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GERMPLASM EVALUATION IN THE ARID HIGHLANDS OF BALOCHISTAN ANNUAL REPORT 1987/88

by

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Quetta, 1989

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GERMPLASM EVALUATION IN THE ARID HIGHLANDS OF BALOCHISTAN

ANNUAL REPORT 1987/88

by

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INTRODUCTION

Due to rapid increases in population, increasingly large deficits in the production of crops are forecast for the West Asian and North African Region (FAO 1987). In order to meet the demands for increased agricultural output not only will productivity need to rise from currently high yielding farmland, but also more marginal land will have to become a better and more consistent contributor to the agricultural sector of national economies.

The very large upland (>1000m) areas of Balochistan province of Pakistan are presently a much underutilized agricultural resource, which with careful management could provide more assistance to the Pakistani economy as the country tries to cope with a population estimated to be 101 million and increasing at a rate not less than 3.1% per annum (G.O.P 1988).

As a result of the prevailing marginal, and highly variable, climatic conditions in upland Baluchistan considerable forethought is required in attempting to select an appropriate germplasm selection and breeding strategy designed to identify crop cultivars which can permit more consistent and rewarding agricultural productivity from this environment.

The Pakistan Agricultural Research Council (PARC) in partnership with the International Centre for Agricultural Research in the Dry Areas (ICARDA) at the Arid Zone Research Institute (AZRI), Quetta has been developing a germplasm evaluation program in upland Balochistan over the previous five years.

OBJECTIVES

1. Selection of improved disease free/resistant crop species/lines/genotypes suitable for production under non-irrigated conditions to diversify the current wheat monocropping system in upland Balochistan.

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

RESEARCH STRATEGY

Germplasm evaluation research emphasises the need for a better understanding of yield limiting factors imposed by varying environmental and biotic factors in the major agro-ecological zones of upland Balochistan.

The program makes use of multi-locational testing and different times of sowing for selection of genotypes/lines that are either widely adapted or specifically suited to different zones. In order to develop genetic material with increased yield and stability of production when exposed to multiple stresses such as drought, cold, heat and rust pathogens in wetter years.

Three locations Quetta (altitude 1750m, latitude 30° 14'N, longitude 67° 2'E), Khuzdar (altitude 1250m, latitude 27° 46'N, longitude 66° 39'E) and Kan Mehtarzai (altitude 2250m, latitude 67° 45'N, longitude 31° 00'E), sites which cover the representative range of upland Balochistan, selected for the planting of research experiments.

Seeding times were determined by following the practices of local farmers. Thus, the first seeding time was in Autumn (late September to the end of October) only if summer monsoonal rains occurred (approximate recurrence 1-2 years in ten at Quetta). If they did not, irrigation water was used to simulate this condition to allow pre-winter emergence. The second seeding time was in Spring (late January to the end of February) following winter rains. The precise time was determined by the degree of cold exposure at each site. The crops in germplasm evaluation trials were bread wheat, durum wheat, barley, lentils and forage legumes.

Soil fertility conditions at all sites were generally poor and were amended by the addition of fertilizer at the rate of 60 kg/ha N and 60 kg/ha P_2O_5. Leguminous crops were inoculated with *Rhizobia*. The crops under germplasm evaluation are bread wheat, durum wheat, barley, lentils and forage legumes.

GENERAL CLIMATIC CONDITIONS

The climatic conditions in Balochistan are highly variable and inconsistent. Precipitation of 200mm or less are expected in at least three years in ten (Keatinge and Rees 1988). Furthermore rainfall is often not well distributed in relation to crop growth requirements. Most of the rain occurs in the winter but occasionally a small but important summer monsoonal rain is experienced. Late rainfall in winter may delay the sowing of winter crops and subsequent crop emergence due to low air temperatures experienced at altitudes above 1000m.

Air temperatures in upland Balochistan are usually very low in winter and growth of crops in the period late November to mid February is very slow. High air temperatures in early summer, in the absence of rainfall, may become an important factor in hastening crop maturity.

CLIMATIC CONDITIONS DURING 1987/88 CROPPING SEASON

The cropping season of 1987/88 was very dry and less cold in general than in 1986/87. No rainfall was received during the months of September to December at all locations. Rain was received in January to March at all sites but in seriously inadequate amounts which created a problem of seed survival in germplasm (Table 1). Therefore, pre-harvest supplemental irrigation was used at Khuzdar and Kan Mehtarzai to save the material to allow sufficient stocks for trials in the 1988/89 season nurseries. Trials at Quetta, the site receiving most rain, were allowed to "hay off" to examine drought tolerance in extremis.

As less cold air temperatures than expected were experienced during the season in general, not much cold damage was observed in the genotypes/lines. Some of the highly cold susceptible lines of Vicia sativa (new lines) however could not survive even in this milder winter and died.

TABLE 1.

CLIMATIC DATA (1987/88 SEASON)

MONTH	QUETTA			KHUZDAR			FAN MEHTARZAI		
	Total Rainfall (mm)	Mean Max. temp.* (°C)	Mean Min. temp. (°C)	Total Rainfall (mm)	Mean Max. temp. (°C)	Mean Min. temp. (°C)	Total Rainfall (mm)	Mean Max. temp. (°C)	Mean Min. temp. (°C)
Sept.	0	32.1	12.6	0	37.1	17.4	0	29.1	12.0
Oct.	0	25.3	6.3	0	33.7	11.4	0	27.2	6.4
Nov.	0	18.0	-3.4	0	27.3	9.0	0	16.0	-7.3
Dec.	0	17.0	-2.3	0	22.1	1.8	0	7.5	-9.0
Jan.	9.1	13.4	-1.1	10.6	20.3	1.5	34.4	2.4	-9.7
Feb.	17.8	15.6	1.3	14.5	20.4	5.2	31.2	11.5	-2.3
Mar.	117.0	19.0	4.3	2.0	24.3	8.4	0	7.4	-2.4
Apr.	3.6	26.9	13.1	0	33.2	14.1	0	17.7	0.5
May	0	32.4	18.0	0	35.1	17.4	0	22.4	7.2
June	3.8	35.8	20.2	14.8	39.6	20.7	0	30.0	13.0
No. of suppl. irrigations	Autumn		1			2			2
	Spring		1			2			2
Total suppl. water=approx. rainfall (mm)	Autumn		50			150			100
	Spring		50			150			150
Abs. min. air temp. during the season (°C)			-7			-5			-12
Seasonal totals of days below 0°C			112			12			111

* Screened air temperature at 1.5 m.

RESULTS

1. CEREALS

A. Bread Wheat

Bread Wheat is the most important crop in Balochistan. It is grown at all elevations under both rainfed and irrigated conditions. In upland Balochistan the farmers have the practice of grazing bread wheat in winter when there is a scarcity of green feed.

In upland Balochistan the dominant commercial bread wheat cultivar is the local white landrace. Although this cultivar is very well adapted, and also has good bread-making quality, it however is highly susceptible to yellow rust (Puccinia striiformis). This disease has occurred in epidemic fashion twice in the last decade. Thus there is an urgent need to evolve a disease resistant and high yielding bread wheat variety which can survive the harsh environment of Balochistan. Farmers can still benefit in this difficult environment by adopting suitable varieties and appropriate cultivation practices for low rainfall areas (Ceccarelli and Mekni 1988).

i) Bread Wheat Preliminary Yield Trial

The ICARDA Bread Wheat Yield Trial (high altitude areas) was planted at Khuzdar, Quetta and Kan Mehtarzai. Three drought tolerant and high yielding lines were identified (Table 2). At Kan Mehtarzai the material was severely damaged by birds close to maturity. The check, local white, was less damaged when compared to introduced lines because it was later maturing. Selection for grain yield was made in the trials planted at Quetta and Khuzdar.

At Quetta the ICARDA improved check line Sham-4 gave a slightly higher grain yield when compared to local white. This entry is largely a spring type in growth habit and may not perform well at low temperatures. Three winter types were selected lines ICW-HA81-1610-1AP-3A--0AP, ICW-HA81-1532-2AP-6AP-2AP and ICW-HA81-1667-1AP-1AP-1AP. All these lines are prostrate in growth habit and cold tolerant.

TABLE 2.

PERFORMANCE OF BREAD WHEAT YIELD TRIAL (H.A) DURING 1987/88

S. NO.	PEDIGREE	QUETTA		KHUZDAR		KAN MEHTARZAI	
		Biological yield kg/ha	Grain yield kg/ha	Biological yield kg/ha	Grain yield kg/ha	Biological yield kg/ha	Grain yiel kg/ha
1	Shaa 4 (Spring type check)	2766	391	1942	719 c	3166	449 bcde
2	ICW-HA81-1473-2AP-1AP-2AP-1AP-0AP	2966	282	2915	1064 abc	3900	502 bcde
3	ICW-HA81-1369-1AP-3AP-2AP-0AP	3333	216	1953	602 c	3466	223 de
4	ICW-HA81-1470-1AP-1AP-1AP-0AP	2533	194	2122	582 c	3600	356 bcde
5	ICW-HA81-1470-1AP-1AP-2AP-0AP	2366	145	2723	784 bc	3300	283 cde
6	ICW-HA81-1500-1AP-2AP-1AP-0AP	2066	124	2077	356 c	2966	374 bcde
7	ICW-HA81-2213-3AP-1AP-2AP-0AP	2766	269	2851	1132 abc	3433	414 bcde
8	ICW-HA81-1409-1AP-3AP-3AP-0AP	2733	173	1822	689 c	2633	492 bcde
9	ICW-HA81-1337-3AP-4AP-3AP-0AP	2300	109	3124	1060 abc	3300	433 bcde
10	ICW-HA82-0595-1AP-1AP-0AP	2733	230	2794	1045 abc	2133	174 e
11	ICW-HA82-0595-1AO-2AP-0AP	1733	104	1773	665 c	2033	222 e
12	Bezostaya	1666	97	3184	823 bc	3500	419 abcd
13	ICW-HA81-1587-4AP-1AP-0AP	2633	203	2287	780 bc	4100	819 ab
14	ICW-HA81-1610-1AP-2AP-0AP	2933	191	3790	1215 abc	4033	793 abc
15	ICW-HA81-1610-1AP-3AP-0AP	3200	309	3419	1762 a	2966	417 bcde
16	ICW-HA82-0626-2AP-2AP-0AP	3166	291	2044	657 c	2400	205 de
17	ICW-HA81-1863-2AP-1AP-3AP-1AP	2533	211	2772	910 abc	2433	158 e
18	ICW-HA81-1587-1AP-3AP-3AP-1AP	1966	58	1937	629 c	2666	280 cde
19	ICW-HA81-1337-4AP-1AP-1AP	3133	187	2824	920 abc	3733	716 abcd
20	ICW-HA81-1369-1AP-1AP-1AP	2433	158	4133	953 abc	3000	545 abcd
21	ICW-HA81-1532-2AP-6AP-2AP	2300	220	4163	1698 ab	2600	383 bcde
22	ICW-HA81-1667-1AP-1AP-1AP	1933	143	4610	1661 ab	2766	229 de
23	ICW-HA82-0785-7AP-1AP	2000	105	2040	533 c	3000	346 bcde
24	Local white (check)	3666	370	3579	1149 abc	4500	1032 a
	COEFFICIENT OF VARIATION (%)	32	64	44	51	30	63
	STANDARD ERROR	169	26	249	96	191	55

Values with different letters within same column differ (P<0.05)

ii) Advanced Yield Trial

The bread wheat lines selected during 1986/87 from the Bread Wheat Observation Nursery and Bread Wheat Yield Trial (high altitude areas) on the basis of cold tolerance were promoted to an Advanced Yield Trial and planted at three sites.

The year 1986/87 was an excellent year for cold screening and a positive association was observed between cold tolerance and grain yield. These results agreed with the findings of Ceccarelli, Grando and Van Leur (1987). Tolerance to frost during the cooler months and the ability to grow under relatively low temperatures are desirable traits in a Mediterranean climate (Nachit 1984).

Two lines were identified from this trial with a higher grain yield than the local check (Table 3). The year 1987/88 was dry and provided good natural conditions for screening germplasm material for drought tolerance. As genotypes selected in sites with less than 250mm of rainfall perform better under drought stress than do barley or wheat selected in stress free environments (ICARDA Cereal Improvement Program Annual Report 1986).

TABLE 3

PERFORMANCE OF SELECTED HIGH YIELDING LINES OF BREAD WHEAT DURING 1987/88

S.NO.	ENTRY	KHUZDAR		KAN MEHTERZAI	
		Biological yield(kg/ha)	Grain yield(kg/ha)	Biological yield(kg/ha)	Grain YIELD(Kg/ha)
1.	ICW-HAB1-1802-2AP-2AP-6AP-2AP-0AP	2045	842 a	-	-
2.	ICW-HAB1-1610-1AP-3 AP-0AP	-	-	4350 a	925 a
3.	LOCAL WHITE (CHECK)	2283	799 ab	4150 ab	480 ab
COEFFICIENT OF VARIATION (%)		56	63	32	69
STANDARD ERROR		178	59	230	67

Note:-

i) Coefficient of Variation and Standard Error are of total tested entries, i.e. 19.
ii) Values with different letters within same coluen differ (P < 0.05).

At all three sites the average grain yield was low due to the adverse climatic conditions.

At Quetta the total biological (3850 kg/ha) and grain yield (425 kg/ha) of local white was higher than all other lines whereas the entry KW-HA81-1610-IAR3AP-0AP performed well at Kan Mehtarzai and entry KW-HA81-180-2-2AP-6AP-2AP-0AP performed well at Khuzdar when compared to the local check (Table 3). The irregular performance of these entries might be due to the large environmental effects on grain yield in some families, the association of heterotic effects and the association of yield with cold resistance and not drought tolerance in some families (ICARDA Cereal Improvement Program Annual Report 1986).

iii) Observation Nurseries

During the 1987/88 season two hundred lines/cultivars of bread wheat were tested at multilocational sites. Observations were recorded on characters such as cold tolerance, early growth vigour, rapid stand establishment, good grain filling and early maturity which are associated with stable yields under dry conditions (Ceccarelli and Mekni 1985). Seven lines were identified which gave higher grain yields than the check, local white (Table 4). No disease symptoms were observed on selected lines.

TABLE 4

PERFORMANCE OF HIGH YIELDING LINES OF BREAD WHEAT SELECTED FROM OBSERVATION NURSERIES DURING 1987/88

S.NO.	ENTRY	SEED SOURCE	BIOLOGICAL YIELD(Kg/ha)	GRAIN YIELD (Kg/ha)
		WBW.F1 1981-82		
1.	ICWB1. 1471	136	4700	928
2.	ICWB1. 1505	170	2400	804
3.	ICWB1. 1673	338	4800	672
4.	ICWB1. 1683	348	3800	612
		RBWON (H.A)87-88		
5.	ICW-WA82-0626-2AP-2AP -0AP.	122	3072	608
6.	SWM-766018 OR 8300279	124	2840	672
		WBWON 84-85		
7.	SWM-11507-4AP-1AP-2AP -0AP.	111	4344	1044
8.	LOCAL WHITE (CHECK)	-	3376	568

iv) Spring Planted Bread Wheat

The spring planted genotypes are usually as productive as winter planted genotypes in upland Balochistan because winter planted crops use the autumn/winter rainfalls more efficiently and avoid heat and drought more efficiently during the month of June which catches spring planted crops at the final grain filling stage (Shevtsov 1986).

During 1986/87, out of 104 entries of the Regional Bread Wheat Observation Nursery (low rainfall), 54 lines were selected and promoted to the yield trial planted during 1987/88. The material was planted at Quetta, Khuzdar and, one new location, Kalat (altitude 1800m) with one pre-planting irrigation. The material at all four sites was severely affected by drought. One extra irrigation was applied at Khuzdar and Kalat to save germplasm for further testing while at Quetta no irrigation was applied to observe drought effects.

Even in such harsh environmental conditions some lines still performed creditably (Table 5). Though the yield of these selected entries was not very high but these lines were better than the local check and they possess desirable genes for drought tolerance, high yield potential and short maturity period.

At Quetta entry CM4985-2AP-2AP-1AP-2AP-1AP-0AP gave the highest grain yield of 244 kg/ha while at Kalat and Khuzdar the highest yielding lines were SWM11027-2AP-3AP-3AP-4AP-0AP and SWM11027-2AP-2AP-2AP-1AP-0AP respectively. Spring planted lines had a smaller number of heads per unit area which is one of the reasons for their low yield (Nachit 1984).

TABLE 5

PERFORMANCE OF SELECTED HIGH YIELDING AND SHORT DURATION GENOTYPES OF BREAD WHEAT DURING 1987/88.

S.NO.	ENTRY	QUETTA		KALAT			KHUZDAR	
		Biological yield (kg/ha)	Grain yield (kg/ha)	Biological yield (kg/ha)		Grain Yield (kg/ha)	Biological yield (kg/ha)	Grain yield (kg/ha)
1	SWM11625-2AP-3AP-4AP-0AP	866	33	2000	abc	498 ab	1466	216
2	SWM11623-2Y-0Y-1AP-0AP	1266	56	14600	abcde	349 abcdefghi	1066	205
3	CM59456-3AP-1AP-3AP-1AP-0AP	1200	60	1933	abcd	424 abcde	1533	264
4	CM4985-2AP-2AP-1AP-2AP-1AP-0AP	1466	273	1733	abcde	437 abcd	933	146
5	CM56718-5Y-2Y-3M-3Y-1M-0Y	1333	230	800	c	154 ghi	1000	136
6	CM70307-9M-3Y-1M-2Y-0M	1000	78	1133	cde	272 bcdefghi	1133	224
7	ICW80-0157-1AP-1AP-2AP-0AP	1733	244	1266	bcde	205 defghi	1066	165
8	CM69599-2AP-1AP-2AP-0AP	1600	202	1266	bcde	248 cdefghi	1466	178
9	CM69599-2AP-2AP-2AP-0AP	1333	90	1933	abcd	440 abc	1200	210
10	SWM11027-2AP-3AP-3AP-4AP-0AP	666	37	1333	bcde	344 abcdefghi	1333	314
11	SWM11027-2AP-2AP-2AP-1AP-0AP	933	64	1933	abcd	506 a	1133	178
12	Local White (check)	666	38	1400	bcde	122 i	400	56
	COEFFICIENT OF VARIATION (%)	58	138	30		36	38	53
	STANDARD ERROR	80	15	62		15	57	11

Note:- i) Coefficient of Variation and Standard Error are of total tested entries, i.e. 55.
ii) Values with different letters within same column differ (P<0.05).

B. DURUM WHEAT

Durum wheat in general is not as cold tolerant as bread wheat. The last two years' results confirm that durum wheat is not suitable for winter planting in upland Balochistan as suggested by Srivastava (1984). Testing of durum wheat lines for winter planting has been stopped but testing of a few lines for spring planting is being continued to allow selection for high yielding short maturity genotypes. The durum wheat trials planted during 1986/87 in spring gave better results than the local bread wheat check. The selected entries were again planted in 1987/88 in spring at three sites to confirm their genetic stability (Table 6).

These results showed that most of the durum wheat lines are spring type, grow rapidly and mature earlier than many bread wheat lines as observed by Srivastava (1984). The highest yielding lines identified during 1987/88 are Barika, Karasu and Shwa/Pt1 at different sites. It is clear from the results now that durum wheat may only be suitable for spring planting in upland Balochistan.

TABLE 6

PERFORMANCE OF DURUM WHEAT IN SPRING PLANTING DURING 1987/88

S.NO.	NAME/CROSS/PEDIGREE	QUETTA		KALAT		KHUZDAR	
		Biological Yield, (kg/ha)	Grain Yield (kg/ha)	Biological Yield, (kg/ha)	Grain Yield (kg/ha)	Biological Yield, (kg/ha)	Grain Yield (kg/ha)
1.	STORK	500	32	1500	328	1000	272 ab
2.	KARASU	600	26	1300	216	1150	224 abc
3.	SHAM 1 (IMPROVED DURUM WHEAT CHECK)	600	36	1600	300	950	228 abc
4.	SHWA/Pt 1	650	32	1200	152	1300	306 a
5.	SEBOU	600	25	1450	228	1000	192 abc
6.	Fg/3/GS/TC60//STK	400	15	1450	352	700	156 ab
7.	D PIN/GRE//Trab	600	24	1400	214	800	126 abc
8.	AWALI 1	550	32	1300	228	1050	164 abc
9.	LAHN	500	23	1550	274	700	90 c
10.	KARASU	450	12	1500	382	750	112 c
11.	HAZAR	600	25	1250	182	1150	222 abc
12.	BARIKA	850	56	1300	238	950	186 abc
13.	GEDIZ/BIT	550	36	1650	362	1000	226 abc
14.	ZEROUDI	500	20	1350	292	550	104 c
15.	OMRABI 11	500	28	1350	324	950	172 abc
16.	OMRABI 9	550	27	1400	284	750	138 bc
17.	OMRABI 12	450	25	1450	266	800	176 abc
18.	GEDIZ/Fg	750	47	1700	364	750	230 abc
19.	CEYHAN	500	44	1400	312	600	122 c
20.	BYE 2/Tae E//AA/3/Shaml	500	30	1600	356	950	226 abc
21.	KABIR 6	500	13	1850	322	750	118 c
22.	KORIFLA	500	20	1800	326	700	160 abc
23.	LOCAL WHITE	500	29	1400	188	650	140 bc
	COEFFICIENT OF VARIATION (%)	37	62	25	36	41	48
	STANDARD ERROR	42	4	75	21	73	18

Values with different letters within same coluan differ (P<.05).

C. BARLEY

Barley is the second most important crop in upland Balochistan. Barley is the predominant crop below 300mm of annual rainfall in areas which are characterized by high inter-seasonal and intra-seasonal variation in terms of amount and distribution of rainfall (Ceccarelli, Grando and Van Leur 1987). Barley is also a dual purpose crop in upland Balochistan. In a good season the farmers graze their sheep in the barley fields in winter when there is a scarcity of green fodder and also harvest the crop after maturity for grain. If the farmers are unable to harvest the crop for seed production in dry years, the hay is also regarded as valuable feed. Drought is one of the main problems faced by farmers in upland Balochistan and barley has been reported more resistant than wheat to such conditions (Khaled 1987). A barley genotype which shows cold and drought tolerance, disease resistance, early growth vigour and higher grain yield is sought for upland Balochistan.

i) Barley Yield Trial for Winter Planting

Thirteen winter types selections of barley were tested during 1987/88 at two high land sites (Quetta and Kan Mehtarzai). Four cold tolerant and high yielding lines were identified (Table 7).

Among the selected lines, Arabi abiad was the highest yielding and earlier maturing line when compared to the check, local barley. It is clear from the results that Arabi abiad performed well (grain yield) in variable conditions which is a desirable character for stable yield in dry areas. The capacity of a crop variety under variable conditions in a range of environments is as important as its yield potential (Nachit 1984).

The line Kenya Research/Belle gave more total dry matter at Kan Mehtarzai but lower grain yield than the local barley. This line required a long period of vernalization and is good for extremely low temperature areas. This line has the advantage of being taller than the local barley as plant height is desirable character for adaptation to dry areas because the main effect of drought condition during the growing season is a drastic reduction of stem elongation with a consequent reduction in straw yield (Ceccarelli, Grando and Van Leur 1987).

The other highest yielding lines which performed well at Quetta were barley landrace 39-60 and 39-58 and gave the grain yields of 607 and 874 kg/ha respectively with comparison of 597 kg/ha by the local check (See Table 7).

TABLE 7

BARLEY YIELD TRIAL (H.A) 1987/88 (WINTER PLANTING).

S.NO.	NAME/CROSS/PEDIGREE	Total Dry Matter (kg/ha) QUETTA	K. MEHTARZAI	Grain yield (kg/ha) QUETTA	K. MEHTARZAI
1.	ALGER UNION	3450	4970 bcd	356 abcd	1211
2.	ROHO/MASURKA ICB-78-0170-4AP-5AP-1AP-0AP	3900	6600 ab	224 bcd	1560
3.	KENYA RESEARCH/BELLE ICB-78-0877-4AP-2AP-1AP-0AP	3200	7800 a	23 d	1092
4.	AGER	2500	4300 cd	32 cd	1084
5.	Cg/Ca//Apm/3/Eqypt 20/4/11012 -2/70-22425/5/AGER CMSWB-78A-0381-1AP-3AP-0AP.	2750	5190 bcd	319 abcd	1623
6.	KITCHIN/MULLERS HEYDLA CMSWB-78A-0501-1AP-1AP-1AP -2AP-0AP	4050	6520 ab	406 abcd	1390
7.	ROHO/ALGER/CERES,362-1-1 ICR-77-0187-2AP-2AP-2AP-2AP -3AP-0AP	3850	6050 abc	233 bcd	1592
8.	BARLEY LANDRACE 45-34	3150	3700 d	338 abcd	1009
9.	BARLEY LANDRACE 39-60	4550	4320 cd	607 ab	1533
10.	BARLEY LANDRACE 39-58	3900	4750 bcd	874 a	1310
11.	BARLEY LANDRACE 46-72	3400	4920 bcd	374 abcd	1229
12.	ARMA (A)	2350	3850 d	52 bcd	1038
13.	ARABI ABIAD	3800	6400 ab	537 abcd	2488
14.	LOCAL BARLEY	6450	5327 bcd	597 abc	1463
	COEFFICIENT OF VARIATION (%)	41	23	95	40
	STANDARD ERROR	403	330	90	150

Note:- Values with different letters are significantly different (P<.05).

ii) Barley Yield Trial for Spring Planting

Eighteen genotypes of barley were tested during 1987/88 with spring planting at three sites. Three high yielding and early maturing genotypes were identified (Table 8). The line W12291/W12269 performed well in grain yield terms and showed evidence of wide genetic adaptability. It is clear from these results that the rain occurs late in the season, farmers may be able to take advantage of such short maturity genotypes and reduce their risk of crop failure.

TABLE 8

PERFORMANCE OF SELECTED HIGH YIELDING, SHORT DURATION GENOTYPES OF BARLEY DURING 1987/88

S.NO.	VARIETY	QUETTA Biological yield (kg/ha)	QUETTA Grain yield (kg/ha)	KHUZDAR Biological yield (kg/ha)	KHUZDAR Grain yield (kg/ha)	KAN MEHTARZAI Biological yield (kg/ha)	KAN MEHTARZAI Grain yield (kg/ha)
1.	W12291/4/11012-2/70 -22425/3/Apm/1865//Alb ICB-78-0635-1AP-0AP	933	103	1466 a	117 ab	3066	280 a
2.	W12291	933	71	1266 a	224 ab	1800	188 abc
3.	W12291/W12269 ICB-78-0594-BAP-1AP-0AP	1266	57	1400 a	338 a	2133	223 ab
4.	LOCAL BARLEY (CHECK)	933	31	800 abcd	125 bc	2133	93 bc
	COEFFICIENT OF VARIATION (%)	52	73	44	95	24	59
	STANDARD ERROR	117	9	90	23	112	19

Note:- i) Coefficent of Variation & Standard Error are of total tested entries (i.e. 18).
ii) Values with different letters are significantly different (P<.05)

2. LEGUMES

A. Lentils

Lentil is the second most important grain legume crop in Pakistan. It is grown in winter over an area of 82,300 ha with an annual production of 29,900 metric tonnes (Bashir et al., 1988). Out of the four provinces of Pakistan, 70% of the cultivated area is in the Punjab, while Balochistan has presently the lowest hectarage (Anwar et al., 1986). Lentils are capable of growth in the poorer soils and more extreme climates of Pakistan, as are found and experienced in upland Balochistan (Asghar et al., 1988). At present, the mono-cropping of wheat, or wheat in rotation with long, unproductive fallows are the present cropping practices under the traditional low input system of husbandry. The introduction of more legume crops may intensify agricultural production and at the very least reduce the risks of disease-induced total crop failure (Asghar et al., 1988). The local landrace presenty being grown is well adapted to the severe temperature conditions, but has the disadvantage of being ultra-small seeded. So, the Arid Zone Research Institute is searching for lentil lines with larger seed size from ICARDA breeding material or from ICARDA's international germplasm collection which can suitably adapted to the environmental conditions of upland Balochistan.

i) Lentil Yield Trials (Selection 1986/87)

The selections of 1986/87 were promoted to a second year of testing and planted at three representative sites with two seeding times. The yield results from all locations and sowing times were significantly different and the entries behaved differently at different sites and seeding times. ILL No. 1939, 5720, 5865 at Quetta, ILL No. 5747 at Khuzdar and ILL No. 5865 at Kan Mehtarzai gave significantly higher dry matter production than the local check with autumn sowing (Table 9).

With spring sowing ILL No. 5720 at Quetta, ILL NO. 975 at Khuzdar and ILL No. 5865 at Kan Mehtarzai gave significantly higher dry matter production over the local control (Table 9).

TABLE 9.

TDM (kg/ha) OF LENTIL LINES (SELECTION 1986/87) DURING 1987/88
(AUTUMN AND SPRING PLANTING)

ENT. NO.	ILL NO.	ORIGIN	AUTUMN PLANTING			SPRING PLANTING		
			QUETTA	KHUZDAR	K.MEHTARZAI	QUETTA	KHUZDAR	K.MEHTARZAI
1	975	CHILE	1111	1828	1084	325	749 a	767
2	1939	MOROCCO	1327 abc	1449	1325	472	643	667
3	5677	ICARDA	1102	974	1376	496	587	733
4	5687	ICARDA	285	644	1370	334	303	333
5	5690	ICARDA	350	1320	933	249	305	533
6	5714	ICARDA	876	1291	1441	357	350	733
7	5720	ICARDA	1591 a	1379	1023	542 a	634	400
8	5730	ICARDA	1114	1680	912	215	497	583
9	5731	ICARDA	659	1161	709	212	286	533
10	5838	ICARDA	508	1104	1129	183	287	483
11	5855	ICARDA	445	1310	1187	163	261	450
12	5865	ICARDA	1572 ab	1791	1640 a	302	310	833 a
13	707	CYPRUS	1152	1477	1390	197	241	733
14	842	LEBANON	841	1807	1069	85	523	617
15	5747	ICARDA	873	2123 a	1432	160	472	583
16	5750	ICARDA	905	1625	1149	125	251	617
17	PRECOZ	-----	691	1137	539	143	316	400
18	CHECK	LOCAL	1105 cde	1449 abc	1203 abc	93 c	188 f	767 ab
GRAND MEAN			917	1420	1162	258	400	598
COEFF. OF VAR.			26	26	28	77	35	35
STANDARD ERROR			139	213	191	115	82	120
PROBABILITY			<0.05	<0.05	<0.05	>0.05	<0.05	>.05

Only ILL No. 5865 gave significantly higher seed yield over the local check at each location in the autumn planting. But in the spring planting the seed yield results were not significantly different at Quetta and Kan Mehtarzai while ILL NO. 5677 and Precoz gave significantly higher seed yields than the local check at Khuzdar (Table 10).

It can be concluded from the results that ILL No. 5865 is a better line for autumn planting, having wide adaptability and better performance than the local check in a dry year.

TABLE 10

SEED YIELD (kg/ha) OF LENTIL LINES (SELECTION 1986/87) DURING 1987/88
(AUTUMN AND SPRING PLANTING)

ENT. NO.	ILL NO.	ORIGIN	AUTUMN PLANTING			SPRING PLANTING		
			QUETTA	KHUZDAR	K.MEHTARZAI	QUETTA	KHUZDAR	K.MEHTARZAI
1	975	CHILE	14	612	129	64	26	7
2	1939	MOROCCO	10	530	137	85	14	4
3	5677	ICARDA	25	308	243	92	29 ab	7
4	5687	ICARDA	12	209	236	88	7	3
5	5690	ICARDA	7	471	134	50	7	11
6	5714	ICARDA	8	510	266	30	11	2
7	5720	ICARDA	22	497	231	79	21	5
8	5730	ICARDA	20	643	124	14	3	9
9	5731	ICARDA	8	294	172	12	1	8
10	5838	ICARDA	12	275	221	10	4	5
11	5855	ICARDA	11	425	239	2	6	3
12	5865	ICARDA	29 a	772 a	428 a	44	16	2
13	707	CYPRUS	18	396	370	9	1	7
14	842	LEBANON	10	575	165	0	5	8
15	5747	ICARDA	9	602	295	2	2	2
16	5750	ICARDA	13	516	276	0	4	5
17	PRECOZ	-----	12	269	143	4	39 a	4
18	CHECK	LOCAL	22 ab	483 bcde	153 cd	0	2 c	6
GRAND MEAN			15	466	220	32	11	5
COEFF. OF VAR.(%)			64	31	38	175	116	95
STANDARD ERROR			5	84	49	33	7	3
PROBABILITY			>0.05	<0.05	<0.05	>0.05	<0.05	>0.05

ii) Lentil Observation Nurseries

Selections from the 1986/87 observation nurseries planted at Quetta only were planted in autumn at all three experimental sites in a single row observation nursery only due to a shortage of seed. Further bulking will be required in 1988/89 season observation nurseries before promising lines can be selected for promotion to yield trials.

B. FORAGE LEGUMES

i) Yield Trials (Selection 1986/87)

Selections behaved differently at different locations and planting times. However the winter planted trials were considerably more productive than those planted in spring.

Vicia sativa Acc. 384, Vicia dasycarpa Acc. 683 (improved check), Lathyrus sativus Acc. 3 all gave higher dry matter production than the lentil landrace control at Quetta with autumn sowing while Vicia ervillia Acc. 2542, Lathyrus sativus Acc. 347 and 3 performed significantly better than the local check at Khuzdar. A new entry of Vicia villosa L-1437 was the only line at Kan Mehtarzai which resulted in significantly higher dry matter production than in the local control with autumn sowing. In the spring sowing Vicia sativa Acc. 2541 at Quetta, Acc. 384 at Khuzdar, Acc. 490 at Kan Mehtarzai and Lathyrus sativus Acc. 3 showed significantly higher production than the local check (Table 11).

TABLE 11.

TDM (kg/ha) OF FORAGE LEGUME LINES/GENOTYPES (SELECTION 86/87) DURING 1987/88 (AUTUMN AND SPRING PLANTING)

ENT. NO.	NAME	ACC.NO.	AUTUMN PLANTING			SPRING PLANTING		
			QUETTA	KHUZDAR	K.MEHTARZAI	QUETTA	KHUZDAR	K.MEHTARZAI
1	V.SATIVA	384	1331 a	575	366	279	1417 a	600
2	"	709	672	538	191	305	517	500
3	"	507	643	562	365	269	383	667
4	"	1652	352	639	372	213	333	733
5	"	1486	399	349	291	346	633	517
6	"	2541	669	625	229	548 a	617	400
7	V.ERVILLIA	2542	969	1033 a	224	294	333	267
8	V.DASYCARPA	683	1245 a	544	238	131	633	617
9	L.SATIVUS	347	681	957 ab	208	308	617	700
10	"	3	1195 a	974 ab	200	434 ab	783 b	950
11	V. SATIVA	709	700	487	258	222	400	583
12	"	1361	207	87	80	81	167	617
13	"	490	927	665	318	232	500	1033 a
14	V.VILLOSA*	L-1437	796	589	733 a	49	317	467
15	V.DASYCARPA*	L-2527	689	635	203	59	483	917
16	V.PANNONICA*	L-1464	0	185	183	0	0	269
17	LOCAL LENTIL	CHECK	831 abc	472 bcd	546 b	104 def	467 bcd	783 abc
18	"	CHECK	701 abc	475 bcd	424 bc	101 def	350 bcd	750 abc
GRAND MEAN			723	577	302	221	497	632
COEFF. OF VAR.			49	44	34	34	61	32
STANDARD ERROR			206	147	59	43	176	117
PROBABILITY			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

* Genotypes in first year of testing.

For seed yield Lathyrus sativus Acc. 3 gave significantly greater production than the local check at Khuzdar with autumn sowing and at all three sites in the spring sowing while its Acc. 347 was the second most promising line at all locations and plantings. Lathyrus sativus Acc. 347 produced significantly higher seed yields at Khuzdar in both autumn and spring sowing and at Kan Mehtarzai in spring planting only than the local control treatment. Other promising lines were Vicia ervillia Acc. 2542 at Quetta and Khuzdar (autumn sowing), Vicia sativa Acc. 384 and 1652 at Kan Mehtarzai (autumn sowing) and Acc. 2541 at Quetta with spring sowing (Table 12).

TABLE 12.

SEED YIELD (kg/ha) OF FORAGE LEGUME LINES/GENOTYPES (SELECTION 86/87) DURING 1987/88 (AUTUMN AND SPRING PLANTING)

ENT. NO.	NAME	ACC.NO.	AUTUMN PLANTING			SPRING PLANTING		
			QUETTA	KHUZDAR	K.MEHTARZAI	QUETTA	KHUZDAR	K.MEHTARZAI
1	V.SATIVA	384	48	69	116 a	3	0	88
2	"	709	37	166	62	89	0	141
3	"	507	9	25	99	20	0	117
4	"	1652	10	30	110 a	3	0	134
5	"	1486	4	34	82	2	0	67
6	"	2541	58	196	85	187 a	7	125
7	V.ERVILLIA	2542	225 a	435 a	94	118	6	65
8	V.DASYCARPA	683	9	123	64	13	0	167
9	L.SATIVUS	347	47	280 abc	76	128	163 a	290 b
10	"	3	42	341 ab	68	156 ab	120 b	407 a
11	V. SATIVA	709	20	28	66	14	0	95
12	"	1361	9	14	24	2	0	128
13	"	490	28	32	97	24	0	186
14	V.VILLOSA*	L-1437	9	21	38	0	0	17
15	V.DASYCARPA*	L-2527	11	71	51	3	0	211
16	V.PANNONICA*	L-1464	0	6	9	0	0	11
17	LOCAL LENTIL	CHECK	10 bc	65 d	105 ab	0 d	5 c	18 gh
18	"	CHECK	12 bc	95 c	54 abcd	0 d	1 c	18 gh
GRAND MEAN			33	113	72	42	17	127
COEFFICIENT OF VARIATION (%)			87	87	47	64	142	45
STANDARD ERROR			16	57	20	16	14	33
PROBABILITY			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

* Genotypes in first year of testing.

ii) Yield Trials (New Material)

Twenty new advanced lines of Vicia sativa received from ICARDA were planted at three representative sites with two sowing times. Most of the lines did not perform well at all three sites. Some of the lines showed acute cold susceptibility at Quetta and Kan Mehtarzai while at Khuzdar they failed to survive under the prevailing high temperature and drought conditions.

Autumn planting gave better results than when compared to spring planting. In the autumn planting, dry matter production and seed yield of some lines were better than the control while for the spring planting (except Kan Mehtarzai) gave no seed in most of cases. However on the basis of overall performance the eight lines which performed significantly ($P<.05$) better than the local control were selected for testing for another two years for confirmation of results and assessment of their adaptability to variable environmental conditions (Tables 13,14).

TABLE 13.

TDM (kg/ha) OF NEW LINES OF VICIA SATIVA (SELECTION 1987/88 FROM 20 LINES, AUTUMN AND SPRING PLANTING) FOR FURTHER TESTING.

ENT. NO.	NAME	ACC.NO.	AUTUMN PLANTING			SPRING PLANTING		
			QUETTA	KHUZDAR	K.MEHTARZAI	QUETTA	KHUZDAR	K.MEHTARZAI
1	V.SATIVA	713	1482	533	957	497	933	650
2	"	715	673	643	727	347	853	717
3	"	308	892	527	622	227	833	667
4	"	490	581	569	553	345	767	800
5	"	709	1007	519	358	337	460	617
6	"	1459	1175	267	929	263	467	767
7	"	1485	530	621	587	173	400	850
8	"	2	318	515	374	296	447	733
9	V.DASYCARPA	683	1444	358	685	222	647	733
10	LOCAL (CHECK)	-	1153	477	467	93	367	600
GRAND MEAN			926	503	626	280	617	713
COEFFICIENT OF VARIATION (%)			52	108	54	41	56	22
STANDARD ERROR			156	196	144	56	155	73
PROBABILITY			<.05	>.05	<.05	<.05	<.05	<.05

TABLE 14

SEED YIELD (kg/ha) OF NEW LINES OF VICIA SATIVA (SELECTION 1987/88 FROM 20 LINES, AUTUMN AND SPRING PLANTING) FOR FURTHER TESTING

ENT. NO.	NAME	ACC.NO.	AUTUMN PLANTING			SPRING PLANTING		
			QUETTA	KHUZDAR	K.MEHTARZAI	QUETTA	KHUZDAR	K.MEHTARZAI
1	V.SATIVA	713	83	121	333	33	0	187
2	"	715	18	177	202	6	0	218
3	"	308	9	71	223	5	0	185
4	"	490	1	43	185	2	0	227
5	"	709	7	48	86	17	0	85
6	"	1459	34	26	235	2	0	258
7	"	1485	0	38	197	0	0	240
8	"	2	1	79	94	3	0	92
9	V.DASYCARPA	683	12	53	235	28	11	207
10	LOCAL (CHECK)	-	12	86	40	0	15	90
GRAND MEAN			18	74	183	10	3	179
COEFFICIENT OF VARIATION (%)			175	156	66	142	88	35
STANDARD ERROR			9	39	49	6	1	22
PROBABILITY			<.05	>.05	<.05	<.05	<.05	<.05

iii) Observation Nurseries (New Material)

Some 41 different lines/genotypes were received from New Zealand and planted in autumn at the three regular sites of germplasm testing. Some lines of Vicia villosa and Vicia sativa appeared to be suitable for promotion to the yield trials but shortage of seed has limited this. However the material will be maintained in the observation nursery for multi-locational testing for the dual purpose of; a) testing and b)increasing seed for future yield trials.

It is now evident from three years' testing of newly introduced annual sown forage legumes that good progress towards confirmation of adaptability has been made and a range of species capable of being more productive than the local control have been identified. These will be upgraded to wider scale agronomic testing in the 1989/90 season following seed bulking in 1988/89.

RECOMMENDATIONS

The germplasm evaluation group, after compiling the results of the previous three years' work, has recommended the following lines/genotypes of different crop species to be handed over to the AZRI Agronomy Group and provincial Agricultural Research Institute for wide scale agronomic testing under the variable environment of upland Balochistan:

S.No	Crop	Seed Source	ILL No.	Acc.No
1	Breadwheat	WF5H86 2133	___	___
2	"	WF5H86 9030	_ _	___
3	Barley (Arabi Abiad)	ICARDA	___	___
4	Lentil	ICARDA	5690	_ _
5	"	"	5865	___
6	"	"	5720	__
7	"	"	5730	___
8	"	"	5838	___
9	"	"	5750	___
10	"	"	5687	___
11	Forage Legume (L.sativus)	"	___	347
12	" (L.sativus)	"	___	3
13	" (V. dasy.)	"	___	683

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