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GERMPLASM EVALUATION IN THE ARID HIGHLANDS OF BALOCHISTAN: ANNUAL REPORT OF THE AZRI GERMPLASM EVALUATION GROUP 1990/91

BY

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SUMMARY

This report presents the results for the 1990/91 season from the germplasm evaluation and screening program. The crops under test were cereals (barley and bread wheat), and food/forage legumes (lentils and vetches). A large proportion of the material tested was exotic germplasm obtained from ICARDA and CIMMYT. Yield trials and observation nurseries were conducted during both fall and spring seasons in 1990/91 at Quetta, Kan Mehtarzai, Kalat and Loralai, locations chosen to cover the main agro-ecological zones in highland Balochistan. The exotic genotypes were tested against local cultivars in terms of yield and resistance to drought, heat, cold, diseases and pests. In the 1990/91 season, Quetta and Kan Mehtarzai received above-average and well-distributed rain/snow , but the precipitation at Loralai was below average, while it was about average at Kalat. Severe frost/cold injury was not experienced in the germplasm trials but a serious outbreak of Yellow Rust, (**Puccinia striiformis**) was observed on cereals. Food/forage legumes at Loralai were severely damaged by Army-worms (**Spodoptera spp.**)

412 exotic lines of barley were tested at Quetta, Kalat, Kan Mehtarzai, and Loralai with fall and spring planting, and 53 promising entries were selected for further testing. Out of 432 bread wheat exotic lines, 203 proved themselves potentially promising, and have been selected for next season's trials. In the case of food legumes (lentil), 49 exotic entries were tested and nine promising exotic lines have identified and will go forward into further trials. Out of 31 exotic genotypes of forage legumes, 30 have been selected for further intensive testing.

GERMPLASM EVALUATION IN THE ARID HIGHLANDS OF BALOCHISTAN

INTRODUCTION

Environmental stresses are the main limiting factors that adversely affect rainfed crop yields in the highlands of Balochistan. Winter crops mainly suffer from cold, drought, and fungal diseases (Yellow Rust generally being serious in years with high rainfall); occasionally viral diseases such as Barley Yellow Dwarf Virus cause damage. Both spring and winter crops usually suffer terminal drought coupled with heat stress. Local cultivars are well-adapted to the prevailing environmental conditions, but their yield potential is low and they are susceptible to fungal diseases whenever there is a good rainfall season. It is therefore, of paramount importance to explore and evaluate new and exotic germplasm with the potential for higher grain yield and biomass production, coupled with stability and improved disease resistance.

Germplasm collections are the basic source of genetic variability for such characteristics as cold and drought resistance, better yield potential and stability in a wide range of environments. Crops currently under evaluation in the germplasm group are bread wheat, barley, lentil and forage legumes. These evaluation and selection programs aim at improving the food and forage output of the highlands of Balochistan, and reducing the high risks associated with growing these crops.

This report presents the results of the evaluation and selection of promising germplasm for the 1990/91 season. The experiments were conducted at different locations with fall and spring plantings in the highlands of Balochistan in 1990-1991. The use of a good range of environments allows thorough screening/selection of desirable genetic material. The selected genotypes should then be well-adapted to the environmental conditions prevailing throughout the highlands.

OBJECTIVES

1. To select superior, well-adapted, disease-free/resistant crop species/lines/genotypes suitable for growth under non-irrigated conditions; better genotypes of crops other than wheat would give farmers an opportunity of diversifying away from the wheat mono-cropping system which most cultivators in highland Balochistan 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 higher-yielding food crops grown under rainfed conditions.

MATERIALS AND METHODS

The germplasm evaluation trials were conducted at the following four locations, selected to provide a representative cross-section of the agro-ecological conditions in the rainfed cropping areas of the highlands of Balochistan.

Site	Altitude (m)	Latitude	Longitude
ARI, Quetta	1690	30° 07'N	66° 58'E
Loralai, Kili Bokhara	1340	30° 24'N	68° 36'E
Kalat, Kili Ahmadabad	1850	29° 07'N	66° 24'E
Kan Mehtarzai	2250	31° 00'N	67° 45'E

Nine different barley, eight bread wheat, five lentil and five forage legume trials were conducted at these sites. In order to ensure satisfactory germination (without which it is difficult to evaluate the material) a pre-soaking irrigation was applied at ARI, Quetta, Kalat and Kan Mehtarzai for fall planting. At Kili Bokhara, Loralai, the trials were planted on conserved moisture from earlier monsoon rains; however, during the winter season there, there was very little rain and a supplemental irrigation had to be applied to save the germplasm at the site. Spring trials were conducted on conserved moisture from winter rains and no additional irrigation was applied at Quetta and Kalat. NPK fertilizer was used at rates per ha. of 60:60:0 for cereals and 0:60:0 plus **Rhizobium** inoculum for the legumes.

Randomized complete block designs (RCBD) were used for the yield trials; each entry had 6 rows/plot (rows were 5 m long and 0.25 m apart) giving a plot size of 7.5 m^2. However, at Loralai the plot size was 6.6 m^2 (4 rows/plot, row length 5.5 m and rows 0.3 m apart.) Harvesting was done by hand at the end of May at Loralai and in mid-June at Quetta, Kalat and Kan Mehtarzai. Growth habit (erect/prostrate/ intermediate), cold tolerance (scale 1-5), heading date (days from planting), plant height (cm), and disease resistance (yes/no) was recorded before harvest. Data on biological yield (TDM kg/ha), grain yield (kg/ha), and 1000 kernel weight (g) were taken after harvest.

The data analysis was done with the MSTAT.4C program.

CLIMATIC CONDITIONS

The salient meteorological data (total rainfall, mean maximum and mean minimum temperatures) for the four sites are presented in table 1a (Quetta, and Kalat) and table 1b (Loralai and Kan Mehtarzai). During the 1990/91 cropping season, the precipitation was well above average at Quetta (>300 mm) and Kan Mehtarzai (>500 mm), and as it came in late winter and early spring it provided sufficient moisture for both winter and spring crops at Quetta (table 1a). No severe frost/cold damage was observed in these trials. Moreover, the Quetta site has been very favourable for screening the materials for Yellow Rust resistance for the last two consecutive seasons, due to the high rainfall and atmospheric humidity.

At Kan Mehtarzai, the precipitation of 540 mm was higher than usual (table 1b.) Heavy snowfall occurred in the winter, and the crops were under a good blanket of snow during the coldest months; this suppressed vegetative growth and helped the crops to escape cold damage. At Kalat (Kili Ahmadabad) the rains were scanty, only 13 mm. The winter rain started in late November and continued up to April. Total seasonal precipitation was 249.3 mm, slightly above average (table 1a). At Loralai (Kili Bokhara) the monsoon rains of 44 mm. were better than at the other sites, but during October-January the rain was scarce and crops came under stress at the tillering stage. No frost/cold damage was observed at this site.

TABLE 1a. - Climatic data at Quetta and Kalat during 1990/91.

	Quetta - ARI			Kalat, Kili Ahmadabad		
Month	Total rainfall (mm)	Mean Temp.* (°C) Max.	Min.	Total rainfall (mm)	Mean Temp.* (°C) Max.	Min.
Jul.	0.0	35.8	17.4	0.0	32.9	15.2
Aug.	0.5	35.1	18.6	13.0	32.0	16.4
Sep.	0.3	30.6	11.1	0.0	29.5	10.5
Oct.	0.0	24.0	4.0	0.0	21.8	3.0
Nov.	0.0	18.6	1.0	0.4	17.2	0.4
Dec.	22.4	11.3	-0.5	28.3	7.8	-4.3
Jan.	80.0	8.4	-1.1	60.2	9.1	-2.5
Feb.	78.2	10.8	-0.4	65.2	10.2	-0.2
Mar.	103.2	15.6	4.4	63.1	14.8	2.9
Apr.	39.6	22.1	7.3	19.1	20.6	8.0
May	19.3	27.5	12.9	0.0	27.0	10.9
June	0.0	32.9	15.4	0.0	31.6	13.2
Total	343.5			249.3		
Irrg.	50** mm			50** mm		

* Screened air temperature at 1.5 m.
** Applied as one supplemental irrigation before sowing.

TABLE 1b. - Climatic data at Loralai and Kan Mehtarzai, 1990/91.

	Loralai- Kili Bokhara			**Kan Mehtarzai**		
	Total rainfall	**Mean Temp.* (°C)**		**Total rainfall**	**Mean Temp.* (°C)**	
Month	**(mm)**	**Max.**	**Min.**	**(mm)**	**Max.**	**Min.**
Jul.	+	+	+	0.0	32.4	16.5
Aug.	28.4	26.0	23.2	15.4	31.3	15.4
Sep.	15.6	22.2	20.0	0.0	28.5	11.4
Oct.	0.0	20.3	11.0	0.0	21.5	4.5
Nov.	0.0	24.0	6.0	0.0	16.3	2.2
Dec.	1.6	16.0	1.3	85.4	7.8	-3.4
Jan.	1.6	11.0	-0.1	171.4	4.6	-0.6
Feb.	13.6	16.4	3.0	80.4	+	+
Mar.	50.6	21.0	7.1	105.1	+	+
Apr.	30.4	25.0	8.0	70.6	21.4	10.9
May	0.0	33.9	16.1	12.0	+	+
June	0.0	40.3	19.1	0.0	+	+
Total	141.4			540.3		
Irrg.	150** mm			50*** mm		

* Screened air temperature at 1.5 m.
\+ Data was not available.
** Applied as one supplemental irrigation at tillering.
*** Applied as one supplemental irrigation before sowing.

RESULTS AND DISCUSSION

The results are presented in four sections, namely barley, wheat, food legumes (lentils) and forage legumes (vetches). This season, the material was divided into two categories, namely selections from previous years, and new material (yield trials and observation nurseries). Most of the new material was received from ICARDA, and some from CIMMYT. The aim of the evaluation work is to select new genotypes which yield more than, or at least as much as local cultivars, and have better winter-hardiness, resistance to diseases and tolerance to high temperatures during grain-filling, along with acceptable palatability. In the following tables, the local checks are shown in **bold print**.

1. BARLEY

1.1 Barley Yield Trial Selection (Winter 1988/89):

Nineteen selected barley genotypes from four trials in 1988/89 were planted at Quetta, Kalat and Loralai in the fall for second year testing: the entries are shown in Table 2.

TABLE 2. TDM production and grain yield (kg/ha) of selected barley genotypes (1988-89), winter-planted in 1990/91.

Entry No.	Seed Source	TDM			Grain Yield		
		Que.	Kal.	Lor.	Que.	Kal.	Lor.
1	BOC87 92	10133	2367	4545	3215**	765	1124
2	BOC87 34	9267	2633	3737	2433**	606	984
3	BYL88 11	10067	3300	4999	3348**	570	1457
4	BYL88 6	9800	2667	3535	2404*	518	1185
5	TOKAK	10867	6000	4832	1462	1269	1409
6	IWFBSN 20	9667	4400	4343	1511	1108	594
7	ABU88 129	10333	5066	4292	1596	1045	1312
8	ABU88 134	9000	4800	3787	1294	952	1092
9	ABU88 150	9067	3633	5555	1750	974	2153
10	BKL88 49	10800	4800	2878	2611**	1200	444
11	BKL88 114	8267	4767	2676	1245	1059	696
12	BKL88 116	10333	4767	3838	1461	1151	493
13	BKL88 187	9867	4033	5100	1811	831	1294
14	BKL88 197	10667	4600	7171	1236	1063	1857
15	BKL88 208	10333	4667	3939	1857	1314	1070
16	BKL88 266	9333	4767	4494	1568	1269	1345
17	BKL88 271	9533	5033	4752	1458	1223	1597
18	BKL88 294	12000	5400	4040	1780	1283	927
19	BKL88 372	9133	3800	4040	1272	747	1009
20	ARABI ABIAD	9867	2167	4141	1871	607	1045
21	**FRONTIER 87**	**9400**	**2100**	**3636**	**2138**	**483**	**844**
22	**Local check**	**8600**	**4800**	**3535**	**1363**	**1283**	**1312**
LSD (5%)		N.S	1530	N.S	793	559	N.S
LSD (1%)		N.S	2045	N.S	1060	N.S	N.S

*, ** Significantly different from local check, at P<0.05, 0.01 respectively. N.S.= No significant differences

Due to the good rainfall, no drought stress was experienced at Quetta at the important growth and developmental stages. However, moisture deficiency was experienced at Loralai during the early vegetative stages. Biotic stresses were not severe at Quetta and Kalat, but at Loralai genotypes BKL88 208 and BKL88 372 were infected with Loose Smut, (*Ustilago nuda*). Due to the high rainfall at Quetta most genotypes lodged, which caused some reduction in grain yield. At Kalat and Loralai, the plant populations were not uniform due to uneven soil moisture, thus the estimation of yield potentials for the different genotypes was affected. Frost/cold damage was not observed at any site.

Some exotic genotypes yielded significantly more grain than the local landrace, as in the previous year, but no difference was observed in TDM production at all the sites, in contrast to the previous year's results (1). At Quetta, the grain yields of genotypes BOC87 92, BOC87 34, BYL88 11 and BKL88 49 were significantly higher than the local check at p<0.01 level, while Genotype BYL88 6 outyielded the local check at p<0.05 level. In last year's trial at Quetta, the above-mentioned entries were not significantly different from the local check in terms of grain yield, whereas genotypes BOC87 92, and BYL88 11 did outyield the local landrace at Loralai (1). This trial will be repeated for another year at the same sites, so that final conclusions can be made; selected entries will then go forward into agronomy trials.

1.2 Barley Yield Trial Selection (Winter 1989/90):

Five barley lines (BYC88 1, BYC89 16, BYC89 17, BYC89 19, and BOC89 53) selected from the 1989/90 trials (1) on the basis of winter hardiness, drought tolerance, disease resistance and yield were planted at Quetta, Kan Mehtarzai and Loralai.

TABLE 3. TDM production and grain yield (kg/ha) of selected barley genotypes (1989-90) for winter planting in 1990/91.

Entry No.	Seed Source	TDM			Grain Yield		
		Que.	Kmz.	Lor.	Que.	Kmz.	Lor.
1	BYC88 1	6067	2533	6110	993	112	949
2	BYC89 16	8467	2967	4696	1103	138	1690
3	BYC89 17	8467	5067	6363	1699	254	2231
4	BYC89 19	9400	4000	6969	1598	280	2508
5	BOC89 53	8667	4033	6363	1289	361	1834
6	**Local check**	**8600**	**5267**	**7575**	**1234**	**510**	**2816**
LSD (5%)		1999	1133	N.S	N.S	N.S	N.S
LSD (1%)		N.S	1612	N.S	N.S	N.S	N.S

*, ** Significantly different from local check, at P<0.05, 0.01 respectively.

N.S.= No significant differences

All these lines survived at the higher elevation sites of Quetta and Kan Mehtarzai, and showed good winter hardiness and resistance to freezing temperature injury. At Kan Mehtarzai the crop was under snow cover for three months; this retarded the vegetative growth during the winter months and thus TDM and grain yields were lower than in Quetta. At Kan Mehtarzai grain yield was also reduced by bird damage, which was more severe on exotic lines due to their early heading and maturity than the local check. At Loralai genotype BOC89 53 was affected by Leaf Spot (**Septoria nodorum**) in its early vegetative stages. However, the disease was not observed later, at the reproductive stage. TDM production differences were significant at Quetta ($p<0.05$) and Kan Mehtarzai ($p<0.01$), but grain yield differences were not significant at any sites, just as in the previous year.

1.3 Barley Yield Trial Selection (Spring 1988/89):

Thirteen exotic lines of barley selected from 1988-89 trials (3), were planted at Quetta and Kalat, as shown in Table 4. At Quetta rainfall was high (>300 mm) during the spring season and therefore, no terminal stress was observed. However, at Kalat the terminal stress was severe and grain yield was comparatively low.

TABLE 4. TDM production and grain yield (kg/ha) of selected barley genotypes (1988-89) for spring planting in 1990/91.

Entry No.	Seed Source	TDM		Grain Yield	
		Quetta	Kalat	Quetta	Kalat
1	BYC88 7	4067	1333	927	79
2	BYC88 22	3867	1100	511	21
3	BYL88 1	4000	1600	842	31
4	BYL88 15	3434	1200	595	49
5	BYL88 16	4234	1368	645	72
6	BYL88 6	3600	2500**	612	513**
7	BYL88 12	4100	1400	608	90
8	BYL88 18	4000	1767	684	273**
9	BOL87 95	3667	1667	632	37
10	ABU88 134	3867	1567	931	153
11	ABU88 151	3900	1933	789	287**
12	ABU88 162	3867	1767	649	295**
13	ABU88 152	4200	2000	891	303**
14	**FRONTIER 87**	**3467**	**1167**	**678**	**46**
15	**Local check**	**4067**	**1633**	**1061**	**121**
LSD (5%)		N.S	392	N.S	109
LSD (1%)		N.S	529	N.S	148

*, ** Significantly different from local check, at P<0.05, 0.01 respectively. N.S.= No significant differences

There were significant differences in TDM production and grain yields at Kalat. Genotype BYL88 6 produced significantly ($p<0.01$) higher TDM than the local check. At Kalat 5 genotypes (BYL88 6, BYL88 18, ABU88 151, ABU88 162 and ABU88 152) gave significantly ($p<0.05$) higher grain yield than the local check. BYL88 18 behaved in the same way at Kalat last year (1). These results showed that environmental stresses can be minimized by selecting the appropriate genotypes according to the season and rainfall distribution.

1.4 Barley Yield Trial Selection (1986/87):

Four selected Syrian barley landraces (Arabi Abiad, Arabi Aswad, Wadi Hassa, and Tadmor) were compared with the local barley in spring planting for the fourth year at multiple sites in highland Balochistan (1, 3, and 4). This was the last year of testing, and these landraces have now been evaluated under a wide range of different environmental stresses.

TABLE 5. TDM production and grain yield (kg/ha) of selected Syrian barley landraces for spring planting in 1990/91.

Entry No.	Name	TDM		Grain Yield	
		Quetta	Kalat	Quetta	Kalat
1	Wadi Hassa	3067	2000	465	173
2	Tadmor	3267	1600	670	107
3	Arabi Aswad	3300	1867	772	166
4	Arabi Abiad	3367	1300	545	60
5	**Local check**	**3467**	**1900**	**585**	**43**
LSD (5%)		N.S	N.S	N.S	N.S
LSD (1%)		N.S	N.S	N.S	N.S

*, ** Significantly different from local check, at $P<0.05$, 0.01 respectively. N.S.= No significant differences

This year there were no significant differences between genotypes in TDM production or seed yield at both sites (table 5), although Wadi Hassa had given significantly ($p<0,05$) higher grain yields than the others in the 1989-90 season at Quetta (1). All these landraces mature earlier than the local check and thus have a better chance of escaping terminal drought. Terminal moisture stress is one of the main yield-limiting factors in spring-sown crops in this area (2) and by selecting such short duration and early maturing lines it is possible to make use of moisture available during the crop growth period more effectively than by using long duration lines. The data will be combined across sites and years for a stability analysis, and then final conclusions will be drawn from these trials.

1.5 Barley Yield Trial selection (Spring 1989/90):

Five barley lines were picked from the 1989/90 trials on the basis of their growth vigour, early maturity and yield potential (1), and were planted in spring 1991 at Quetta and Kalat.

TABLE 6. TDM production and grain yield (kg/ha) of selected barley genotypes (1989-90) for spring planting in 1990/91.

Entry No.	Seed Source	TDM		Grain Yield	
		Quetta	Kalat	Quetta	Kalat
1	BYL88 17	5300	1767	1451	85
2	BYL88 19	3733	1633	1159	245
3	BYL88 18	4500	2300*	1203	463**
4	BOL87 66	4833	2000	1231	379**
5	BOL87 75	5067	2100*	1267	379**
6	**Local check**	**5133**	**1600**	**1298**	**162**
LSD (5%)		968	427	N.S	140
LSD (1%)		N.S	N.S	N.S	198

*, ** Significantly different from local check, at P<0.05, 0.01 respectively. N.S.= No significant differences

The genotypes differed significantly in TDM production (p<0.05) at both sites. At Quetta, the TDM production of the selected lines was not significantly higher than the local check. At Kalat genotypes BYL88 18, and BOL87 75 produced significantly (p<0.05) higher TDM than the local check (table 6). Three genotypes (BYL88 18, BOL87 66 and BOL87 75) gave significantly (p<0.01) higher grain yield than the local barley landrace at Kalat. The testing of these lines will be continued in future.

1.6 Barley Yield Trial (HA 1990/91):

Genetic variability is the basis for making selections for any target environment. To broaden the genetic variability this year 23 new exotic barley genotypes were introduced and tested at Quetta, Kan Mehtarzai and Loralai, (table 7).

TABLE 7. TDM production and grain yield (kg/ha) of barley yield trial (High Altitude Areas 1990-1991) with winter planting.

Entry No.	Seed Source	TDM			Grain Yield		
		Que.	Kmz.	Lor.	Que.	Kmz.	Lor.
1	BYC90N 1	9733	2600	4191	2193	716	876
2	BYC90N 7	11070	3267	4596	2957*	826	1377
3	BYC90N 8	9867	2933	5606	3451*	536	2204
4	RBYT90 15	10930	5067	4848	2932*	1373	1594
5	PBT190 6	11600*	3400	5151	2713*	72	1654
6	BYC90N 6	10930	4067	4697	2456*	437	1158
7	BYC90N 17	9867	3267	4926	1595	1021	975
8	PBT190 7	11600*	5400	4747	2892*	821	1030
9	BYC90N 23	8667	4467	5151	2449*	705	1842
10	BOC89N 4	10533	3000	2838	3175*	548	546
11	BOC89N 12	10800	4800	4545	1920	1121	1543
12	BYC90N 12	9333	3267	4141	2949*	551	1211
13	BOC89N 15	9600	3933	3737	2540*	759	546
14	BOC89N 26	8667	3333	5656	3379*	555	1493
15	BOC89N 34	9733	3200	3434	3055*	431	688
16	BOC89N 41	7867	2667	4292	2485*	643	1329
17	BOC89N 82	11333	4600	4848	2484*	611	1124
18	BYC90N 18	10800	4333	4797	1667	421	1138
19	BOC89N 105	10933	4333	4545	2217	525	519
20	PBT190 23	9600	2933	2676	1713	268	427
21	BOC89N 79	9600	4933	5959	2377*	668	1020
22	BOC89N 101	9600	3269	2662	1693	135	367
23	BOC89N 77	9467	5600	4949	2224	677	1171
24	**Local check**	**9333**	**4667**	**6464**	**1403**	**1173**	**2617**
LSD (5%)		2111	1481	1778	933	547	890
LSD (1%)		N.S	1977	2373	2818	730	1188

*, ** Significantly different from local check, at P<0.05, 0.01 respectively. N.S.= No significant differences

At Quetta two genotypes (PBT190 6 and PBT190 7) produced significantly (p<0.05) higher TDM than the local check, whereas at Kan Mehtarzai and Loralai the TDM production of exotic barley genotypes were not significantly better than the local barley landrace (table 7). At Quetta 15 genotypes (BYC90N 7, BYC90N 8, RBYT90 15, PBT190 6, BYC90N 6, PBT190 7, BYC90N 23, BOC89N 4, BYC90N 12, BOC89N 15, BOC89N 26, BOC89N 34, BOC89N 41, BOC89N 82 and BOC89N 79) gave significantly (P<0.01) higher grain yields than the local check. These genotypes have been selected for further testing in highland Balochistan.

1.7 Barley Yield Trial (Low rainfall & Cold winter 1990/91).

Twenty-three new exotic barley lines were planted at Quetta, Kan Mehtarzai and Loralai in fall 1990 (table 8). At Quetta some genotypes lodged at the heading stage due to excessive vegetative growth. The grain yield at Kan Mehtarzai was lower than at the other sites, due to bird damage.

TABLE 8. TDM production and grain yield (kg/ha) of barley yield trial (Low Rainfall & Cold Winter 1990-1991), winter-planted.

Entry No.	Seed Source		TDM			Grain Yield		
			Que.	Kmz.	Lor.	Que.	Kmz.	Lor.
1	BYC90N	1	10670	3133	3838	3113**	289	853
2	BYC90N	11	11467	4333	5403	2125	671	1824
3	BYL90N	16	10667	3800	4393	3199**	397	1013
4	BYL90N	20	12133	7267	4848	2293	929	1337
5	BYL90N	21	11467	5067	5100	3324**	773	1470
6	BYC90N	6	12533*	4533	4696	2304	147	1049
7	BYL90N	22	9733	3800	5201	2064	700	962
8	BOM90N	71	10400	4067	4797	2796*	364	1359
9	BOL89N	22	10533	2733	5201	2555*	471	1434
10	BOL89N	89	12000	3200	4393	2772*	477	839
11	BOL89N	61	9600	3400	4545	2037	539	905
12	BYC90N	12	12533*	5667	4696	3107**	631	1587
13	BOL89N	62	9600	3133	4595	2591*	724	1208
14	BOL89N	68	10800	4533	3939	2903**	424	991
15	BOC89N	49	10400	4533	5454	964	21	930
16	BOC89N	54	12267	4200	5302	2157	323	918
17	BOC89N	55	11600	4267	4141	1621	92	846
18	BYC90N	18	11067	4667	5201	1708	512	1212
19	BOC89N	5	9600	4733	4545	1704	536	1319
20	BOL89N	34	11733	4267	5252	3179**	509	1519
21	BOC89N	103	11600	4533	4191	1665	113	789
22	BOC89N	104	11200	4467	3787	1243	56	833
23	BOL89N	84	10267	4400	4797	2099	627	1720
24	**Local check**		**10667**	**7267**	**5555**	**1529**	**987**	**1839**
LSD (5%)			1728	1350	N.S	980	531	N.S
LSD (1%)			2307	1803	N.S	1308	N.S	N.S

*, ** Significantly different from local check, at P<0.05, 0.01 respectively. N.S.= No significant differences

At Quetta two genotypes (BYC90N 6 and BYC90N 12) produced significantly (P<0.05) higher TDM than the local check (table 8). On the other hand, at Kan Mehtarzai and Loralai, the TDM production of exotic lines was not significantly better than that of the local check.

At Quetta six genotypes (BYC90N 1, BYL90N 16, BYL90N 21, BYC90N 12, BOL89N 68 and BOL89N 34) gave significantly higher grain yields than the local check, at the P<0.01 level. Four genotypes (BOM90N 71, BOL89N 22, BOL89N 89 and BOL89N 62) also performed significantly better in terms of grain yield than the local check at the P<0.05 level. No significant differences were observed at Kan Mehtarzai and Kalat.

All these ten high yielding lines have been selected for further testing in highland Balochistan.

1.8 Barley Observation Nurseries (Winter 1990/91):

Two sets of observation nurseries were evaluated during fall 1990/91 season. The first nursery was the "International Winter and Facultative Barley Observation Nursery" consisting of 150 entries. The other nursery, (Barley Observation Nursery Low Rainfall and Cold Winter) consisted of 58 entries. These two nurseries were evaluated both at Quetta and Loralai. Observations were made on growth habit, cold tolerance, days to heading, plant height, disease resistance, and yield parameters. On the basis of desirable traits 10 genotypes, shown in table 9, were picked from these nurseries for further testing at multiple sites in highland Balochistan.

TABLE 9. High Yielding Winter Type Barley Lines Selected From Observation Nurseries, 1990/91. (Kg/ha)

Name	TDM		Grain yield	
	Que.	Lor.	Que.	Lor.
IWFBON				
15	14400	6363	3144	1163
62	10400	4848	2448	152+
63	9600	6969	3000	1575
72	9600	4242	1696	1109
79	16000	3333	2864	351+
BONCLR				
8	7200	8484	1544	3678
14	16000	8484	5432	3739
52	-	5757	-	2381
54	-	6060	-	2303
55	-	7272	-	1212
Local	12000	10700	2192	2000

\- Due to lodging these entries could not be harvested.
\+ Bird damage.

2. BREAD WHEAT

2.1 Bread Wheat Yield Trial Selection (WINTER 1990-91):

This trial included 26 genotypes of different origin and was planted in winter 1990/91 at Quetta, Kalat and Loralai. Materials were screened and evaluated for cold, drought and disease resistance. At Quetta there was no severe cold/frost damage to the wheat genotypes.

TABLE 10. TDM production and grain yield (kg/ha) of selected bread wheat lines in 1990-1991 with winter planting.

Entry No.	Seed Source		TDM Que.	TDM Kal.	TDM Lor.	Grain Yield Que.	Grain Yield Kal.	Grain Yield Lor.
1	PWT288	22	8667	4367	3687	1377	876	437
2	PWSN88	79	10200	4100	2323	2061	756	340
3	WOL87	50	12000	5467*	2256	2130	1470**	380
4	WAT87	209	10333	5167*	3030	2055	1197**	475
5	WAT87	607	10533	4767	2575	2233	709	653
6	WAT87	608	10200	4300	4798	1981	733	499
7	WPT87	621	10800	3600	2525	1926	951*	606
8	WPT87	1511	11533	4667	1868	1571	809	204
9	IWON87	209	12133	5233*	2676	1939	1223**	345
10	PWSN87	335	11000	4133	2929	2335	1088**	708
11	PWSN87	419	12000	5267*	1919	2105	1167**	328
12	PWSN87	701	10067	4000	3131	1593	749	576
13	PWSN87	711	11400	4633	3282	1983	965*	652
14	WBWON84	111	13000	5333*	3181	1473	865	360
15	MEXIPAK	65	8867	3233	2626	2097	421	379
16	W3918A/JUP		12333	5767**	1515	1685	1041*	259
17	ICW81	1471	10933	4440	3535	2046	680	537
18	ICW81	1504	11067	4400	2929	1895	733	685
19	ICW81	1636	9667	5000	1767	1870	813	192
20	ICW81	1673	10000	4167	3114	1478	714	529
21	ICW81	1673	10133	4433	3787	1147	641	896
22	ICW81	1673	12000	4467	5757	1667	924*	1169
23	ICW81	1683	11000	4933	2020	1509	866	529
24	GEREK		11133	4667	5050	1542	641	997
25	**ZARGHOON**		**12267**	**2900**	**3081**	**2242**	**467**	**491**
26	**Local check**		**10200**	**3900**	**4292**	**1200**	**481**	**930**
LSD (5%)			N.S	1200	N.S	N.S	427	N.S -
LSD (1%)			N.S	1599	N.S	N.S	569	N.S

*, ** Significantly different from local check, at P<0.05, 0.01 respectively.
N.S.= No significant differences

Significant differences in TDM production and grain yield occurred at Kalat but not at the other two sites (table 10). At Kalat, only one genotype (W3918A/JUP) gave significantly higher TDM production than the local check at the p<0.01 level, whereas 5 genotypes (Entries WOL87 50, WAT87 209, IWON87 209, PWSN87 419, and WBWON84 111) outyielded the local check at the p<0.05 level. The grain yields of five lines (WOL87 50, WAT87 209, IWON87 209, PWSN87 335, and PWSN87 419) were superior to the local check at the p<0.01 level. Moreover, four genotypes (WPT87 621, WPSN87 711, W3918A/JUP, and ICW81 1673) outyielded the local cultivar at p<0.05 level.

Promising lines will be included in next year's trials.

2.2 Bread Wheat Yield Trial Selection (SPRING 1989/90):

Fourteen different genotypes selected from trials in previous years (BWYT-H.A. and BWYT-LR 1988/89) were compared with four local checks and (Syrian) Sham-4, at Quetta and Kalat.

TABLE 11. TDM production and grain yield (kg/ha) of selected bread wheat genotypes, planted in spring at two sites, 1990/91.

Entry No.	Seed Source	TDM		Grain Yield	
		Quetta	Kalat	Quetta	Kalat
1	PWT188 14	2933	1267	352	35
2	PWT188 17	3200	1367	586	93
3	PWT188 23	3633	1500	809	70
4	PWSN88 73	2800	1033	527	51
5	MEXIPAK 65	3100	1033	534	75
6	WOL87 25	3600	1233	609	33
7	WOL87 32	3667	1267	589	61
8	WOL87 33	2933	1200	464	64
9	NESSER	3667	1033	584	68
10	WOL87 53	3733	1133	827	50
11	WOL87 75	3900	1033	784	68
12	WOL87 91	3600	1000	515	52
13	WOL87 99	3500	1100	733	69
14	**Local white**	**3600**	**1167**	**778**	**73**
15	**ZAMINDAR**	**3700**	**1700**	**736**	**87**
16	**SONALIKA**	**3733**	**1500**	**543**	**110**
17	**KAHANI**	**3800**	**1133**	**736**	**45**
18	**SHAM-4**	**3533**	**933**	**809**	**37**
LSD (5%)		575	N.S	N.S	N.S
LSD (1%)		722	N.S	N.S	N.S

*, ** Significantly different from local check, at P<0.05, 0.01 respectively. N.S.= No significant differences

TDM production differed significantly (p<0.01) among the exotic genotypes but none outyielded the four checks at Quetta (table 11). There were no significant differences in grain yields. Last year, similar results were obtained (1).

This experiment will be repeated for another year to obtain more data on the adaptability and yield potential under drought and heat stress of these selections.

2.3 Bread Wheat Yield Trial (Spring Selection 1989/90):

Five genotypes (WOL88 14, WOL88 83, WOL88 110, WAT87 105, and WAT87 305), selected from BWYT-LR 1989-90 and BWON (LR) 88-89, were compared with five local checks.

TABLE 12. TDM production and grain yield (kg/ha) of selected bread wheat genotypes (1989-90) for spring planting in 1990/91.

Entry No.	Seed Source	TDM		Grain Yield	
		Quetta	Kalat	Quetta	Kalat
1	WOL88 14	3067	1133	572	39
2	WOL88 83	2933	1200	631	38
3	WOL88 110	3533	1067	765	50
4	WAT87 105	3233	1033	521	43
5	WAT87 305	3467	1067	690	16
6	Local white	3567	1167	597	37
7	ZAMINDAR	2933	1600*	587	198**
8	SONALIKA	3400	1467	680	120
9	KAHANI	3533	1367	527	67
10	SOREVIKI	3333	1333	469	45
LSD (5%)		N.S	301	N.S	80
LSD (1%)		N.S	412	N.S	110

*, ** Significantly different from local check, at P<0.05, 0.01 respectively.
N.S.= No significant differences

No exotic entry was significantly better in TDM and grain yield than any of the checks (table 12). At Kalat, Zamindar sinificantly out-yielded nearly all other entries, both exotic and local, but the yields there were very low.

2.4 Bread Wheat Yield Trial (Low Rainfall) 1990/91:

Twenty three exotic lines for low rainfall conditions received from ICARDA this year were compared with a local check.

TABLE 13. TDM production and grain yield (kg/ha) of bread wheat yield trial (Low Rainfall 1990-1991) with winter planting.

Entry No.	Seed Source	TDM			Grain Yield		
		Que.	Kal.	Lor.	Que.	Kal.	Lor.
1	MEXIPAK 65	10130	3400*	3858	1884	530	690
2	WOL89 4	10400	4500*	4747	1877	541	817
3	WOL89 10	9733	4933*	5757	1788	1080	1201
4	WOL89 19	10530	2900	4393	1824	566	834
5	WOL89 21	11070*	3300*	5504	1817	761	1164
6	WOL89 26	9333	2500	4292	1878	740	871
7	WOL89 52	11067*	3633*	5555	2300	795	1109
8	WOL89 69	12400**	3800*	5024	1814	619	940
9	WOL89 72	7600	4233*	4444	1689	705	993
10	WOL89 73	10267	3300*	4949	2224	560	1216
11	WOL89 78	10400	3600*	3889	1894	895	250
12	NESSER	10000	1733	3939	1516	420	928
13	WOL89 81	10400	3500*	4747	2196	668	909
14	WOL89 84	11867**	4167*	3131	1833	877	897
15	WOL89 88	9200	2867	3434	1843	681	621
16	WOL89 98	11067*	3500*	3232	2232	797	472
17	WOL89 107	12667**	3200*	7222	2067	536	1299
18	WOL89 109	11200*	3967*	6313	2291	757	1062
19	D.P90 10	9067	3267*	4899	1877	557	1218
20	WOL88 22	9067	2367	5454	1661	401	1028
21	WOL88 34	9200	3567*	2857	1360	820	545
22	WOL88 38	11600**	2933	5656	1695	735	1112
23	BELIKH	7867	2933	4797	1744	471	1321
24	**Local check**	**8667**	**1500**	**5808**	**1269**	**433**	**1437**
LSD (5%)		2183	1560	N.S	N.S	N.S	N.S
LSD (1%)		2914	N.S	N.S	N.S	N.S	N.S

*, ** Significantly different from local check, at P<0.05, 0.01 respectively. N.S.= No significant differences

Four genotypes (WOL89 69, WOL89 84, WOL89 107, and WOL88 38) exceeded the local check in TDM production at the $p<0.01$ level at Quetta (table 13). At the $p<0.05$ level, four genotypes at Quetta (WOL89 21, WOL89 52, WOL89 98, and WOL89 109), and 16 at Kalat were significantly better than the local check in terms of TDM. No grain yield differences were observed at any sites. How-ever, six genotypes (WOL89 52, WOL89 73, WOL89 81, WOL89 98, WOL89 107, and WOL89 109) have been selected for further testing due to their relatively high yield and resistance to Yellow Rust.

2.5 Regional Bread Wheat Yield Trial (Low Rainfall) 1989/90:

This trial, repeated from last year, included 23 exotic genotypes plus the local check, and was planted only at Quetta.

TABLE 14. Performance of regional bread wheat yield trial (Low rainfall areas 1989-90), planted at Quetta in winter, 1990/91.

Entry No.	Seed Source	Dry Matter (kg/ha)	Grain Yield (kg/ha)
1	MEXIPAK 65	9467	1712
2	WYL88 10	10530	1889
3	WYL88 21	10530	1845
4	WOL88 12	8133	1707
5	WOL88 14	8933	1491
6	WOL88 41	10667	1917*
7	WOL88 47	9067	1463
8	WOL88 57	10667	2027*
9	WOL88 62	10133	2037*
10	WOL88 67	10933	1992*
11	WOL88 70	12133**	2327*
12	NESSER	10133	1905*
13	WOL88 71	10667	2353*
14	WOL88 72	12133**	2401*
15	WOL88 74	9867	1811
16	WOL88 78	10000	2205*
17	WOL88 83	10133	2279*
18	WOL88 92	9733	1925*
19	WOL88 94	11467	2873*
20	WOL88 99	9867	1560
21	WOL88 102	11467	2521*
22	WOL88 110	10133	2255*
23	BELIKH	7867	1180
24	**Local check**	**9867**	**1048**
LSD (5%)		1677	854
LSD (1%)		2239	N.S

*, ** Significantly different from local check, at P<0.05, 0.01 respectively. N.S.= No significant differences

Out of these genotypes, two (WOL88 70, and WOL88 72) produced significantly higher TDM than the local wheat landrace ($p<0.01$). Fourteen genotypes (table 14) outyielded the local check in grain yield at $p<0.05$ level. Moreover, no Yellow Rust was observed on these lines. This material, received from ICARDA, Syria, has been tested for the first time under cold conditions. Therefore, all these lines have been retained for future multilocation testing in winter.

2.6 Bread Wheat Yield Trial (Winter 1990/91):

ICARDA wheat breeders sent this material because of its good performance under environmental conditions similar to highland Balochistan. The trial, with 48 entries, was planted at Kalat.

TABLE 15. Performance of new bread wheat yield trial with winter planting at Kalat in 1990/91.

Entry No.	Seed Source	Height (Cm.)	TDM (kg/ha)	Grain Yield (kg/ha)	Harvest index	1000 Kernel weight (g)
1	INDONA 198	61	4000	524	13	26
2	INDONA 201	58	3400	684	21	25
3	INDONA 205	64	3300	448	13	23
4	INDONA 207	51	3550	400	12	21
5	INDONA 212	63	3100	562	18	23
6	INDONA 214	67	3900	1008	25	30
7	INDONA 216	58	3400	898	27	22
8	INDONA 217	65	3100	822	27	24
9	INDONA 218	67	3400	638	19	22
10	INDONA 119	46	3500	448	13	24
11	INDONA 239	51	3500	494	14	18
12	INDONA 240	62	2900	424	15	23
13	INDONA 241	47	3700	648	18	24
14	INDONA 242	51	2700	276	10	18
15	INDONA 244	64	4500	664	15	25
16	INDONA 247	53	4400	796	19	22
17	INDONA 248	57	3100	664	22	26
18	INDONA 249	55	3300	408	13	23
19	INDONA 250	41	3000	262	9	20
20	INDONA 251	48	2800	304	11	19
21	INDONA 252	47	2900	274	10	21
22	INDONA 253	67	3800	494	13	26
23	INDONA 254	61	3400	420	13	23
24	INDONA 255	65	4100	682	17	26
25	INDONA 256	65	4100	916	22	27
26	INCYTW 15	65	4200	634	15	23
27	INCYTW 16	62	4000	792	20	26
28	INCYTW 17	56	3700	498	14	20
29	INCYTW 19	57	4700	820	18	30
30	INCYTW 20	61	4100	690	17	25
31	INCYTW 27	56	3200	540	17	23
32	INCYTW 28	68	4700	878	19	24
33	INCYTW 30	55	4000	722	18	24
34	INCYTW 36	59	3500	402	12	20
35	INCYTW 50	53	4400	536	12	23
36	INCYTW 51	54	3200	328	10	23
37	WCBH90 95	56	4600	670	14	24
38	WCBH90 97	58	5200	588	11	19
39	WCBH90 98	56	4700	684	15	22
40	WCBH90 101	66	4400	1362*	32*	26

(continued on next page)

TABLE 15. (continued) Performance of new bread wheat yield trial with winter planting at Kalat in 1990/91.

Entry No.	Seed Source	Height (Cm.)	TDM (kg/ha)	Grain Yield (kg/ha)	Harvest index	1000 Kernel weight (g)
41	WCBH90 102	61	3900	604	15	27
42	WCBH90 104	60	3400	850	26	25
43	WCBH90 111	59	4500	478	10	19
44	WCBH90 112	48	4000	658	15	25
45	WCBH90 113	64	5200	902	20	23
46	WCBH90 174	70	4400	658	15	22
47	WCBH90 175	52	4000	428	11	18
48	WCBH90 194	66	4300	892	20	27
49	**Local check**	**71**	**2700**	**544**	**21**	**28**
LSD (5%)		N.S	N.S	475	11	4
LSD (1%)		N.S	N.S	N.S	N.S	5

*, ** Significantly different from local check, at P<0.05, 0.01 respectively. N.S.= No significant differences

Although only one line (WCPH90 101) significantly exceeded the local check in grain yield and harvest index at the 5% level of significance, the material will be tested again at a wider range of germplasm screening sites in highland Balochistan.

2.7 Wheat Observation Nurseries (Winter 1991):

Two different sets of observation nurseries from ICARDA were evaluated for desirable traits: a) 6th International winter wheat screening nursery (**6th IWWSN**) consisting of 137 entries and b) Regional bread wheat observation nursery - high altitude (**RBWON-HA**) consisting of 150 entries. Parameters were recorded on growth habit, cold tolerance, disease resistance and yield potential, and 84 high yielding and disease resistance genotypes were picked from these observation nurseries for next year's multilocation trials; these selections are shown in table 16.

TABLE 16. Performance of selected high-yielding bread wheat genotypes during the 1990/91 season, Kg/ha

Entry No.	TDM	Seed Yield
a) 6th IWWSN		
3	12000	2376
7	13600	3016
9	12000	2584
10	14400	2408
12	10400	2112
14	12000	2200
15	11200	2016
17	12000	2080
18	20000	3200
19	16000	3416
24	12000	2544
28	11200	2400
30	12800	2632
34	8000	4384
39	10400	2200
43	12000	2592
44	13600	2584
46	11200	2032
51	12800	1920
54	11200	1976
57	12800	2480
67	21600	5296
75	12800	2336
84	12000	2648
87	9600	2424
112	14400	2128
121	9600	2240
122	13600	2032
123	11200	2032
124	10400	2344
125	8000	2360
126	20000	4500
127	19200	3688
128	12800	2360
129	11200	1688
132	13600	2832
136	16000	3744

(continued on next page)

TABLE 16. (continued) Performance of high yielding selected bread wheat genotypes during the 1990/91 season, Kg/ha

Entry No.	TDM	Seed Yield
RBWON (HA)		
10	13600	2296
12	11200	2488
13	10400	1696
18	8800	2208
21	12000	2904
22	11200	3088
23	10400	2648
28	12800	3392
29	8800	2480
31	12000	2832
39	10400	2200
42	9600	2600
46	8800	1680
49	14400	2480
51	11200	1976
54	10400	2496
58	8000	2016
61	16800	4256
62	11200	2040
63	10400	2480
64	11200	2000
65	8800	1600
66	10400	2504
67	12000	2888
70	8000	1664
72	12800	2048
73	15200	2656
75	12800	1848
77	13600	1032
81	8000 - (Bird damage) -	640
92	11200	1672
94	9600	1392
97	11200	2080
107	15200	2312
114	12800	1168
119	11200	2176
121	20000	4000
122	16000	3400
125	12000	2280
126	10400	2272
127	13600	2856
128	12000	2232
137	11200	2288
138	9600	1728
139	12800	2288
142	14400	3256
149	11200	2568
Local Check	**10400**	**1400**

3. FOOD LEGUMES - LENTILS.

As local lentils have very small seeds, an important aim is to identify larger-seeded types, which are also winter-hardy, disease resistant, and drought- and heat-tolerant.

3.1 Lentil Yield Trial Selection (Winter 1988/89).

Nine large-seeded selected lines from 1988/89 trials were again compared with local lentil at Quetta, Kalat and Loralai.

TABLE 17. TDM production and seed yield (kg/ha) of large seeded lentil lines (selection 1988/89) at different sites, from winter planting during 1990/91.

Entry No.	ILL No.	Origin	TDM Que.	TDM Kal.	TDM Lor.	Seed Yield Que.	Seed Yield Kal.	Seed Yield Lor.
1	5582	JORDAN	4667	1050	2121*	675	197	90**
2	5668	SYRIA	3933	1133	1363	609	273	60
3	5699	ICARDA	4600	1300	1262	582	287	36
4	5751	ICARDA	3733	1250	1161	478	208	28
5	5816	ICARDA	4800	1017	1616	449	214	30
6	5817	ICARDA	4467	983	1515	545	155	38
7	5842	ICARDA	4467	1117	1616	446	145	30
8	5876	ICARDA	4467	1183	2020*	694	225	23
9	5988	ICARDA	4667	1367	1666	448	261	39
10	**Local**	**check**	**4933**	**1467**	**1212**	**315**	**342**	**51**
LSD (5%)			N.S	N.S	614	N.S	N.S	20
LSD (1%)			N.S	N.S	N.S	N.S	N.S	28

*, ** Significantly different from local check, at P<0.05, 0.01 respectively. N.S.= No significant differences

TDM production differed significantly (p<0.05) only at Loralai, where the two genotypes ILL 5582 and ILL 5876 outyielded the local check; the others were all as good as the local. Seed yields of the exotic genotypes were not significantly superior to the local check at Quetta and Kalat. However, one genotype, ILL 5582, gave a significantly (p<0.01) higher seed yield than the local landrace at Loralai. In the previous (1989/90) season, the TDM and seed yields of the exotic genotypes did not significantly exceed the local check at Quetta and Loralai (1). In both years, a severe attack of Army-Worm at the pod formation and seed setting stages considerably reduced seed yields at Loralai. Therefore, valid comparisons for seed yield at that site were not possible. However, the larger seed and higher seed weight of these exotic genotypes is an advantage over the local landrace with its ultra small seeds. This trial will be repeated for another year to confirm the performance of these genotypes in different agro-ecological zones of Balochistan.

3.2 Lentil Yield Trials Selection (Winter & Spring 1988/89).

Nine winter and six spring genotypes were selected from the 1988/89 observation nurseries. The winter types were planted at Quetta, Kalat and Loralai in winter, while the spring types were planted at Quetta and Kalat in spring.

3.2.1 Lentil Yield Trial Selection, Winter.

TABLE 18. TDM production and seed yield (kg/ha) of selected (1988/89) winter type lentil lines at different sites in winter planting during 1990/91.

Entry No.	ILL No.	Origin	TDM Que.	TDM Kal.	TDM Lor.	Seed Yield Que.	Seed Yield Kal.	Seed Yield Lor.
1	2500	INDIA	4867	1250	2121	501	254	90
2	2573	INDIA	3867	1300	2323	381	367	62
3	2581	INDIA	5200	1200	2424	621	299	35
4	3493	INDIA	3733	933	2121	445	213	47
5	3517	INDIA	4733	1117	2020	590	283	83
6	3614	INDIA	4333	933	2272	581	373	35
7	4403	PAKISTAN	5533	1333	2323	661	331	66
8	590	TURKEY	6600	1233	1717	381	88	29
9	857	ALGERIA	3800	1100	1868	579	205	20
10	**Local**	**check**	**4800**	**1400**	**1616**	**307**	**243**	**12**
LSD (5%)			N.S	N.S	N.S	N.S	N.S	N.S
LSD (1%)			N.S	N.S	N.S	N.S	N.S	N.S

*, ** Significantly different from local check, at P<0.05, 0.01 respectively. N.S.= No significant differences

TDM and seed yield did not differ significantly among the genotypes across the trial sites (table 18). Similar results were observed in the 1989/90 season at Quetta (1). Most genotypes showed good winter hardiness and disease resistance in both these seasons, but the seed yield was very low at Loralai due to the severe Army-worm attacks.

As this material has desirable characteristics such as larger seed size and weight along with cold and disease resistance, the material will be tested for another two years.

3.2.2 Lentil Yield Trial Selection, Spring.

During the 1989/90 season these genotypes were planted at Quetta only. The genotype ILL 6260 gave a better yield than the local check, although the difference was not statistically significant (1).

TABLE 19. TDM production and seed yield (kg/ha) of selected (1988/89) spring type lentil lines at different sites during 1990/91.

Entry No.	ILL No.	Origin	TDM Quetta	TDM Kalat	Seed Yield Quetta	Seed Yield Kalat
1	6027	ICARDA	1800	533	113	145
2	6254	ICARDA	1267	550	183	198
3	6256	ICARDA	1333	600	192	228
4	6260	ICARDA	1267	417	157	138
5	6263	ICARDA	1200	583	117	183
6	4354	JORDAN	1467	500	145	156
7	**Local**	**check**	**1533**	**567**	**147**	**283**
LSD (5%)			N.S	N.S	N.S	62
LSD (1%)			N.S	N.S	N.S	87

*, ** Significantly different from local check, at P<0.05, 0.01 respectively. N.S.= No significant differences

The TDM production and seed yields of the selected genotypes were not significantly better than the local check at Quetta and Kalat (table 19). However, these genotypes mature earlier than the local check, and thus have an advantage over local lentil in escaping terminal stress. Testing of these genotypes will be continued in future.

3.3 Lentil International Yield Trial, Early (1990/91)

Fifteen new exotic genotypes of different origin were planted at Quetta and Loralai for comparison with local lentil in terms of cold, drought and disease resistance and yield potential.

TABLE 20. TDM and seed yield (kg/ha) of lentil international yield trial, early (1990/91), during 1990/91.

Entry No.	ILL No.	Origin	TDM Quetta	TDM Loralai	Seed Yield Quetta	Seed Yield Loralai
1	2501	INDIA	4467	1161	796	155
2	2573	INDIA	4533	1212	805	194
3	2581	INDIA	4067	861	921	5
4	4403	PAKISTAN	4467	1515	970	122
5	4605	ARGENTINA	2467	656	560	36
6	5486	EGYPT	2600	1262	601	60
7	5888	BANGLADESH	3200	883	966	84
8	6256	ICARDA	5267	909	925	108
9	6262	ICARDA	1933	959	557	87
10	6458	ICARDA	3200	1313	865	197
11	6463	ICARDA	4933	1060	713	89
12	6467	ICARDA	2333	808	549	71
13	6810	ICARDA	4933	909	478	113
14	6811	ICARDA	5133	1161	611	108
15	6818	ICARDA	3800	1060	1191*	71
16	**Local**	**check**	**5067**	**1666**	**698**	**285** -
LSD (5%)			1067	N.S	394	27
LSD (1%)			1437	N.S	·N.S	N.S

*, ** Significantly different from local check, at P<0.05, 0.01 respectively. N.S.= No significant differences

Two genotypes (ILL 2573 and ILL 6458) showed good winter hardiness, whereas the other genotypes were damaged by frost/ freezing temperatures. However, in spring all these genotypes recovered and exhibited good regrowth. TDM production of these newly introduced genotypes was not significantly higher than the local check at Quetta and Kalat. ILL 6818 gave significantly (p<0.05) higher seed yield than the local check at Quetta. At Loralai the severe Army-worm attack reduced yields considerably.

This trial will be repeated next season in both fall and spring in highland Balochistan.

3.4 Lentil Yield Trial, Winter - 1990/91:

This trial, consisting of ten new genotypes, was conducted at Quetta, Kalat and Loralai in order to evaluate the material and select desirable lines.

TABLE 21. Performance of new exotic lentil genotypes in yield trial with winter planting in 1990/91.

Entry No.	ILL No.	TDM			Seed Yield		
		Quetta	Kalat	Loralai	Quetta	Kalat	Loralai
1	465	5267*	967	2121	415	95	14
2	468	5733*	967	2525*	372	79	36
3	590	5667*	1333	2171	401	82	163
4	662	5467*	1417	1919	416	253	4
5	5599	3667	967	1818	689**	246	0
6	5684	5333*	1400	2272*	1111**	322	49
7	5725	6200*	1567	1767	838**	373	203
8	6245	4600	1500	2323*	561*	331	270
9	6777	5533*	1600	2575*	644*	435	146
10	6827	4000	1367	1515	244	375	200
11	**Local check**	**3733**	**1700**	**1616**	**275**	**558**	**317**
LSD (5%)		1465	406	608	267	108	141
LSD (1%)		N.S	553	N.S	377	147	193

*, ** Significantly different from local check, at P<0.05, 0.01 respectively. N.S.= No significant differences

All these genotypes survived in winter at Quetta and Kalat and no severe frost/cold damage was experienced. However, severe attacks by Army-worms affected seed production at Loralai.

Seven genotypes (ILL 465, ILL 468, ILL 590, ILL 662, ILL 5684, ILL 5725 and ILL 6777) at Quetta and four genotypes (ILL 468, ILL 5684, ILL 6245 and ILL 6777) at Loralai produced significantly (p<0.05) higher TDM than the local landrace.

In the case of seed yields, three genotypes (ILL 5599, ILL 5684, and ILL 5725) outyielded the local check at P<0.01 level and two genotypes (ILL 6245 and 6777) gave significantly (P<0.05) higher yields than the local check at Quetta. However, at Kalat and Loralai, the seed yields of exotic genotypes were not superior to the local landrace (table 21).

Testing of these genotypes will be continued in future.

4. FORAGE LEGUMES

4.1 Vicia villosa Yield Trial (Selection 1988/89):

Eight selected genotypes of **Vicia villosa ssp. dasycarpa** from the 1988/89 trials were compared with local lentil and improved vicia check Acc 683 at Quetta and Kalat.

TABLE 22. TDM and seed yield (kg/ha) of forage legume lines (Selection 1988/89) planted at different sites during winter 1989/90.

Entry No.	Name of Genotype	Acc. No.	TDM		Seed Yield	
			Quetta	Kalat	Quetta	Kalat
1	V. dasycarpa	596	6000**	1733	111	256
2	V. dasycarpa	717	7333**	1133	202	131
3	V. dasycarpa	800	5933**	1333	90	137
4	V. dasycarpa	801	6933**	1433	148	119
5	V. dasycarpa	956	7000**	1433	367*	154
6	V. dasycarpa	958	7133**	1833	69	218
7	V. dasycarpa	966	5733**	1533	108	156
8	V. dasycarpa	2558	7467**	1600	154	226
9	V. dasycarpa	683	5800**	1333	121	167
10	L. culinaris	Local	2667	1100	103	595*
LSD (5%)			1898	N.S	148	240
LSD (1%)			2600	N.S	N.S	N.S

*, ** Significantly different from local check, at P<0.05, 0.01 respectively. N.S.= No significant differences

All **V. v. dasycarpa** genotypes at Quetta produced significantly (p<0.01) higher TDM than the local lentil. However, TDM production was not significantly better than the improved check of **V. v. dasycarpa** Acc 683, just as in 1989/90 (1). However, during the 1988/89 season TDM production did not differ signifi-cantly across the trial sites (3).

Seed yield differences were significant (p<0.05) at Quetta and Kalat. **V. v. dasycarpa** 956 gave significantly (p<0.05) higher seed yield than the local check at Quetta. At Kalat the local lentil landrace significantly (p<0.05) outyielded **V. v. dasycarpa** genotypes. However, during the previous (1989/90) season an entirely different set of entries of **V. v. dasycarpa** (Acc 596, 717, 800, 958, 966, 2558, and 683) had given signif-icantly (p<0.05) higher seed yields than the local check (1).

These genotypes will be tested for another year in highland Balochistan in order to confirm their genetic stability for desirable characters.

4.2 Vicia ervilia Yield Trial (Selection 1988/89).

Twelve selected genotypes of **V. ervilia**, another promising forage, were tested both in fall and spring plantings at various sites (tables 23 & 24).

TABLE 23. TDM and seed yield (kg/ha) of forage legume lines (Selection 1988/89) planted at different sites during winter 1990/91.

Entry No.	Name of Genotype	Acc. No.	TDM Que.	TDM Kal.	TDM Lor.	Seed Yield Que.	Seed Yield Kal.	Seed Yield Lor.
1	V. ervilia	225001	4800	2633	1464	847*	1085**	274
2	V. ervilia	225004	4667	2500	1919	671*	1068**	562**
3	V. ervilia	225006	4667	2400	1565	783*	905	415*
4	V. ervilia	225007	4400	2200	1717	835*	939*	484**
5	V. ervilia	225008	4467	2500	1161	734*	1147**	310
6	V. ervilia	225010	4333	2233	1616	831*	1057**	460**
7	V. ervilia	225011	4333	2433	1666	766*	902	367*
8	V. ervilia	225012	4867	2400	1565	913*	1251**	356
9	V. ervilia	225014	4267	2167	1616	730*	1045**	378*
10	V. ervilia	225015	4733	2300	1969	819*	1105**	611**
11	V. ervilia	225016	5000	1867	1969	754*	767	4
12	**L. culinaris**	**Local**	**4600**	**1967**	**1919**	**247**	**673**	**115**
LSD (5%)			N.S	N.S	N.S	314	248	242
LSD (1%)			N.S	N.S	N.S	N.S	337	328

*, ** Significantly different from local check, at P<0.05, 0.01 respectively. N.S.= No significant differences

In the fall/winter plantings, TDM production of **V. ervilia** genotypes was not significantly better than the local lentil. Seed yield differences were significant across the sites. All **V. ervilia** genotypes gave significantly ($p<0.05$) higher seed yield than the local check at Quetta. At Kalat, eight genotypes gave significantly higher seed yield than the local check, (Acc nos. 225001, 225004, 225008, 225010, 225012, 225014 and 225015 at the $p<0.01$ level, and 225007 at the $p<0.05$ level.)

Four genotypes (Acc no. 225004, 225007, 225010, and 225015) and three genotypes (Acc no. 225006, 225011, and 225014) at Loralai were significantly better in seed yield than the local check at $p<0.01$, and $p<0.05$ level respectively (table 23). Similarly during 1989/90 season the performance of these **V. ervilia** genotypes was superior at Quetta when compared to the local check (1).

TABLE 24. TDM and seed yield (kg/ha) of forage legume lines (Selection 1988/89) planted at different sites during spring 1990/91.

Entry No.	Name of Genotype	Acc. No.	TDM		Seed Yield	
			Quetta	Kalat	Quetta	Kalat
1	**V. ervilia**	225001	1000	933**	573**	505**
2	**V. ervilia**	225004	1200	633	705**	327*
3	**V. ervilia**	225006	1400	700	589**	311
4	**V. ervilia**	225007	1333	850*	665**	444**
5	**V. ervilia**	225008	1067	967**	601**	512**
6	**V. ervilia**	225010	1133	967**	745**	515**
7	**V. ervilia**	225011	1400	767*	674**	401**
8	**V. ervilia**	225012	1200	667	623**	352*
9	**V. ervilia**	225014	1133	850*	579**	444**
10	**V. ervilia**	225015	1133	850*	515**	457**
11	**V. ervilia**	225016	733	650	331*	297
12	**L. culinaris**	**Local**	**1200**	**467**	**43**	**179**
LSD (5%)			N.S	282	217	144
LSD (1%)			N.S	383	295	195

*, ** Significantly different from local check, at P<0.05, 0.01 respectively. N.S.= No significant differences

In the spring planting at Kalat, three genotypes (Acc no. 225001, 225008, 225010) and four genotypes (Acc no. 225007, 225011, 225014, and 225015) produced higher TDM than the local check at the $p<0.01$, and $p<0.05$ levels respectively (table 24). There were no significant differences at Quetta.

The seed yield of **V. ervilia** genotypes was significantly ($p<0.01$) better at Quetta and Kalat than the local check. At Quetta all the **V. ervilia** genotypes gave significantly ($p<0.01$) higher seed yield than the local check except one (Acc no. 225016), which was better than the local check only at $p<0.05$ level. Seven genotypes (Acc no. 225001, 225006, 225008, 225010, 225011, 225014, and 225015) at Kalat gave significantly ($p<0.01$) higher seed yield than the local check, while another two geno-types (Acc no. 225004, and 225012) were better in seed yield at $p<0.05$ level than the check (table 24).

Fall and spring testing of these genotypes will be carried out again next season in highland Balochistan.

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