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RESEARCH REPORT

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GERMPLASM EVALUATION IN THE ARID HIGHLANDS OF BALOCHISTAN: ANNUAL REPORT OF THE AZRI GERMPLASM RESEARCH GROUP

M. Anwar Khan, Irshad Begum, Sarfraz Ahmad, S.A. Jalil and E.F. Thomson

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GERMPLASM EVALUATION IN THE ARID HIGHLANDS OF BALOCHISTAN: ANNUAL REPORT OF THE AZRI GERMPLASM EVALUATION GROUP 1991/92

BY

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ABSTRACT[1]

This report describes the results of AZRI evaluation and selection trials with bread wheat, barley and food and forage legumes in the 1991/92 season. The trials were conducted at sites with varied agro-ecological conditions (Quetta, Kan Mehtarzai, Loralai and Kalat) which represent the range experienced in the highlands of Balochistan. Fall and spring sowing were used. Unfortunately at Loralai and Kan Mehtarzai a heavy hail storm and flooding occurred close to harvesting which either partially or completely damaged the crops. Therefore, direct yield comparisons for Loralai and Kan Mehtarzai with Quetta and Kalat would be misleading. In terms of precipitation, the 1991/92 season was above average. These high rainfall conditions resulted in an epidemic of yellow rust (*Puccinia striiformis*) which occurred throughout the highlands of Balochistan. High humidity and optimum temperatures encouraged the spread of the disease. Local landraces of bread wheat and barley suffered severely and hence the season provided a good screening opportunity for selecting yellow rust resistant genotypes. Most of the exotic cereal lines proved to be specifically resistant to the yellow rust race 0E16 prevalent in Balochistan. Although no severe cold damage was observed during the growing season, desiccating winds during anthesis and the grain filling stage shrivelled the seed of most exotic bread wheat genotypes.

During the 1991/92 season, eight bread wheat trials (totalling 1026 entries) were sown in fall and two advanced yield trials (total 28 entries) were sown in spring for screening against biotic and abiotic stresses. From this range of material 102 entries were selected for further testing. Moreover, two bread wheat lines HAW-16 and WOL 89-73 were promoted to seed multiplication with the current best lines Gerek and ICW1471. All these lines have shown resistance to yellow rust and better productivity than the local landrace. For barley, 11 trials (total 496 entries) sown in fall and two trials (total 21 entries) sown in spring, were conducted at several locations. From this exotic material 159 lines were selected for future testing. Three genotypes (Di Jou 3-2-5; Rihane-03; and Arabi Abiad/Emir, ICB82-1292-0AP-0AP-6AP-0AP) were promoted to the seed multiplication stage. These lines have exhibited superior performance at different test sites and resistance to yellow rust.

Six lentil trials were performed with fall sowing (total 113 entries) and three lentil trials with spring sowing (total 62 entries). Out of them, 38 superior lines were selected for testing next year. One lentil genotype (ILL 5668) was selected for seed multiplication after four years of multi-location testing. Forage legumes were tested for adaptability in three trials with fall sowing (total 46 entries) and in three trials with spring sowing (total 307 entries). Some promising genotypes were selected for further testing.

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[1]The editorial help of E.F. Thomson and J.D.H. Keatinge (both of ICARDA) is much appreciated.

INTRODUCTION

Balochistan province of Pakistan is mostly arid and semi-arid but its highlands are famous for winter crop production, despite the limitations on plant growth due to the continental Mediterranean climate and other environmental stresses. The rapidly increasing population of people and small ruminants requires that all areas of rainfed land be used with maximum efficiency.

In the highlands of Balochistan which have an altitude above 1000 m, abiotic stresses such as moisture deficits and temperature extremes, and biotic stresses such as yellow rust on wheat and army worm on legumes, affect crops at critical stages of the growth cycle. As well as selecting crops resistant to these stresses, attention is being given to alternative crops to wheat which is the principal crop grown in highland Balochistan. These include the annual forage legumes such as vetches which are not currently grown and barley which is already grown on a limited scale. They would allow farmers to diversity their cropping systems and provide more feed for livestock. Therefore, a comprehensive and well-planned research program of breeding and selection is required to develop crop cultivars with better and sustainable production.

The Germplasm Section of the Arid Zone Research Institute (AZRI) is presently working with scientists of the International Center for Agricultural Research in the Dry Areas (ICARDA) on both winter/facultative and spring wheats, barleys, lentils and forage legumes. The objectives of the research are:

1. to develop, select and release superior, well adapted, disease and disease resistant crop species, lines and genotypes suitable for growing under rainfed conditions in highland Balochistan, and

2. to investigate the potential of forage legumes and the residues from better yielding food crops grown under rainfed conditions, to provide additional feed for livestock.

This report presents the research results of the 1991/92 season which used fall and spring sowing at multiple test sites in highland Balochistan.

MATERIALS AND METHODS

Four test sites were used for the trials: ARI - Sariab Quetta (altitude 1690m), Kalat - Ahmad Abad (altitude 1850m), Loralai - Killi Bokhara (altitude 1340m), and Kan Mehtarzai (altitude 2250m). These sites represent the different agro-ecological zones of the area which allows exposure of germplasm to the prevailing environmental stresses experienced in highland Balochistan.

Fall and spring sowing times were chosen since this is the practice of local farmers of the area. Fall sowing was made between mid-October to mid-November at Quetta, Loralai and Kan Mehtarzai for selecting disease resistant and cold tolerant genotypes. At ARI trials were sown after applying a pre-sowing irrigation of about 50 mm. At Loralai trials were conducted on conserved moisture from monsoon rains. At Kan Mehtarzai the trials were sown after the rains in November. Trials with spring sowing were conducted at ARI and Kalat for selecting short duration, disease resistant and drought tolerant genotypes. At Quetta trials were sown in early February after sufficient winter rains. At Kalat trials were sown in last week of February after a pre-sowing irrigation.

A randomized complete block design was used for yield trials and each entry had four-to-six rows per plot at the different sites. Rows were 5 m long with an inter-row distance of 25 cm. Cereals were hand sown at a seed rate of 100 kg per ha and food and forage legumes at 60 kg per ha. Three replicates were used except at ARI where two replications were used because of a shortage of land. Twenty kg N and P per ha were applied before sowing to all crops and *Rhizobium* inoculum was used for food and forage legumes to promote symbiotic N fixation. Harvesting was from mid-May to the end of June depending upon the maturity times at the different sites.

Observations were made before harvesting on growth habit (erect/prostrate/intermediate), cold tolerance (scale 0-5), 50% heading (days from sowing), plant height (cm), number of spikelets per spike (only in barley), tillers per m^2 and yellow rust resistance (Modified Cobb Scale). Production data (total biological yield as total dry matter - TDM), grain yield and 1000 kernel weight were also recorded. Harvest index was calculated as the percentage of grain in the TDM. The middle two rows of each plot were used to measure yield data.

CLIMATE

The 1991/92 cropping season had generally above average precipitation at all the test sites which provided favourable conditions for a yellow rust epidemic. At Quetta 301 mm rain was received during the cropping season (Table 1). Favourable climatic conditions were experienced for spring sowing as well. Above average rains (259 mm at Quetta and 278 mm at Kalat) were received during the spring crop season from February to June. Winter temperatures were not low enough to cause

Table 1. Climatic data at ARI (Quetta) and Kalat during 1991/92

	ARI (Quetta)			Kalat		
Month	Total rainfall (mm)	Mean Temp.[1] (°C) Max.	Min.	Total rainfall (mm)	Mean Temp.[1] (°C) Max.	Min.
July	1.5	35.2	16.9	0.2	32.7	16.2
August	0.0	35.2	18.3	0.1	32.6	14.3
September	13.7	30.6	11.0	0.2	28.8	9.2
October	0.0	23.5	3.2	0.0	20.9	2.2
November	9.4	10.1	1.3	13.4	15.6	0.3
December	17.8	14.7	1.2	147.0	13.4	-0.5
January	61.0	11.4	-0.5	76.6	9.9	-1.6
February	46.4	13.4	-0.4	58.4	12.0	-0.9
March	41.9	15.9	2.0	29.0	14.2	1.2
April	92.4	20.0	7.3	33.4	18.8	6.9
May	15.0	25.3	10.5	158.0	27.0	10.9
June	2.3	33.8	13.4	0.0	31.6	13.2
Total	301.4			278.8 (Feb. to June)		
Irrg.	50 mm^2 (approx.)			50 mm^2 (approx.)		

[1]Screened air temperature at 1.5 m. [2]One supplemental irrigation applied before sowing to ensure pre-winter emergence.

mortality due to cold or frost in the genotypes under test. A severe hail storm was experienced at Loralai and Kan Mehtarzai close to harvesting. As a result at Kan Mehtarzai harvesting of only two forage legume trials was possible before the hail storm and the remainder of the trials were destroyed. At Loralai wheat and barley and food and forage legumes were damaged either partially or totally by hail depending on the degree of maturity.

RESULTS 1: Bread Wheat

Bread wheat (*Triticum aestivum L.*) is the most important staple food crop grown in highland Balochistan under rainfed conditions. The majority of farmers of the area prefer to grow wheat for domestic use. Although the local wheat landraces are highly adapted to the environmental stresses of the area, they are very susceptible to diseases, especially yellow rust (Ahmad *et al.*, 1990a; Mohammad, 1989) and this can result in very low yields. Therefore, AZRI seeks to develop, evaluate and select drought, cold and disease resistant and high yielding genotypes suitable for sowing in the winter and spring seasons in the Balochi highlands. During the 1991/92 season, eight bread wheat trials were sown in fall and two advanced bread wheat trials were sown in spring at multiple sites in highland Balochistan. In addition, five additional winter bread wheat nurseries were also sown at various test sites. Details are given in Table 2.

Bread Wheat Preliminary Yield Trial (Winter 1990/91)

This trial was first sown at Kalat in 1990/91. In 1991/92 it was conducted at ARI, Loralai and Kan Mehtarzai and used the entries shown in Table 3. Screening for yellow rust resistance was possible at Quetta (Table 4). Most exotic entries were resistant but entries 1, 2, and 18 were not and the local check was highly susceptible to the disease. However, late rains and high air temperatures may have helped it produce some grain.

At Quetta entries 1 and 26 produced significantly ($P<0.05$) more TDM than the local check. At the same site eleven genotypes were superior ($P<0.05$) in grain yield to the local landrace (Table 4). No significant TDM differences were found between exotic and the local genotype at Loralai (Table 4). However, entry 23 outyielded ($P<0.05$) the local check in grain yield at Loralai. The 1000 kernel weight of entries 23, 24 and 29 at Loralai was significantly higher ($P<0.05$) than the local landrace (Table 4). The harvest index of seventeen exotic genotypes was significantly ($P<0.05$) superior at Quetta to the local check (Table 4).

Although in the 1990/91 season only entry 40 gave a significantly ($P<0.05$) better grain yield and harvest index than the local check (Ahmad *et al.*, 1991), in 1991/92 it gave better production at Quetta than the local check. However, grain size and color of this genotype is not attractive and it is thought that farmers will not accept it for cultivation.

After two years of testing entry 6 (HAW-16) was chosen for seed multiplication. It had shown drought tolerance and resistance by producing higher grain yields than the local landrace in the 1990/91 season at Kalat (Ahmad *et al.*, 1991). In the favorable rainfall and disease promoting conditions of 1991/92 the same genotype at Quetta was also superior in grain yield to the local check and yellow rust resistant. Twenty one genotypes including entry 6 from this trial were selected for further testing.

Table 2. Bread wheat genotypes evaluated and selected during 1991/92 season

Name of trial	Total Entries	Selected Entries
Winter sown trials		
1. Preliminary bread wheat yield trial (B.C) 1991/92	49	21
2. Advanced bread wheat yield trial selections 1991/92	25	11
3. New regional bread wheat yield trial (LRA) 1991/92	24	15
4. Bread wheat observation nursery selections 1991/92	90	5
5. Bread wheat germplasm pool for yellow rust resistance	65	8
6. First facultative and winter wheat observation nursery 1991/92	140	14
7. Regional bread wheat observation nursery (LRA) 1991/92	270	18
8. National wheat disease screening nursery 1991/92	363	10
Spring sown trials		
1. Advanced bread wheat yield trial selections 1991/92	18	0
2. Advanced bread wheat yield trial selections 1991/92	10	0

Table 3. Name and cross/pedigree of Bread Wheat Yield Trial (B.C.) 1991/92

Entry No.	Name or cross/pedigree
1	HAW-1 or Hanza 6 ICW81-134-1AP-2AP-0AP
2	HAW-4 ICW81-1610-1AP-1AP-0AP
3	HAW-7 ICW-1612-3AP-3AP-0AP
4	HAW-9 ICW81-1931-1AP-2AP-0AP
5	HAW-14 YE484-7E-2E-1E-0E
6	HAW-16 SWM11623-10AP-1AP-3AP-0AP

Table 3 (continued). Name and cross/pedigree of Bread Wheat Yield trial (B.C.) 1991/92

Entry No.	Name or cross/pedigree
7	WW4394
8	Hanza-3
	ICW-HA81-1863-6AP-3AP-0AP
9	HAW-18
	SWM765614 -09P-0S
10	Kraai 75-658 (*T. aes. V. Lutescens*) 55121
11	Pamir 2
12	Hanza-2
	ICW-HA81-1781-2AP-3AP-0AP
13	Hanza-4
	ICW-HA81-1341-1AP-3AP-0AP
14	WWP 4258
15	HAD-16
	CD 18271-5Y-1AP-4AP-2AP-1AP-0AP
16	HAW-20
	ICW-HA81-1610-1AP-2AP-0AP
17	HAW-21
	ICW-HA81-1610-1AP-3AP-0AP
18	HAW-22
	ICW-HA81-1610-1AP-1AP-0AP
19	HAW-23
	ICWHA82-0650-2AP-1AP-0AP
20	HAW-24
	ICWHA82-0626-2AP-2AP-0AP
21	HAW-25
	ICWHA82-0626-2AP-1AP-0AP
22	HAW-26
	SWM-11623-10AP-1AP-1AP-0AP
23	HAW-27
	SWM-11582-7AP-1AP-2AP-0AP
24	HAW-28
	SWM11623-10AP-1AP-2AP-0AP
25	HAW-29
	SWM-11031-2AP-1AP-1AP-02AP
26	Tx62A4794-7//CB809//Veery S'
	ICWH81-1863-2AP-1AP-5AP-2AP-1AP-0AP
27	Tx62A4793-7/CB809//Veery S'
	ICWH81-1863-2AP-2AP-5AP-3AP-2AP-0AP
28	Au/Tob66/3/Cndr S'/Ana//Cndr S'/Mus S'
	ICWH81-1849-5AP-6AP-2AP-0AP
29	Bez//Tob/8156/4/On/3/6 Th/Kh//6 Lee/5/Bgs/Sort//Kal/Bb
	ICWH81-1470-1AP-1AP-0AP
30	Chambord/5133//Mt/3/Kkc/4/Lfn.//Nd/2 P101/5/Car61-1523/Drc//Emu
	ICWH81-1617-9AP-5AP-1AP-2AP-0AP
31	Tx62A4793-7/CB809//Veery S'
	ICWA81-1863-2AP-5AP-3AP-0AP
32	Tx62A4793-7/CB809//Veery S'
	ICWHA81-1863-2AP-2AP-5AP-4AP-1AP-0AP

Table 3 (continued). Name and cross/pedigree of Bread Wheat Yield trial (B.C.) 1991/92

Entry No.	Name or cross/pedigree
33	Au/Tob66/3/Cndr S'/Ana//Cndr S'/Mus S' ICWHA81-1849-5AP-6AP-2AP-1AP-0AP
34	T.aest (Rom)//Top S'/8156/3/Tx69A460-1/4/Pat7268/Hotk S' ICWHA81-1337-4AP-2AP-2AP-1AP-0AP
35	Tx62A4793-7/CB809//Veery S' ICW-HA81-1863-2AP-1AP-8AP-3AP-1AP-0AP
36	Chambord/5133//Mt/3/Kkc/4/Lfn//ND/2 P101/5/Maya74 S'/Mon S' ICW-HA81-1619-2AP-2AP-3AP-4AP-1AP-0AP
37	Bez//Tob/8156/4/On/3/6 Th/Kf//6 Lee/Kf/5/Tob S'/Napo//NO66 ICW-HA81-1473-2AP-1AP-2AP-0AP
38	Soty/Sut//Ler/4/2 Rfn/3/Er//Kad/Gb/5/Tmp64//Bb/Gallo/6/Trakia ICW-HA81-1369-1AP-2AP-1AP-0AP
39	Bl/E72-23/3/T11a 2 Er/Kad//Gb/Gb ICW-HA81-1395-1AP-3AP-0AP
40	Lom11/Son64/4/Pj S'/Gb55//093/3/44/Stw597947/5/Trakia ICW-HA81-1500-1AP-3AP-1AP-0AP
41	Lom11/Son64/4/Pj S'/Gb55//093/3/44/Stw597947/5/Yr//Son64/NY5207 ICW-HA81-1502-4AP-5AP-2AP-0AP
42	Ymh/Hys/4/Kvz/Ti71/3/May S'/Bb/Inia ICW-HA81-2254-3AP-1AP-2AP-0AP
43	Ticonderoga//Asp/Hys ICW-HA82-0626-2AP-2AP-0AP-0AP
44	Bez//Tob/8156/4/On/6 Th/Kf//6 Lee/Kf/5/Tob S'/Napo//No66/E ICW-HA81-1473-2AP-1AP-2AP-0AP
45	Soty/Sut//Ler/4/2 Rfn/3/Er//Kad/Gb/5/Tmp64//Bb/Gallo/6/Trakia ICW-HA81-1369-1AP-1AP-1AP-0AP
46	T.aest(Rom)//Top S'/8156/3/Tx69A460-1/4/Pat7268/Hotk S' ICW-HA81-1337-3AP-6AP-2AP-1AP-0AP
47	Chambord/5133//Mt/3/Kkc/4/Lfn//ND/2 P101/5/Car61-1523/Drc//Emu S' ICW-HA81-1617-8AP-4AP-1AP-1AP-0AP
48	Zincirli/4/Kkz/3/Nai60/NloB//Staring/2 Cmn/5/Dove S' ICW-HA81-1545-1AP-1AP-3AP-0AP
49	Local check (local white)

Table 4. Performance of the winter sown Bread Wheat Yield trial (B.C) during 1991/92 at Quetta and Loralai

Ent. No.	Days to 50% heading	Yellow rust disease	Tillers per m^2	Plant height (cm)	TDM (kg/ha)		Grain yield (kg/ha)		1000 kernel weight (g)		Harvest Index(%)	
					Quetta	Lor.	Quetta	Lor.	Que.	Lor.	Que.	Lor.
1	155	40MS	577	111	14200*	2933	3400**	337	28	32	24	12
2	154	20MR	677	91	10800	3067	2600	293	22	30	24	10
3	153	OR	572	115	6400	2933	1300	200	26	28	29	6
4	157	OR	688	89	9600	2800	2000	302	21	28	21	11
5	164	OR	716	111	12000	2133	1600	168	18	31	13	8
6	155	OR	633	100	12600	2000	3600**	185	29	33	28	17
7	179	TR	616	96	10800	2000	3200*	232	24	24	30	12
8	154	OR	711	106	11600	1733	3000*	141	27	24	26*	8
9	155	OR	788	97	11800	2267	3400**	208	27	30	29**	9
10	154	OR	827	93	12800	2533	3200*	258	22	28	25*	10
11	156	OR	688	99	12200	2533	2800	218	22	31	23	9
12	154	OR	550	109	12400	2667	3400**	228	28	28	27*	8
13	153	OR	650	106	14000	2533	4200**	381	30	31	30**	15
14	179	OR	522	72	10400	1867	2400	120	20	22	23	6
15	154	OR	666	105	11600	2667	2800	281	32	33	24	10
16	156	OR	672	95	10200	3067	2200	326	21	31	21	10
17	154	OR	650	98	11400	2800	2200	202	25	33	19	8
18	153	TR	588	110	11400	2667	2400	233	27	32	21	9
19	157	OR	711	92	12600	3200	2400	426	28	29	19	13
20	156	OR	655	90	10000	3067	2000	244	20	27	20	9
21	158	OR	655	89	12000	2533	2600	245	22	29	22	10
22	154	OR	644	106	13400	2267	3200*	229	31	29	24	10
23	153	OR	616	104	7600	2667	2000	521*	33*	33	27*	20*
24	153	OR	705	102	10000	2800	2200	326	34*	30	22	12
25	155	OR	655	111	8600	2267	1800	148	27	30	20	6
26	157	OR	655	105	14800*	3067	3800**	317	31	29	26*	10
27	154	OR	688	103	12600	2800	3000*	254	29	29	24	9
28	154	OR	788	96	13400	3067	3800**	268	29	31	28**	9
29	155	OR	494	96	12200	2400	3200*	274	35**	34	26*	12
30	154	OR	733	101	12800	2267	3200*	277	26	28	25*	12
31	157	OR	711	100	12800	2933	3000*	224	31	29	23	8
32	153	OR	777	103	13200	3333	3000*	253	31	30	23	7
33	153	OR	766	106	12400	2133	2800	204	27	29	23	10
34	157	OR	738	101	12200	2267	2200	265	27	26	18	10
35	155	OR	777	108	12000	2133	2400	224	24	30	20	10
36	157	OR	711	125	12400	2667	2200	200	19	28	19	7
37	159	OR	766	91	11400	2667	2600	177	27	30	23	7
38	155	OR	650	97	11200	2400	2800	264	22	35	25*	11
39	156	OR	666	93	13200	2400	2600	245	27	26	20	10
40	153	OR	772	88	10200	2800	3000*	365	25	28	30**	12
41	155	OR	761	92	12400	2000	2200	105	24	38	18	5
42	179	OR	661	98	10800	2267	2400	194	25	31	22	8
43	156	OR	733	87	12200	3200	3000*	380	22	28	25*	12
44	179	OR	766	89	10000	2400	2600	133	30	31	26*	6
45	156	OR	800	91	13000	2400	2400	262	25	33	18	12
46	156	OR	900	104	11600	2400	2000	253	23	27	17	10
47	179	OR	733	100	9400	2667	2000	258	18	26	21	10
48	179	OR	722	114	12600	2800	2000	349	20	28	16	12
49	150	90S	922	123	11400	2800	1800	321	25	34	16	12
LSD(5%)	9	-	173	7	3481	1163	1096	182	8	5	8	6
LSD(1%)	12	-	230	10	2609	1540	1462	241	10	7	11	ns

*, ** significantly different from check at P<0.05 and P<0.01, respectively.
ns = no significant difference (P>0.05).

Advanced Bread Wheat Yield trial Selection (Winter 1990/91)

This trial consists of 25 genotypes taken from different trials. The seed source and pedigrees of these genotypes are given in Table 5. In 1991/92 TDM production of one exotic entry 3 was higher ($P<0.05$) than the local check at Quetta and Loralai. Moreover, entry 14 and entries 10 and 16 at Loralai outyielded the local check in TDM ($P<0.01$ and $P<0.05$, respectively, Table 6). Twelve exotic genotypes at Quetta were significantly ($P<0.01$) better in grain yield than the local check (Table 6). At Loralai entries 3 and 11 and entries 9, 13, 14 and 16) gave significantly higher grain yields than the local check ($P<0.01$ and $P<0.05$, respectively, Table 6). While making comparisons between Quetta and Loralai, entries 3, 9, 13 and 16 behaved similarly by outyielding the local check in terms of grain yield (Table 6). Regarding 1000 kernel weight, only entry 20 was significantly ($P<0.05$) better than the local landrace at Quetta but not at Loralai (Table 6). Similarly, the harvest index of exotic genotypes was superior to the local check at Quetta but not at Loralai, with the exception of entries 8 and 11. However, entry 11 did not have a higher harvest index at Quetta. In this trial entry 22 was found susceptible to yellow rust and discarded. Some of these genotypes were also superior in TDM production and grain yield to the local check in 1990/91 (Ahmad *et al.*, 1991). Eleven genotypes were selected for further testing and seed multiplication of entry 2 has started. This will mean there is sufficient seed after completing the trial, as well as seed for quality testing at NARC. The trial could not be harvested at Kan-Mehterzai.

Table 5. Name of cross/pedigree of Bread Wheat Yield trial selection 1991/92

E. No.	Name or cross/pedigree	Seed Source/Entry
		BWYT (LR) 1990/91
1	Clement/Ald S' SWM9813-5Y-3Y-0Y-1AP-1AP-0AP	7
2	Bow S'/Crow S' CM69599-4AP-2AP-2AP-1AP-0AP	10
3	Shi#4414/Crow S' SWM11508-4AP-4AP-3AP-4AP-0AP	13
4	Vee S'/Lira S' CM73996-04AP-300AP-1AP-0AP	16
5	Ns723/Her SWM11179-2AP-3AP-1AP-2AP-2AP-0AP	17
6	HD1944/Cno S'//G11/3/Cc/Inia//Bb (18M) ICW79-0767-3AP-7AP-3AP-3AP-3AP-0AP	18
		BWYT (LR) 1989/90
7	C182.24/C168.3/3/Cno/7C*2//Cc/Tob SWM 6828-6AP-2AP-2AP-1AP-2AP-1AP-0AP	6
8	Vee S'/Tsi CM 58943-1AP-4AP-1AP-1AP-0AP	8
9	Tzpp*2/Ane//Inia/3/Cno/Jar/Kvz/4/Mn72252 CM 59483-2AP-2AP-1AP-1AP-1AP-0AP	9
10	A0041/Emu S' L 1971-6AP-2AP-1AP-0AP	10

Table 5 (continued). Name of cross/pedigree of Bread Wheat Yield trial selection 1991/92

E. No.	Name or cross/pedigree	Seed source/Entry
11	Inia/R14220/7C/3/YR S'/5/12300/LR64/ 8156/3/Nor67/Y50E ICW80-0745-4AP-1AP-3AP-0AP	11
12	Neseer	12
13	Rsk/5/21931/3/Ch53/An/Gb56/4/An64 ICW80-0787-1AP-3AP-1AP-0AP	13
14	Vee S'/Nac CM 67404-7AP-1AP-3AP-0AP	14
15	55.1744/7C/Su/Rdi/3/Crow S' SWM 12008-2AP-1AP-3AP-0AP	16
16	F134-71/Crow S' SWM 11147-1AP-2AP-4AP-1AP-0AP	17
17	Dove S'/Buc S' CM 58808-6AP-2AP-1AP-1AP-0AP	18
18	Vee S'/Tsi CM 58943-1AP-1AP-2AP-2AP-0AP	19
19	Shi#4414/Crow S' SWM 11580-1AP-1AP-5AP-1AP-0AP	21
20	SD648.5/8156/3/Chr/Sn64/K1.Rend/ 4/Cc/Iwp19	22
		BWF2-1982
21	ICW81	156
22	ICW81	1504
23	Gerek	
24	S-19	
25	Local check	

Table 6. Performance of Bread Wheat Yield trial selection during 1991/92

Ent. No.	Days to 50% heading	Yellow rust disease	Tillers per m^2	Plant height (cm)	TDM (kg/ha)		Grain yield (kg/ha)		1000 kernel weight (g)		Harvest Index(%)	
					Quetta	Lor.	Quetta	Lor.	Que.	Lor.	Que.	Lor.
1	154	OR	705	80	12200	4400	3400**	390	26	32	28**	7
2	152	OR	1028	90	12400	3867	4200**	425	22	32	34**	10
3	150	OR	905	100	13600*	6000*	3400**	754**	27	30	25*	13
4	156	OR	1050	87	12200	4667	3200**	552	26	31	26*	12
5	157	OR	811	113	11800	3733	2200	388	24	30	19	10
6	155	OR	783	95	13400*	4267	3400**	195	25	33	26*	4
7	154	OR	644	93	12400	4133	3600**	298	26	31	29**	11
8	158	OR	583	91	11600	3200	3600**	417	21	27	31**	20*
9	153	OR	677	86	11000	4800	3200**	630*	27	33	29**	12
10	155	CR	611	91	10000	5467*	2600	352	21	34	26*	7
11	154	OR	844	89	12400	4800	2400	850**	17	30	19	19*
12	154	OR	905	86	12600	5067	3000**	545	21	29	24	11
13	153	OR	805	87	11000	4933	3400**	576*	23	32	31**	11
14	156	OR	733	93	11400	6933**	2400	577*	26	36	21	8
15	155	OR	777	83	10800	5067	2400	542	19	33	22	10
16	151	OR	727	96	11800	5467*	4000**	673*	24	30	34**	13
17	156	OR	755	88	11600	4267	2400	237	21	30	21	5
18	156	OR	666	90	11800	4667	2200	291	14	32	19	6
19	153	OR	722	86	12000	2933	2800	250	21	29	22	8
20	150	OR	716	89	12600	3733	3200**	364	22	32	25**	9
21	156	OR	805	92	11400	4667	2600	576	28*	31	23	10
22	156	90S	805	117	10200	3067	1600	220	17	31	16	7
23	155	OR	1278	108	12400	3600	2200	336	19	30	18	10
24	155	20MS	644	97	11200	3067	2600	245	25	30	23	8
25	150	90S	1083	117	10600	3067	1800	189	21	32	17	6
LSD(5%)	3	-	246	6	2280	2326	1012	64	7	5	7	8
LSD(1%)	4	-	334	8	3089	3116	1372	485	9	6	10	ns

*, ** significantly different from check at P<0.05 and P<0.01, respectively.
ns = no significant difference (P>0.05).

New Regional Bread Wheat Yield Trial (Low Rainfall Areas) 1991/92

This trial comprised 23 exotic genotypes and was conducted only at Quetta for the first year. The genetic background of these genotypes is given in Table 7. All of them were resistant to yellow rust except for entries 1 and 23. Thirteen exotic genotypes produced significantly (P<0.05) more TDM than the local check (Table 8) and eight genotypes gave significantly (P<0.05) higher grain yields. The exotic genotypes were not superior in 1000 kernel weight and harvest index to the local check. Fifteen lines have been included in next year's testing program.

Table 7. Name or cross/pedigree of Regional Bread Wheat Yield trial (Low Rainfall Areas) 1991/92

Entry No.	Name or cross/pedigree
1	Mexipak
2	Tsi/Vee S' CM 64335-3AP-3AP-1AP-0AP
3	Inia/RL4220//7C/3/YrS'/5/12300//LR64/8156/3/Nor67/4/Y50E ICW80-0745-4AP-1AP-3AP-0AP
4	Rsk/5/21931/3/Ch53/An/Gb56/4/An64 ICW80-0787-1AP-3AP-1AP-0AP
5	Vee S'/Nac CM 67404-7AP-1AP-3AP-0AP
6	Goman
7	Tzpp*2/Ane//Inia/3/Cno/Jar//Kvz/4/Mn72252 CM 59483-2AP-2AP-1AP-1AP-0AP
8	Vee S'/Nac CM 67404-10AP-1AP-1AP-1AP-0AP
9	Vee S'/Nac CM 67575-7AP-3AP-1AP-1AP-0AP
10	Bow S'/Crow S' CM 69599-4AP-2AP-3AP-3AP-0AP
11	Shi#4414/Crow S' SWM 11508-4AP-4AP-3AP-1AP-0AP
12	Cham
13	Shi#4414/Crow S' SWM 11508-4AP-4AP-3AP-3AP-0AP
14	Nac/Vee S' CM 64224-2AP-2AP-1AP-1AP-1AP-0AP
15	Tr380-16-3A614/Chat S' CM 64868-1AP-1AP-1AP-3AP-1AP-0AP
16	Tr380-16-3A614/Chat S' CM 64868-1AP-1AP-3AP-1AP-3AP-0AP
17	Tr380-16-3A614/Chat S' CM 64868-1AP-1AP-3AP-2AP-1AP-0AP
18	Tr380-16-3A614/Chat S' CM 64868-1AP-1AP-3AP-4AP-3AP-0AP
19	Maya S'/Sap S' CM 59008-6AP-1AP-4AP-1AP-3AP-3AP-0AP
20	2Ca542C/Skorospelka//Neuzucht/3/Nac76 SWM 8943-1Y-1Y-0Y-4AP-3AP-3AP-0AP
21	Vee S'/3/Hork S'/Ymh//Kal/Bb CM 78045-06AP-300AP-3AP-300L-0AP
22	47777*2//Fkn/Gb/3/Nac#5/4/Buc S'/Pvn S' CM 66684-B-1M-6Y-2M-2Y-1M-0Y
23	Belikh
24	Local check

Table 8. Productivity and agronomic data of Regional Bread Wheat Yield trial (LRA) 1991/92

Entry No.	Days to 50% heading	Yellow rust disease	Tillers per m^2	Plant height (cm)	Yields (kg/ha) TDM	Yields (kg/ha) Grain	1000 kernel weight (g)	Harvest Index(%)
1	152	60MS	822	101	14200*	2600	20	18
2	152	OR	900	95	14400*	3600	22	25
3	153	OR	55	89	13800*	4000*	23	29
4	152	OR	938	84	12600	3400	30	28
5	152	OR	972	88	11600	3000	18	25
6	152	OR	922	88	15200**	2800	25	18
7	153	OR	816	91	12800	3600	22	28
8	153	OR	794	95	11800	3400	25	29
9	153	OR	783	99	15000**	4800**	29	32
10	152	OR	855	90	13800*	4200*	28	30
11	152	OR	966	95	14400*	3800	23	26
12	153	OR	988	87	13000	4600**	25	35
13	153	OR	994	89	12400	2600	20	22
14	153	OR	733	96	13400	3800	30	29
15	151	OR	805	94	13400	4600**	27	34
16	152	OR	855	96	14200*	3400	23	24
17	153	OR	822	96	13000	2000	24	15
18	152	OR	644	98	15600**	4000*	25	26
19	153	OR	883	111	14200*	3600	23	25
20	152	OR	966	103	13600*	4400**	32	32
21	152	OR	833	99	15000**	3600	29	24
22	153	OR	811	97	14200*	3600*	33	26
23	152	30MR	522	91	9400	2400	28	27
24	151	90S	1117	126	11000	2400	28	22
LSD(5%)	1.5	-	282	6	2535	1462	7	ns
LSD(1%)	2.0	-	383	8	3441	1984	9	ns

*, ** significantly different from check at P<0.05 and P<0.01, respectively.
ns = no significant difference (P>0.05).

Bread Wheat Observation Nurseries 1991/92

During 1991/92 five bread wheat observation nurseries including 928 entries were tested against the prevailing stresses in highland Balochistan. These nurseries contained a wide range of genetic diversity to allow selection of desirable traits. The genetic backgrounds of the selected genotypes are given in Table 9. The performance of the material selected from each observation nursery is outlined in the following paragraphs and tables.

Bread Wheat Observation Nursery Selections (Winter 1990/91). This observation nursery consisted of 90 entries selected from different observation nurseries from last year. Out of 90 entries this year (1991/92), five genotypes have been selected on the basis of cold and drought tolerance, disease resistance and yield potential. The performance of these selected genotypes is presented in Table 10.

Bread Wheat Germplasm Pool for Yellow Rust Resistance 1990/91. This new nursery included 65 entries which have performed well against yellow rust and other disease pressures in the WANA region. The nursery was introduced particularly for screening against the prevalent race of yellow rust race in highland Balochistan. All the exotic genotypes were resistant to this disease. However, on the basis of better yield and healthier grain than the local check, eight genotypes were selected from this observation nursery for further testing (Table 9 and 10).

First Facultative and Winter Wheat Observation Nursery 1991/92. This nursery was prepared by the National Wheat Improvement Program of Turkey, the International Maize and Wheat Improvement Center (CIMMYT) and ICARDA. The nursery included 140 entries and was evaluated for the first time in highland Balochistan against environmental stresses and yield potential at Quetta. From this nursery 14 genotypes were picked for future testing (Table 9 and 10).

Regional Bread Wheat Observation Nursery (Low Rainfall Areas) 1991/92. This nursery comprised 270 entries for testing under low rainfall and moderate fertility conditions. The nursery was sown at Quetta. Different parameters (growth habit, cold tolerance, disease resistance and yield potential) were recorded. From this observation nursery 18 genotypes were selected for multilocation testing next year (Table 9 and 10).

National Wheat Disease Screening Nursery 1991/92. This nursery was received from the Cereal Disease Research Institute, Islamabad. The nursery was evaluated for different desirable traits. Ten high yielding and disease resistant lines were picked for further evaluation (Table 10).

Table 9. Name or cross/pedigree of selected bread wheat genotypes from Observation Nurseries during 1991/92

E. No.	Name or cross/pedigree	Seed Source/Entry
Selection from BWON-SEL. 1991/92		RBWON (HA) 1990/91
1	Rmn F12-71/Ska//CA 8055 ICWH83-0603-3AP-1AP-1AP-0AP	92
2	Smb/Pch//Kal/Bb/3/CA 8055 ICWH83-0503-1AP-1AP-1AP-1AP-0AP	138
		6th IWWSN 1990/91
3	F12.71/COC SWM05784-01H-2P-1S-0P-5M-0M-4WM-0WM	34
4	Fundulea_490	87
5	Shi 4414/Pew S' SWM 11507-4AP-1AP-1AP-0AP	
6	Local check	
7	Bolal	
8	Seri 82	
9	Gerek	
10	Zarghoon	
11	Zardana	
12	S-19	

Table 9 (continued). Name or cross/pedigree of selected bread wheat genotypes from Observation Nurseries during 1991/92

E. No.	Name or cross/pedigree	Seed Source/Entry
Selection from WYRGP-1991/92		WYRGP 1991/92
1	71St2959/Crow S' SWM 11623-2Y-0Y-1AP-0AP	2
2	71St2959/Crow S' SWM11623-9AP-3AP-7AP-5AP-4AP-0AP	3
3	Bow S' CM 33203-K-9M-4M-4Y-1M-0Y	16
4	Clement/Ald S' SWM9813-5Y-2Y-0Y-3AP-1AP-0AP	19
5	GH S'/Bow S' CM67350-9Y-1M-1Y-1M-0Y	23
6	HD2169/Bow S' ICW81-0705-05AP-300AP-7AP-0AP	25
7	Ns732/Her SWM11179-2AP-3AP-1AP-2AP-2AP-0AP	41
8	Van S'//Bb/Kal ICW80-0660-3AP-4AP-1AP-1AP-0AP	62
9	Local check	
Selection from IST FAWWON 1991/92		Ist FAWWON 1991/92
1	Seri 82	2
2	CA8335 = YOU BAO 36//YOU4/LOV10	29
3	YAN7578.128 CHINA-4M-2WM-0WM	32
4	1D13.1/MLT SWM12174-18M-0M-1M-3M-0YE-12R-0R	44
5	1D13.1/MLT SWM12174-18M-0M-4M-1M-0YE-16R-0R	45
6	1D13.1/MLT SWM12174-18M-0M-4M-1M-0YE-7R-0R	46
7	RSK/NAC SWM801092	58
8	NS5558/VEE SWM833795*-08H-1P-0TK-0TK-0TK	59
9	NA160/HN7//BUC/5/F59.71/4/BB/KAL// ALD/3/Y50E/3*KAL//EMU SW0791095-0R840335-5M-4M-0M	63
10	A8055/6/PATO(R)/CAL/3/7C//BB/CNO/ 5/CAL//CNO/SN64/4/CNO//NAD/CH ICW840431-2AP-2AP-1AP-1AP-0AP	108
11	CBC//CNO/INIA/3/LFN/4/KLPE/RAF/5/ HYS//DRC*2/7C ICWH840228-6AP-1AP-1AP-1AP-0AP	110
12	ID800994/VEE SWM15134-2WM-0WM-0SE*-0YC*-0YC	119
13	TAST/SPRW//ZAR ICW840048-3AP-1AP-1AP-0AP	131
14	Local check	

Table 9 (continued). Name or cross/pedigree of selected bread wheat genotypes from Observation Nurseries during 1991/92

E. No.	Name or cross/pedigree	Seed Source/Entry
Selection from RBWON (LRA) 1991/92		BWON (LRA)-1991/92
1	HD2206/HORK//BUC/BUL CM88500-25M-0Y-0M-10Y-0M	25
2	BB/2*7C//Y50E/3*KAL/3/GEN CM90825-13Y-0M-0Y-3M-0Y	32
3	Tr380-16-3A614/Chat S' CM64868-1AP-1AP-3AP-1AP-3AP-0AP	46
4	P106.19//Soty/Jt*3/3/Crow S' ICW85-0637-03AP-300AP-300L-2AP-0L-0AP	62
5	GEN/PRL "S" CM91622-7Y-0H-0Y-3M-0Y	71
6	KANCHAN	77
7	PRL "S"/VEE#6//MYNA "S"/VUL "S" CM90722-17Y-0H-0Y-5M-0Y	116
8	MON/IMU//ALD/PVN CM85835-4Y-0H-4M-0Y	118
9	BUC/FLK//MYNA/VUL CM91575-24Y-0H-0Y-4M-0Y	135
10	OPATA/BOW CM83398-5M-0Y-0M-5Y-0M	137
11	PFAU "S"/4/BB/GLL//CJ/3/F35.70// KAL/BB/5/VEE#7 CM92053-P-0Y-0H-0Y-5M-0Y	141
12	Bez/Nad//Kzm/4/Sn64//Ske/2*Ane/3/ Sx/5/Seri/6/Vee#5 S' CM 93948-B-0M-0AP-0L-0AP	155
13	PFAU "S"/4/BB/GLL//CJ/3/F35.70// KAL/BB/5/VEE#7 CM92053-P-0Y-0H-0Y-3M-0Y	168
14	LIRA/TRN CM88144-12Y-0M-0Y-5M-0Y	207
15	Vee S'/Gh S' CM77894-06AP-300AP-2AP-300L-2AP-300L-0AP	241
16	FCH3/TRT//VEE#9 CM82534-08TOPM-7Y-025H-0Y-12M-0Y	249
17	Lira S'/Tan S' CM 88144-41Y-0M-0AP-0L-0AP	263
18	Local check	
Selection from NWDSN 1991/92		NWDSN 1991/92
1	17	17
2	77	77
3	97	97
4	182	182
5	230	230
6	240	240
7	245	245
8	282	282
9	333	333
10	343	343
11	Local check	

Table 10. Performance of promising wheat lines selected from Observation Nurseries during 1991/92

Entry No.	DHD (50%)	PH (cm)	YR	TDM (kg/ha)	GY (kg/h)	1000 KW(g)
Selection from BWON-Sel. 1991/92						
1	153	100	OR	15200	4000	31
2	150	98	OR	11200	3200	30
3	158	87	OR	10400	4000	31
4	152	97	OR	16000	4800	29
5	152	91	OR	12800	3200	26
6	150	121	100S	11800	1850	25
7	153	109	OR	13600	3200	24
8	160	89	OR	12800	2000	24
9	160	105	OR	14400	4000	24
10	160	96	OR	12800	4000	29
11	152	101	60S	13600	4800	30
12	150	86	20S	6400	1600	37
Selection from WYRGP-1991/92						
1	152	96	OR	10400	4500	40
2	152	94	OR	9600	3200	40
3	154	88	OR	8800	2400	44
4	153	96	OR	10400	3200	40
5	153	93	OR	11200	4000	36
6	158	95	OR	8800	2400	42
7	160	104	OR	10400	3200	32
8	155	86	OR	12000	4000	27
9	150	126	80S	18000	1750	27
Selection from 1st FAWWON-1991/92						
1	152	91	OR	13600	4800	40
2	153	90	OR	12000	4000	34
3	158	72	OR	11200	4000	41
4	158	100	OR	10400	4000	36
5	159	99	OR	11200	4000	34
6	158	95	OR	10400	3200	42
7	152	90	OR	11200	4000	46
8	157	99	OR	10400	4000	39
9	160	84	OR	11200	4800	31
10	150	100	OR	9600	3200	47
11	158	96	OR	11200	3200	39
12	160	94	OR	13600	4000	26
13	154	109	OR	14400	4000	45
14	151	114	100S	16000	1800	24
Selection from RBWON (LRA) 1991/92						
1	150	101	OR	16000	4800	30
2	151	97	OR	12800	4000	40
3	153	86	OR	12000	4000	36
4	152	90	OR	14400	4500	36
5	150	91	OR	14400	4800	35

Table 10 (continued). Performance of promising wheat lines selected from Observation Nurseries during 1991/92

Entry No.	DHD (50%)	PH (cm)	YR	TDM (kg/ha)	GY (kg/ha)	1000 KW(g)
6	149	92	OR	10400	3200	35
7	152	93	OR	12800	4000	41
8	153	107	OR	12800	4000	37
9	152	103	OR	12000	4000	33
10	152	100	OR	11200	4000	33
11	150	106	OR	13600	4800	35
12	150	88	OR	8800	3200	41
13	150	103	OR	17600	4500	40
14	148	97	OP	11200	3200	43
15	151	98	OR	16000	4800	42
16	148	94	OR	10400	3200	41
17	150	84	OR	9600	3200	34
18	152	119	100S	14400	1689	25
Selection from NWDSN 1991/92						
1	152	93	OR	12800	4000	38
2	150	91	OR	13600	2400	38
3	151	93	OR	15200	4000	36
4	153	101	OR	11200	3200	37
5	153	120	OR	14000	2400	47
6	151	73	OR	11200	3200	41
7	153	95	OR	12700	4000	35
8	160	97	OR	16000	4000	36
9	149	94	OR	13600	3200	37
10	149	100	OR	20000	4300	32
11	151	120	100S	18400	1884	25

DHD = Days to 50% heading
PH = Plant height (cm)
YR = Yellow rust resistance
TDM = Total dry matter
GY = Grain Yield
1000 KW = Thousand kernel weight

Advanced Bread Wheat Yield Trial Selection (Spring 1988/89)

Fourteen exotic bread wheat genotypes selected from the 1988/89 trials were compared with four check entries 14, 15 ,16 and 17 in a spring sown trial (Table 11). The exotic genotypes did not outyield the checks in TDM production, grain yield and harvest index at both Quetta and Kalat (Table 12). However, the 1000 kernel weights of entries 2, 3, 5, 14 and 17 were significantly higher ($P<0.05$) at Quetta. Similarly, in the previous two years (1989/90 and 1990/91), TDM and grain yield of the exotic genotypes were not significantly better ($P<0.05$) than the check entries (Ahmad *et al.*, 1991; Ahmad *et al.*, 1990b).

This trial has now been conducted for three years at Quetta and Kalat. At Quetta no supplemental irrigation was applied and thus lines were tested under strictly

rainfed conditions. After three years multilocation testing it was noticed that although the exotic genotypes have shorter maturity periods, their yield potential was not better than the check entries. Therefore, further testing of these genotypes have been terminated.

Table 11. Name or cross/pedigree of Bread Wheat Yield trial selection spring 1991/92

E. No.	Name or cross/pedigree	Seed Source/Entry
		RBWYT (HA) 1988/89
1	Chambord/5133//Mt/3/KKc/4/Lfn// No/2*P101/5/Maya 74 S'/Mon S' ICWHA81-1619-2AP-2AP-3AP-4AP-1AP-0AP	5
2	YKt 406/Wren//Veery S' ICWHA81-1362-1AP-1AP-1AP-2AP-0AP	6
3	Kanred/Euno/4/7C//Cno S'/Chr/3/ Bb7C/5/WWP4394 ICWHA81-1530-1AP-2AP-1AP-1AP-0AP	10
4	Chambord/5133//Mt/3/KKc/4/Lfn// Nd/2*P101/5/Car 61-1523/Drc//Emu S' ICWHA81-1617-9AP-5AP-1AP-2AP-0AP	21
		RBWYT (LR) 1988/89
5	Mexipak 65	1
6	Maya 74 S'/On//1160-147/3/Bb/G11/ 4/Chat S' CM 58924-1AP-1AP-1AP-1AP-0AP	5
7	Tow S'/Pew S' CM 59443-4AP-1AP-4AP-1AP-0AP	7
8	Tz PP* 2/Ane//Jnia/3/Cno/Jar//Kv2/ 4/Mn 72252 CM 59483-2AP-2AP-1AP-1AP-0AP	8
9	Nesser	12
10	Cno/7C//Tob/Cno/3/Pato(B)/4/Emu S' CM 49856-2AP-2AP-1AP-2AP-1AP-0AP	15
11	Jnia/R 14220//7C/3/Yr S'/5/12300// LR 64/8156/3/Nor 67/4/Y50E ICW80-0745-4AP-1AP-3AP-0AP	17
12	Vul S'/Gh S' CM 64432-1AP-1AP-1AP-2AP-0AP	21
13	Nfn/Yongkwang//Bow s' SWM 11582-2AP-1AP-1AP-0AP	22
14	Local white	
15	Zamindar	
16	Sonalika	
17	Kahani	
18	Sham-4	

Table 12. Performance of Bread Wheat Yield Trial Selection for Spring 1991/92.

E. No.	Plant height (cm)	Tillers per m^2	TDM (kg/ha)		Grain(kg/ha)		1000 KW (g)		Harvest Index	
			Que.	Kal.	Que.	Kal.	Que.	Kal.	Que.	Kal.
1	66	233	6133	3733	1413	633	23	24	22	16
2	61	214	6266	5066	1146	473	27	28	18	11
3	70	266	7466	4400	1333	740	24	25	18	17
4	53	266	5733	3866	1200	582	21	25	21	15
5	57	233	6400	5866	1320	780	24	24	19	15
6	55	244	5866	3733	1146	434	23	24	20	12
7	58	259	6400	5066	1293	556	23	26	20	13
8	51	222	5466	4133	1133	570	21	23	21	14
9	53	188	5466	3866	1066	532	23	27	19	13
10	52	277	5466	5266	933	633	21	26	17	14
11	49	244	4666	3200	800	288	18	23	17	9
12	44	203	5066	2533	800	346	23	23	16	13
13	48	255	4800	2666	866	250	18	23	18	9
14	57	207	5466	3200	866	332	24	25	16	10
15	52	359	6266	3600	1013	612	23	27	16	17
16	59	233	5600	3466	1000	385	22	24	17	11
17	54	359	6000	4266	1266	681	25	29	20	16
18	60	337	5600	3466	880	973	18	26	16	30
LSD (5%)	ns	ns	ns	2453	ns	ns	ns	ns	ns	ns
LSD (1%)	ns	ns	ns	3294	ns	ns	ns	ns	ns	ns

*, ** = significantly different from check at P<.05 and P<0.01, respectively.
ns = non-significant difference (P>0.05).

Advanced Bread Wheat Yield Trial (Spring 1989/90)

Five genotypes selected from the spring trials during 1989/90 were compared with five check entries for their adaptability and yield potential at Quetta and Kalat (Table 13). No significant difference among genotypes was observed in TDM and grain yield, 1000 kernel weight and harvest index at both test sites (Table 14). In the previous season (1990/91) exotic genotypes had the same TDM production and seed yield at Quetta and Kalat as the check entries (Ahmad *et al.*, 1991). These genotypes will not be included in the future spring germplasm evaluation program.

Table 13. Name or cross/pedigree of Bread Wheat Yield trial selection spring 1991/92

E. No.	Name or cross/pedigree	Seed Source/Entry
		BWYT (LR) 1989/90
1	Maya 74 S'/On//1160-147/3/Bb/ G11/4/Chat S' CM 58924-1AP-1AP-1AP-1AP-0AP	5
2	F134-71/Crom S' SWM 11147-1AP-2AP-4AP-1AP-0AP	17
3	SD 648-5/8156/3/Chr//Sn64/Kl.Rend/ 4/Cc/5/IWP19	22
		BWON(LR) 1988/89
4	Van S'//Bb/Kal ICW80-0660-3AP-3AP-1AP-0AP	3
5	Bow S'/Crow S' CM 69599-4AP-2AP-2AP-0AP	15
6	Local white	
7	Zamindar	
8	Sonalika	
9	Kahani	
10	Soreviki	

Table 14. Performance of Bread Wheat Yield trial Selection (LR) for Spring 1991/92

E. No.	Plant height (cm)	Tillers per m^2	TDM (kg/ha)		Grain(kg/ha)		1000 KW (g)		HI(%)	
			Que.	Kal.	Que.	Kal.	Que.	Kal.	Que.	Kal.
1	55	174	5067	4533	840	769	20	26	16	16
2	39	218	4667	5066	867	612	21	23	19	12
3	56	222	5333	5666	1067	612	22	26	20	12
4	51	181	5600	4666	920	709	19	24	17	15
5	60	207	5600	4400	1306	489	24	27	23	10
6	54	177	5600	3733	800	573	23	31	14	15
7	49	222	5467	3600	920	492	21	25	17	13
8	50	107	4800	5333	893	904	19	25	18	17
9	53	185	5600	5066	1067	884	21	27	19	17
10	56	207	5733	3866	1040	489	19	24	18	13
LSD(5%)	ns	147	ns	2453	448	ns	ns	ns	ns	ns
LSD(1%)	ns	201	ns	3294	ns	ns	ns	ns	ns	ns

ns = No significant difference (P>0.05).

RESULTS 2: Barley

Barley (*Hordeum vulgare L.*) is the second most important cereal crop in highland Balochistan where about 25,000 hectares is grown. About 17 million hectares are sown with barley in developing countries (ICARDA, 1992), mostly in areas where rainfall is lower than for wheat due to barley's better drought tolerance. In West Asia and North Africa it is the dominant crop in areas receiving less than 300 mm annual rainfall (Ceccarelli *et al.*, 1987).

In highland Balochistan barley is grown either as green fodder for winter grazing or to produce grain and straw for animals. Recent studies have shown that it is well adapted crop to the rainfed areas of Balochistan (Ahmad *et al.*, 1991 and Rees *et al.*, 1989). Therefore, efforts are being made to select exotic lines adapted to the prevailing environmental conditions and sowing times. During the 1991/92 cropping season 11 barley trials (six yield trials and five different observation nurseries) were sown in the fall and two trials were sown in the spring. The material was evaluated for adaptability to the environment and resistance to stresses. Trial details and selections from these trials are presented in Table 15. None of the barley trials were harvested at Kan Mehterzai because of hail damage.

Table 15. Barley genotypes evaluated and selected during the 1991/92 season

Name of trial	Total Entries	Selected Entries
Winter-sown trials		
1. Advanced barley yield trial selections 1991/92	22	continued
2. Preliminary barley yield trial selections winter 1991/92	26	13
3. Preliminary winter and facultative barley yield trial selections 1991/92	14	11
4. Advanced barley yield trial selections (HA) 1991/92	6	0
5. International winter and facultative barley yield trial 1991/92	24	9
6. Barley yield trial (Low rainfall and cool winter 1991/92)	24	19
7. Barley observation nursery low rainfall and cool winter 1991/92	100	25
8. Second international winter and facultative barley observation nursery 1991/92	150	34
9. Barley observation nursery USA 1991/92	15	0
10. Barley observation nursery USA 1991/92	64	31
11. Barley observation nursery USA 1991/92	51	17
Spring-sown trials		
1. Advanced barley yield trial selections spring 1988/89	15	0
2. Advanced barley yield trial selections 1989/90	10	0

Advanced Barley Yield trial (Selections Winter 1988/89)

Nineteen exotic barley genotypes selected from the 1988/89 trials were evaluated for the third consecutive year against biotic and abiotic stresses (Table 16). The main feature of the 1991/92 season was the occurrence of yellow rust which also affected bread wheat. Screening for resistance to this fungal disease was effective at Quetta and some exotic genotypes showed susceptibility. However, others were less susceptible that the local barley landrace (Table 17). The disease spores appear to have been subsequently washed away by heavy rains since little reduction in grain yield was observed (Table 17). Some of the genotypes

lodged which was partly due to the above average rainfall which stimulated more vegetative growth than is observed in average years.

Table 16. Name or cross/pedigree of Barley Yield trial Selection 1991/92

E. No.	Name or cross/pedigree	Seed Source
		BYT (HA) 1988/89
1	Di Jou 3-2-5	10
2	DMR 27/W12197 Sel,4AP-3AP-3AP-1AP-1AP-0AP	14
		BYT (LR) 1988/89
3	Rihane-03	1
4	Harmal	6
		ICON 1988/89
5	Tokak	11
		IWFBSN1988/89
6	Pakistan barley	20
	Barley Advanced Bulk Lines for Pakistan 1988/89	
7	Arabi Abiad/Emir ICB82-1292-0AP-0AP-0AP-6AP-0AP	9
8	Arabi Abiad/Emir ICB82-1292-0AP-0AP-0AP-11AP-0AP	12
9	Arabi Abiad/Emir ICB82-1292-0AP-0AP-0AP-27AP-0AP	16
	Barley Screening Nursery for Pakistan 1988/89	
10	SD73350-B-104-16-1-3//ER/APm ICB82-0005-7AP-0SH-0AP	4
11	Lignee 131/Arabi Abiad ICB81-0642-10AP-4AP-0AP	7
12	Lignee 131/Arabi Abiad ICB81-0642-10AP-6AP-0AP	8
13	Alger/Ceres//Salmas/3/Arabi Abiad ICB82-0499-1AP-0AP	12
14	Aramir/Arabi Abiad *2 ICB82-1018-5AP-0AP	13
15	Aramir/Arabi Abiad ICB81-0397-1AP-5AP-0AP	15
16	APi/Arabi Abiad *2 ICB82-0341-5AP-0SH-0AP	18
17	Bonus/Arabi Abiad ICB81-0014-1AP-9AP-0AP	19
18	Lignee 131//Sul/Nacta ICB81-2206-3AP-2AP-0AP	23
19	SLD 39-39	28
20	Arabi Abiad	
21	Frontier-87	
22	Local check	

The TDM production of entries 2 and 12 was significantly ($P<0.05$) higher at Quetta than the local check (Table 17). However, at Loralai genotypes 5, 9, 10, 18, and 19 were superior ($P<0.05$) in TDM production to the local check. In terms of grain yield genotypes 1, 2 and 15 at Quetta outyielded ($P<0.05$) the local landrace. The 1000 kernel weight of entries 4, 11 and 16 was superior to the local check ($P<0.05$) at Quetta. No significant differences were observed between the local landrace and the exotic genotypes at Loralai, nor were there any significant differences of the harvest index among the genotypes both at Quetta and Loralai.

In the 1989/90 and 1990/91 seasons the TDM of the exotic genotypes was equal to the local barley landrace whereas the grain yield of some exotic genotypes was significantly higher (P<0.05) (Ahmad *et al.*, 1990a; Ahmad *et al.*, 1991). In 1991/92 entries 1 and 2 behaved in the same way as in 1990/91 by outyielding the check. But no differences were recorded in the first year of the trial. The differences in TDM and grain yield are mainly associated with variations in the environmental conditions. After three years of multi-location testing three genotypes [Di Jou 3-2-5; Rihane-03; Arabi Abiad/Emir (ICB82-1292-0AP-0AP-0AP-6AP-0AP)] have been selected for seed multiplication. However, this specific trial will be repeated for another year.

Table 17. Performance of Barley Yield trial (Selection 1991/92)

E. No.	Days to 50% heading	Yellow rust disease	No. of spikelets per spike	Tillers per m^2	Plant height (cm)	TDM (kg/ha)		Grain yield (kg/ha)		1000 kernel weight (g)		Harvest Index (%)	
						Que.	Lor.	Que.	Lor.	Que.	Lor.	Que.	Lor.
1	134	OR	60**	638	117**	9800	3733	4600*	561	40	44	47	15
2	136	5MR	56**	694	107	12200*	2533	4800*	547	34	40	39	22
3	141	OR	59**	777	102	10400	3066	4200	439	35	41	40	14
4	130	OR	22	1044	87	10800	2533	3600	597	43*	37	33	23
5	154	20MS	22	666	103	8200	4800*	2400	596	36	41	30	20
6	145	80S	48*	944	110	9000	2933	3600	321	38	39	40	11
7	143	OR	24	805	95	10600	4400	4200	601	35	41	40	14
8	142	5MR	24	1183	95	10000	3866	3600	693	36	35	36	18
9	144	OR	27	766	105	9000	4666*	3800	612	41	34	43	13
10	140	5MR	25	1072	105	11200	5600**	4200	903	37	33	38	16
11	146	10MR	26	494	95	7000	4133	1600	543	42*	38	23	14
12	147	10MR	25	1011	100	12600*	4000	4200	856	31	41	35	21
13	144	10MR	22	1272*	98	9800	4133	3800	916	39	38	40	21
14	148	10MR	24	1688**	99	8400	3866	3600	776	33	40	43	20
15	145	10MR	27	1216	107	11000	2533	4600*	787	32	36	42	33
16	142	10MR	22	955	105	11400	4000	3800	703	44**	38	34	18
17	144	OR	24	1177	95	10800	4400	3800	743	33	40	35	17
18	147	10MR	24	1055	107	11200	4933*	3200	823	36	36	29	16
19	141	10MR	22	1138	99	10000	4533*	3200	592	32	37	32	13
20	133	OR	21	1288*	90	11000	3613	4200	692	35	34	39	15
21	149	10MR	54*	655	103	8200	4000	2400	535	26	40	29	13
22	143	90S	48	888	106	8600	3200	3400	708	35	41	41	22
LSD(5%)	5	-	5	359	6	3087	1318	1082	ns	6	6	ns	9
LSD(1%)	7	-	7	490	9	4203	1762	1473	ns	8	ns	ns	11

*, ** = significantly different from local check at P<0.05 and P<0.01, respectively. ns = non-significant difference (P>0.05).

Barley Preliminary Yield trial (Selection Winter 1990/91)

Twenty five genotypes selected from the 1990/91 trials were compared with the local landrace for adaptability in highland Balochistan (Table 18). The trial could only be harvested at Quetta because of hail damage at Loralai and Kan Mehterzai after anthesis. Data from different parameters are presented in Table 19. Some exotic genotypes showed susceptibility to yellow rust.

TDM production of exotic genotypes was not significantly greater than the local check (P>0.05) (Table 19). However, the grain yield of genotypes 1, 2, 8, 11, 12, 13, 18, 21, 23, and 25 was superior to the local barley landrace (P<0.05). The 1000 kernel weight of entries 11 and 20 was found to be significantly greater than the local check (P<0.05). The harvest index of the exotic genotypes was not significantly higher (P>0.05) than the local check. Some of these genotypes were also superior to the local check in the 1990/91 season (Ahmad *et al.*, 1991). From this trial 13 genotypes have been chosen for further testing.

Table 18. Name or cross/pedigree of Barley Yield trial (Selection 1991/92)

E. No.	Name or cross/pedigree	Seed Source
		BYT (HA) 1990/91
1	DMR27/WI2197 Sel,4AP-3AP-3AP-1AP-1AP-0AP	2
2	Alt/EH8B-FYE-E-L-7-C ICB78-1062-1AP-0AP	3
3	Roho//Alger/Ceres,362-1-1 ICB77-0187-2AP -2AP-2AP-2AP-3AP-0AP	4
4	4679/105//YEA132TH YAA460-13A-5A-2A-0AP	5
5	Lignee 131 (Improved 2 row check)	6
6	YEA541-1/Tokak YAA393-20A-3A-1A-0AP	8
7	Giza 121/CI 06248/4/Apm/IB65//11012-2/3/ Api/CM67//Ds/Apro CMB78A-1125-2AP-3AP-4AP 4AP-0AP	9
8	M126/CM67//C63 ICB78-0522-3AP-2AP-0AP	10
9	Beecher (Long-term check)	12
10	Noyep/PI 002917 ICB78-0105-1AP-1AP-2AP-3AP-0AP	13
11	Cel/XV2240/3/Choya/Galt//11012-2 CMB80-0341-6Y -2B-1Y-3H-1Y-0B	14
12	Mja C4715//Olli/M64-69/3/Amp/IB65/4/M65-167/M66-69-1/Mona/3/Ben	15
13	Mz/M59-247//Mi/Ds/3/Ben/4/Bahtim 10/5/Api/CM67// Alaska CMB81a-0065-6B-1Y-5M-1Y	16
14	Lignee 131/Irania ICB82-0657-3AP-0AP	17
15	Lignee 131//Sul/Nacta ICB81-2206-3AP-2AP-0AP	21
		BYT CLR 90/91
16	Matnan-01 (Improved 6-row check)	1
17	Impala/Julia//Api ICB78-1085-2AP-2AP-1AP-2AP-0AP	3
18	WI2291/CI 13520 ICB78-0626-2AP-1AP-1AP-1AP-0AP	5
19	Lignee 527/Rihane ICB81-2529-2AP-13AP-0AP	8
20	M-Att-73-337-1	9
21	Mo.BI337/WI2291 ICB81-2606-2AP-0AP-0AP	10
22	Beecher (Long-term check)	12
23	CI 08887/CI 05761/Harmal-02 ICB81-0813-10AP-0AP	13
24	As46/Pro//Bal.16/Api/4/11012-2/Tern/H252/3/Nopal 's'/5/Assala ICB82-0172-2AP-0AP-0AP	14
25	Alger/Ceres//Salmas/3/ER/Apm ICB82-0502-2AP-0SH-0AP	20
26	Local Barley	

Table 19. Performance of Barley Yield trial (Selection Winter 1991/92)

E. No.	Days to heading (50%)	Yellow rust disease	Spikelets/ spike	Tillers/ m^2	Plant height (cm)	Yields (kg/ha) TDM	Yields (kg/ha) Grain	1000 kernel weight(g)	Harvest index (%)
1	140	OR	55	761	113	12600	5200**	34	42
2	144	OR	66	816	111	12600	4600*	29	36
3	150	40MS	28	1017	103	10400	2800	26	27
4	156	OR	23	927	102	9000	2000	23	25
5	150	OR	22	1144	105	12200	3800	26	31
6	154	OR	22	1111	110	9000	2400	29	33
7	147	40MS	64	972	109	9600	2800	26	30
8	139	20MR	61	850	106	11600	4200*	27	36
9	138	10MR	52	705	122	7400	3400	38	46
10	137	OR	25	972	105	9000	3200	32	35
11	138	5MR	56	1156	120	10000	4400*	40	44
12	143	40MS	62	794	114	10600	4600*	33	44
13	140	OR	58	583	113	11800	4200*	34	36
14	149	OR	24	1217	107	12600	4000	31	32
15	149	OR	27	1133	111	11600	4000	38	36
16	143	OR	61	1133	100	9000	3400	28	37
17	143	OR	47	833	103	11600	4000	32	35
18	134	OR	23	1489	102	12000	4200*	38	35
19	146	OR	59	988	100	9200	3000	27	33
20	133	OR	46	911	109	11000	3400	42	31
21	141	OR	27	1206	101	12000	4400*	33	37
22	138	OR	53	1150	117	9000	3400	37	38
23	139	OR	28	1200	103	11200	4600*	37	41
24	138	OR	57	800	104	11000	3600	32	33
25	138	OR	26	1083	98	12000	4300*	37	36
26	148	100S	50	977	110	9600	2600	33	27
LSD(5%)	4	-	11	542	8	4205	1493	6	ns
LSD(1%)	5	-	15	733	11	ns	2020	8	ns

*, ** = significantly different from local check at P<0.05 and P<0.01, respectively.
ns = non-significant difference (P>0.05).

Barley Preliminary Yield trial (Selection Winter 1990/91)

This trial consisted of 12 genotypes: five selected from the International Winter and Facultative Barley Yield trial 1990/91, five selected from the Barley Observation Nursery (Low Rainfall Areas 1990/91) and two advanced barley lines from ARI-Sariab. The pedigrees of the genotypes are given in Table 20. Most of the genotypes were susceptible to yellow rust but to a lesser degree than the local check (Table 21).

At Quetta genotypes 1, 5, 7, 9, 11 and 13 yielded more TDM (P<0.01) than the local check (Table 21) and genotypes 2, 5, 7, 9, 11, 12, and 13 had significantly (P<0.05) higher grain yields. Only entry 11 had a better 1000 kernel weight than the local check (P<0.01). TDM production, grain yield and 1000 kernel weight were similar to the local check at Loralai, but genotypes 2, 4 and 11 had a superior harvest index (P<0.05). Eleven genotypes were selected and promoted to the advanced yield trial stage for further testing in 1992/93.

Advanced Barley Yield trial (Selection Winter 1989/90)

Five genotypes selected from the barley yield trial (HA) 1989/90 were tested at Quetta and Loralai during the 1991/92 season (Table 22). Out of five exotic barley genotypes only entry 3 was resistant to yellow rust at Quetta (Table 23). The TDM production of this entry was significantly (P<0.01) higher than the local check at Loralai but not at Quetta. The grain yield of exotic genotypes was not

Table 20. Name or cross/pedigree of International winter and Facultative Barley Yield trial (Selection 1991/92)

E. No.	Name or cross/pedigree	Seed Source
		IWFBON 1990/91
1	132TH/Tokak	
	YAA147-5A-7A-2A-1A-0AP	15
2	M25-84/Attiki//Assala-02	
	ICB85-0471-0AP-1AP-1AP	62
3	M25-84/Attiki//Assala-02	
	CB85-0471-0AP-1AP-2AP	63
4	Rihane-05//M25-84/Attiki	
	ICB85-1376-0AP-1AP-2AP	72
5	Matnan-05//CI 07117-9/Deir Alla 106	
	ICB85-1402-0AP-1AP-1AP	79
		BON-LRA 1990/91
6	Arar/Gerbel	
	ICB85-0629-0AP-37APH-0AP	8
7	Rihane-07/IFB974	
	ICB84-1581-2AP-0AP-9APH-0AP	14
8	Arar/Arabi Aswad	
	ICB84-1697-7AP-0AP-10APH-0AP	52
9	Arar/Arabi Aswad	
	ICB84-1697-16AP-0AP-6APH-0AP	54
10	Arar/Arabi Aswad	
	ICB84-1697-16AP-0AP-7APH-0AP	55
11	V1 (ARI-SARIAB)	
12	V2 (ARI-SARIAB)	
13	ARABI ABIAD	
14	Local Barley	

Table 21. Performance of International Winter and Facultative Barley Yield trial (Selection 1991/92)

E. No.	Days to heading (50%)	Yellow rust disease	No. of spikelets per spike	Tillers per m^2	Plant height (cm)	TDM (kg/ha)		Grain(kg/ha)		1000 KW(g)		HI(%)	
						Que.	Lor.	Que.	Lor.	Que.	Lor.	Que.	Lor.
1	154	10MR	25	966*	107	11200**	2533	3000	542	31	36	28	21
2	150	OR	51	833	102	9400	2133	3400*	444	25	36	36	20*
3	149	OR	55	1094*	105	9400	1333	3000	221	22	35	32	15
4	151	10MR	61*	783	112	8200	1867	2200	360	23	36	27	20*
5	149	30MS	52	744	110	11000**	1733	3800*	228	29	38	35	13
6	136	OR	70**	872	105	7800	933	2200	90	34	35	29	9
7	138	OR	55	644	107	11800**	2133	3200*	408	35	36	27	15
8	136	30MR	53	850	102	9000	1333	2000	202	21	30	23	15
9	133	5MR	59*	750	101	11400**	1200	3800*	161	32	31	33	13
10	131	10MR	70**	83*	102	8400	933	2400	105	31	31	29	12
11	135	OR	28	1144*	105	10600**	1733	4000*	402	41**	36	38	22**
12	144	OR	28	672	105	9600	1600	3800*	212	37	34	40	13
13	143	30MR	27	172**	97	11600**	1333	4400*	202	36	37	38	15
14	145	100S	48	594	107	8200	933	2000	121	34	38	24	12
LSD(5%)	4	-	11	369	7	1685	ns	1171	ns	5	4	10	7
LSD(1%)	5	-	15	515	10	2349	ns	ns	ns	7	6	ns	9

*, ** = significantly different from local check at P<0.05 and P<0.01, respectively. ns = non-significant difference (P>0.05).

Table 22. Name or cross/pedigree of Barley Yield trial (Selection 1991/92)

E. No.	Name or cross/pedigree	Seed Source
		BYT(HA)89/90
1	Matnan-01	1
2	Jerusalem a barbes lisses/Bonus ICB77-0320-1AP-0SH-3AP-1AP-2AP-0AP	9
3	W12291/3/SP (2h)//Cr.115/Por ICB78-0618-9AP-1AP-2AP-0AP	10
4	Lignee 527	11
5	Foma 72-1144-R-174/Izmir 256-2 ICBHA81-2119-1AP-1AP-0AP	17
6	Local barley	

significantly greater than the local check at both Quetta and Loralai (Table 23). Entry 2 at Quetta was significantly (P<0.05) superior in harvest index to the local check. In the previous year 1990/91 the productivity of these exotic genotypes was the same as the local check (Ahmad *et al.*, 1991). Further testing has been stopped due to their susceptibility to yellow rust and inadequate yield potential.

Table 23. Performance of Barley Yield trial (Selection (H.A.) 1991/92)

E.No.	Days to 50% heading	Yellow rust disease	No. of spikelets per spike	Tillers per m^2	Plant height (cm)	TDM (kg/ha)		Grain (kg/ha)		1000 kernel weight (gm)		Harvest index(%)	
						Que.	Lor.	Que.	Lor.	Que.	Lor.	Que.	Lor.
1	142	80S	48	900	97	8200	3200	2800	450	32	32	35	13
2	146	30MR	27	1233	104	8800	3333	3200	1027	33	31	37*	31
3	147	OR	26	1094	98	9000	6000**	3000	1191	35	42	35	20
4	145	10MR	60	766	105	7400	3733	2200	588	33	37	31	16
5	136	30MR	24	1322	101	10200	3867	3400	777	37	37	34	19
6	144	100S	48	1322	109	8800	2800	2200	933	34	38	25	30
LSD(5%)	1.4	-	24	ns	ns	ns	1489	ns	ns	ns	5	10	ns
LSD(1%)	2.1	-	37	ns	ns	ns	2118	ns	ns	ns	6	ns	ns

*, ** = significantly different from local check at P<0.05 and P<0.01, respectively. ns = non-significant difference (P>0.05).

First International Winter and Facultative Barley Yield trial (New 1991/92)

Twenty three new exotic barley genotypes were tested at Quetta and Loralai for the first time (Table 24). Most of them were resistant to yellow rust and TDM production was equal to that of the local barley, with no significant differences among the genotypes (Table 25). Only genotype 4 had a grain yield better than (P<0.01) the local check at Quetta. 1000 kernel weight and harvest index of the exotic genotypes were not significantly different (P>0.05) from the local check at both sites. Nine genotypes were chosen for future multi-locational testing.

Table 24. Name or cross/pedigree of First International Winter and Facultative Barley Yield trial 1991/92

E. No.	Name or cross/pedigree
1	Salmas
2	Roho//Alger/Ceres,362-1-1 ICB77-0187-2AP-2AP-2AP-2AP-3AP-0AP
3	YEA541-1/Tokak YAA393-20A-3A-1A-0AP
4	M126/CM67//C63 ICB78-0522-3AP-2AP-0AP
5	Cel/XV2240/3/Choya/Galt//11012-2 CMB80-0341-6Y-2B-1Y-3H-1Y-0B
6	Lignee 131//Sul/Nacta ICB81-2206-3AP-2AP-0AP
7	Steptoe/Lignee 640 ICB81-0970-1AP-2AP-0AP
8	Igri/MOB2639F1//F1P1361/Igri OR 1861163
9	Kenya Research/Belle/3/Roho//Alger/Ceres ICB85-1767-0AP-1AP-2AP-0AP
10	Tipper
11	Wieselburger/Ahor 1303-61 ICB77-0432-1AP-2AP-2AP-2AP-0AP
12	Tokak
13	73TH/105//E10Bulk CI 7321 YAA1824-5AP-2AP-1AP-0AP
14	MV-46/Masurka ICB81-0674-1AP-1AP-0AP
15	Th.Unk.48//Roho/Delisa ICB85-1504-0AP-1AP-2AP-0AP
16	CWB117-5-9-5
17	PI 000505/Alpha ICB85-0983-0AP-1AP-4AP-0AP
18	Atem/3/Roho//Alger/Ceres ICB85-0692-0AP-1AP-5AP-0AP
19	Alpha/Durra OR 1861016
20	WA 2196-68/Ny6005-18,F1//Scotia I OR WF8410
21	Robur/WA2196-68 OR 1871027
22	NY6005-18/OWB70173-2H-4H,F1//F1,NY6005-19/J-126 OR 1871016
23	WA1245/B67-1623,F1//J126/3/SCO1/WA1356 OR 1870025
24	Local check

Table 25. Performance of First International Winter and Facultative Barley Yield trial at Quetta and Loralai 1991/92

E. No.	Days to 50% heading	Yellow rust disease	No. of spikelets per spike	Tillers per m^2	Plant height (cm)	TDM (kg/ha)		Grain yield (kg/ha)		1000 kernel weight (g)		Harvest index (%)	
						Que.	Lor.	Que.	Lor.	Que.	Lor.	Que.	Lor.
1	144	OR	28	872	106	13600	1867	3400	317	35	35	25	17
2	150	OR	29	844	101	10200	2000	2800	235	29	34	28	12
3	154	5MR	23	1378**	108	11000	2133	2800	384	27	37	26	18
4	134**	OR	69**	744	96	14600	2000	5400**	273	33	28	37	13
5	143	10MR	61**	555	114	9400	1867	3400	192	37	33	36	10
6	146	OR	25	1022	104	11800	2000	3400	241	35	32	29	12
7	146	5MR	26	822	109	11400	2267	3200	158	33	33	29	7
8	150	OR	26	661	97	11200	2267	3000	326	31	34	26	14
9	154	OR	28	794	116*	13000	2400	4000	334	31	36	32	14
10	152	OR	33	738	103	12800	1733	3800	156	24	30	30	9
11	147	OR	29	1056	105	11000	2133	4200	394	30	35	39	18
12	154	5MR	28	916	105	10200	1733	2000	205	25	34	20	11
13	152	OR	26	761	104	10200	3200	3050	272	40	41**	30	11
14	148	OR	28	794	98	11000	2400	3140	292	36	34	29	12
15	153	OR	31	744	105	10000	2133	2200	180	28	37	22	8
16	152	OR	28	1078	98	13200	1467	4000	285	28	31	30	20
17	149	OR	28	766	101	12200	2400	3200	430	31	35	27	17
18	154	OR	24	833	104	9200	2000	3000	332	25	34	33	17
19	149	OR	29	844	99	16800	1733	4200	345	32	34	25	20
20	152	OR	68**	894	80	11200	2400	2800	330	15	23	25	13
21	154	OR	52	755	102	13400	1333	3800	222	25	26	28	17
22	152	OR	52	933	82	12400	1733	3200	353	19	24	26	20
23	146	OR	76**	650	102	12000	1067	3200	140	21	29	27	12
24	146	80S	50	711	105	11000	1867	4000	220	38	36	36	12
LSD(5%)	3	-	6	402	11	ns	948	995	ns	7	2	10	ns
LSD(1%)	4	-	8	545	14	ns	1266	1351	ns	9	3	ns	ns

*, ** = significantly different from local check at P<0.05 and P<0.01, respectively. ns = non-significant difference (P>0.05).

Barley Yield trial (Low Rainfall and Cool Winter Areas New 1991/92)

This trial consisted of 23 new exotic lines of germplasm (Table 26) and material was evaluated for abiotic and biotic stresses only at Quetta. Amongst the biotic stresses yellow rust was recorded on some exotic genotypes (Table 27). However, no severe abiotic stresses were seen during this trial. The TDM production and grain yield of the exotic genotypes were not significantly better than the local check. For 1000 kernel weight six genotypes were better than the local check (P<0.05) and the harvest index of most exotic genotypes was better than the local check. Nineteen genotypes were chosen for further testing against the prevailing stresses of the area.

Table 26. Name or cross/pedigree of Barley Yield trial (Low Rainfall and Cool Winter Areas, New 1991/92)

E. No.	Name or cross/pedigree
1	Matnan-01
2	Rihane/Lignee 527 ICB81-0156-0SH-2AP-0AP-0AP
3	M-Att-73-337-1
4	Mo.B1337/W12291 ICB81-2606-2AP-0AP-0AP
5	W12298/Harmal-02 ICB82-0833-4AP-0AP
6	Lignee 131

Table 26 (continued). Name or cross/pedigree of Barley Yield trial (Low Rainfall and Cool Winter Areas, New 1991/92)

E. No.	Name or cross/pedigree
7	CI 08887/CI 05761//Harmal-02 ICB82-0813-10AP-0AP
8	As46/Pro//Bal.16/Api/4/11012-2/Tern//H252/ 3/Nopal S'/Assala ICB82-0172-2AP-0AP-0AP
9	Alger/Ceres//Salmas/3/ER/Apm ICB82-0502-2AP-0SH-0AP
10	Lignee 640/Lignee 686 ICB82-0855-20AP-0AP-0AP
11	ER/Apm//AC253 ICB82-0707-2AP-0AP
12	Beecher
13	W12291/W12269 ICB78-0594-8AP-3AP-2AP-2AP-0AP
14	W12291//Mzg/DL71 ICB78-0637-4AP-3AP-1AP-1AP-0AP
15	W12291/4/11012-2/70-22425/3/Apm/IB65//A16 ICB78-0635-1AP-1AP-1AP-1AP-0AP
16	INRA55-86-2/B1701 ICB82-1140-13AP-0AP
17	P1d10342//Cr.115/por/3/Bahtim 9/4/Ds/Apro/5/W12291 ICB78-0058-3AP-5AP-4AP-3AP-0AP
18	Salmas
19	SLB 47-81
20	26216 (=Avt.Sv.73608)
21	24569 (=80-5138/Aths)
22	24571 (=Walfajr/Lignee 686)
23	24572 (=Walfajar/Lignee 686)
24	Local check

Barley Observation Nurseries 1991/92

During 1991/92 season five barley observation nurseries containing 380 entries were tested at Quetta for selection of desirable genotypes. These observation nurseries had different cross combinations and have a wider genetic diversity of useful breeding traits than the yield trials. Pedigrees of the selected genotypes from these observation nurseries are presented in Table 28.

(i) Barley Observation Nursery Low Rainfall and Cool Winter 1991/92: This observation nursery consisted of 100 entries which were evaluated at Quetta. Screening for cold and frost tolerance was not possible because of the relatively mild winter. Thus, all the genotypes survived the winter months. However, on the basis of resistance to yellow rust and yield potential, 23 genotypes were chosen from this observation nursery for further evaluation and selection in the area (Table 29).

(ii) Second International Winter and Facultative Barley Observation Nursery 1991/92: This observation nursery comprised 150 entries of winter/facultative types for highland areas. Most of the entries were later maturing than the local check. On the basis of days to heading, yellow rust resistance and yield potential, 33 genotypes were selected for next year's testing (Table 29).

(iii) Barley Observation Nursery USA (1991/92): This nursery was collected by Mohammad Anwar Khan while in the USA. The nursery was planted at Quetta. Some

Table 27. Performance of Barley Yield trial (LR and CWA, New 1991/92) at Quetta

E. No.	Days to 50% heading	Yellow rust disease	No. of spikelets /spike	Tillers per m^2	Plant height (cm)	TDM (kg/ha)	Grain yield (kg/ha)	1000 kernel weight(g)	Harvest index(%)
1	145	OR	55	938	88	11000	4200	26	38*
2	145	OR	62	811	104	10400	4200	27	41*
3	132**	OR	48	766	102	13600	4800	44**	36*
4	141*	OR	26	1256*	96	12200	5400	39*	44*
5	135**	OR	24	1272*	94	10800	4200	36	40*
6	149	OR	23	938	100	13600	4200	35	31
7	138**	OR	28	983	100	11200	4600	33	41*
8	135**	OR	57	844	99	12000	4800	33	40*
9	138**	OR	26	1006	93	14600	5200	40**	35
10	148	OR	57	822	88	9000	3600	28	40*
11	135**	OR	24	1078	95	14200	4000	38*	28
12	135*	OR	54	577	113*	12400	4800	41**	38*
13	134	OR	27	1211*	86	11000	4400	35	40*
14	133	OR	75**	700	95	10200	4200	27	39*
15	138**	OR	25	1517**	88	11200	4400	36	39*
16	137**	OR	27	1211*	101	11000	4400	33	40*
17	138**	OR	28	1100	108	10800	4600	45**	43*
18	147	5MR	27	988	107	12800	4200	36	33
19	144	5MR	26	1522**	96	10600	3400	31	32
20	146	5MR	59	700	94	12200	4600	24	38*
21	148	80S	56	827	102	10000	3200	30	32
22	150	OR	65	638	111	10600	3000	23	28
23	147	OR	67**	500	108	13400	4000	35	30
24	148	80S	51	761	102	11400	3200	31	27
LSD (5%)	4	-	9	435	9	ns	ns	6	9
LSD (1%)	6	-	12	591	13	ns	ns	9	ns

*, ** = significantly different from local check at P<0.05 and P<0.01, respectively. ns = non-significant difference (P>0.05).

entries in this observation nursery performed favourably in terms of disease resistance, TDM production and grain yield. Thirty entries were selected for further multi-location testing (Table 29).

(iv) Barley Observation Nursery USA (Chickbar) 1991/92: This nursery was also collected by Mohammad Anwar Khan in the USA. Chickbar barley has a high content of protein and a low content of low beta-glucan. Thus, it has potential as a poultry feed. Fifty hulless entries were evaluated for desirable characteristics and 17 entries were selected for next year's testing program (Table 29).

Table 28. Name or cross/pedigree of selected barley genotypes from Observation Nurseries during 1991/92

E. No.	Name or cross/pedigree	Seed Source
		BON (LR & CWA) 1991/92
1	Arr/Esp//Alger/Ceres,362-1-1/3/W12291/Bus ICB84-1193-1AP-0AP-16APH-0AP	2
2	Arr/Esp//Alger/Ceres,362-1-1/3/Kv//Alger/ Ceres,362-1-1 ICB84-1195-1AP-0AP-15APH-0AP	4
3	Weeah 11//W12291/Bgs ICB83-1826-1AP-5AP-0AP-13APH-0AP	5
4	P1d10342//Cr.115/Por/3/Bahtim 9/4/Ds/Apro/5/W12291/6/W12291/W12269 ICB86-0133-0AP-33APH-0AP	7
5	Harmal/W12291 ICB85-0539-0AP-3AP-0TR	9

Table 28 (continued). Name or cross/pedigree of selected barley genotypes from Observation Nurseries during 1991/92

E. No.	Name or cross/pedigree	Seed Source
6	Harmal/W12291 ICB85-0593-0AP-18AP-0TR	11
7	W12198/Harmal-02 ICB82-0833-4AP-0AP-13AP-0TR	12
8	W12198/Harmal-02 ICB82-0833-4AP-0AP-15AP-0TR	13
9	Orge 905/Cr.289-53-2 ICB82-1451-8AP-0AP-4AP-0TR	14
10	Orge 905/Cr.289-53-2 ICB82-1451-8AP-0AP-21AP-0TR	16
11	ER/Apm//AC253 ICB82-0707-2AP-0AP-5AP-0TR	22
12	CI 08887/CI 05761//Harmal-02 ICB82-0813-10AP-0AP-2AP-0TR	23
13	CI 08887/CI 05761//Harmal-02 ICB82-0813-10AP-0AP-6AP-0TR	24
14	Orge 905/Cr.289-53-2 ICB82-1451-8AP-0AP-1AP-0TR	28
15	Mari/Aths*2 CYB-0180-2AP-2AP-2AP-0AP	29
16	Matnan//CI 07117-9/Deir Alla 103/3/ Deir Alla 103 ICB85-1175-0AP-3APH-0AP	32
17	Mari/Aths*3//mari/Aths*2 CYB-3649-0D-0AP-1APH-0AP	52
18	Harmal	60
19	Arabi Abiad/Moroc 9-75 ICB85-0245-6AP-0AP	61
20	Arabi Abiad/Emir ICB82-1292-0AP-0AP-0AP-23AP-0AP	66
21	Arabi Abiad/W12291 ICB85-0235-2AP-0AP	67
22	Arabi Abiad/Emir ICB82-1292-0AP-0AP-0AP-2AP-0AP	72
23	PI 386540/Arabi Abiad ICB84-1700-2AP-4AP-0AP	75
24	Local check	
	2nd. Int. WFBON 1991/92	
1	Salmas	1
2	Sonja/MST,F1//Pu1112222 OR 1871011	7
3	Sonate OR-ID 2863152	8
4	Salmas//W122197/CI 13520 ICB85-0371-0AP-1AP-2AP	10
5	Salmas/3/OP/Zy//Alger/Union,385-2-2 ICB85-1300-0AP-1AP-2AP	11
6	Hh/Jul-78//P12222/3/WA2475-7/13334/kgS// 1245/3/Sonja OR-ID 1861480	15
7	3896-28/284-28/4/3887 Swan-28//3892/Gzk/ 3/Tok(M)	19
8	Sonja/J-115//P12222/4/CI13334/kgS// WA1245/3/Sonja OR-ID 1861477	26
9	Salmas/3/Kv//Alger/Ceres,362-1-1 ICB85-1294-0AP-1AP-4AP-0AP	29
10	80-5001	34
11	CWB22-6-13	44

Table 28 (continued). Name or cross/pedigree of selected barley genotypes from Observation Nurseries during 1991/92

E. No.	Name or cross/pedigree	Seed Source
12	Scio OR 1700173	45
13	3896/1-15/3/3896/28//284/28/4/ Einbull CI7321 YAA1827-21A-8A-1A-2A-0AP	47
14	Sonja/Rebekka/4/CI13334/kgs//WA1245-/3 /Sonja OR-ID 1861559	49
15	Alpha/Durra OR-1861165	53
16	Astrix (C)	58
17	Kavir	70
18	VA 84-44-342	76
19	DZ-21-16 ALG ICB 116141	111
20	DZ-40-11 ALG ICB 116145	114
21	DZ-1-36 ALG ICB 116138	119
22	Rihane-03	120
23	ZDM ICB 117574 CHIN ICB 117574	129
24	Deir Alla 106/Strain 205//Gerbel ICB85-0672-0AP-1AP-1AP-1AP-0AP-0AP	133
25	Kv/Masurka/4/W.W.Wing/3/Bal.16/CM67// Ds*2/Apro-3Y ICB85-0085-0AP-1AP-2AP-2AP-0AP-0AP	135
26	Kv/Masurka/4/W.W.Wing/3/Bal.16/CM67// Ds*2/Apro-3Y ICB85-0085-0AP-1AP-2AP-3AP-0AP-0AP	136
27	Arr/Esp//Alger/Ceres,362-1-1/3/ER/Apm ICB85-0107-0AP-1AP-3AP-2AP-0AP-0AP	138
28	Salmas*2/3/Vg/Julia//Zy ICB85-0373-0AP-1AP-4AP-2AP-0AP-0AP	141
29	Kv/Masurka/3/Arr/Esp//Alger/Ceres,362-1-1 ICB85-0563-0AP-1AP-4AP-1AP-0AP-0AP	142
30	Arr/Esp//Alger/Ceres,362-1-1/Varunda ICB85-0665-1AP-4AP-1AP-0AP-0AP	143
31	PI 000505//W12197/CI 13520 ICB85-0984-0AP-1AP-2AP-1AP-0AP-0AP	146
32	Soufara/4/Lth/3/Nopal//Pro/11012-2 ICB85-1498-0AP-1AP-2AP-1AP-0AP-0AP	147
33	Roho//Alger/Ceres/3/Jerusalem a barbes lisses/Bonus ICB85-1559-0AP-1AP-1AP-1AP-0AP-0AP	149
34	Local check	
		BMTON-USA 1991/92
1	6 Row MSFRS Pop (89-32-74) MT 93274	1
2	6 Row MSFRS PoP (89-32/90) MT 93290	2
3	6 Row MSFRS Pop (89-32-116) MT 932116	5
4	6 Row MSFRS Pop (89-32-197) MT 932197	15
5	6 Row MSFRS Pop (89-32-236) MT 932236	17
6	6 Row MSFRS Pop (89-32-266) MT 932266	20

Table 28 (continued). Name or cross/pedigree of selected barley genotypes from Observation Nurseries during 1991/92

E. No.	Name or cross/pedigree	Seed Source
7	Lewis CI 15856	24
8	6 Row MSFRS Pop (89-32-452) MT 932452	27
9	6 Row MSFRS Pop (89-32-462) MT 932462	28
10	6 Row MSFRS Pop (89-32-513) MT 932513	31
11	6 Row MSFRS Pop (89-32-520) MT 932520	32
12	6 Row MSFRS Pop (89-32-533) MT 932533	33
13	6 Row MSFRS Pop (89-32-554) MT 932554	34
14	Har msm1 rfm1/kgs Rfm1 Rfm1,F1 MT 950113	36
15	Har msn1 rfm1/Mnt Rfm1 Rfm1,F1 MT 950115	41
16	Pon msm1 rfm1/kgs Rfm1 Rfm1,F1 MT 950133	43
17	Harrington SK 76333	44
18	Har msm1 rfm1/Pon Rfm1 Rfm1,F1 MT 950117	45
19	Har/Mnt & Mnt/Har BuLk MT 049112	46
20	Mnt msm1 rfm1/Pon Rfm1 Rfm1,F1 MT 950126	47
21	Mnt/Pon & Pon/Mnt Bulk MT 049114	48
22	Morex CI 15773	49
23	Mnt msm1 Rfm1/ar Rfm1 Rfm1,F1 MT 950122	50
24	Bearpaw PI 531228	52
25	Mnt msm1 rfm1/kgs Rfm1 Rfm1,F1 MT 950124	53
26	Piroline CI 9558	56
27	Har/Pon & Pon/Har Bulk MT 049123	57
28	Lewis CI 15856	61
29	Menuet VD 3	63
30	Pon msm1 rfm1/Mnt Rfm1 Rfm1,F1 MT 950135	64
31	Local check	
		BAON-USA1991/92
1	Chickbar 2 Rowed Hulless	2
2	"	3
3	"	6
4	"	8
5	"	9
6	"	12
7	"	16
8	"	17
9	"	20

Table 28 (continued). Name or cross/pedigree of selected barley genotypes from Observation Nurseries during 1991/92

E. No.	Name or cross/pedigree	Seed Source
10	"	25
11	"	37
12	"	40
13	"	41
14	"	43
15	"	44
16	"	47
17	"	50
18	Local check	

Table 29. Performance of promising barley lines selected from Observation Nurseries during 1991/92

E. No.	DHD (50%)	Spk/ spike	YR	TDM (kg/ha)	GY (kg/ha)	1000 KW
Selection from BON (LR & CW) 1991/92						
1	130	23	OR	8000	3200	40
2	134	21	OR	9600	3200	50
3	134	21	OR	8800	3200	46
4	139	25	OR	12800	5600	43
5	130	21	OR	11200	4800	49
6	130	21	OR	11200	4800	45
7	131	21	OR	9600	3200	40
8	137	23	OR	8800	3200	48
9	141	54	OR	12000	4000	50
10	139	48	OR	12000	4000	47
11	132	21	OR	12800	4800	45
12	135	29	OR	21600	8800	38
13	141	30	OR	16000	6400	40
14	140	54	OR	11200	4800	44
15	130	48	OR	7200	2400	38
16	139	56	OR	10400	3200	37
17	129	46	OR	11200	3200	42
18	131	20	OR	12000	4800	44
19	133	20	OR	11200	4800	47
20	130	19	OR	8800	2400	44
21	140	23	OR	11200	3200	44
22	139	23	OR	14400	5600	39
23	140	21	OR	9600	4000	30
24	143	44	80S	14400	4000	32
Selection from 2nd IWFBON 1991/92						
1	147	29	OR	11200	4560	50
2	161	26	OR	11200	3200	45
3	149	25	OR	8800	3200	37
4	147	25	OR	11200	3360	43
5	145	29	OR	16000	4800	47
6	154	23	OR	8800	2400	44
7	160	-	OR	10400	4800	45
8	162	-	OR	9600	4000	46
9	150	29	OR	8800	4000	38
10	160	-	OR	10400	4000	40
11	160	-	OR	16000	6400	42
12	160	-	OR	5600	2400	42
13	160	-	OR	8800	3200	32
14	155	24	OR	11200	3200	34
15	150	26	OR	8800	3200	33

Table 29 (continued) performance of promising barley lines selected from Observation Nurseries during 1991/92

E. No.	DHD (50%)	Spk/ spike	YR	TDM (kg/ha)	GY (kg/ha)	1000 KW
16	150	52	OR	12000	4000	27
17	141	58	OR	14400	4800	33
18	147	58	OR	16000	4800	26
19	150	56	OR	13600	4800	41
20	152	42	OR	10400	4000	39
21	150	54	OR	10400	3200	46
22	142	54	OR	11200	4800	38
23	160	39	OR	8000	3200	39
24	145	68	OR	10400	5600	38
25	148	32	OR	8000	5600	36
26	147	29	OR	12000	4000	37
27	145	33	OR	10400	4000	42
28	149	27	OR	8000	1600	40
29	160	31	OR	8000	4000	29
30	147	28	OR	8800	4000	45
31	131	23	OR	8800	4800	47
32	149	29	OR	10400	4800	41
33	160	29	OR	9600	3200	30
34	143	46	80S	15200	5600	31
Selection from BMTON-USA 1991/92						
1	131	66	OR	16800	3200	37
2	148	84	OR	16800	4000	28
3	142	56	OR	13600	3200	33
4	139	66	OR	11200	2400	40
5	139	66	OR	11200	3200	34
6	139	70	OR	14400	4000	38
7	145	25	OR	11200	3200	48
8	144	66	OR	12000	3200	39
9	132	62	OR	14400	4000	39
10	146	72	OR	14400	4000	33
11	135	70	OR	11200	2400	37
12	142	76	OR	13600	2400	33
13	143	66	OR	16800	3200	37
14	150	27	OR	11200	2400	35
15	146	28	OR	16800	3200	33
16	147	28	OR	14400	4800	31
17	148	28	OR	12000	4000	34
18	147	29	OR	14400	4000	34
19	146	25	OR	12000	4000	31
20	147	29	OR	15200	4000	31
21	148	27	OR	17600	4800	28
22	144	74	OR	8800	2400	29
23	148	31	OR	11200	3200	30
24	148	31	OR	16800	3200	27
25	148	29	OR	13600	3200	34
26	147	30	OR	14400	4000	27
27	147	29	OR	10400	3200	27
28	145	30	OR	12800	3200	35
29	150	31	OR	12800	3200	24
30	147	28	OR	9600	2400	31
31	145	54	80S	15200	4800	32
Selection from BAON-USA (Chickbar) 1991/92						
1	149	24	OR	8800	3200	34
2	147	29	OR	12000	3200	32
3	146	30	OR	14400	3200	34
4	146	31	OR	12800	3200	35
5	148	32	OR	10400	3200	34

Table 29 (continued) performance of promising barley lines selected from Observation Nurseries during 1991/92

E. No.	DHD (50%)	Spk/ spike	YR	TDM (kg/ha)	GY (kg/ha)	1000 KW
6	150	31	0R	12800	4000	36
7	146	30	0R	20800	4000	35
8	140	32	0R	18400	5600	37
9	144	33	0R	12800	4000	37
10	134	28	0R	10400	3200	34
11	150	32	0R	11200	4000	37
12	150	33	0R	9600	3200	40
13	150	31	0R	8800	3200	39
14	145	29	0R	8800	3200	41
15	150	29	0R	8000	3200	39
16	150	33	0R	8000	4000	43
17	150	27	0R	9600	4000	38
18	143	52	80S	15200	5600	30

DHD = days to 50% heading, PH = plant height (cm), YR = yellow rust disease, TDM = total dry matter, GY = Grain yield, 1000 KW = thousand kernel weight (g)

Advanced Barley Yield trial (Selection Spring 1988/89)

Thirteen exotic barley genotypes selected from the 1988/89 trials were evaluated for a third year with spring sowing at Quetta and Kalat (Table 30). Rainfall was above average during the cropping season with a total of 259 mm and 278 mm being received between the beginning of February and harvest at Quetta and Kalat, respectively (see page 3). At Quetta the trial was conducted on rainfall alone, with no supplemental irrigation being applied.

Table 30. Name or cross/pedigree of Barley Yield trial (Selection Spring 1991/92)

E. No	Name of cross/pedigree	Seed source
		BYT(HA)88/89
1	H272/Bgs/3/MZg/Gva//P1 002917 ICB79-1171-2AP-0AP	2
2	DC/Jyoti ICB77-0130-3AP-1AP-2AP-0AP	9
		BYT(LR)88/89
3	Rihane-03	1
4	P1d10342//Cr.115/Por/3/Bahtim 9/4/ DS/Apro/5/W12291 ICB76-0058-9AP-4AP-4AP-0AP	3
5	W12197/Cl 13520 ICB77-0014-1AP-2AP-1AP-1AP-0AP	4
6	Harmal	6
7	Bal.16/MZg/3/M67-18/M14//Ds/Apro/4/Iris CMB76A-0338-2AP-1AP-2AP-1AP-0AP	12
8	Moroc 9-75	18
9	Deir Alla 106//7028/2759 ICB78-0333-5AP-1AP-1AP-1AP-0AP	23

Table 30 (continued). Name or cross/pedigree of Barley Yield trial (Selection Spring 1991/92)

E. No.	Name of cross/pedigree	Seed source
	Barley Advance Bulk lines 88/89	
10	Arabi Abiad/Emir ICB82-1292-0AP-0AP-0AP-11AP-0AP	12
11	Arabi Abiad/Emir ICB82-1292-0AP-0AP-0AP-28AP-0AP	17
12	Arabi Abiad/Emir ICB82-1292-0AP-0AP-0AP-40AP-0AP	21
13	Arabi Abiad/Emir ICB82-1292-0AP-0AP-0AP-29AP-0AP	18
14	Frontier-87	
15	Local Barley	

TDM production, grain yield and harvest index were similar amongst the genotypes at both Quetta and Kalat. However, the 1000 kernel weight of some exotic genotypes was significantly higher ($P<0.05$) than the local check at both sites (Table 31). During the 1989/90 season the TDM and grain yield of the exotic genotypes were not significantly higher than the local barley landrace (Ahmad *et al.*, 1990a) and in the 1990/91 season at Kalat only entry 6 gave significantly ($P<0.01$) more TDM than the local check. At the same test site in 1989/90 some exotic genotypes also had significantly better grain yields than the local check (Ahmad *et al.*, 1991).

These genotypes have been tested for three years and exposed to the prevailing stresses associated with spring planting. It was observed that the exotic genotypes were not better in TDM and grain yield than the local check under water stressed conditions. Therefore, further testing of these genotypes has stopped.

Table 31. Performance of Barley Yield trial (Selection for Spring 1991/92)

E. No.	Plant height (cm)	Tillers per m^2	TDM (kg/ha)		Grain yield (kg/ha)		1000 kernel weight (gm)		Harvest index (%)	
			Que.	Kal.	Que.	Kal.	Que.	Kal.	Que.	Kal.
1	60	140	5200	4400	1280	952	29	38	25	23
2	61	181	4800	5200	1320	1094	29	28	28	22
3	64	185	5200	5600	1560	1474	32	34	30	23
4	54	178	4667	7066	1507	1824	32	35	33	24
5	53	248	5600	7600	1373	1560	39*	43*	25	20
6	64	189	5866	6000	1493	1997	39*	42	27	33
7	73**	141	5200	5733	1867	1577	38	40	37	26
8	58	248	4933	6400	1360	1474	37	38	28	20
9	61	233	4133	8000	1107	1366	28	35	27	15
10	52	237	4533	6933	1433	1581	31	35	32	21
11	58	166	4400	6533	1360	1425	39*	38	30	23
12	60	218	5333	4800	1880	1174	36	35	36	24
13	61	262	4667	5733	1413	1229	39	36	30	18
14	61	174	4400	7200	1013	1056	29	33	24	15
15	60	222	5733	4266	1973	856	31	35	34	20
LSD(5%)	9	ns	ns	ns	ns	ns	8	8	ns	ns
LSD(1%)	12	ns	ns	ns	ns	ns	10	ns	ns	ns

*, ** = significantly different from local check at $P<0.05$ and $P<0.01$, respectively. ns = non-significant difference ($P>0.05$).

Advanced Barley Yield trial (Selection Spring 1989/90)

Five exotic genotypes selected from the Barley Yield trial (Low Rainfall Areas 1989/90) were compared with the local landrace in a spring planted trial at Quetta and Kalat (Table 32). TDM production, grain yield, harvest index and 1000 kernel weight were the same as the local check at both sites (Table 33). The same result was seen in 1990/91 (Ahmad *et al.*, 1991).

The 1991/92 season was useful for checking the performance of the exotic genotypes under strict dryland conditions at Quetta. However, no exotic genotype was better than the local check in productivity (Table 33). Further testing of these genotypes is terminated.

Table 32. Name or cross/pedigree of Barley Yield trial (Selection Spring 1991/92)

E. No.	Name or cross/pedigree	Seed Source
		BYT(LR)89/90
1	Man/4/Bal.16/Pro//Apm/DW11-1Y/3/Api/oM67 OMB77A-0110-4AP-0SH-4AP-1AP-0AP	5
2	AW Black/Aths CYB-0079-19A-6A-0A	7
3	Moroc 9-75	18
4	Pld 10342//Cr.115 /Por/3/Bahtim 9/4/ DS/Apro/5/W12291 ICB78-0058-4AP-1AP-3AP-1AP-0AP	19
5	Zanbaka SLB 42-60	20
6	Local barley	

Table 33. Performance of Barley Yield trial (Selection LR, Spring 1991/92)

E. No.	Plant height (cm)	Tillers per m^2	TDM (kg/ha)		Grain yield (kg/ha)		1000 kernel weight (g)		Harvest index(%)	
			Que.	Kal.	Que.	Kal.	Que.	Kal.	Que.	Kal.
1	64	159	4400	6400	1133	532	35	32	26	10
2	65	118	4133	5066	1266	401	34	25	31	8
3	61	174	4400	4666	1373	469	38	31	31	11
4	73	196	4400	4933	1200	674	40	32	27	14
5	69	322*	5200	3200	1840	490	35	31	36	16
6	68	200	5066	5866	2042	994	34	28	40	19
LSD(5%)	6	87	ns	ns	ns	279	ns	5	ns	ns
LSD(1%)	ns	124	ns	ns	ns	397	ns	ns	ns	ns

*, ** = significantly different from local check at $P<0.05$ and $P<0.01$, respectively. ns = non-significant difference ($P>0.05$).

RESULTS 3: Lentils

Lentil (*Lens culinaris*) is the second major pulse crop in Pakistan and an important source of protein in the national diet. However, in Balochistan the local landrace is unattractive to consumers because of its very small seed size (Keatinge *et al.*, 1990). The identification and selection of large seeded, cold, drought and disease resistant genotypes is an important way to boost lentil production in the highlands of Balochistan.

Lentil evaluation and selection studies in highland Balochistan have shown that some exotic large seeded lentil genotypes have potential in this area (Ali *et al.*, 1991). Therefore, efforts are continuing to introduce additional exotic germplasm for testing. Details of the lentil trials in the 1991/92 season are summarized in Table 34.

Table 34. Lentil genotypes evaluated and selected during the 1991/92 season

Name of Trial	Total Entries	Selected Entries
Winter-sown trials		
1. Lentil advanced yield trial selection (winter 1988/90)	10	1
2. Lentil advanced winter yield trial selections (1988/89)	10	continued
3. Lentil preliminary yield trial selections (winter 1990/91)	23	continued
4. New international yield trial large seeded 1991/92	24	12
5. New international cold tolerance observation nursery 1991/92	15	6
6. New international screening nursery large seeded 1991/92	31	5
Spring-sown trials		
1. Lentil advanced yield trial selections (1988/89)	7	continued
2. New international yield trial early 1991/92	24	7
3. New international screening nursery early 1991/92	31	7

Lentil Advanced Yield trial (Selection Winter 1988/89)

Nine exotic large-seeded lentil lines from the 1988/89 trials were compared with the local check for potential productivity and adaptability. Although the trial was sown at Quetta, Loralai and Kan Mehtarzai, harvesting was only possible at Quetta because of hail damage. TDM production and seed yields of the exotic genotypes were not found to be significantly different ($P>0.05$) from the local check (Table 35). However, 100 seed weight of all the exotic genotypes was significantly ($P<0.01$) higher than the local check.

In the 1988/89 season TDM production of the exotic genotypes was superior at some test sites and ILL 5582, 5668, 5876, and 5988 had superior seed yields to the local check at Quetta (Ali *et al.*, 1989). In 1989/90 exotic genotypes gave the

same TDM yield as the local check and ILL 5816 and 5842 gave significantly (P<0.05) higher seed yields at Kan Mehtarzai as compared with the local check (Ahmad *et al.*, 1990a). In the 1990/91 season ILL 5582 and 5876 produced significantly (P<0.05) higher TDM yields than the local check at Loralai and ILL 5582 yielded significantly more seed than the local check (P<0.01) (Ahmad *et al.*, 1991).

These genotypes have been tested for four years under various environmental stresses and some of them have potential for cultivation in the rainfed areas of highland Balochistan. The trial has been stopped and ILL 5668 has been selected for seed multiplication. However, a final selection of desirable genotypes will be made after thoroughly checking overall performance of genotypes across the test locations, cooking quality and protein analysis.

Table 35. TDM production, seed yield and 100 seed weight of large seeded lentil lines (selection 1988/89) at Quetta from winter sowing during 1991/92

Entry No.	ILL No.	Origin	TDM (kg/ha)	Seed yield (kg/ha)	100 seed weight(g)
1	5582	JORDAN	6000	1084	4.51**
2	5668	SYRIA	6200	1297	3.77**
3	5699	ICARDA	6600	1256	3.62**
4	5751	ICARDA	6300	828	5.78**
5	5816	ICARDA	5700	780	6.14**
6	5817	ICARDA	6600	1266	4.90**
7	5842	ICARDA	5700	1056	5.43**
8	5876	ICARDA	5300	1123	4.67**
9	5988	ICARDA	5300	941	3.98**
10	Local	Check	5500	1103	1.90
LSD(5%)	-	-	ns	ns	1.18
LSD(1%)	-	-	ns	ns	1.70

** = significantly different from local check at P<0.01. ns = non-significant difference (P>0.05).

Lentil Advanced Yield trials (Selection Winter and Spring 1988/89)

Nine exotic winter and six exotic spring lines selected from the 1988/89 trials were evaluated for biotic and abiotic stresses with winter sowing at Quetta, and spring sowing at Quetta and Kalat.

Lentil Yield trial (Selection Winter): TDM production of most exotic genotypes was significantly better than the local check. Entries ILL 2500, 3517, 3614, 2573, 2581, 3493, 4403, and 857 produced significantly (P<0.05) higher TDM than the local check (Table 36). In the 1988/89 and 1989/90 seasons exotic genotypes did not outyield the local check in TDM production (Ali *et al.*, 1989; Ahmad *et al.*, 1990a).

Seed yield of the exotic genotypes was not significantly better than the check during the 1991/92 season at Quetta, as was the case in the 1988/89 and 1989/90 seasons at the various sites (Ali *et al.*, 1989; Ahmad *et al.*, 1990a). Genotypes ILL 590 and 857 had a better (P<0.01) 100 seed weight than the local check (Table 36). This trial will be repeated for another year to confirm the adaptability, resistance and tolerance of the lines to environmental stresses.

Table 36. TDM production, seed yield and 100 seed weight of winter type lentil lines at Quetta with winter sowing during 1991/92 (Selections 1988/89)

Entry No.	ILL No.	Origin	TDM (kg/ha)	Seed yield (kg/ha)	100 seed weight(g)
1	2500	INDIA	5700*	680	1.50
2	2573	INDIA	6400**	691	1.49
3	2581	INDIA	6500**	864	1.42
4	3493	INDIA	6700**	1130	1.51
5	3517	INDIA	6100*	949	1.45
6	3614	INDIA	5800	768	1.78
7	4403	PAKISTAN	6500**	823	1.57
8	590	TURKEY	3600	580	2.27**
9	857	ALGERIA	6600**	1170	2.85**
10	Local	Check	4400	1069	1.39
LSD(5%)	-	-	1262	ns	0.14
LSD(1%)	-	-	1813	ns	0.20

*, ** = significantly different from local check at P<0.05 and P<0.01, respectively. ns=non-significant difference (P>0.05).

Lentil Yield trial (Selection, Spring): Six exotic genotypes originally selected from the 1988/89 trials were sown at Quetta and Kalat during the spring 1992. TDM production and seed yield did not differ significantly at both sites. However, the 100 seed weight of all the exotic genotypes was significantly (P<0.01) higher than the local check (Table 37). TDM and seed yield of these genotypes were also similar in the 1988/89 and 1989/90 seasons at different locations (Ali *et al.*, 1989; Ahmad *et al.*, 1990a). These exotic lines will be exposed to a further season of testing.

Table 37. TDM production, seed yield and 100 seed weight of spring type lentil lines during the 1991/92 season at Quetta and Kalat (Selections 1988/89)

Entry No.	ILL No.	Origin	TDM (kg/ha)		Seed yield (kg/ha)		100 seed weight(g)	
			Que.	Kal.	Que.	Kal.	Que.	Kal.
1	6027	ICARDA	1440	1800	308	646	4.37**	3.96**
2	6254	ICARDA	1333	1333	449	445	3.05**	2.98**
3	6256	ICARDA	1280	1733	370	694	3.27**	2.89**
4	6260	ICARDA	1173	2000	372	783	2.92**	3.07**
5	6263	ICARDA	1280	1666	450	668	3.02**	3.03**
6	4354	JORDAN	1333	1533	318	534	4.85**	4.51**
7	Local	Check	1173	1866	347	731	1.78	1.99
LSD(5%)		-	ns	ns	86	ns	0.61	0.54
LSD(1%)		-	ns	ns	ns	ns	0.85	0.76

** = significantly different from local check at P<0.01. ns = non-significant difference (P>0.05).

Lentil Preliminary Yield trial (Winter Selection 1990/91)

Twenty-two exotic selected lines from various trials in 1990/91 with different genetic backgrounds were evaluated for cold, drought, disease and yield potential at Quetta. No significant differences in TDM production were recorded (Table 38). However, seed yield and 100 seed weight of some exotic lines were significantly higher (P<0.01) than the local check. In 1990/91 genotypes ILL 5599, 5684 and 5725 outyielded the local check (P<0.01) at Loralai. At the same site ILL 6254 and 6777 produced higher TDM yields than the local check (P<0.05) (Ahmad *et al.*, 1991).

During 1991/92, ILL 6818 and 5684 gave significantly higher seed yields than the local check (P<0.01) (Table 38). In the previous year 1990/91, these genotypes also outyielded the local landrace in seed yield at Quetta (Ahmad *et al.*, 1991). ILL 465, 468, 590, 662, 5599, 5684, 5725, 6245, 6777, 5814, 5825, 6434, 6798 and 6980 were superior in 100 seed weight to the local check (P<0.05). All these genotypes will be tested in 1992/93 across the various agro-ecological zones of Balochistan.

Table 38. Performance of new exotic lentil genotypes in a yield trial with winter sowing in 1991/92 at Quetta

Entry No.	ILL No.	TDM (kg/ha)	Seed yield (kg/ha)	100 seed weight(g)
1	2501	5100	942	1.72
2	2573	5500	730	1.67
3	2581	5900	419	1.58
4	4403	7200	1258	2.15
5	6256	4650	983	2.49
6	6463	6100	1117	2.53
7	6818	7400	1567**	1.94
8	465	7900	551	3.78**
9	468	4300	362	4.07**
10	590	4400	292	2.46*
11	662	4400	435	2.50*
12	5599	5200	1117	5.53**
13	5684	7400	1777**	3.93**
14	5725	5800	837	3.45**
15	6245	6200	1287	3.62**
16	6777	6700	1175	3.24**
17	6827	5300	776	2.07
18	5814	4400	796	5.13**
19	5825	4800	1131	5.24**
20	6434	4800	1163	5.20**
21	6798	4900	963	2.73**
22	6980	5700	1278	4.54**
23	Local check	4300	921	1.54
LSD(5%)	-	ns	416	0.77
LSD(1%)	-	ns	565	1.04

*, ** = significantly different from local check at P<0.05 and P<0.01, respectively. ns = non-significant difference (P>0.05).

New Lentil International Yield trial (Large Seeded 1991/92)

Twenty-three new large seeded exotic genotypes were evaluated for cold, drought and disease resistance and yield potential at Quetta. Exotic genotypes could not compete with the local check in TDM production. Genotypes ILL 5991 and 5996 gave significantly higher seed yield than the local check (P<0.05). All the exotic genotypes had significantly (P<0.01) better 100 seed weights than the local check (Table 39). From this trial 12 genotypes have been selected for further multilocation testing in highland Balochistan.

Table 39. Performance of new exotic large seeded lentil genotypes with winter sowing at Quetta during 1991/92

Entry No.	ILL No.	Origin	TDM (kg/ha)	Seed yield (kg/ha)	100 seed weight(g)
1	4400	Syria	5400	826	5.33**
2	5582	Jordan	5800	938	4.10**
3	5597	Syria	4500	304	5.66**
4	5766	ICARDA	5600	958	5.44**
5	5991	ICARDA	5200	1282*	3.80**
6	5996	ICARDA	5800	1304*	3.87**
7	6192	ICARDA	5000	744	4.69**
8	6206	ICARDA	6000	1134	4.09**
9	6207	ICARDA	5400	912	3.80**
10	6430	ICARDA	6200	1192	4.24**
11	6431	ICARDA	7000	1212	4.05**
12	6437	ICARDA	5800	1092	4.32**
13	6438	ICARDA	7800	1016	4.07**
14	6456	ICARDA	5800	1030	4.19**
15	6763	ICARDA	5600	904	3.96**
16	6765	ICARDA	5600	928	3.82**
17	6970	ICARDA	6200	1106	4.19**
18	6972	ICARDA	6200	912	3.64**
19	6973	ICARDA	5400	1036	5.49**
20	6977	ICARDA	6200	1130	4.57**
21	6979	ICARDA	5000	672	4.06**
22	6980	ICARDA	5000	916	4.81**
23	6981	ICARDA	5800	1144	4.46**
24	Local check		4800	818	1.57
LSD(5%)	-	-	ns	450	0.88
LSD(1%)	-	-	ns	ns	1.20

*, ** = significantly different from local check at P<0.05 and P<0.01, respectively. ns = non-significant difference (P>0.05).

New International Cold Tolerance Observation Nursery 1992

This observation nursery consisted of 14 new exotic genotypes and was sown at Quetta for cold screening. No severe cold damage was observed and all the entries survived during the winter months. TDM production and seed yield of the newly introduced genotypes were the same as the local check (Table 40). However, the 100 seed weight of eight genotypes was significantly (P<0.05) higher than the local check. Six high yielding genotypes (ILL 52, 323, 468, 590, 857 and 1918) have been selected from this observation nursery for further testing in highland Balochistan.

Table 40. Performance of Lentil International Cold Tolerance Observation Nursery-1992 at Quetta

Entry No.	ILL No.	Origin	TDM (kg/ha)	Seed yield (kg/ha)	100 seed weight(g)
1	ILL 52	Iraq	7200	1423	2.50
2	ILL 323	Yugoslavia	8400	1578	5.22**
3	ILL 465	Chile	4000	743	3.78*
4	ILL 468	Chile	8000	1481	3.13
5	ILL 590	Turkey	7600	1738	3.53*
6	ILL 759	Iran	5600	1119	1.92
7	ILL 780	Syria	6000	1026	5.45**
8	ILL 857	Algeria	8000	1747	3.31*
9	ILL 975	Chile	6000	1387	2.20
10	ILL 1878	Turkey	5200	476	3.27*
11	ILL 1918	Australia	7600	1741	3.43*
12	ILL 4400	Syria	5600	967	3.13
13	ILL 7155	Turkey	6000	378	4.29*
14	Local check	Balochistan	7200	1016	1.42
15	ILL 2580 (Susceptible check)	India	4107	803	1.53
LSD(5%)			2392	ns	1.82
LSD(1%)			ns	ns	2.52

*, ** = significantly different from local check at P<0.05 and P<0.01, respectively. ns = non-significant difference (P>0.05).

New International Screening Nursery (Large Seeded 1992)

Thirty exotic large seeded genotypes were compared with the local check for biotic and abiotic stresses at Quetta. TDM production and seed yield differences were significant (P<0.05) among the genotypes. However, they did not outyield the local check in TDM and seed yield (Table 41). Five genotypes (ILL 5582, 7175, 7176, 7177 and 7180) have been selected for future testing in highland Balochistan.

Table 41. Performance of Lentil International Screening Nursery (Large Seeded 1992) at Quetta

Entry No.	ILL No.	Origin	TDM (kg/ha)	Seed yield (kg/ha)	100 seed weight(g)
1	ILL 4400	Syria	5600	1060	6.04**
2	ILL 5582	Jordan	7200	1704	4.30**
3	ILL 5699	ICARDA	4800	1276	3.88**
4	ILL 6975	ICARDA	6400	1448	4.98**
5	ILL 6982	ICARDA	6800	1460	5.59**
6	ILL 7129	ICARDA	6800	1168	4.20**
7	ILL 7131	ICARDA	6800	1488	5.57**
8	ILL 7132	ICARDA	7600	1352	7.59**
9	ILL 7134	ICARDA	6400	1092	5.58**
10	ILL 7135	ICARDA	5200	1164	4.83**
11	ILL 7136	ICARDA	6800	1404	4.73**
12	ILL 7137	ICARDA	5200	1164	4.39**
13	ILL 7138	ICARDA	5200	876	4.30**
14	ILL 7159	USSR	4800	300	3.15*
15	ILL 7161	USSR	2000	60	2.29
16	ILL 7166	ICARDA	6000	972	5.35**
17	ILL 7167	ICARDA	6800	1156	5.27**
18	ILL 7168	ICARDA	6000	1068	4.47**
19	ILL 7169	ICARDA	6000	1504	3.68**
20	ILL 7170	ICARDA	6400	1544	4.43**
21	ILL 7171	ICARDA	5200	1148	3.82**
22	ILL 7172	ICARDA	6800	1240	4.59**
23	ILL 7173	ICARDA	4800	1108	4.08**
24	ILL 7174	ICARDA	6000	1492	4.37**
25	ILL 7175	ICARDA	7200	1824	4.86**
26	ILL 7176	ICARDA	6800	1628	4.38**
27	ILL 7177	ICARDA	7600	1844	4.72**
28	ILL 7178	ICARDA	6000	1252	4.03**
29	ILL 7179	ICARDA	6400	1232	5.61**
30	ILL 7180	ICARDA	6400	1616	3.59**
31	Local check		6400	1600	1.81
LSD (5%)	-	-	2269	688	1.31
LSD (1%)	-	-	ns	926	1.77

*, ** = significantly different from local check at P<0.05 and P<0.01, respectively. ns = non-significant difference (P>0.05).

New Lentil International Yield trial (Early 1992)

Twenty three exotic genotypes were evaluated for a short growing period and yield potential when spring sown at Quetta and Kalat. Some exotic genotypes had earlier maturity than the local check. TDM production of exotic genotypes was not significantly better than the local check at both locations (Table 42). Genotype ILL 6819 gave a significantly (P<0.05) higher seed yield than the local check at Kalat. 100 seed weight of many exotic genotypes was significantly (P<0.01) higher at both sites (Table 42). Seven genotypes (ILL 6002, 6024, 6025, 6256, 6810, 6811 and 6819) will be tested again in highland Balochistan with spring sowing.

Table 42. Performance of new exotic lentil genotypes (Early 1992) with spring sowing at Quetta and Kalat

Entry No.	ILL No.	Origin	TDM (kg/ha)		Seed yield (kg/ha)		100 seed weight(g)	
			Que.	Kal.	Que.	Kal.	Que.	Kal.
1	2501	India	1980	1200	638	323	2.37	2.48
2	2580	India	880	1200	325	293	1.99	2.07
3	2581	India	1540	933	492	245	2.17	1.94
4	2582	India	1650	1066	576	300	2.14	2.09
5	4403	Pakistan	1034	1333	385	365	2.42	3.17*
6	6002	ICARDA	1430	1466	564	353	4.61**	6.06**
7	6024	ICARDA	1980	1466	590	397	3.71**	5.33**
8	6025	ICARDA	1980	1200	822	308	3.38	3.64**
9	6256	ICARDA	1980	1600	766	481	3.34**	3.44**
10	6260	ICARDA	1430	1333	447	387	2.40	2.79*
11	6262	ICARDA	1760	1333	543	379	4.21**	4.06**
12	6458	ICARDA	1430	800	380	172	2.86*	2.86*
13	6459	ICARDA	1760	1200	640	387	2.86*	3.40**
14	6467	ICARDA	1320	933	418	143	3.86**	3.39**
15	6792	ICARDA	1650	1200	539	180	3.74**	3.77**
16	6806	ICARDA	1760	1066	438	268	4.51**	5.33**
17	6810	ICARDA	2090	1200	754	469	3.07**	3.04**
18	6811	ICARDA	1760	1200	746	395	2.74*	3.12**
19	6813	ICARDA	1122	933	543	236	2.68*	2.37
20	6816	ICARDA	1210	1333	589	293	2.70*	2.09
21	6818	ICARDA	1760	933	583	367	3.83**	2.69
22	6819	ICARDA	1980	1733	668	560*	2.57	2.34
23	6825	ICARDA	1430	1200	498	283	2.14	2.40
24	Local	check	1650	1200	587	316	1.80	1.96
LSD(5%)	-	-	615	ns	199	195	0.82	0.77
LSD(1%)	-	-	821	ns	265	ns	1.10	1.03

*, ** = significantly different from local check at P<0.05 and P<0.01, respectively. ns = non-significant difference (P>0.05).

New Lentil International Screening Nursery (Early 1992)

Thirty early maturing exotic genotypes were evaluated for desirable spring-sown characteristics in highland Balochistan. TDM production and seed yield differences among genotypes were non-significantly different at Quetta and Kalat (Table 43). However, 100 seed weight of many exotic genotypes was significantly (P<0.01) higher at both sites (Table 43). Seven genotypes (ILL 7127, 7165, 7207, 7211, 7214, 7218 and 7219) have been selected from this nursery for further testing.

Table 43. Performance of Lentil International Screening Nursery (Early 1992) with spring sowing at Quetta and Kalat

Entry No.	ILL No.	Origin	TDM (kg/ha)		Seed yield (kg/ha)		100 seed weight(g)	
			Que.	Kal.	Que.	Kal.	Que.	Kal.
1	ILL 6036	ICARDA	1650	1200	472	224	6.50**	7.00**
2	ILL 6265	ICARDA	1320	2000	343	464	3.23**	3.11*
3	ILL 6465	ICARDA	1650	1800	386	504	6.32**	5.89**
4	ILL 6466	ICARDA	1650	1600	343	344	6.33**	3.74**
5	ILL 6803	ICARDA	1320	1600	337	360	5.92**	5.68**
6	ILL 6814	ICARDA	660	800	274	288	2.54	2.73
7	ILL 6820	ICARDA	1320	1600	300	308	2.57	2.73
8	ILL 6829	ICARDA	1650	1600	498	552	1.89	1.97
9	ILL 7127	ICARDA	1650	1600	551	516	3.13**	3.29*
10	ILL 7162	Pak/ICARDA	1320	1600	317	508	2.31	2.26
11	ILL 7163	Pak/ICARDA	1320	1600	393	464	2.75*	2.97
12	ILL 7164	Pak/ICARDA	1320	1200	337	432	2.79*	2.97
13	ILL 7165	Pak/ICARDA	1320	2400	485	644	3.00**	3.20*
14	ILL 7204	ICARDA	2640	1200	347	412	3.42**	3.73**
15	ILL 7205	ICARDA	1650	1200	419	436	4.08**	4.14**
16	ILL 7206	ICARDA	2013	1600	436	452	5.05**	5.10**
17	ILL 7207	ICARDA	1320	1600	502	716	4.32**	4.73**
18	ILL 7208	ICARDA	2013	1200	459	300	4.73**	5.00**
19	ILL 7209	ICARDA	1650	1600	363	548	6.41**	5.93**
20	ILL 7210	ICARDA	1320	2400	383	588	4.98**	4.45**
21	ILL 7211	ICARDA	1980	2000	409	644	4.24**	4.87**
22	ILL 7212	ICARDA	1650	2400	363	612	4.16**	4.61**
23	ILL 7213	ICARDA	1320	1600	363	504	4.76**	4.58**
24	ILL 7214	ICARDA	1320	1600	413	632	3.67**	3.50*
25	ILL 7215	ICARDA	1320	2000	304	392	3.79**	3.52**
26	ILL 7216	ICARDA	1320	2000	456	600	2.46	2.79
27	ILL 7217	ICARDA	1980	2000	482	516	5.51**	5.96**
28	ILL 7218	ICARDA	1650	2400	462	656	6.01**	6.06**
29	ILL 7219	ICARDA	1650	1600	459	628	2.71*	2.54
30	ILL 7220	ICARDA	1353	1600	267	392	3.17**	3.53**
31	--------	Local	1650	2000	412	496	1.74	1.89
LSD(5%)	-	-	ns	ns	ns	ns	0.84	1.19
LSD(1%)	-	-	ns	ns	ns	ns	1.14	1.61

*, ** = significantly different from local check at P<0.05 and P<0.01, respectively. ns = non-significant difference (P>0.05).

RESULTS 4. Forage legumes

Annual forage legumes have a high nutritive value and are grown for animal feed or grazing. They have potential for cultivation in Mediterranean and highland environments (Moneim *et al.*, 1990) and therefore *Vicia* species are being tested under rainfed conditions in highland Balochistan which has a continental arid Mediterranean climate (Keatinge *et al.*, 1991). Introduction of these species will help to increase the number of options to feed the small ruminants during winter and thus reduce grazing pressure on the degraded rangelands.

In highland Balochistan the forage legumes under evaluation and testing are *V. villosa* ssp. *dasycarpa* (woollypod vetch), *V. sativa* (common vetch), *V. ervilia* (bitter vetch), *Lathyrus sativus* (common chickling) and *V. narbonensis* (narbon vetch). Moreover, *V. sativa* spp. *amphicarpa* has been included in the forage legume evaluation program this year due to its self-regenerating ability. During 1991/92 four forage legumes trials were conducted at different test sites (Table 44).

Table 44. Forage legume genotypes evaluated and selected during the 1991/92 season

Name of Trial	Total Entries	Selected Entries
Winter-sown trials		
1. Vicia villosa advanced yield trial selections 1988/89	10	10
2. Vicia ervilia yield trial selections 1988/89	12	10
3. New international vetch adaptation yield trial 1991/92	24	9
Spring-sown trial		
1. Vicia ervilia yield trial selections spring 1988/89	12	12

Vicia villosa Advanced Yield trial (Selections 1988/89)

Eight *Vicia villosa* spp. *dasycarpa* lines selected from the 1988/89 trials were compared with the already promising line *V. dasycarpa* Acc. 683 and local lentil. TDM production and seed yield did not differ at Quetta. However, at Kan Mehtarzai four genotypes (Acc. No. 717, 800, 801 and 966) produced significantly ($P<0.05$) higher TDM than the local lentil check (Table 45). At the same test site seed yield of all the *V. dasycarpa* genotypes was significantly ($P<0.05$) higher than the local check (Table 45).

In 1988/89 the same eight genotypes were tested with fall and spring sowing at Quetta, Khuzdar and Kan Mehtarzai. TDM production did not differ significantly at the test sites except at Khuzdar where significant differences were observed in spring-sown trials (Ali *et al.*, 1989). In the 1988/89 season TDM production was not significantly different at Quetta, Loralai, and Kan Mehtarzai (Ahmad *et al.*, 1990a). However, in the 1989/90 season all the *V. dasycarpa* genotypes produced significantly ($P<0.01$) more TDM at Quetta than the local check but did not perform significantly better than the *V. dasycarpa* Acc. 683 (Ahmad *et al.*, 1991).

In terms of seed yield these genotypes performed differently across the locations and years. In the 1988/89 season, seed yield of exotic genotypes was not better than the checks except at Kan Mehtarzai (Ali *et al.*, 1989). In the 1989/90 season at Quetta *V. dasycarpa* Acc. No. 596, 800, 2558 and 683 outyielded (P<0.05) the local check in terms of seed yield whereas at Kan Mehtarzai all the genotypes except two (Acc. 801 and 956) had a significantly (P<0.05) higher seed yield than the local check (Ahmad *et al.*, 1990a). In the previous year 1990/91 only Acc. 956 yielded significantly (P<0.05) more seed than the improved *V. dasycarpa* and local lentil at Quetta (Ahmad *et al.*, 1991).

These genotypes have been exposed to the various environmental stresses experienced in highland Balochistan. A final selection will be made on the basis of overall performance across the locations and years.

Table 45. TDM and seed yield of forage legume lines (Selections 1988/89) sown at different sites during winter 1991/92

Entry No.	Name of Genotype	Acc. No.	TDM (kg/ha)		Seed yield(kg/ha)	
			Quetta	Kan Meh.	Quetta	Kan Meh.
1	V. dasycarpa	596	6500	836	327	288*
2	V. dasycarpa	717	7700	1400*	249	360*
3	V. dasycarpa	800	11000	902*	343	316*
4	V. dasycarpa	801	5800	956*	449	346*
5	V. dasycarpa	956	7300	744	348	298*
6	V. dasycarpa	958	6800	650	310	218*
7	V. dasycarpa	966	6700	862*	352	280*
8	V. dasycarpa	2558	6200	754	272	228*
9	V. dasycarpa	683	6800	920*	238	300*
10	L. culinaris	Local	5500	440	700	110
LSD(5%)	-	-	ns	416	ns	106
LSD(1%)	-	-	ns	ns	ns	ns

* = significantly different from local check at P<0.05. ns = non-significant difference (P>0.05).

***Vicia ervilia* Yield trial (Selection 1988/89)**

Eleven *Vicia ervilia* selected genotypes of Iranian origin were evaluated for forage production with winter sowing at Quetta and Kan Mehtarzai, and with spring sowing at Quetta and Kalat.

In the winter sowing no significant differences across the material were observed in TDM production at Quetta and Kan Mehtarzai. However, in seed yield eleven genotypes (Acc. 225001, 225004, 225006, 225007, 225008, 225010, 225011, 225012, 225014, 225015 and 225016) were significantly (P<0.05) better than the local check. At Kan-Mehtarzai the seed yield of *V. ervilia* genotypes were comparatively better than the local check (Table 46).

In 1989/90 and 1990/91 TDM production of *V. ervilia* genotypes with winter sowing was not superior at any site to the local check (Ahmad *et al.*, 1990a; Ahmad *et al.*, 1991). In terms of seed yield *V. ervilia* genotypes were generally superior to the local check. In the 1989/90 season eight genotypes (Acc. 225001, 225004, 225006, 225007, 225008, 225012, 225014 and 225015) significantly (P<0.05) outyielded the local check in seed yield (Ahmad *et al.*, 1990a). In the 1990/91

season all the *V. ervilia* genotypes gave significantly (P<0.05) higher seed yield at Quetta with winter sowing than the local check. At Kalat seven genotypes (Acc. 225001, 225004, 225008, 225010, 225012, 225014 and 225015) and one genotype (Acc. 225015) outyielded the local check (P<0.05). However, at Loralai four genotypes (Acc. 225004, 225007, 225010 and 225015) and three genotypes (Acc. 225006, 225011 and 225014) were superior to the local check (P<0.01 and P<0.05, respectively) (Ahmad *et al.*, 1991).

Table 46. TDM and seed yield of forage legume lines (Selections 1988/89) sown at different sites during winter 1991/92

Entry No.	Name of Genotype	Acc. No.	TDM (kg/ha)		Seed yield(kg/ha)	
			Quetta	Kan Meh.	Quetta	Kan Meh.
1	V. ervilia	225001	7900	496	2294**	218
2	V. ervilia	225004	6300	640	1799**	334
3	V. ervilia	225006	6500	666	1956**	364
4	V. ervilia	225007	6900	670	2052**	234
5	V. ervilia	225008	7300	1020	1668*	268
6	V. ervilia	225010	6100	558	1898**	328
7	V. ervilia	225011	7100	922	1895**	276
8	V. ervilia	225012	7000	710	2002**	260
9	V. ervilia	225014	6200	712	1688**	308
10	V. ervilia	225015	6100	320	1845**	224
11	V. ervilia	225016	6100	1000	1037*	146
12	L. culinaris	Local	6600	420	553	140
LSD (5%)	-	-	ns	ns	416	ns
LSD (1%)	-	-	ns	ns	586	ns

*, ** = significantly different from local check at P<0.05 and P<0.01, respectively. ns = non-significant difference (P>0.05).

In spring sowing TDM production of *V. ervilia* genotypes was not significantly higher than the local check. However, nine genotypes at Quetta (Acc. 225004, 225006, 225007, 225008, 225010, 225011, 225012, 225014 and 225015) and nine genotypes at Kalat (Acc. 225001, 225004, 225006, 225007, 225008, 225010, 225012, 225014 and 225015) outyielded the local check in seed yield at the P<0.01 and P<0.05 levels of significance, respectively (Table 47).

In the previous year 1990/91 these genotypes were also significantly (P<0.01) superior in seed yield during spring sowing at Quetta and Kalat. However, genotype Acc. 225006 did not outyield the local check in seed yield at Kalat (Ahmad et al., 1991).

From these multilocation trials it was observed that *V. ervilia* genotypes have a high seed production ability at both winter and spring sowing times. Selection of desirable genotypes from this trial will be made after analyzing the protein content in straw and seed, resistance and tolerance against environmental stresses, and adaptability of genotypes to different sowing times.

Table 47. TDM and seed yield of forage legume lines (Selection 1988/89) sown at different sites during spring 1992

Entry No.	Name of Genotype	Acc. No.	TDM (kg/ha)		Seed yield(kg/ha)	
			Quetta	Kalat	Quetta	Kalat
1	V. ervilia	225001	1173	2266	500	1182*
2	V. ervilia	225004	1333	2200	611**	1125*
3	V. ervilia	225006	1226	2000	618**	974*
4	V. ervilia	225007	1440	2533	674**	1125*
5	V. ervilia	225008	1520	2066	659**	1068*
6	V. ervilia	225010	1386	2400	563**	1200*
7	V. ervilia	225011	1493	2266	680**	1153*
8	V. ervilia	225012	1280	2333	657**	1203*
9	V. ervilia	225014	1547	2000	710**	1075*
10	V. ervilia	225015	1333	1866	698**	952
11	V. ervilia	225016	1067	1533	350	654
12	L. culinaris	Local	1088	1600	299	527
LSD(5%)	-	-	297	ns	162	443
LSD(1%)	-	-	ns	ns	221	ns

*, ** = significantly different from local check at P<0.05 and P<0.01, respectively. ns = non-significant difference (P>0.05).

New International Vetch Adaptation Yield trial 1992

Twenty three new vetch genotypes originating from ICARDA were evaluated for their adaptability and potential winter forage production in the rainfed areas of highland Balochistan. Improved selection *Vicia dasycarpa* Acc. 683 was used as a check. Differences in TDM production among genotypes were not statistically significant (Table 48).

Seed yield of some of the newly introduced *V. sativa* and *V. narbonensis* genotypes were better than the *V. dasycarpa* check. Five *V. narbonensis* genotypes (Acc. 574, 565, 573, 577 and 568) produced significantly (P<0.05) higher seed yields than the *V. dasycarpa* check (Table 48).

From this trial five *V. narbonensis* genotypes (Acc. 574, 565, 573, 577 and 568) and four *V. sativa* genotypes (Acc. 384, 534, 705 and 1361) have been selected for further multilocation testing in highland Balochistan.

***Lathyrus sativus* trials**

Lathyrus sativus, known as grass pea as well as chickling, is a conventional crop grown for centuries in lowland Pakistan, mainly in the province of Sindh. It is a multipurpose crop and is used both as a green fodder as well as a food crop. It has other uses such as a green vegetable and as a snack food. Among the pulses of Pakistan, chickpea is first in importance while *Lathyrus sativus* is second both in terms of area under cultivation and total annual production. Grass pea, the Matar of Sindh, Charal of Punjab and Chilo of Swat (NWFP), is a remarkably hardy crop which can tolerate both drought and waterlogging. It is highly nutritious, and has good palatability, wide spread acceptance by local people and can be cultivated under very low input farming regimes.

Table 48. Performance of International Vetch Adaptation trial with winter sowing at Quetta during 1991/92

Entry No.	Name of Genotype	Acc. No.	TDM (kg/ha)	Seed yield (kg/ha)
1	V. sativa	2	3400	634
2	V. sativa	2	4800	334
3	V. sativa	4	6600	722
4	V. sativa	7	3200	270
5	V. sativa	7	4000	792
6	V. sativa	384	6400	1170
7	V. sativa	482	2800	318
8	V. sativa	507	5600	706
9	V. sativa	534	4800	1000
10	V. sativa	708	2000	394
11	V. sativa	709	4200	886
12	V. sativa	705	6600	1688
13	V. sativa	716	3800	908
14	V. sativa	1331	3600	272
15	V. sativa	1361	4800	1302
16	V. sativa	1461	2600	538
17	V. sativa	2541	3000	720
18	V. narbonensis	67	6600	826
19	V. narbonensis	574	5600	2720*
20	V. narbonensis	565	7800	2696*
21	V. narbonensis	573	4200	1814*
22	V. narbonensis	577	5800	2206*
23	V. narbonensis	568	8600	2220*
24	V. dasycarpa (check)	683	9200	648
LSD(5%)	-	-	ns	1460
LSD(1%)	-	-	ns	ns

* = significantly different from local check at P<0.05.
ns = non-significant difference (P>0.05).

However, the seed contains a free amino acid called beta-N-oxalyl-amino alanine (BOAA) which is toxic if consumed in large quantities for over three months. The neurological disease called lathyrism affects both humans and animals and can lead to paraplegia. It causes significant public health problems in countries such as Ethiopia, Bangladesh and pockets of India and Europe, including Spain. In Pakistan however, the occurrence and extent of the disease has never been recorded systematically.

In the highlands of Balochistan a scarcity of water is one of the main abiotic factors limiting crop production. Therefore, species which have low water requirements and fit into the existing farming system could increase the farmer's income and provide a better chance of food security. For this reason two trials were conducted in which the potential productivity of *Lathyrus sativus* was evaluated in highland Balochistan during the 1991/92 season. Selections will be made for next year's trials after BOAA analysis has been conducted at NARC.

Lathyrus Yield Trial: The trial consisted of 30 entries which were sown in the spring of 1992 at Kalat. Plant height was similar between genotypes but they differed significantly (P<0.01) in TDM and seed yield (Table 49). Genotypes K-546, K-579, K-425 and K-536 produced above 1000 kg/ha TDM whereas genotype K-505 produced only 220 kg seed/ha followed by genotype K-460 which produced 188 kg seed/ha (Table 49). Shattering was observed in all genotypes.

Table 49. Performance of Lathyrus sativus yield trial with spring sowing at Kalat in 1992

Acc. No.	Plant ht (cm)	TDM (kg/ha)	Seed yield (kg/ha)
1. K-305	31	348.5	48.3
2. K-547	32	831.8	129.2
3. K-47	32	948.5	99.8
4. K-546	38	1199.0	80.0
5. K-505	27	781.8	220.0
6. K-399	32	648.5	152.0
7. K-437	30	648.5	67.0
8. K-467	31	998.5	126.0
9. K-44	36	631.8	54.0
10. K-579	36	1049.0	170.0
11. K-424	33	981.8	93.0
12. K-104	34	981.8	163.0
13. K-545	32	781.8	101.3
14. K-206	33	831.8	143.0
15. K-241	25	398.5	47.2
16. K-242	30	515.2	64.0
17. K-243	31	515.2	72.0
18. K-244	29	518.8	78.4
19. K-27	32	431.8	51.0
20. K-280	32	465.2	138.2
21. K-288	27	515.2	56.0
22. K-289	29	598.5	47.0
23. K-311	29	515.2	70.2
24. K-319	32	831.8	97.0
25. K-425	35	1015.0	133.0
26. K-322	30	548.5	67.0
27. K-323	32	398.5	49.4
28. K-536	35	1049.0	155.3
29. K-460	27	631.8	188.0
30. K-333	30	381.8	59.4
LSD(5%)	ns	386.0	84.0
LSD(1%)	ns	513.3	112.0

ns = non-significant different (P>0.05).

Lathyrus Observation Nursery: This observation nursery consisted of 265 entries of which genotype K-535 had the highest TDM yield (2200 kg/ha) and genotype K-504 the best seed yield (356 kg/ha). Shattering was also recorded in the observation nursery. Selection for the next season will be made after obtaining the BOAA results from NARC, Islamabad.

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