced at 2 and 1 m^2. Farmers will be involved from the outset in the planting of the shrubs, and once the shrubs reach a suitable size, they will be grazed by farmers' sheep according to a plan recommended by researchers. Farmers will be interviewed at each location to gain an insight into their perceptions about the technology.

4. Experimental design

The planting spacing data will be analysed as a RCB with farms as replicates.

5. Publication

MART/AZR Research Report and national/international journal.

AZRI Research Protocol

Protocol code: R7 (new) **Priority:** 2

Title of project: Effect of soil media on germination of fourwing saltbush

Collaborating institutions: none

Principal AZRI investigator: Dr. Abdul Wahid Jasra (SSO)

Collaborating AZRI scientific staff: Mr. Javed Afzal (SO)
Mr. Abid Hussain (SO)

Collaborating non-AZRI scientific staff: Nil

Date of commencement: September, 1991

Date of completion: November, 1991

Site of project: AZRI Range Nursery, Quetta

1. Introduction

To achieve the goal of range improvement in Balochistan, fourwing saltbush is a very promising forage shrub for the harsh conditions of this Province. However, it is difficult to obtain satisfactory stands of fourwing saltbush by direct seeding over an extensive scale. This study is a first step towards finding a more economical and efficient method of maximizing fourwing saltbush germination from viable seeds. Six different types of soil media will be tested for their effect on *Atriplex canescens* seed germination.

2. Objectives

General: to achieve improved germination of fourwing saltbush.
Specific: to test germination of viable *Atriplex* seeds in different types of soils and soil mixtures.

3. Methods

Six different types of soil media will be used to determine their effect on *Atriplex canescens* seed germination. Each of the following soil media will be considered as an independent treatment;

T1 = ordinary light textured soil
T2 = plain sand mixed with sieved manure at a ratio of 1:1
T3 = plain sand, light textured soil and sieved manure mixed at the ratio of 2:1:1
T4 = 2/3 ordinary soil and 1/3 soil from under fourwing saltbush (FWSB) plants
T5 = 2/3 good garden soil and 1/3 soil from under FWSB plants
T6 = ordinary soil and Nitrophas fertilizer (NPK in a ratio of 23:23:0) at a rate of 100 kg. ha^{-1} will be used or 0.2 g of fertilizer added to 0.5 kg soil/pot in nursery

This study will be conducted at range nursery, AZRI, Quetta. Seed rate/pot will be adjusted according to the viability of *Atriplex* seeds. Viability of seeds will be measured by the following procedure; 100 seeds will be picked up at random from a lot of one year old *Atriplex* seeds. Each of the one hundred seeds will be cut down into halves and will be examined whether filled or hollowed. All filled seeds will be considered as viable seeds. Approximately 15 partially dewinged seeds/pot will be seeded to insure one Atriplex plant in each pot.

Each treatment will be tested within six replications using a completely randomized design. Each replicate will contain a lot of 20 black plastic pots used in nursery for germination purposes. *Atriplex* seeds will be sown in the pots during September or October, 1991 when the temperature is optimum (13 °C to 24 °C) for germination. Germination rate will be recorded in all treatments daily for at least one month.

4. Experimental design

Randomised complete block with 6 replications of the 6 treatments. MSTATC, a statistical package will be used to analyze the data and test for significant differences.

5. Publication: MART/AZR Research Report

AZRI Research Protocol

Protocol code: R8 (new) **Priority:** 2

Title of project: optimising the utilisation of fourwing saltbush by sheep and goats

Collaborating institutions: none

Principal AZRI investigator: Dr. Abdul Wahid Jasra (SSO)

Collaborating AZRI scientific staff: Mr. Javed Afzal (SO)
Mr. Abid Hussain (SO)

Collaborating non-AZRI scientific staff: Nil

Date of commencement: September, 1991

Date of completion: November, 1991

Site of project: AZRI, Quetta

1. Introduction

Atriplex canescens, once established, can live for a long period, and plants have survived for at least 100 years in Australian shrub lands (Osmond et al., 1980). However, unless suitable management techniques are applied, sustained productivity is not maintained (Jefferies and Pitman, 1986). By the use of long-lived shrub plants better able to exploit the existing environment and with proper management techniques, an great increase in stocking can be achieved (Cocks et al., 1988). It is important to keep the plants short either by intense and frequent grazing or by periodically cutting them back. In experiments in N.Africa, the amount of browse available from 6 and 12 months old regrowth was 30-50% and 70-100% greater than the respective amounts present in unpruned shrubs (Houerou, 1986). Cutting back of the plants at 6-12 months interval increased the amount of available feed by a factor of 2 to 5 (Houerou, 1986). The quality of the feed is also considerably improved, particularly the protein and carotene content of leaves.

Kernick (1986) stressed the need to develop relationships between site characteristics and plant productivity for *Atriplex* species. Efforts are also needed to establish effective methods of utilizing and managing established *Atriplex* stands particularly for grazing (Kernick, 1986) to avoid the risk of over browsing (Houerou, 1986) which increases the chances of damage by rodents. This study is planned to evaluate the potential of *Atriplex canescens* browsed by sheep and goats at different intensities.

2. Objectives

1. To study the effects of utilization intensities on regrowth and forage production of fourwing saltbush
2. To determine the impact of the browsing animal species (sheep & goats) on regrowth and forage production of fourwing saltbush.

3. Methods

3.1. Experiment No.1: Sheep

This experiment will start in the fall of 1991 and will be conducted at AZRI fields, Quetta. Fourwing saltbush will be browsed by sheep at given levels of utilization in two plots of 35 x 163 m each. In these two plots fourwing saltbush has been planted at two different row spacings i.e. 1.5 x 1.5 m and 2.0 x 2.0 m. Each block (plot) will be divided into three sub plots by fencing, and will be browsed by sheep at 3 utilization levels.

3.2. Experiment No.2: Goats

This experiment will also be conducted at AZRI, Quetta during fall, 1991 Goats will be allowed to browse fourwing saltbush planted at two different row spacings in two plots. Each plot with different row spacing will be considered as an independent block. Each block will be further divided into three sub plots and will be browsed by goats at given utilization levels.

Utilization Levels: a) 50% b) 70% c) 90%

In both experiments, these three utilization levels will be randomly assigned to sub-lots of each block. Five plants in each sub plot will be marked out and individual plants will be frequently observed to insure respective utilization levels using "ocular estimate by plant" method (Pieper, 1978). All plots will be subjected to respective treatments twice a year (1st week of April and 1st week of October).

3.3. Data Collection: Years I, II & III

a) Browseable forage production of each sub plot on per hectare basis will be estimated twice a year before allowing the animals to graze the plots. Forage production in each sub plot will be estimated by the twig count method (Shafer, 1963). Five plants in each sub plot will be randomly selected to estimate the average weight of browseable forage/twig and total twigs/plant. Forage production/plant will be estimated by multiplying the average weight of browseable forage/twig with total number of twigs/plant. Total forage production on sub plot or hectare basis will be calculated by multiplying forage production/plant with total number of plants per sub plot.

b) Plant height and crown diameter: plant height and crown diameter of five randomly selected plants will be measured in each sub plot after every three months.

4. Experimental design

Randomised block design

5. Publication: MART/AZR Research Report

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