# Iran/ICARDA Collaborative Project

## Summary of Achievements and Research and Training Program

## 1998/99

Sixth Planning and Coordination Meeting

5-10 September 1998
Maragheh, Islamic Republic of Iran

Agricultural Research, Education and Extension Organization (AREEO)
Ministry of Agriculture
Islamic Republic of Iran

International Center for Agricultural Research in the Dry Areas (ICARDA)
Aleppo, Syria

# About ICARDA and the CGIAR

Established in 1977, the International Center for Agricultural Research in the Dry Areas (ICARDA) is governed by an independent Board of Trustees. Based at Aleppo, Syria, it is one of 16 centers supported by the Consultative Group on International Agricultural Research (CGIAR).

ICARDA serves the entire developing world for the improvement of lentil, barley and faba bean; all dry-area developing countries for the improvement of on-farm water-use efficiency, rangeland and small-ruminant production; and the West and Central Asia and North Africa region for the improvement of bread and durum wheats, chickpea, and farming systems. ICARDA's research provides global benefits of poverty alleviation through productivity improvements integrated with sustainable natural-resource management practices. ICARDA meets this challenge through research, training, and dissemination of information in partnership with the national agricultural research and development systems.

The results of research are transferred through ICARDA's cooperation with national and regional research institutions, with universities and ministries of agriculture, and through the technical assistance and training that the Center provides. A range of training programs is offered extending from residential courses for groups to advanced research opportunities for individuals. These efforts are supported by seminars, publications, and specialized information services.

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The mission of the CGIAR is to promote sustainable agriculture to alleviate poverty and hunger and achieve food security in developing countries. The CGIAR conducts strategic and applied research, with its products being international public goods, and focuses its research agenda on problem-solving through interdisciplinary programs implemented by one or more of its international centers, in collaboration with a full range of partners. Such programs concentrate on increasing productivity, protecting the environment, saving biodiversity, improving policies, and contributing to strengthening agricultural research in developing countries.

The World Bank, the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), and the United Nations Environment Programme (UNEP) are cosponsors of the CGIAR. The World Bank provides the CGIAR System with a Secretariat in Washington, DC. A Technical Advisory Committee, with its Secretariat at FAO in Rome, assists the System in the development of its research program.

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## FOREWORD

The Islamic Republic of Iran is blessed with enormous natural resources, fertile land and diverse climate. Approximately 18.5 million ha of land is used for agriculture, of which 7.4 million ha are irrigated and 6.6 million ha are under rainfed annual crops and the rest under fallow. Winter cereals (wheat and barley) occupy more than 8 million hectares out of 14 millions ha of cultivated area. Inspite of this huge area under food and feed crops the country is not yet self sufficient to meet its national needs. Due to climatic limitations the scope to increase production horizontally is not only difficult but can be extremely environmentally hazardous. However, there is tremendous potential to increase production vertically by increasing production per unit of area, both in irrigated and especially in rainfed areas through the development of better production technology.

The Ministry of Agriculture through its Agricultural Research, Education and Extension Organization (AREEO) developed close collaboration with International Agricultural Centers (ICARDA, CIMMYT, ICRISAT, etc.) to strengthen its agricultural research capabilities and capacities. Special emphasis has been laid on improving agricultural production from the rainfed areas in close collaboration with ICARDA.

Under the collaborative arrangement an annual joint meeting of Iranian and ICARDA scientists is held to review the research and training activities of the past year and develop plans for the following crop season. This document, therefore, has been prepared at the end of an exhaustive "6$^{th}$ Annual IRAN/ICARDA Research and Coordination Meeting". Very useful information on the major crop species (wheat, barley, food and feed legumes, and oilseed crops) and natural resources management is presented in this document. A number of improved, stress tolerant, with better yield and quality, varieties of different crop species for different ecological zones were identified during 1997/98 crop season. Equally good information on the development of production technology to realize higher and sustainable production with out damaging the natural resource base is enumerated in this write up.

The success or failure of such an endeavor heavily depends on the availability of well educated and highly skilled technical manpower. Therefore, continous efforts are being made to improve the knowledge and technical skills of the local researchers.

This document contains not only the achievements, research and training activities of the previous year but a very elaborate and well targeted research and training plan to increase agricultural production through appropriate technology development. Therefore this will be a very useful document for the scientists engaged in agricultural research in various agro-ecological zones of Iran.

A. Keshavarz
Deputy Minister of Agriculture and
Head of AREEO, The Ministry of Agriculture

# I. WHEAT AND BARLEY IMPROVEMENT

Winter cereals (wheat and barley) are cultivated on more than 8 million ha under very diverse agroclimatic conditions and play a pivotal role in the Iranian agriculture. In fact, the predominant farming system is cereal-pasturalism-livestock. Both crop species are grown under irrigated (1/3 of the total cereal area) and rainfed conditions. Wheat and barley cultivars with various growth habit (winter, spring or facultative types) are grown in various parts of the country. In spite of extensive and large-scale cultivation of wheat and barley the country is not yet self sufficient in its food requirements due to low yields per unit of area. The low yields in irrigated as well as rainfed areas are attributed to several biotic and abiotic stresses. A comprehensive research plan, especially to address the problems of cereals in dryland has been developed covering all the ecological regions and presented in detail here for each species (bread wheat, durum wheat and barley).

## A. Statement of Objectives:

1. To develop new varieties/ cultivars of wheat and barley with better yield and quality for different dryland regions of Iran.
2. To investigate the biotic (diseases and insects) and abiotic (environmental) stresses depressing the productivity of wheat and barley; and incorporate genes for resistance into the germplasm.
3. To develop an improved package of production practices for adoption by the farmers.
4. To strengthen the research capability and capacity of researchers in the dryland areas.

The research and training activities carried out during 1996/97 and research plan presented in the following pages have been prepared to achieve the stated objectives.

## B. Brief Review of Research Work and Achievements during 1997/98

The cereal committee reviewed the research work carried out by each Agricultural Research Center of DARI in the dryland areas of Iran. The salient features of the cereal research carried out and a very brief summary of the results are presented in the following pages.

**Maragheh:**

Growing conditions were slightly better than the previous two seasons. Total seasonal rainfall (347 mm) was close to the long-term average. Moisture deficit in October affected stand establishment in most of the fields. However, the greater stress was a combination of drought and heat during May and June. The season was therefore characterized a cold winter (125 days with temperature $<0^{0}$C) and hot spring. Yields were therefore in the range of 1-2.5 t/ha for bread wheat, 1-2 t/ha for durum, and 1.5-2.5 t/ha for barley.

Yellow rust started to develop on bread wheat but was checked by the heat wave in early May and did not affect yield. Few entries only could compete with Sardari. On-farm trials were conducted at 3 sites with yields below 1 t/ha in 2 sites. The lines Ogasta/Sefid, Kvz/Tm 71/... and Sabalan/1-27-56-4 had copmarable yields to Sardari, in on-farm and in URWYT trials. In advanced testing, the following lines had comparable yield to the check Sardari with good

resistance to yellow rust:

| | |
|---|---|
| 90 ZHONG657 | (2.4 t/ha vs 2.6 t/ha) |
| Sbn/1-64-99 | (2.5 t/ha vs 2.6 t/ha) |
| 87ZHONG 291 | (2.2 t/ha, same as Sardari) |
| TJB368.25/BUC//CUPE | (1.9 t/ha, vs 2.2 t/ha) |

In preliminary tests, the following entries compared well with the check Sardari (2.11 t/ha)
- OK82282//BOW/NKT (2.06t/ha, RtoYR, TKW=35)
- RSK/NAC//SBN (2.02 t/ha, R to YR, TKW=29).

Durum wheat did not perform well at Maragheh and most plants were short and suffered from cold. Among the promising materials in different trials were the following two entries:
Valnova/598/Yuma//Fato's' (2.2 t/ha, 125% of Gerdish)
Massara-1 (2.2 t/ha, 121% Gerdish)

Barley yielded higher than wheat, although yields were also low generally less than 2.5 t/ha). In on-farm testing, Yesevi performed similar to Sahand although both yielded low (around 1 t/ha).
In the uniform regional yield trial URBYT, the following two entries yielded better than the check Sahand:
- Yea 932/Yea 557.6 (ent. 20, 2.7 t/ha, 112% check)
- ICB 111838 (ent. 14, 2.7t/ha, 112% check)

In advanced yield testing, 4 entries, yielded higher than Sahand. They were:
- Cum –50/1146 (ent. 10 in BYT B4; 3.3 t/ha; 110%)
- 4847/Yea 605.5/ (ent. 22 in BYTB3, 3.2 t/ha, 114%)
- Yea 1819/Yea 195.4//Grivita (ent. 2 in BYTA3, 2.92 t/ha, 119%)
- Obruk 86

**Table 1: Total (T) and Selected (S) number of entries from different winter cereal nurseries at various stations in Iran, 1997-98.**

| Nursery | Station | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Maragheh | | Sararood | | Qamloo | | Shirvan | | Uromieh | | Zanjan | |
| | T | S | T | S | T | S | T | S | T | S | T | S |
| **Bread Wheat** | | | | | | | | | | | | |
| $F_1$ | 89 | 89 | | | | | | | | | | |
| Seg Pop. | 847 | 257 | 67 | 27 | 78 | 65 | | | | | 53 | 30 |
| PWYT | 169 | 20 | 92 | 23 | 81 | 17 | 81 | 25 | | | | |
| A | 168 | 37 | 84 | 13 | 84 | 13 | 24 | 6 | | | 48 | 10 |
| B | 48 | 11 | 48 | 26 | 48 | 4 | 48 | 8 | | | 24 | 6 |
| URWYT | 2 | 4 | 12 | 3 | 12 | 4 | 12 | - | 12 | 5 | 12 | 4 |
| Land races | 2050 | 400 | | | | | | | | | | |
| On-farm | 6 | - | | | | | | | | | | |
| AYT(RF)-TCI | 125 | 40 | | | 125 | 14 | | | | | | |
| DRN | - | 12 | | | | | | | | | | |
| **Durum** | | | | | | | | | | | | |
| Seg.Pops | 107 | 41 | 164 | 61 | 50 | 25 | 87 | 87 | | | 87 | 34 |
| PDYT | 81 | 22 | 49 | 46 | 64 | 5 | 36 | 20 | | | | |
| A | 42 | 15 | 46 | 35 | 20 | - | | | | | | |
| B | | | 13 | 8 | | | | | | | | |
| DWYT-HAA | 24 | 8 | 24 | 21 | 24 | 6 | 24 | 6 | 24 | 15 | | |
| DWYT-CA | 24 | 9 | 24 | 11 | 24 | 4 | 24 | 5 | | | | |
| DON-HAA | 72 | 24 | 72 | 37 | 72 | 10 | 72 | 28 | 72 | 16 | 72 | 11 |
| DOW-CA | 96 | 17 | 96 | 52 | 96 | 10 | 96 | 37 | 96 | 29 | 96 | 11 |
| On-farm | | | 6 | 5 | | | | | | | | |
| **Barley** | | | | | | | | | | | | |
| $F_1$ | 70 | 70 | 49 | 43 | | | | | | | | |
| Seg Pops | 2135 | 660 | 420 | 216 | 451 | 117 | 780 | 326 | | | 273 | 121 |
| PBYT | 1000 | 139 | 107 | 48 | 100 | 7 | 720 | 79 | | | 49 | 11 |
| A | 96 | 24 | 40 | 11 | 15 | 1 | 72 | 18 | | | 24 | 6 |
| B | 72 | 21 | 24 | 14 | 24 | - | 24 | 8 | | | 24 | 3 |
| URBYT | 24 | 24 | 24 | 10 | 24 | 3 | 24 | 24 | 24 | 9 | 24 | 4 |
| On-farm | | | 6 | 3 | | | | | | | | |
| IWBON | 150 | 48 | 150 | 95 | 150 | 6 | 150 | 30 | 150 | 31 | 150 | 33 |
| IFBON | 150 | 43 | 150 | 96 | 150 | 16 | 150 | 36 | 150 | 22 | 150 | 24 |
| IWFFBON | 46 | 10 | | | | | | | | | | |
| IWFHBON | 45 | 16 | 45 | 28 | | | 45 | - | | | | |
| IWFBCB | 157 | 34 | 157 | 81 | 157 | 10 | 157 | 24 | | | 157 | 34 |
| IWBYT | 24 | 4 | | | 24 | 2 | 24 | 6 | | | 24 | 6 |
| IFBYT | 24 | 2 | 24 | 14 | 24 | 5 | 24 | 6 | | | 24 | 5 |

**Sararood:**

This season's rainfall (616 mm) was much above average, although moisture was deficient early in October. The winter was not severe but transition from cold to warm was abrupt, and high temperature prevailed in April (up to 28°C), May (33°C), and June (38°C).

In bread wheat, 67 segregating populations, and 236 fixed lines were evaluated. Yields were generally in the range 3.5-5 t/ha. Due to the relatively mild winter, facultative (and even spring types) yielded well. In the URWYT 98 the line Sbn//Trm/K253 (ent.10) significantly outyielded Sardari (3.89 versus 3.13 t/ha).

It also had a similar maturity but higher protein content, and is resistant to yellow rust. Entry 8 also performed well (3.37 t/ha). In advanced yield testing, the folowing entries outyielded Sardari and were resistant to yellow rust:

- KS73146/TX71A103...(ent. 11 in BWYT-$B_2$, 4.86 t/ha 130%, Sardari)
- KS 82214/GALVEZ (ent. 12 in BWYT-$B_1$, 5.06 t/ha 130% Sardari)
- SBN/1-64-99 (ent. 14 in BWYT-$B_1$, 4.74 t/ha, 122% Sardari)
- GENARO/SARDARI (ent. 16 in BWYT-$B_1$, 4.78 t/ha 123% Sardari)
- SHI#4414/CROW's' (ent. 23 in BWYT-$A_2$, 5.21 t/ha, 125% Sardari)
- TRK13/4/TJB 916-4... (ent. 10 in BWYT-$A_2$, 5.0 t/ha, 120% Sardari)

In more recent trials (PWYT) the following entries showed an excellent performance:

- GRK//ESDA/LIRA (ent. 88),
- MANNING/SDVI//DOGU (ent. 45).
  OK82282//BOW/NKT (ents. 46 and 50)

In durum wheat, 165 segregating populations and 324 fixed lines were evaluated in observation nurseries (168 lines) or yield trials (156 lines). Yields were slightly lower than those of bread wheat.

In on-farm trials, the entries HEIDER//MT/HO... and CHAM 1 yielded higher than Zardak (3.25 t/ha and 3.03 t/ha versus 2.53 t/ha).

In advanced testing, the following three lines outyielded significantly the local check Zardak with a better resistance to yellow rust:

- MRB5/GENIL-2 (ent. 2 in DWYT-$A_2$, 5.22 t/ha, 139%)
- MRBL1//SNIPE/MAGH/3/RUFOM (ent. 6 in DWYT-$A_1$, 5.52 t/ha, 133%)
- CHAHBA 88/DERAA (ent. 17 in DWYT-$A_1$; 5.77 t/ha, 138%)

Most newly tested entries in PDWYT yielded higher than Zardak. The best two entries were:

- LLOYD/KIA//CH1: (ent. 25, 8.35 t/ha, 189% Zardak)
- MENCEKI/RUFOM-5/CH1 (ent. 2, 8 t/ha, 181%)

Durum wheat performed best in this region and this is where cold tolerant durum should be grown. In colder areas such as Kordestan, and Maragheh, durum performance was mediocre, and therefore durum should not be considered for these areas until suitable, more cold tolerant germplasm is developed.

In barley, segregating populations (469) and fixed lines (225 in yield trials, and 502 in observation plots) were evaluated. The yield level is higher than that of wheat, most yielded in the range of 5-6 t/ha. In on-farm testing the entries Yesevi 93 and Boyer//J-126...

performed similar to or better than the check Sahand, with yield of around 3 t/ha in those on-farm plots. Another entry CHICM/AN57//ALBERT also performed well. This last entry yielded consistently well over 8-year testing in the Kermanshah area and is resistant to most barley diseases in that region, with an overall yield avarge of 3 t/ha. It has an acceptable tolerance to cold and a good kernel size.

Advanced materials that showed promise in 4-year testing at Sararood include:
- ROHO/MAZURKA//ICB-10 2874
- XEMUS
- YEA 762.2/YEA 605

All three lines have an average yield of aout 4 t/ha and a TKW of 38, and are resistant or tolerant to prevailing diseases) scald, net blotch, powdery mildew).

Among other yield-tested materials, the following were promising:
- CWB117-77-9-7/1C... (6.23 t/ha, 129% Sahand)
- K-615-1/K-616-... (similar yield as the previous line)
- WIESEI BURGER/AHO (ent. 104 in PBYT, 8.33 t/ha, 200% Sahand)
- ARR/ESP/ALGER/CERES (ent. 88 in PBYT, also 8.33 t/ha)

## QAMLOO

Although this season's rainfll (430 mm) was much higher than last years's, the crops suffered from prolonged cold that started early in the season (116 days with temperatures $<0^{0}$C). Terminal drought-heat combination limited growth and yield, as the absence of rain in June was coupled with a high temperature ($>30^{0}$C) in this month.

In bread wheat, both segregating (78 populations) and fixed materials (350 yield trial entries) were evaluated. Yields were generally around 1.5-2.0 t/ha, and none of the tested entries was better than Sardari. However, certain entries had equivalent yield. This includes:

- SBN/1-64-99 (ent. 14 in BWYT-B1; 1.73 t/ha, 92% Sardari).
- SBN/Tui's'KORDESTAN (ent. 72 in PBWYT, 2.28 t/ha, 86%).
- BOW's'/CROW's'/3/RSH/KAL/BB (ent. 13 in BWYT-A1, 2.06 t/ha, 85% Sardari).

It is to be noted that international materials were planted one month later than other materials and therefore had poor performance. It is suggested in the future that international materials either should reach the station early enough for normal planting or they should be reevaluated in totality without any selection if late planted.

Durum wheat generally performed poorly, partly due to cold damage and partly to late planting. In one accetable yield trial (DWYTA), yield was arround 1-1.5 t/ha, with Kunduru and CHAM 1 having highest yield (1.59 t/ha, 116% Peresht). The total number of durum entries tested in the station is 350 including 50 segregating populations.

Barley performed better with yields generally in the range of 1.5-2 t/ha. A total of 1209

entries were evaluated in segregating populations (451), observation nurseries (457) and *yield* trials. Among the promising advanced entries are the following:

- BOYER//J-126/GEM 14, F/... (2.15 t/ha) and YESEVI 93 (2.00 t/ha). Both yielded higher than Sahand, in an on-farm trial near the station. However, most of the entries in other trials were outyielded by Sahand.

**Hayderloo (Oroumich)**

The season is characterized by a lower rainfall (223 mm), with moisture deficit in October through December, and in May, coupled with high temperatures during April and May (>27°C) and June (>35°C). This resulted in low wheat yields. Only a limited number of entries/nurseries were evaluated this season,:1 nursery (12 ent.) of bread wheat, 3 durum nurseries and 3 barley nurseries. The URWYT entries had similar yields (around 1.4 t/ha). While those of DWYT-HAA were lower (around 1t/ha). Barley yielded higher, and among URBYT, the following entries outyielded the check Sahand:

132 Th/Tokak (ent. 9, 120%), ICB 1118777 (ent. 10, 120%) and ICB 111838 (ent. 14, 121%).

**Qaidar (Zanjan)**

Rainfall was above average (397 mm). However soil moisture was deficient early in the season and in June. Although the winter was relatively mild (98 days with below freezing temperature), the terminal drought-heat complex affected yields in all three crops.
In bread wheat, 53 segregating populations and 84 fixed lines were evaluated (Table 1).

Among good-performing bread wheat entries are the lines: Sbn/1-27-56-4 (ent.1 in URWYT, 1.38 t/ha, 127% Sardari), Sbn//Trm/K253 (ent 10 in URWYT, 1.25 t/ha, 115% Sardari), Ymh//A12/32438/3/Sardari (ent. 17 in B1 test, 1.68 t/ha, 106% Sardari) Pvn's'/Chi//Sabalan (ent. 6 in BWYT-A1, 1.61 t/ha, 130% Saradari), and Omid//1-27-5489/Condor's' (ent. 22 in BWYT-A1, 159 t/ha, 129%).

In durum, a number of entries were selected from segregating, populations (34 entries) and observation nurseries (22 entries). Durum wheat does not seem adapted to this region. A related large number of barley entries have been evaluated at this site (Table 1). Yields are around 1 t/ha. Among promising entries that significantly out yield the check Sahand are the following lines:

- YEA 762.2/YEA 605.5 (ent. 3 in URBYT, 1.74 t/ha, 122%, Sahand also better than the local check).
- TH1BAULT/3/LIGNEE 131//4341 N/... (ent 1 in BYT-B1, 1.54 t/ha, 119% Sahand)
- TOK//LIGNEE 1246/GZK/3/... (ent. 44 in PBYT, 1.25 t/ha 141% Sahand).
- ROHO//ALGER/CERES, 362-1-/3/SA... (ent. 33 in PBYT, 1.39 t/ha, 156% Sahand)
- ROHO//ALGER/CERES, 362-1... (ent. 5 in PBYT, 1.31 t/ha, 147% Sahand)
- ALPHA/DURRA//CWB 117-77-9-7 (ent. 9 in IWBYT, 1.98 t/ha, 120% Sahand).

**Shirvan**

Rainfall was low in the month of December and June, but otherwise was relatively mild (86 days with temperature <0°C), and spring was hot. Grain yields were therefore moderate. In bread wheat, 39 entries were selected from yield trials. A number of entries outyielded significantly the well performing check, Sardari.

These included: - KVZ/TM71/MAYA's'//BB/INIA/4/SEFID (ent. 8 in URWYT, 2.28 t/ha, 110% Sardari).
- AGRI/093.44//MOMTCHILL (ent. 9 in BWYT-B1, 2.51 t/ha, 115%)
- OK82282//BOW/NKT (ent. 41 in PBWYT, 2.24 t/ha, 122%)
- F12.71/COC (ent. 78 in PBWYT, 2.06 t/ha, 113%)

In durum wheat, 87 entries were selected from segregating populations and 96 entries from yield tests or observation nurseries. Yields were around 1-1.5 t/ha, and most of entries in international nurseries showed poor performance, due to late planting. Entry 10 in PDWYT (AWL 1/SBL4) had the highst yield (2.0 t/ha) in the trial.

In barley, yield were higher. Among the most promissing selections are the following entries from IWPBYT: TARM92 (3.1 t/ha), YESEV193 (3.4 t/ha), METEOR/STAR (3.5 t/ha), and ICB-100945/DONOR (3.4 t/ha), and from WFPBYT: YEA 168.4/YEA 605.5//MARAGHEH (3.4 t/ha) and STEPTOE/LIGNEE 640//ALPHA/DURR (3.6 t/ha).

A large number of selections (557) were made for future testing.

## WARM AREAS

**Gachsaran**

The very high rainfall recorded this season (855 mm) was concentrated in the period November-March. No rainfall fell after March. High temperature (>31°C in March, and >41°C in May) marked the end of the season. The newlyreleased cultivars of wheat and barley performed well in all trials. The materials tested this season included: bread wheat (observ: 238 entries, yield trials: 272 entries), durum wheat (observ.: 96, yield trials: 160) and barley (Seg. Pops. 215, obser.: 299, yield trials: 163)

In bread wheat, yields were relatively high despite the terminal drought and heat. Disease development was miner, likely due to high temperatures in March and thereafter. Among the entries resistant to yellow rust and leaf rust and outyielding the check Zagros are the following selections:
- OPATA/KILL (ent. 6 in BWYT-B2; 6.91 t/ha; 121% of Zagros).
- 5560 Karaj (ent. 15 in BWYT-A3; 5.06 t/ha, 140% of Zagros).
- SNB'S'/5/MAYA74 'S'/ON//II60.14 (ent.10 in BWYT-A1, 4.98 t/ha, 129% of Zagross).
- TR380-16-3A614//CHAT 'S'/5/SKH8 (ent. 17 in PWYT; 2.10 t/ha, 136% of Zagross).

**Table 2: Total (T) and selected (S) number of entries from different spring cereal nurseries of various stations in Iran, 1997-98.**

| Nursery | Station | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Gachsaran | | Kohdasht | | Moghan | | Gorgan | |
| | T | S | T | S | T | S | T | S |
| **Bread Wheat** | | | | | | | | |
| $F_1$ | 61 | 61 | | | | | | |
| Seg. Pop. | | | 164 | 861 | 149 | 59 | | |
| PWYT | 140 | 18 | 140 | 36 | | | | |
| A | 36 | 15 | 60 | 16 | 20 | 8 | 20 | 6 |
| B | 40 | 11 | 20 | 6 | 20 | 13 | 20 | 6 |
| URWYT | 16 | 6 | 16 | 5 | 16 | 13 | 16 | 6 |
| RWYT-FA | | | 24 | 11 | | | 24 | 7 |
| RWYT-SA | | | 24 | 15 | | | 24 | 10 |
| PWYT | | | | | 168 | 31 | | |
| WCB | | | 150 | 45 | | | 150 | 8 |
| WON-FA | | | 148 | 36 | | | 148 | 23 |
| WON-SA | 182 | 13 | 182 | 44 | | | | |
| HDTON | 56 | 9 | 56 | 20 | 56 | 27 | 56 | 4 |
| WON (Nat) | | | | | 29 | 18 | | |
| **Durum Wheat** | | | | | | | | |
| Seg. Pops. | | | 60 | 31 | 20 | 16 | | |
| PDYT | 100 | 19 | 111 | 27 | 60 | 12 | 107 | 10 |
| A | 40 | 15 | 20 | 6 | | | | |
| B | | | 20 | 7 | 20 | 11 | | |
| RDYT-TA | | | 24 | 7 | 24 | 11 | 24 | 7 |
| URDYT | 20 | 4 | 20 | 6 | 20 | 10 | | |
| DON-TA | 96 | 26 | 96 | 32 | 96 | 27 | 96 | 21 |
| DON (Nat) | | | | | 21 | 10 | | |
| DYRGP YR97 | | | | | 10 | 5 | | |
| **Barley** | | | | | | | | |
| BCB | 93 | 20 | | | 93 | 27 | 93 | 17 |
| Seg.Pops. | 215 | 62 | | | 213 | 111 | | |
| PBYT | 122 | 38 | 190 | 36 | 60 | 17 | | |
| A | 18 | 5 | 20 | 8 | | | 20 | 8 |
| B | | | | | 20 | 10 | | |
| URBYT | 18 | 6 | 20 | 8 | | | 18 | 6 |
| ISBYT-MRA | | | | | 24 | 14 | 24 | 10 |
| ISBYT-LRA-C | | | | | 24 | 9 | 24 | 5 |
| ISBYT-LRA-M | | | | | 24 | 9 | 24 | 5 |
| ISBON-LRA-C | | | | | 107 | 46 | 106 | 29 |
| ISBON-LRA-M | 101 | 60 | | | 101 | 25 | 101 | 19 |
| ISBON-MRA | 105 | 60 | | | 105 | 23 | 105 | 23 |
| BON-(Nat) | | | | | 27 | 8 | | |
| DPBYT | 5 | 1 | | | | | | |
| SBGPPM | | | | | 19 | 5 | | |
| SBGPSC | | | | | 18 | 4 | | |

A total of 72 selections were made in different nurseries. In durum wheat, Seimareh outyielded most of the entries, with an average yield of about 4.5 t/ha. The following two entries had high yields and were resistant to both yellow rust and leaf rust:

- MRB/CHEN (ent.2 in DWYT-A2, 4.70 t/ha, 120% of Seimareh).
- M20/OMRABI 5 (ent. 5 in DWYT-A2; 4.38 t/ha, 112% of Seimareh).

In barley, disease development was more important especially net blotch and tolesser extent, scald. Many of the tested entries outyielded the check Izeh but were susceptible to diseases. Among the promising selections that were tolerant or resistant to net blotch and scald are the following entries:

- DRAM/EMIR//ER/APM (ent. 8 in URBYT; 4.96 t/ha, 116% of Izeh).
- WI2198/EMIR/3/ARR/ESP/.. (ent.7 in BYT-A; 5.16 t/ha, 129% of Izeh).
- JLB 70-20/SEN 'S' (ent.110 in PBYT; 5.11 t/ha; 134% of Izeh).

In other trials, 4 entries plus a local check were tested at 4 sites for their ability to produce green matter plus grain (dual-purpose barley). At Gachsaran, a wet site, variety Izeh produced 11 t/ha of green forage plus 3.2 t/ha of grain. Other entries behaved similarly. At the drier sites, the green forage yield decreased and the grain yield loss due to cutting increased. It is therefore concluded that dual purpose barley may be more effectively grown in areas with reasonable rainfall.

**KOHDASHT**

Rainfall was adequate, despite moisture deficit in October and June. High temperature was recorded in May and June. This site, contrary to others in the warm areas is characterized by relatively cold winter (54 days of below freezing, minimum temperature, with an absolute minimum of –19.6°C in January). This explains the good performance of germplasm received from Aleppo, despite their tendency for lateness.

Materials tested at this station include bread wheat (Seg.pops: 164; Obs.: 536; and yield tests: 284 entries), durum wheat (Seg. Pops: 60; Obs.: 96, and yield tests: 195), and barley (yield trials only: 230 entries).

In bread wheat, most entries of RWYT-FA and RWYT-SA outyielded the local check. In contrast the local check outyielded most of the entries in other national trials. The promising selections included:

- SERI 82//SHI # 4414/CROW's' (ent. 15 in RWYT-FA, 5.06 t/ha, 157% Zagros.
- FONG CHAN-3/TRT's'//VEE9/3/CO... (ent. 9 in RWYT.FA, 4.67 t/ha, 145% Zagros)
- ANZA/3/PI/NAR//HYS/4/VEE's'/5/... (ent. 21 in RWYT-SA, 4.37 t/ha, 123% Zagros)
- BOCRO-4 (ent. 2 in RWYT-SA, 4.26 t/ha, 120% Zagros)
- FOW-1 (ent. 18 in BWYT-A, 4.24 t/ha, 111% Zagros)

All selections were resistant to yellow rust and leaf rust.

In durum, yields were slightly lower than in bread wheat. Among the selected entries, the following lines had high yield and good reaction to yellow and leaf rusts:

- SYRIAN 1 (ent. 9 in RDWYT-TA, 4.77 t/ha, 158% Shahivandi)
- SYRIAN 2 (ent. 10 in RDWYT-TA, 4.39 t/ha, 145% Shahivandi)
- MRB3/CHEN (ent 14 in DWYT-A, 3.95 t/ha, 113% Shahivandi)
- MRB11//SNIPE/MGH/3/RUFOM-7 (ent. 3 in DWYT-B, 3.94 t/ha, 122% Shahivandi)
- MRB11//SNIPE/MGH/3/RUFOM-7 (ent. 4 in DWYT-B, 4.07 t/ha, 126% Shahivandi)
- MRB3/4/BYE*2/TC/ZB/W/3/CiT *ent. 14 in URDYT, 3.66 t/ha, 112% Shahivandi)

In barley yield trials, yields were slightly higher (averaging about 5 t/ha) with a few lines better than Izeh. Among the selections are the following lines:

- BAL.16/API//DEIR ALLA 106/3/AS.. (ent. 11 in A test, 5.75 t/ha, 126% Izeh)
- ATEM/WI 2291//HML (ent. 15 in A test, 5.90 t/ha, 129% Izeh)
- ER/AOM//CERISE/3/LIGNEE 131/E... (ent. In A test, 5.72 t/ha, 125% Izeh)
- TRIUMPH/MOROC 9-75 (ent. 3 in PBYT, 6.48 t/ha)
- ROHO//ALGER/CERES (ent. 12 in URBYT, 5.32 t/ha, 118% Izeh) but lower than the local check)

All these entries were resistant to scald.

**Gonbad (Gorgan)**

Rainfall was high (412 mm between Oct-June) with a good start and well distributed in the season. Winter was warm and the spring hot (maximum temperatues of 34.5$^0$C, 40.$^0$C and 42.5$^0$C in April, May and June, respectively).

The tested material included all three crop species (Table 2).
In bread wheat, yields were around or a little over 5 t/ha. All tested entries had lower or equivalent yield as compered to the check Zagros which yielded up to 4 t/ha.

In trial BWYT-A, the entry KAUZ*2/BOW//KAUZ yielded 5.74 t/ha (106% Zagros in that trial). In durum wheat, most of the entries yielded lower than the check Stork, with some exceptions, such as:
- BCR/LKS4 (ent. 17 in DWYT-TA, 5.59 t/ha, 116% Stork)
- BRCH-1 (ent. 18 in DWYT-TA, 5.71 t/ha, 118% Strok)
- OMRAB1 5 (ent. 19 in URDYT, 5.57 t/ha, 113% Strok)

In barley, a large number of entries outyielded the check Turkman, including:

- MOROC 97-5/HML-02 (ent. 21 in ISBYT-LRA-MW, 8.08 t/ha, 184%)
- LIGNEE 527/NK 1272 (ent. 11 in ISBYT-MRA, 5.59 t/ha, 151%)
- ER/APM/6/P1 d10342//CR 115/PRO (ent. 19 in ISBYT-LRA-CW, 5.37 t/ha, 117% Turkman)
- WI2291/WI 2269/ER/APM (no. 11 in URBYT, 5.01 t/ha, 111% Turkman)

## MOGHAN

The 1997-98 was very dry with only 138mm of rainfall. Drought was coupled with high temperature in the spring (maximum of 37°C (and 32°C in April and May, respectively). As a result, yields of tested bread wheat, durum wheat, and barley germplasm, was around 1 t/ha, with few exceptions.

The following bread wheat lines were selected:
- KASYON/GENARO81 (ent. 7 in URWYT, 1.51 t/ha, 148% Zagros)
- PIK/OPATA (ent. 4 in URWYT, 1.48 t/ha, 145% Zagros)
- LIRA'S'/TAN'S' (ent. 9 in URWYT, 1.42 t/ha, 139% Zagros)

In durum trials, the following selections performed relatively well, as compared to the check Seimareh:
- ZAN4 (ent. 4 in DYT-TA, 2.14 t/ha, 125%)
- MRB3/CHEN (ent. 10 in DW-B, 1.58 t/ha, 166%)
- BICRE//BADRI/SAPI (ent. 11 in DW-B, 1.56, 164%)

In barley trials, the following lines were among the retained entries:

- HML-02/5/CQ/CM/APM/3/12410/4/... (ent. 20 in ISBYT-MRA, 2.16 t/ha, 186% check)
- ROHO//ALGER/CERES (ent. 5 in ISBYT-MRA, 2.03 t/ha, 176% check)

## REMARKS ON PERFORMANCE OF BEST WHEAT LINES IN COLD AREAS

Results of Uniform Regional Yield Trial led to the identification of promissing bread wheat lines for the cold-winter, rainfed areas of Iran. Three advanced lines are propossed for release in those areas. These are:

1. KVZ/TM71/3/MAYA's'/BB/INIA/4/SEFID:
   IW89-1-10838-0MA-0MA-0MA-6MA-0MA
   Higher grain yield than Sardari in Sararood (108%), Shirvan (110%), and Oroumeih (114%) and superior yield performance in the past three years. It is moderately tolerant to yellow rust, and to common and dwarf bunt, possesses large white/amber kernel, and high protein (12.6% versus 10.5% for Sardari) and good bread making gucality.
2. SBN//TRM/K253
   IW89-1-11302-0MA-0MA-0MA-6MA-0MA.
   Has higher grain yield than Sardari in Sararood (124%), Shirvan (110%), Zanjan (115%) and Uromieh (120% in 1997). It is moderatly, resistant to yellow rust and bunt and has good grain quality (white kernel, 11.6% protein, and good hardness index).

- SABALAN/1-27-56-4
  IW89-1-10870-OMA-OMA-4MA-OMA
  This line had higher yield than Sardari in Shirvan (105%), and Zanjan (127%) and is equivalent to it in most testing sites/years. It is resistant to yellow rust and moderately

tolerant to dwarf and common bunt. It has red kernels slightly smaller than Sardari but with a better protein content.

All three lines have been tested for 3 or more years in 4-5 sites in cold-winter, rainfed areas and have consistently performed well in those areas.

**Physiology Breeding:**

Several experiments were conducted in field and in controlled-environment conditions to provide breeders with information on mechnisms of tolerance to abiotic stresses including cold and drought.

- In one experiment 142 advanced bread wheat lines were planted in concrete beds to study their response to cold at Maragheh. In addition 125 advanced lines plus 106 Sardari selecions were eveluated to cold tolerance in field conditions at Maragheh. 50% of the materials survived the cold winter of 1997-98.
- In another study, 6 cultivars (2 each of winter, spring and facultative types) were evaluated for their tolerance when seedlings of different ages (20, 30, 40, 50, or 60 days) were subjected to $-10^0$C, under controlled conditions. Winter types were more resistant at 50-60 days, where as spring types were more tolerant to cold at 20-30 days.
- In another experiment, 500 lines of bread wheat and durum wheat were evaluated for their growth habit by late (end May) planting in fields at Maragheh.
- 34 bread wheat lines were grown in 3 reps in concrete beds for the study of their crown node depth and coleoptile length as a means of identifying traits associated with tolerance to cold and drought.
- Finally, seeds of 22 durum wheat lines were imbibed and kept at $-3^0$C for 2 months to identify tolerant entries and understand the mechanism of tolerance to long periods of snow cover in field conditions.

Results from all experiments will be analyzed and experiments reconducted in 1999 to confirm the results.

## Pathology-Achievement

217 lines and cultivars from DARI stations were evaluated for resistance against Yellow Rust, Leaf Rust, Stem rust, Common Bunt and dwarf Bunt in different stations.Due to the favorable conditions, high infections of different Rusts occurred in the nurseries at different stations either inoculated artificially or under natural infections. Infection of common and dwarf bunt was also high. The detail and complete results are in pages No. 633-709 of DARI Cereal Annual Report.

**1. Rusts:**

**A) Evaluation of resistance in the dryland bread wheat advanced lines to leaf rust caused by *Puccinia recondita* in greenhouse condition at Karaj and in field in different areas.**

Number of entries showing different responses to Leaf rust in different locations has been summarized in Table 3.

**Table 3. Numbers of entries with different responses to Leaf Rust.**

| Location | Responses | | | | Total |
|---|---|---|---|---|---|
| | R | MR | MS | S | |
| Gachsaran | 38 | 28 | 124 | 27 | 217 |
| Ilam | 71 | 62 | 32 | 52 | 217 |
| Moghan | 115 | 9 | 57 | 36 | 217 |
| Lorestan | 200 | ---- | 4 | 13 | 217 |
| Islam Abad | 97 | 91 | 19 | 9 | 217(-1) |

In Gachsaran no.s 25, 69, 71, 73, 96, 97, 98, 99, 100, 101, 102, 112, 127, 128, 129, 134, 136, 138, 150, 151, 154, 156, 157, 164, 167, 168, 171, 179, 201, 202, 205, 209, were resistant, other entries were moderately susceptible or susceptible.
In Lorestan only no.s 21, 41, 43, 44, 46, 60, 63, 81, 119, 120, 121, 153, 162, 187, 193, 194, 217 were susceptible, other entries were resistant.
In Ilam no.s 13, 16, 17, 21, 25, 26, 27, 29, 33, 36, 47, 49, 51, 60, 69, 70, 71, 73, 75, 76, 78, 79, 80, 81, 82, 83 98, 102, 112, 122, 124, 125, 126, 127, 128, 130, 135, 136, 141, 142, 146, 147, 148, 149, 150, 151, 152, 153, 156, 157, 159, 160, 161, 164, 166, 167, 168, 169, 173, 174, 175, 177, 183, 185, 186, 187, 188, 189, 190, 193, 196, 197, 198, 199, 200, 201, 202, 204, 205, 207, 209 were resistant, other entries were susceptible.
In Moghan no.s 12, 13, 33, 49, 50, 52, 68, 71, 72, 73, 74, 76, 78, 79, 80, 81, 83, 86, 94, 96, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 128, 129, 131, 132, 133, 134, 135, 136, 137, 138, 139, 142 to 169, 173, 174 to 190, 192 to 216, 217 were resistant or moderately resistant, other entries were susceptible .
In Islamabad no.s 11, 44, 45, 60, 62, 64, 65, 72, 97 were susceptible, lines no.s 12, 20, 21, 31, 32, 39, 41, 42, 43, 66, 67, 70, 85, 89, 90, 91, 187, 206, 207 were moderately susceptible , other entries were resistant or moderately resistant.

B) Evaluation of resistance in some bread wheat advanced lines to wheat stem rust caused by *Puccinia graminis* at seedling and adult plant stages in greenhouse condition and drylands areas.

Number of entries showing different responses to Stem rust in different locations has been summarized in Table 4.

**Table 4. Numbers of entries with different responses to Stem Rust.**

| Location | Responses | | | | Total |
|---|---|---|---|---|---|
| | R | MR | MS | S | |
| Gachsaran | 203 | 1 | 9 | 4 | 217 |
| Lorestan | 189 | --- | 4 | 24 | 217 |
| Uromieh | 69 | --- | --- | 31 | 100 |
| Islam Abad | 214 | 1 | 0 | 2 | 217 |

In Uromieh only 100 lines were tested, no.s 3, 6 to 10, 13, 14, 16 to 26, 27, 28, 31, 32, 33, 35, 36, 40, 46 to 56, 59 to 63, 68 to 72, 74, 75, 76, 77, 79 to 87, 89 and 94 to 100 were resistant, other entries were susceptible.
In Gachsaran no.s 11, 12, 37, 38, 45, 46, 50, 52, 53, 135, 159, 160 and 217 were susceptible, other entries were resistant.
In Lorestan no.s 1, 2, 3, 4, 5, 10, 11, 15, 21, 43, 64, 65, 77, 89, 91, 119, 120, 121, 1543, 162, 168, 187, 193, 194, 195, 210, 217 were susceptible, other entries were resistant.
In Islam Abad no.s 62 (60S) and 207 (70S) were susceptible, no. 118 was moderately susceptible, other entries were resistant.

C) Evaluation of resistance in some bread wheat advanced lines to yellow rust caused by *Puccinia striiformis* at seedling and adult plant stages in the greenhouse and field condition of drylands areas.
Number of entries showing different responses to Yellow rust in different locations has been summarized in Table 5.

**Table 5. Numbers of entries with different responses to Yellow Rust.**

| Location | Responses | | | | Total |
|---|---|---|---|---|---|
| | R | MR | MS | S | |
| Maragheh | 35 | --- | 4 | 61 | 100 |
| Uromieh | 31 | --- | 2 | 67 | 100 |
| Ilam | 110 | 72 | 19 | 16 | 217 |
| Moghan | 147 | 21 | 40 | 9 | 217 |
| Lorestan | 186 | 6 | 19 | 16 | 217 |
| Gachsaran | 168 | 14 | 31 | 4 | 217 |
| Islam Abad | 97 | 91 | 19 | 9 | 217 |

In 1997-98 because of weather conditions at Maragheh the severity of yellow rust was high, no.s 3, 4, 29, 33, 34, 35, 39, 41, 44, 45, 46, 47, 49, 51, 56, 58, 59, 61, 64, 65, 66, 71, 72, 73, 77, 79, 80, 83, 88, 91, 92, 93 were resistant, other entries were susceptible.
The response of Azar was (20S), SARDARI (50S), SABALAN (0) and Bolani (100S)
In Uromieh no.s 2, 3, 4, 21, 23, 29, 33, 34, 35, 39, 41, 43, 44, 45, 46, 51, 57, 58, 59, 64, 65, 66, 67, 71, 72, 73, 79, 88, 90, 91, 92, 93 were resistant, other entries were susceptible.
In Ilam no.s 1, 14, 18, 20, 21, 30, 31, 32, 33, 35, 37, 40, 41, 54, 60, 63, 76, 80, 84, 85, 86, 89,203, 204 were susceptible, other entries were resistant.
In Moghan no.s 5, 6, 10, 11, 14, 15, 16, 17, 18, 19, 21, 30, 31, 33, 35, 37, 41, 43, 45, 54, 55, 57, 58, 64, 74, 76, 77, 84, 89, 95, 97, 100, 110, 114, 137, 140, 153, 154, 162, 169, 171, 191, 214, 216 were moderately susceptible or susceptible, other entries were resistant or moderately resistant.
In Lorestan no.s 5, 10, 14, 15, 19, 20, 21, 41, 42, 50, 52, 54, 56, 60, 61, 63, 68, 84, 85, 86, 110, 119, 120, 153, 159, 162, 165, 168, 186, 187, 193, 194, 198, 201, 202, 203, 213, 217 were susceptible or moderately susceptible, other entries were resistant or moderately resistant.
In Gachsaran no.s 1, 2, 5, 6, 11, 15, 18, 27, 28, 32, 35, 36, 37, 50, 52, 62, 72, 75, 84, 87, 88, 95, 100, 114, 158, 162, 165, 167, 168, 174, 177, 181, 190, 193, 216 were susceptible or moderately susceptible, other entries were resistant or moderately resistant.
In Islam Abad no.s 11, 13, 14, 15, 29, 31, 32, 36, 37, 60, 62, 84, 87, 97 and 100 were susceptible, no.s 21, 5, 10, 16, 20, 22, 27, 30, 33, 35, 40, 50, 53, 54, 55, 56, 61, 68, 69, 70, 76, 81, 85, 86, 94, 95, 99, 106, 107, 108, 109, 117, 132, 135, 137, 152, 153, 154, 157, 165, 168, 171, 172, 173, 186, 187, 207, 208, 209,210, 213, 214, 215, 216, 217 were moderately susceptible, other entries were moderately resistant or resistant.

**2. Bunts:**
A) Evaluation of resistance in some bread wheat advanced lines to common bunt caused by *Tilletia laevis* in different drylands areas.
**Table 6. Numbers of entries with different responses to Common Bunt.**

| Location | Responses | | | | Total |
|---|---|---|---|---|---|
| | R | MR | MS | S | |
| Maragheh | 15 | 10 | 9 | 56 | 100 |
| Kordestan | 10 | 10 | 4 | 76 | 100 |
| Gachsaran | 212 | 4 | --- | 1 | 217 |
| Sararood | 77 | 69 | 43 | 28 | 217 |
| Ilam | 97 | 21 | 41 | 58 | 217 |
| Karaj | 60 | 21 | 5 | 14 | 217 |

Infection less than or equal to 5% Resistance (R)
Infection more than 5% & less or equal 10% Moderate resistance (MR)
Infection more than 10% & less or equal 15% Moderate susceptible (MS)

Infection more than 15% Susceptible (S)
This experimental was performed with 217 (100 lines for cold regions and 217 lines for hot areas) dryland advanced materials in Maragheh, Kordestan, Gachsaran, Kermanshah (*Sararood*) and *Ilam*. Number of entries showing different responses to Common Bunt in different locations has been summarized in Table 6.

**B) Evaluation of resistance in some bread wheat advanced lines to dwarf bunt caused by *Tilletia controversa* in different drylands areas.**

One hundred dryland advanced materials were evaluated against Dwarf bunt in Maragheh, Sanandaj and Uromieh using artificial inoculation. Because of a good snow covering during the winter, climatic conditions were suitable for incidence of dwarf bunt , therefor, high infections of the disease occurred in the experimental stations and farmers fields. Number of entries showing different responses to Dwarf Bunt in different locations has been summarized in Table 7.

**Table 7. Numbers of entries with different responses to Dwarf Bunt.**

| Location | Responses | | | | Total |
|---|---|---|---|---|---|
| | R | MR | MS | S | |
| Maragheh | 18 | 24 | 20 | 38 | 100 |
| Sanandaj | 40 | 2 | 2 | 56 | 100 |
| Uromieh | 92 | 8 | --- | --- | 100 |

Infection less than or equal 5% = Resistance (R)
Infection more than 5% & less or equal 10% = Moderate resistance (MR)
Infection more than 10% & less or equal 15% = Moderate susceptible (MS)
Infection more than 15% = Susceptible (S)

**C) Virulence survey of bunts.**

To survey the virulences of *Tilletia laevis,* seeds of 32 monogenic wheat lines, each carrying an individual bunt resistance gene (Bt genes), were artificially inoculated with teliospores of *T. laevis* collected from Maragheh and Hashtrood regions. The inoculated seeds were grown in field on two rows each one meter long. After maturity, the percentage of infected spikes for each was counted and those with more than 10% infected spikes were considered as susceptible. The results indicated the presence of virulence for Bt2, 3, 4, 6, 7, 8, 9 and 13 in these regions. In a separate experiment dwarf bunt virulence factors were also evaluated in the region. Virulence for Bt2, 4, 7 and 8 was found in the population of dwarf bunt.

**D) Evaluation of Sardari morphotypes**

106 Sardari morphotypes were also evaluated against dwarf and common bunts at Maragheh. The result showed that lines no,s. 27, 32, 33, 50, 55, 66, 101 and 102 were resistance, lines no. 15, 29, 30, 82, 98 and 103 moderate resistant and others were susceptible to common bunt caused *by Tilletia laevis*.

For dwarf bunt the line no,s. 3, ,5, 6, 16, 17, 22, 24, 25, 30, 48, 68, 70, 71, 77 and 79 were moderately susceptible, and lines no,s. 18, 19, 23, 26, 29, 45, 57, 59 and 61 were susceptible. The other lines were resistant or moderately resistant.

**Barley Diseases:**

**Candidates for release, advanced, and promising barley lines evaluation against barley leaf stripe and scald.**

In this study 60 barley entries were evaluated against barley leaf stripe in Maragheh Ardabil, Uromieh and entries nos. 3, 7, 11, 13, 14, 17, 18, 19, 22, 23, 25, 26, 28, 29, 30, 33, 34, 37, 38, 39, 40, 43, 46, 48, 53, 58 were susceptible in Ardabil, lines No. 32, 46, 59 , 60 were susceptible in Maragheh.

In Uromieh entries nos. 1, 3, 5, 7, 9, 10, 12, 17, 19, 27, 29, 32, 33, 34, 35, 38, 40, 43, 44, 45, 46, 47, 49, 50, 51, 52, 53, 54 , 55 were susceptible.

**Line No. 34 (Tokak) was very susceptible to Barley leaf stripe.**

For scald, due to unfavorable conditions, no disease record was reported on experimental entries in different stations.

# I. WHEAT AND BARLEY IMPROVEMENT- RESEARCH PLAN FOR 1998/99

**A. Statement of Objectives:**

1. To develop new varieties/cultivars of wheat and barley with better yield and quality for different dryland regions of Iran.
2. To investigate the biotic (diseases and insects) and abiotic (environmental) stresses depressing the productivity of wheat and barley; and incorporate genetic resistance in to the new cultivars.
3. To develop an improved package of production practices for adoption by the farmers.
4. To strengthen the research capability and capacity of researchers in the dryland areas.

The research and training plan presented in the following pages has been prepared to achieve the above stated objectives.

## A. Bread Wheat (*Triticum aestivum* L.)

## INTRODUCTION

In terms of acreage and production bread wheat far exceeds all the cultivated crops in Iran. Two species of wheat, i.e. *Triticum aestivum* L., *and T. turgidum* var. *Durum*, are mainly cultivated. Bread wheat occupies almost 94% of the total 6.6 million wheat hectarage. Due to enormous agro-climatic variation there is a host of factors (biotic and abiotic) which adversely effect the production in each region. Therefore, the research themes/topics, have been priortized to a great extent on the basis of the economic importance of each stress.

**The most serious stresses are:**

1. **BIOTIC:**

i. **Diseases**: Yellow rust (*Puccinia striiformis*), leaf rust or brown rust (*Puccinia recondita*), common and dwarf bunt (*Tilletia carries, T. foetida*, and *T. controversa*), powdery Mildew (*Erysiphe graminis* f. sp. *tritici*) Septoria diseases (*S. tritici, S. nodorum*), Scab (Fusarium spp.) and Barley Yellow Dwarf Virus (BYDV).

ii. **Insects**: Sunn pest (Stink bugs-various species), Aphids (*Rhopalosiphum paidi, R. maidis* and *Diuraphis noxia*)

iii. **Weeds**. Though there are a large number of weed species of broad leaves and grassy plants such as wild oats, carthimus, etc. but the most abnoxious species in Kermanshah, Kordestan, Ourumeh and East Azerbaijan province, are *Glycyirhiza glabra* L. (Shirinbian), and *Sophora alopecuorice* (Talakh-bian) of the family *leguminacea.*

2. **ABIOTIC:**

i. **Thermal:** Cold, frost at vegetative phase and high temperature at reproductive stage of the crop development cause considerable damage in wheat growing regions of Iran.

ii. **Drought:** It is the most serious problem. In the rainfed areas the moisture deficiency is due to inadequate precipitation as well as due to erratic distribution of the precipitation (rain & snowfall) and can occur at any crop development stage but the most serious is at terminal or post anthesis stage.

iii. **Soil nutrients:** Toxicities (salinity, boron) or deficiencies (zinc, etc.) of verious micro and macro nutrients.

3. **Other Factors:**

i. **Transfer of Technology:** On-farm testing and demonstration, linkages with Extension.

ii. **Inadequate Technical Capabilities/Capacity.**

The research and training plan described in the following pages is designed to find solutions to the above mentioned production retarding stresses and factors in a sustainable manner while conserving the natural resource base.

## 1. Breeding: Evaluation and Utilization of Parents.

**Title: Collection, evaluation, and characterization of local bread wheat germplasm from Iran and their utilization in crossing.**

**Objectives:**

1. Evaluation and identification of potential parents with desirable genes for yield, stability, resistance to diseases and environmental stresses.
2. Hybridization among the parents to combine desirable genes for the improvement of bread wheat.

**Locations:** Maragheh, Kermanshah, Gachsaran.
**Design:** Unreplicated with checks included
**Plot size:** 2 rows, 2.5m long.
**Observations:** Growth habit, days to heading/maturity, height, disease reaction, cold/frost damage, grain quality.

Crossing block will be grown at three research centers, i.e. Gachsaran, Kermanshah, and Maragheh. Two dates will be used. At Gachsaran, crosses will be made for the warm and mild areas. At Kermanshah, crosses will be made for the cold and moderately cold areas. At Maragheh, because of severe cold during winter, it is recommended to establish greenhouse facilities to allow crossing under controlled conditions. Until this is done, crossing will be maintained at its present level, i.e. around 50-150 crosses. Crosses will also be made at ICARDA for the incorporation into Iranian materials the genetic resistance to diseases, particularly yellow rust and bunt.

Grain quality will continue to be evaluated at SPII until facilities are established at Kermanshah.

**Breeding: Development of Improved Bread Wheat Germplasm for the Dryland Areas of Iran: Expansion of Genetic Base:**

**Title: Evaluation of International Bread Wheat Nurseries from ICARDA (CIMMYT/ICARDA):**

The nurseries listed in Table 8 will be evaluated in different ecological regions of Iran to identify stress tolerant and high yielding wheat varieties.

**Table 8: Bread wheat nurseries observation from ICARDA and their test locations in Iran.**

| No. | Name of Nursery | No. Entries | Location |
|---|---|---|---|
| **A. Spring type** | | | |
| i. | WYT-CA-Yield Trial-Continental Areas | 24 | Gachsaran, Kohdasht, Moghan, Gorgan, Ilam |
| ii. | WYT-TA-Yield Trial-Temperate Areas | 24 | Gachsaran, Kohdasht, Moghan, Gorgan, Ilam |
| iii. | WON-D-WANA Wheat Observation Nursery-Dryland Areas | 300 | Gachsaran, Kohdasht, Moghan, Gorgan, Ilam |
| iv. | WSP-Segregating Populations | 130 | Gachsaran, Kohdasht, Moghan, Gorgan, Ilam |
| v. | Key Location Disease Nursery (WKLDN) | 100 | Gachsaran, Kohdasht, Moghan, Gorgan, Ilam |
| vi. | **Germplasm Pools for Sources of Disease Resistance** | | |
| A | WYRGP Yellow Rust | 15 | Gachsaran, Kohdasht, Moghan, Ilam, Sararood, Ghamloo, Uromieh, Maragheh, Shirvan |
| B | WSRGP-Stem Rust | 10 | Gachsaran, Moghan, Kohdasht, Gonbad, Ilam, Sararood, Maragheh |
| C | WSTGP-*Septoria tritici* Blotch | 12 | Gachsaran, Moghan, Kohdasht, Gonbad, Ilam, Sararood, Maragheh |
| **B. Winter/facultative type:** | | | |
| A | FAWWON-8th Facultative and Winter Wheat Obs. Nursery | 165 | Maragheh, Ouromieh, Qamloo. |
| B | WWONSA-2nd Winter/Fac. Wheat Obs. Nur. for Semi-Arid Areas | 85 | Maragheh, Sararood, Qamloo. |
| C | WWONIR-2nd Winter/Fac. Wheat Obs. Nur. for Irrigated Areas | 85 | Three irrigated sites (SPII) |
| D | WEYT-RF-3rd Winter/Fac. Wheat Elite Yield Trial for Rainfed Areas | 25 | Maragheh, Sararood, Zanjan, Qamloo, Shirvan |
| E | Segregating Materials | 1086 | Maragheh |

**Title: Breeding of new improved bread wheat varieties for specific adaptability-Evaluation of segregating populations.**

**Objectives:** Selection among and within populations for desirable recombinants. Specific traits will be included to identify and select genotypes possessing the following traits:

a) Frost tolerance and earliness
b) Drought resistance
c) Yellow rust and common bunt resistance.

**Locations:** Maragheh, Kermanshah, Kohdasht, Qaidar, Qamloo and Gachsaran.
**Design:** Unreplicated with systematic checks.
**Plot size:** 6 rows, 5 m long.
**Treatments:** $F_2$-Fn. (Tables 9 and 10)

Mist irrigation will be applied, wherever feasible to enhance disease symptoms for effective selection against diseases in the most advanced populations.

**Title: On-site testing of bread wheat germplasm to develop improved varieties for different regions.**

**a) Preliminary Bread Wheat Yield Trials and Observation Nurseries of Winter and Spring Types.**

**Objectives:** Test the yielding ability, adaptation, disease resistance and stability of new genotypes in different environments.

**Locations:** Winter types: Maragheh, Qaidar, Shirvan, Sararood, Qamloo and spring types: will be tested at three sites: Gachsaran, Moghan, and Kouhdasht.
**Design:** Lattice, or RCB with 2 reps (if seed is available).
**Plot size:** 4 rows x 2.5 m
**Treatments:** Test lines + 3-4 checks. The number of test lines at the different stations will be as shown in Tables 3 and 4.
**Observations:** Frost/cold damage (cold areas)
Dessication (warm areas)
Days to heading/maturity
Plant height
Grain yield
Disease reaction
TKW and protein.

**Table 9. Number of entries in different winter cereal nurseries at various stations in Iran, 1998-1999.**

| Nursery | Station | | | | | | |
|---|---|---|---|---|---|---|---|
| | Maragheh | Sararood | Qamloo | Shirvan | Uromieh | Ardebil | Zanjan |
| **Bread wheat** | | | | | | | |
| $F_1$ | 81 | 21 | | | | | |
| Seg Pop. | F3=60+670, F4= 82+276, F5=60+ 140, F6=25 | F6=27 | F3=60, F4=82,F5=19, F6=10 | | | | F3=60 F4=82 |
| PWYT | 250 | 250 | 250 | | | | 250 |
| A | A1=24, A2=16 | A1=24, 2=16 | A1=24, A2=16 | 16 | | | A1=24 A2=16 |
| B | 24 | 24 | 24 | 24 | 24 | | 24 |
| URWYT | 14+2 | 16 | 16 | 16 | 16 | 16 | 16 |
| Land races | 3074 | | | | | | |
| On-farm | 6 | 5 | 14 | | | | |
| **Durum** | | | | | | | |
| F1 | | 20 | | | | | |
| Seg.Pops | F4=41 | F4=44 | | | | | |
| PDYT | 138 | 64 | 23(from Marag) | 65 | 45 | | 22 |
| A | 23+2 | A1=24, A2=24 | 15+2 | 20 | 15 | | |
| B | 15+2 | B=16+2 | | | | | |
| URDYT | 24 | 24 | 24(if seed avail) | | 24(if seed avail) | 24 | |
| On-farm | | | | | | | |
| **Barley** | | | | | | | |
| BCB | | 30 | | | | | |
| $F_1$ | | 10 | | | | | |
| Seg Pops | F2=70, F3=155, F4=250, F5=85, F6=133 | F2=43, F3=13, F4=112, F5=58, F6=28 | F3=13, F4=33, F5=66, F6=18 | F4=60, F6=170 | | | F3=16, F4=121 |
| PBYT | 175 | 135 | 40 | 155(F5) +90(Int) | | | 131 |
| A-Test | 140 | A1=20, A2=20 | 24 | A1,A2, A3,A4= 24 | | | 24 |
| B-Test | 60 | B1=20, B2=20 | B1=20, B2=20 | 20 | B1=20, B2=20 | | B1=20, B2=20 |
| URBYT | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| On-farm | 12 | 6 | | | | | |
| PHBYT | | 35 | | | | | |

**Table 10. Number of entries in different spring cereal nurseries of various stations in Iran, 1998-99.**

| Nursery | Station | | | |
|---|---|---|---|---|
| | Gachsaran | Kohdasht | Moghan | Gorgan |
| **Bread Wheat** | | | | |
| Seg. Pop. | F2=61, F4=25, F5=9, F6=2 | F3=67, F4=19 | F4=12, F5=27, F6=5 | |
| PWYT | 32 | 206 | 69 | 60 |
| A-Test | 20 | A1=20, A2=20, A3=24 | A1=20, A2=20 | |
| B-Test | 16 | 24 | | 20 |
| URWYT | 24 | 24 | 24 | |
| **Durum Wheat** | | | | |
| Seg. Pops. | | F3=31 | | |
| PDYT | 36 | 62 | 53 | 38 |
| A | 20 | A1=20, A2=18 | 24 | |
| B | 16 | | | |
| URDYT | 20(incl. 2checks) | 20 | 20 | |
| On-farm | | | | 6 |
| **Barley** | | | | |
| Seg.Pops. | F4=48, F5=11, F6=2 | | F4=88, F5=18 | |
| PBYT | 140 | | 72 | 144 |
| A-Test | 40 | A1=20, A2=24 | A1=24, A2=24 | |
| B-Test | | | | 10 |
| URBYT | 24 | 24 | 24 | |

**Title: b) Advanced Yield Trials in Winter and Spring Types of Wheat**

**Objectives:** 1. Yielding ability, and tolerance to cold and drought.
2. Disease resistance:yellow rust and bunt.
3. Adaptation to specific agroecologies. Data on DH, DM, plant height and yield will be recorded.

**Locations:** as indicated in Tables 9 and 10.

**Design:** RCBD with 4 Replications.

**Plot size:** 14-20 new improved lines + 2 checks in each trial, i.e., winter wheat and spring wheat.

**Title: c) Regional Uniform Bread Wheat Yield Trials in Both Winter and Spring Wheat Areas.**

**Objectives:** 1. Yielding ability, 2. Adaptability and stability.
3. Disease resistance under field conditions.
4. Tolerance to environmental stresses.

**Locations:** Winter and spring wheat growing areas of each of the three ecological regions (cold, mild cold, and warm). Sites for the cold and mid-cold regions will be in Maragheh, Kermanshah, Qaidar, Hayderloo, Qamloo, and Shirvan. Sites for the warm region will be in Gachsaran, Moghan, Kohdasht, and Gorgan.

**Design:** RCB with 4 replications.
**Plot size:** 6 rows x 5 m long.
***Treatments:*** 16 improved lines+2 checks for BW in the cold region, and 24 lines+2*checks* in the warm region.
**Observations:** Same as in "a".

**Title: d) On-Farm Evaluation and Demonstration of Improved Varieties and Breeding Lines of Bread Wheat.**

**Objective:** Demonstrate the performance at the farm level of the new varieties and verify performance of new advanced lines in comparison with checks.
**Locations:** 3 sites in each of the provinces: Sararood, Maragheh, and Gachsaran.
**Design:** Unreplicated plots
**Plot size:** 20m x 10m
**Treatments:** 3-5 advanced lines and 2 checks in each case.
**Observations:** Germination (time and status), heading, height, diseases, grain yield.
**Observations:** Same as in 'a' above.

**Title: Develop appropriate breeding strategy for continental dryland areas for bread wheat improvement.**

**Objectives:** 1. Determine breeding strategy on the basis of agroclimatic information, and performance of genetically diverse genotypes.
2. Compare different methods of selection.
**Locations:** Maragheh, Qaidar, Sararood, Qamloo.
**Design:** RCBD with 3 Rep.
**Treatments:** 12 winter types +12 Facultative types.
Two Planting dates; 25 Sept., and Normal.
**Observation:** Yield and yield components.

For objective 2, separate experiments will be conducted to compare pedigree and bulk pedigree methods+accelerated generation advancement. However, carrying-out of this experiment will depend on the availability of research facilities such as green house, growth chambers, etc. (Deferred until facilities become available).

**Title: Application of Doubled-haploid breeding technique to develop stress (disease-yellow rust; and drought) tolerant wheat germplasm.**

**Objectives:** Develop yellow rust resistant wheat varieties.
5 $F_1$ crosses carefully planned for the introgression and combining of desirable gene (s) for disease (YR) and drought tolerance will be given to Physiology Department (Biotechnologist) at SPII-Karaj for producing doubled haploids. DH lines of each cross will be tested under artificial epiphytotic conditions against YR to select resistant recombinants. When greenhouse facilities become available, these crosses will be advanced through accelerated generation advancement to compare the efficacy of the two methods. This experiment was planned to be executed during 1997/98 but deferred until 1998/99 due to lack of resources.

**Locations:** DARI-Maragheh and SPII-Karaj.
**Scientists Involved:** Wheat Breeders (Dryland and Irrigated Programs), Pathologist and Biotechnologist at SPII.

2. **Physiology/Breeding**

**Title: Breeding for improved performance in cold/warm dryland areas-Determine morpho-physiological traits.**

**Objectives:** 1. Assessment of morphological and physiological traits and study of their importance in adaptation and yield of bread wheat under moisture and cold stress.
2. Determine selection criteria.

**Locations:** Sararood, Maragheh and Gachsaran.
**Design:** RCBD, 2-3 reps.
**Treatments:** Varieties with diverse characteristics.
**Observations:** Emergence (crop establishment)
Ground cover and growth habit
Days to ear emergence and maturity
Plant height
Tillers/plant at stem elongation stage
Productive Tillers/plant at maturity
Flag leaf size
Leaf rolling
Glaucousness
Vigor at five leaf stage
Frost and cold damage (%)

Leaf senescence
Plant height
Grain weight
Thousand Kernel weight.

**Note:** Experiment has been initiated. However there is a need to develop more facilities at different research centers.

**Physiology/Breeding: Characterization and development of winter cereal (wheat) germplasm in Iran.**

**Title: Evaluation of wheat germplasm for its vernalization and photoperiodism response.**

**Objectives:** Determine the vernalization requirements and photoperiod sensitivity of Iranian wheat varieties. Classification of new material for different ecological regions.

**Locations:** SPII-Karaj and DARI-Maragheh.

**Design:** Augmented Design.

**Plot size:** One row, one meter long, or 1 pot.
**Treatments:** 200-300 lines of wheat.
Experiment will be planted under controlled and field conditions.
**Observations:** Growth habit
Plant height
Tillers/Plant
Heading and Maturity date
TKW and grain yield

**Title: Studies on agronomic characters of divergent wheat varieties planted early (end September) and late (end October)**

**Objectives:** 1. Determine the need of each region for specific type of variety.
2. Determine the relationship of growth habit with cold, winter-hardiness and yield.
**Locations:** Maragheh, and Sararood.
**Design:** RCB with 3 reps.
**Treatments:** 12 varieties of wheat.
**Observations:** Growth habit, growth vigor, phenology, plant height and grain yield.

**Title: Effect of prolonged sub-zero winter temperature on imbibed wheat seed on agronomic traits.**

**Objective:** Study the relationship between vernal genes and agronomic traits under prolonged winter conditions.
**Location:** Maragheh/Karaj
**Treatments:** Bread wheat varieties: 10 lines of each winter, facultative and spring type. Three Replications.
**Observations:** Germination(%)/Survival(%)
Growth vigor,
Plant height, Tiller No.
Heading and Maturity date; Grain yield

**Title: Effect of high temperature on the performance of bread wheat.**

**Objective:** Determine the effect of high temperature on agronomic traits and yield of wheat varieties (f/w and spring types).
**Site:** Gachsaran/Karaj
**Treatments:** Twenty varieties Lab: Analysis under controlled conditions-SPII.
Two sowing dates: Normal and late. Irrigated and non irrigated.
**Observation:** Germination(%); seedling vigor; tillering; heading and maturity dates; plant height; kernal weight; test weight; and grain yield; seeds/spike; and seed set(%). At the end of the year the results will be analysed and inference drawn. Based on the results the field evaluation of wheat & barley germplasm for heat tolerance

will be carried out regularly.

**Title: Integrated allelopathic management of weeds to minimize the use of herbicides in wheat.**

**Objectives:**

**a.** Screening of wheat varieties for allelopathic properties against problematic weeds.

**b.** Identification of potential varieties to be directly used as weed resistant varieties, or to use them for breeding weed resistant varieties.

**Material:** Winter, facultative and spring types varieties of wheat having drought resistance, disease/pest resistance, and with early seedling vigor. The number test varieties will be determined on the basis of available seed.

**Locations:** Maragheh and Mashhad (winter type), Kermanshah and Karaj (facultative type), Gachsaran and Gorgon (spring type) with above mentioned characters.

**Treatments:** There will be two sets of experiments at each locations. In one set the weeds will be controlled manually.

**Design:** Lattice (planting plan attached).

**Observations:**

**Allelopathic data -**

a. weed population
b. weed density
c. weed biomass
d. allelochemical test for promising varieties.

**Agronomic traits in wheat varieties -**

a. emergence
b. growth vigor at tillering
c. wheat density
d. plant height
e. days to heading
f. days to maturity
g. ground cover
h. days to maturity
i. tillers/ plant
j. spike length
k. grain yield.

**Soil properties -**

Analysis of soil from all locations for physico-chemical properties.

**Collaborating institutions :**

Plant Pests and Disease Research Institute (PPDRI)
Dryland Agricultural Research Institute (DARI)
Seed and Plant Improvement Institute (SPII)
ICARDA.

**Coordinating Scientist :**

Dr. S. J. H. Rizvi (PPDRI)

# B. Durum Wheat (*Triticum turgidum var. durum*) Improvement

## INTRODUCTION

Durum wheat used to be an important cultivated wheat species in Iran. However, in late sixties the research efforts at national and international level were increased for the improvement of bread wheat to avert an eminent famine due to tremendous increase in population and shortage of food, especially in the developing countries. This accelerated global research effort to improve the productivity of bread wheat resulted in the development, introduction and large scale adoption and cultivation of high yielding (HYV) bread wheat varieties. On the other hand durum wheat which was primarily cultivated in developing countries of West Asia and north Africa was given low priority globally and accordingly the resources alloted for its improvement were not adequate to develop new durum wheat varieties as well as production technology. Therefore, traditional old durum wheat varieties and technology continued to be practiced which could not compete with new HYV of bread wheat. Hence, durum wheat has been losing ground to bread wheat until recently almost in all the west Asian countries. In Iran the cultivated durum wheat area declined to approximately 100000 ha, and a few HYV of bread wheat occupied the major wheat growing area.

Those widely cultivated bread wheat varieties broke down against wheat yellow rust during 1994 and 1995 crop seasons which caused a significant reduction in total wheat production of Iran. However, this brought into lime-light the danger associated with narrow genetic variability in the cultivated wheat varieties on a large scale.

As a result a strategy based on expanding the genetic variability by identifying and releasing a large number of wheat cultivars carrying different sources of resistance to the major wheat diseases in Iran was adopted. In addition to this the research on the improvement of durum wheat was expanded to develop HYV for different ecological regions and consequently reverse the trend of the past 20 years, so that the durum wheat should be equally productive and regain its lost area to bread wheat, at the same time act as a genetic buffer against the spread of disease epidemic such as yellow rust on wheat.

Some of the major problems adversely affecting the durum wheat cultivation were: Non-availability of HYV; responsive to high input conditions; low level of tolerance to: a) diseases (Septoria, tan spot, BYDV and fusarium), drought, cold and high temperature; and grain quality. Since breeding is a long term endeavor the following research plan was formulated to develop improved durum wheat varieties for different regions in the shortest possible way.

**Breeding:**

**Title: Expansion of genetic base for durum wheat improvement.**

| | |
|---|---|
| **Objectives:** | 1. Collect evaluate and conserve local durum wheat germplasm.<br>2. Introduction of exotic germplasm, its evaluation under Iranian conditions and make direct or indirect (hybridization) use. |
| **Locations:** | Maragheh, Kermanshah, Kouhdasht, Shirwan and Gachsaran. |
| **Treatments:** | A large number of local and exotic durum wheat lines/cultivars. |
| **Design:** | Augmented with systematic checks. |
| **Observations:** | Growth habit, days to heading/maturity, plant height, disease reaction, heat & cold/frost damage, and grain quality. |

**Title: Evaluation of International Durum Wheat Nurseries from ICARDA in the Dry land Areas.**

The nurseries listed in Table 11 will be evaluated in different ecological regions of Iran to identify suitable stress tolerant varieties with high yield potentials.

| | |
|---|---|
| **Title:** | **Hybridization and introgression of desirable genes for developing improved durum wheat varieties.** |
| **Objectives:** | 1. Establish Crossing Block.<br>2. Hybridization among the desirable parents to combine genes for resistance to biotic and abiotic stresses. |
| **Locations:** | Sararood and Gachsaran. |
| **Design:** | Two rows (2.5 x 0.03 m) of each genotype; and two planting dates with 15 days interval. |
| **Observation:** | 1. 100 $F_1$ hybrid cross combinations will be made using parents with desirable characteristics.<br><br>A few targeted crosses for specific stresses such as septoria leaf blotch, BYDV and tan spot resistance as well as cold and heat tolerance will be made. |

3. All the agronomic characteristics of the crossing block lines will be recorded.

*Table 11.* ***Durum*** **wheat nurseries obtained from ICARDA and their locations.**

| No. | Name of Nursery | No. Ent. | Locations |
|---|---|---|---|
| **A. Improved Germplasm of Durum Wheat.** | | | |
| 1. | DYT-CA-Durum Wheat Yield Trial (Continental Areas) | 24 | Gachsaran, Moghan, Sararood, Kohdasht, Ghorgan |
| 2. | DYT-YA-Durum Wheat Yield Trial (Temperature Areas) | 24 | Gachsaran, Moghan, Sararood, Kohdasht, Ghorgan |
| 3. | Durum Wheat Observation Nursery (DON-D) | 168 | Gachsaran, Moghan, Sararood, Kohdasht, Ghorgan |
| 4. | DSP-D-Durum Wheat Segregating Populations | 192 | Gachsaran, Moghan, Sararood, Kohdasht, Ghorgan |
| **B. Breeding for diseases resistance** | | | |
| 5. | DKLDN-Key location Disease Nursery of Durum Wheat | 200 | Gachsaran, Moghan, Sararood, Kohdasht, Ghorgan, Mragheh, Shirvan, Ghamloo, Orumieh, Ilam |
| 6. | Durum Wheat-Yellow Rust (DYR) Nursery | 50 | Gachsaran, Moghan, Sararood, Kohdasht, Ghorgan, Maragheh, Shirvan, Ghamloo, Orumieh, Zanjan, Ilam |
| 7. | Durum wheat-leaf rust (DLR) Nursery | 50 | Gachsaran, Moghan, Kohdasht, Gorgan, Sararood |
| 8. | Durum Wheat-Stem Rust (DSR) Nursery | 50 | Gachsaran, Moghan, Kohdasht, Gorgan, Sararood |
| 9. | Durum Wheat-*Septoria tritici* Blotch (DST) Nursery | 50 | Gachsaran, Moghan, Kohdasht, Gorgan, Sararood |
| **C. Germplasm Pools for Sources of Disease Resistance** | | | |
| 10. | DYRGP-Durum Wheat Yellow Rust Germplasm Pool. | 10 | Gachsaran, Moghan, Sararood, Kohdasht, Gorgan, |
| 11. | DLRGP-Durum Wheat Leaf Rust germplasm Pool | 10 | Gachsaran, Moghan, Sararood, Kohdasht, Gorgan, |
| 12. | DSRGP-Durum Wheat Stem Rust Germplasm Pool | 10 | Gachsaran, Moghan, Sararood, Kohdasht, Gorgan, |
| 13. | DSTGP-Durum Wheat *Septoria tritici* germplasm pool | 10 | Gachsaran, Moghan, Sararood, Kohdasht, Gorgan, |
| **D. Improved Durum Wheat Germplasm for Mediterranean Areas** | | | |
| 14. | DON-MHA-Durum Wheat Observation Nursery-High Alttitute Areas | 96 | Maragheh, Sararood, Gamloo, Uromieh |
| 15. | DSP-MHA-durum Wheat Segregating Populations-High Altittude Areas | 96 | Maragheh, Sararood, Gamloo, Uromieh |

**Title: Breeding for specific adaptability of new durum wheat and barley varieties: Evaluation of segregating populations.**

**Objectives:** Selection among and within populations for desirable recombinants; special emphasis will be given on selection for:
a) Frost tolerance and earliness
b) Drought resistance (All the sites)
c) Septoria, BYDV and tan spot resistance (all sites)
d) Heat tolerance and earliness (Gachsaran)

**Location:** Maragheh, Karmanshah, Kohdashat, Shirvan and Gachsaran.

**Design:** Unreplicated with systematic checks.

**Plot size:** 6 rows, 5 m long.

**Treatments:** F2-Fn.: as in Tables 9 and 10.

**Title: Evaluation of improved and local old durum wheat germplasm for growth habit.**

**Objectives:**
1. Determine growth habit, i.e. winter, facultative and spring types in the new germplasm based on vernal and photoperiod response.
2. Classify the breeding material on the basis of growth habit and supply to different research stations only adapted germplasm.
3. Heat tolerance.

**Locations:** a)Maragheh and Kalardasht under field conditions during summer plantings.
b) Maragheh under controlled environments.

**Design:** Unreplicated with systematic checks.

**Plot size:**
1. For field evaluation: One row-one meter long of each genotype.
2. Under controlled environment: The test material will be vernalized and planted along with unvernalized under long and short day lengths (20 plants/genotype/treatment) will be used.

**Treatments:** 400 genotypes of durum wheat+checks with known growth habit.

**Observation:** Growth habit, Days to heading, plant height, degree of heading in summer planting; and heat effect (visual scale).

**Note**: For summer planting the material will also be evaluated for its heat tolerance.

**Breeding:** **On-site testing of durum wheat germplasm to identify improved varieties for different regions.**

**Title: a) Preliminary Yield Trials in Winter and Spring Types of durum wheatvarieties/lines.**

**Objectives:** Test the yielding ability, adaptation, disease resistance and stability of new genotypes in different environment.

**Locations:** Winter types: Maragheh, Shirvan, Sararood, Qamloo, and spring types: will be tested at four sites: Gachsaran, Kohdashat, Moghan and Gorgan.

| | |
|---|---|
| **Design:** | Augmented design, or RCB with 2 reps (if seed is available). |
| **Plot size:** | 4 rows x 2.5 m |
| ***Treatment:*** | Test lines+3-4 checks. The number of test lines at the different stations will be as per Tables 9 and 10. |
| **Observation:** | Frost /cold damage (cold areas)<br>Dessication (warm areas)<br>Days to Heading/Maturity, Plant height (cm)<br>Grain yield (kg/ha), TKW and protein content (%).<br>Disease reaction |

**Title: b) Advanced Yield Trials in Winter and Spring Types of durum wheat.**

| | |
|---|---|
| **Objectives:** | 1. Yielding ability, and tolerance to cold heat and drought.<br>2. Diseases resistance: Septoria, BYDV and Tan spot.<br>3. Adaptation to specific agroecologies. |
| **Locations:** | Same as above. |
| **Design:** | RCBD with 4 Replications. |
| **Plot size:** | 6 m2. |
| **Treatments:** | 14-20 new improved lines +2 checks in each trial, i.e., winter durum wheat and spring durum wheat. |
| **Obsevation:** | Same as in "a". |

**Title: c) Regional Uniform Yield Trials for Durum Wheat in Winter and Spring Types.**

| | |
|---|---|
| **Objectives:** | 1. Yielding ability, 2. Adaptability and stability.<br>3. Disease resistance under field conditions.<br>4. Tolerance to environmental stresses. |
| **Locations:** | Winter and spring wheat growing areas of each of the three ecological regions (cold, med. cold, and warm). Sites for the cold and med-cold regions will be in Maragheh, Kermanshah, Oroumieh, Qamloo and Ardebil.. Sites for the warm region will be in Gachsaran, Kohdasht and Moghan. |
| **Design:** | RCB with 4 replications. |
| **Plot size:** | 6 rows x 5 m long. |
| **Treatments:** | as per Tables 9 and 10. |
| **Observation:** | Same as in PYT and ADYT. |

**Title: d) On-farm Evaluation and Demonstration of Improved Varieties and Breeding ines.**

| | |
|---|---|
| **Objective:** | Demonstrate the performance at the farm level of the new varieties and verify the superiority of new advanced lines in comparison with checks. |
| **Locations:** | 3 sites in each of the provinces: Kermanshah, Maragheh, and Gachsaran. |
| **Design:** | Unreplicated plots (replicated for on-farm verification trials) |
| **Plot size:** | 20 m x 10 m |
| **Treatment:** | Improved varieties/lines identified at Kermanshah. |
| **Observations:** | Germination (time), heading, maturity, height, diseases, grain yield, TKW. |

**Special Studies:** **Breeding strategies for durum wheat improvement in dry areas.**

**Title:** **Develop appropriate breeding strategy for continental dryland areas for durum wheat improvement.**

**Objectives:** 1. Determine breeding strategy on the basis of agroclimatic information, and performance of genetically diverse genotypes.

**Locations:** Maragheh, Qaidar, Sararood, Qamloo.

**Design:** RCBD with 3 Rep.

**Treatments:** 4 winter types +4 Facultative types+4 spring Types.
Normal, early December.

**Observations:** Yield and yield components.
Implementation is dependent on staff availability.

## 2. Physiology/Breeding

**Title: Breeding for improved performance in cold/warm dryland areas-Determine morpho-physiological traits.**

**Objectives:** 1. Assessment of morphological and physiological traits and study of their importançe in adaptation and yield of durum wheat under moisture and cold stress.
2. Determine selection criteria.

**Locations:** Sararood, Kohdasht and Gachsaran.

**Design:** RCBD, 2-3 reps

**Treatments:** Varieties with diverse characteristics.

**Observations:** Emergence (crop establishment)
Ground cover and growth habit
Days to ear emergence and maturity
Tillers/Plant at stem elongation stage
Productive Tillers/Plant at maturity
Flag leaf size, Leaf rolling
Glaucousness
Vigor at five leaf stage
Leaf Senescence
Plant height
Grain yield, Thousand Kernel weight
Canopy temperature and leaf color.

**Note**: Experiment has been initiated. However there is a need to develop more facilities at different research centers.

**Physiology/Breeding: Characterization and development of durum wheat germplasm.**

**Title: Studies on vernalization and photoperiodism in Iranian durum wheat.**

**Objectives:** Determine the vernalization requirements and photoperiod sensitivity of

| | |
|---|---|
| | Iranian varieties of durum wheat. |
| | Classification of new material for different ecological regions. |
| **Locations:** | Maragheh. Part of this work will be done at ICARDA. |
| **Design:** | Augmented Design. |
| **Plot size:** | One row, one meter long, or 1 pot. |
| **Treatment:** | 100-200 lines of durum wheat. |
| | Experiment will be planted under controlled and field conditions. |
| **Observations:** | Growth habit |
| | Plant height |
| | Tillers/Plant |
| | Heading and Maturity date |
| | TKW and Grain yield |

**Title: Studies on agronomic characters of divergent durum wheat varieties planted early (Mid October) and late (end November)**

| | |
|---|---|
| **Objectives:** | 1. Determine the need of each region for specific type of variety. |
| | 2. Determine the relationship of growth habit with cold, winter-hardiness and yield. |
| **Location:** | Maragheh, Kermanshah and partly at ICARDA. |
| **Design:** | RCB with 3 reps. |
| **Treatments:** | 10 varieties of durum wheat. |
| **Observations:** | Growth habit, growth vigor, phenology, plant height, yield. |

**Title: Effect of prolonged sub-zero winter temperature in imbibed durum wheat seeds on agronomic traits.**

| | |
|---|---|
| **Objective:** | Study the relationship between vernal genes and agronomic traits under prolonged winter conditions. |
| **Design:** | RCB with three Replications. |
| **Location:** | Maragheh. |
| **Treatments:** | 24 Varieties/lines of durum wheat with different growth habits. |
| **Observations:** | Germination(%) |
| | Growth vigor, |
| | Plant height, Tiller No. |
| | Heading and Maturity date; |
| | Grain yield |

**Title: Effect of high temperature on the performance of durum wheat.**

| | |
|---|---|
| **Objective:** | Determine the effect of high temperature on agronomic traits and yield of durum wheat varieties (f/w and spring types). |
| **Site:** | Gachsaran and ICARDA. |
| **Treatments:** | Twenty varieties of each growth type. |
| | Two sowing dates: Normal and late. |
| | Irrigated and non irrigated. |

**Observations:** Germination (%); seedling vigor, tillering; heading and maturity dates; plant height; thousand kernel weight; test weight; and grain yield.
Seeds/spike; Seed set (%).

**Title:** **Breeding of Wheat (bread and durum wheat) for quality improvement-Evaluation of advance material for quality characteristics.**

**Objectives:**
1. To improve the nutritional quality.
2. Improve bread (Lavish, Sangak, Barberi, etc.) making quality.
3. High TKW and protein.

**Location:** SPII-Karaj.

**Treatments:** All the advanced lines of bread wheat and durum wheat as well as promising exotic germplasm.

**Observations:** Grain color, test weight, thousand kernel weight, protein content (%), bread making characteristics.
Durum wheat lines will be tested for macaroni and pasta making beside the above mentioned traits.

# C. Barley (*Hordeum vulgare* L.) Improvement: Research Plan for 1998/99.

## INTRODUCTION

Barley is cultivated on 1.67 million hectares under diverse and variable agro-climatic conditions in Iran, and ranks second among the cultivated crops in terms of hecterage. However, from such a large area only 2.74 million tons of grain are obtained. Barley is primarily produced and used as animal feed. It is also consumed for malt and as food in the form of "Barley soup" and *Maai Shaer* (Non-alcoholic beer). Beside grain, barley straw is also fed to the animals for stall feeding, especially during winter months when sources of animal feed are either scares or not available.

In the sustainability of agricultural production system barley plays an important and crucial role being the major source of animal feed. The increasing demand for animal feed and food is being met by imports from other countries and by increasing production horizontally. As a consequence the marginal areas are being brought under cultivation and the pressure on rangelands is increasing. The most appropriate solution to overcome this situation is to increase production vertically. Unfortunately, at present the barley production per unit of area (1.3 t/ha) is very low which is attributed to several biotic and abiotic factors.

Barley is normally considered a stress tolerant crop suitable for marginal areas requiring minimum inputs therefore, over a period of time it is gradually being pushed into those areas where cultivation of wheat is un-economical. Therefore, lowest priority is given to barley cultivation and minimum inputs are applied to get optimum yields. The research program, therefore, is geared to find genetical resistance/tolerance to the following major biotic and abiotic stresses; and develop improved germplasm suitable for low input agriculture.

a) Diseases: Scald (*Rhynchosporium secalis*), Net Blotch (*H. teres*), Spot Blotch (*Helminthosporium sativum*), Barley leaf stripe (*Helminthosporium gramineum*), Powdery Mildew (*Erysiphe graminis* f. sp. *Hordei*), Loose smut (*Ustilago nuda*), Septoria leaf and glume Blotch (*Septoria nodorum*, and *Septoria passerinii*), and Barley Yellow Dwarf Virus (BYDV).
b) Drought, cold, heat.

3) Salinity, micromutrient deficiencies and toxicities.

The barley research plan for different ecological regions is described below in the following pages.

**BREEDING: Expansion of Genetic Base:**
**Title: Evaluation of International Barley Nurseries from ICARDA.**

The following nurseries (Table 12) obtained from ICARDA will be evaluated in Iran.

**Table 12: Evaluation barley nurseries/germplasm obtained from ICARDA in Iran.**

| No. | Name of the Nursery | No. Ent. | Locations |
|---|---|---|---|
| **A. International barley yield trials** | | | |
| 1. | IBYT-LRA-C-Low rainfall Areas (Cool Winter) | 24 | Maragheh, Ghamloo, Ardabil, Zanjan, Shirvan, Uromiyeh |
| 2. | IBYT-LRA-M-Low Rainfall Areas (Cool Winter) | 24 | Maragheh, Gamloo, Shirvan, Uromiyeh, Sararood |
| 3. | IBYT-MRA-Moderate Rainfall Areas | 24 | Maragheh, Gamloo, Shirvan, Uromiyeh, Sararood, Ardabil, Zanjan |
| 4. | IBYT-CH-CW-Continental Highlands-(Cold Winters) | 24 | Maragheh, Gamloo, Shirvan, Uromiyeh, Sararood, Ardabil, Zanjan |
| **B. International barley Observation Nurseries** | | | |
| | IBON-LRA-C-Low Rainfall Areas (Cool Winter) | 100 | Maragheh, Gamloo, Ardebil, Zanjan, Shirvan, Uromieh |
| | IBON-LRA-M-Low Rainfall Areas (Mild Winter) | 100 | Maragheh, Gamloo, Shirvan, Uromieh, Sararood |
| | IBON-MRA-Moderate Rainfall Areas | 100 | Maragheh, Gamloo, Shirvan, Uromieh, Sararood, Ardabil, Zanjan |
| | IBON-CH-CW-Continental Highlands-(Cold Winter) | 150 | Maragheh, Gamloo, Shirvan, Uromieh, Sararood, Ardabil, Zanjan |
| **C. International Barley Segregating Populations** | | | |
| | IBSP-S-International Barley Segregating Pop.-Spring type | 90 | Gachsaran, Moghan, Kohdasht, Gorgan, Ilam |
| | IBSP-WF-Int. Barley Segregating Population-Winter Type | 150 | Maragheh, Gamloo, Shirvan, Uromieh, Sararood, Ardabil, Zanjan |
| | IBCB-S-International Barley Crossing Block-Spring type | 100 | Gachsaran, Moghan, Kohdasht, Gorgan, Ilam |
| | IBCB-WF-Int. Barley Crossing Block-Winter Types | 15 | Maragheh, Gamloo, Shirvan, Uromieh, Sararood, Ardabil, Zanjan |
| **D. Special Nurseries** | | | |
| | ISNBON-Int. Hulles Barley Observation Nursery | 100 | Maragheh, Sararood, Gamloo, Shirvan |
| | ISEBON-Int. Early Barley Observation Nursery | 100 | Maragheh, Sararood, Gamloo, Shirvan |
| **E. barley Germplasm pools** | | | |
| | IBYDVGP-barley yellow Dwarf Virus | 50 | Gorgan, Uromieh, Maragheh, Ardebil |
| | IBSCGP-Scald | 10 | Gachsaran, Shirvan, Gorgan |
| | IBCSGP-Covered Smut | 43 | Shirvan, Zanjan, Maragheh, Gorgan, Uromieh, Moghan, Gachsaran, Sararood |
| | IBPMGP-Powdery Mildew | 9 | Uromieh, Gamloo, Kohdasht, Gorgan |
| | IBRWAGP-Russian Wheat Aphid | 30 | Kohdasht, Maragheh, Uromieh, Islamabad, Hamedan, Zanjan |

**Title: Expansion of genetic variability in barley.**

**Objectives:**
1. Evaluation and identification of potential parents with desirable genes for yield, stability, resistance to diseases and environmental stresses.
2. Evaluation of exotic material under Iranian environments for direct or indirect use.
3. Hybridization among the parents to combine desirable genes for the improvement of barley.

**Locations:** Maragheh, Kermanshah, Gachsaran.
**Design:** Unreplicated with checks included.
**Plot size:** 2 rows, 2.5m long each.
**Observations:** Growth habit, days to heading/maturity, height, disease reaction, cold/frost damage, grain quality.

Crossing blocks will be grown at three research centers, i.e. Gachsaran, Kermanshah, and Maragheh. Two dates will be used. At Gachsaran, crosses will be initiated for the warm mild areas. At Kermanshah, crosses will be made for the cold and moderately cold areas. At Maragheh, because of severe cold during winter, it is recommended to establish greenhouse facilities to allow crossing under controlled conditions. Until this is done, crossing will be maintained at its present level, i.e. around 200 crosses. Crosses will also be made at ICARDA for the incorporation into Iranian materials, the genes of resistance to diseases, particularly scald, barley stripe, spot-blotch, and BYDV.

Grain quality will continue to be evaluated at SPII until facilities are established at Kermanshah. Facilities for determining feed, malt, food and forage quality in barley need to be developed. For determining malt quality we may approach the malting industry.

**Breeding: Development of improved barley germplasm for moisture stressed dry land areas Iran.**

**Title: Breeding of new winter and spring type barley varieties for specific adaptability-Evaluation of segregating populations.**

**Objectives:** Selection among and within populations for desirable recombinants. Specific crosses will be included to combine:
a) Cold/frost tolerance and earliness in winter barley.
b) Drought resistance.
c) Resistance to scald, barley leaf stripe, Net blotch, PM and BYDV

**Locations:** Maragheh, Sararood, Qaidar, Qamloo, Shirvan for winter types and Kohdasht, Gorgan, and Gachsaran for spring types.
**Design:** Unreplicated with systematic checks.
**Plot size:** 6 rows, 5 m long, each.
**Treatments:** $F_2$-Fn.as per Tables 9 and 10.

**Breeding:** **On-site testing of improved barley germplasm to develop improved varieties for different regions.**

**Title: a) Test the yielding ability, adaptation, disease resistance and stability of new genotypes in different environments.**

**Locations:** Winter types: Maragheh, Zanjan, Shirvan, Kermanshah, Kordestan, and Spring types: will be tested at three sites: Gachsaran, Moghan, and Kohdasht.
**Design:** Augmented design, or RCB with 2 reps (if seed is available).
**ot size:** 4 rows x 2.5 m
**Treatment:** Test lines +3-4 checks. The number of test lines at the different stations will be as in Tables 9 and 10.

**Title: b) Advanced Yield Trials in Winter and Spring Types of Barley.**

**Objectives:** 1. Yielding ability, and tolerance to cold and drought.
2. Disease resistance: scald and barley leaf stripe.
3. Adaptation to specific agroecologies.
**Locations:** Same as above.
**Design:** RCBD with 4 Replications.
**Plot size:** 6 m2
**Treatments:** 14-20 new improved lines +2 checks in each trial, of winter barley and spring barley, as in Tables 3 and 4.

**Title: c) Regional Uniform Yield Trials for Barley in both winter and spring types.**

**Objectives:** 1. Yielding ability.
2. Adaptability and stability.
3. Disease resistance under field conditions.
4. Tolerance to environmental stresses.
**Locations:** Winter and spring barley growing areas of the three ecological regions (cold, med. cold, and warm). Sites for the cold and med. cold regions will be in Maragheh, Kermanshah, Zanjan, Oroumieh, Kordestan, and Shirvan. Sites for the warm region will be in Gachsaran, Moghan, Kohdasht, and Gorgan.
**Design:** RCB with 4 replications.
**Plot size:** 6 rows x 5 m long.
**Treatments:** 14 improved lines + 2 checks for barley in the cold region, and 20 lines in the warm region.
**Observations:** Same as in 'a'.
**Special Studies:** **Breeding Strategies for Barley Improvement in Dry Areas.**

**Title: Develop appropriate breeding strategy for continental dryland areas for barley improvement.**

**Objectives:** 1. Determine breeding strategy on the basis of genetically diverse genotypes.
2. Compare different methods of selection.

**Locations:** Maragheh, Sararood, Qamloo.
**Design:** RCBD with 3 Rep.
**Treatments:** 8 winter types + 8 Facultative types.
Three Planting dates: 25 Sept. Normal and beginning of Dec.
**Observations:** Yield and yield components.

**Note:** For objective 2, separate experiments will be conducted to compare pedigree and bulk pedigree methods + accelerated generation advancement. However, carrying-out of this experiment will depend on the availability of research facilities such as greenhouse, growth chambers, etc. (Deferred until facilities become available).

**2. Physiology/Breeding**

**Title: Breeding for improved performance in cold/warm dryland areas-determine morpho-physiological traits.**

**Objectives:** 1. Assessment of morphological and physiological traits and study of their importance in adaptation and yield of barley under moisture (drought) and cold stress.
2. Determine selection criteria.
**Locations:** Sararood, Maragheh and Gachsaran.
**Design:** RCBD, 2-3 reps.
**Treatments:** Varieties with diverse characteristics.
**Observations:** Emergence (crop establishment)
Ground cover and growth habit
Days to ear emergence and maturity
Tillers/Plant at stem elongation stage
Productive Tillers/Plant at maturity
Canopy temperature and leaf color
Flag leaf size, Leaf rolling
Glaucousness, Vigor at five leaf stage
Frost and cold damage
Leaf senescence
Plant height
Grain yield, Thousand Kernel Weight
Primordia development at tillering stage and just before stem elongation.

**Note:** Experiment has been initiated. However there is a need to develop more facilities at different research centers.

**Physiology/Breeding: Characterization and development of barley germplasm in Iran.**

**Title: Evaluation of Iranian barley for vernalization and photoperiod response.**

**Objectives:** a. Determine the vernalization requirements and photoperiod sensitivity of

Iranian varieties of barley.
b. Classification of new material for different ecological regions.

**Locations:** Maragheh and Kalardasht.
**Design:** Augmented Design.
**Plot size:** One row, one meter long, or 1 pot.
**Treatment:** 200-300 lines of barley.
Experiment will be planted under controlled and field conditions (during summer).
**Observations:** Growth habit
Plant height
Tillers/Plant
Heading and Maturity date
TKW and grain yield

**Title: Studies on agronomic characteristics of dual purpose (forage & grain) of barley varieties planted early (end September) and late (end October).**

**Objectives:**
1. Determine the forage production and regenerating capacity of different barley varieties.
2. Determine the relationship of dual purpose character with other triats, such as growth habit, drought tolerance, cold, winter-hardiness and yield.

**Locations:** Gachsaran, Kermanshah and partly at ICARDA.
**Design:** Split plot with 3 reps.
**Treatments:** Varieties of barley with early growth vigor.
**Observations:** Growth habit, growth vigor, phenology, plant height, forage yield in various clipping treatments and Total biomass yield (grain+straw) in non-clipped and clipped treatments, and thousand kernel weight (gr).

**Title: Effect of prolonged sub-zero winter temperature in imbibed barley seeds on agronomic traits.**

**Objective:** Study the relationship between vernal genes and agronomic traits under prolonged winter conditions.
**Location:** Maragheh.
**Observations:** Germination (%), survival (%)
Growth vigor
Plant height, Tiller No./plant
Heading and Maturity date;
Spike length and No. of grain/spike.
Grain yield, TKW

**Title: Effect of High Temperature on the Performance of Barley.**

**Objective:** Determine the effect of high temperature on agronomic traits and yield on barley varieties (f/w and spring types).
**Site:** Gachsaran and ICARDA.

**Treatments:** Twenty varieties of barley with different maturity.
Two sowing dates: Normal and late.
Irrigated and non irrigated.

**Observations:** Germination (%), seedling vigor; tillering; heading and maturity dates; plant height, Kernel weight, test weight, and grain yield.
Seeds/spike. Seed set (%).

**Breeding: Hulless Barley Improvement.**

**Title: Agronomic performance of improved hulless barley germplasm in different ecological regions of Iran.**

**Objective:** Determine the yield and quality of hulless barley in comprision to improved hulled barley and bread wheat.
**Treatments:** Improved hulless barley screening nursery + One hulled barley (improved)+ One improved wheat, variety.
(No. of replications will be determined on the basis of available seed).
**Sites:** Maragheh, Kermanshah, Kohdasht and Gachsaran.
**Observation:** Growth habit, Plant height, Days to head and maturity, No. of Tillers/plant, Thousand Kernel Weight, Grain Yield, and Protein content. Reaction to diseases. B-glucan content.

**BREEDING: Hulless Barley Improvement.**

**Title: Studies on the use of hulless barley as animal feed.**

**Objective:** Determine the suitability of hulless barley as animal feed in camparison with wheat and corn.
**Treatments:** Three hullesds barley genotypes to be compared with commercial corn and wheat.
**Sites:** Maragheh, and ICARDA.
**Observations:** Quality (Protein) and B-glucan content.
Animal (poulrty) weight gain

**Note:** This experiment is to be carried out in collaboration with Poultry Research Institute.

**Title: Integrated allelopathic management of weeds to minimize the use of herbicides in barley.**

**Objectives:**

**a.** Screening of barley varieties for allelopathic properties against problematic weeds.
**b.** Identification of potential varieties to be directly used as weed resistant varieties, or to use them for breeding weed resistant varieties.

**Material:** Different varieties of barley having drought resistance, disease/ pest resistance, and with early seedling vigor.

***Locations:*** Maragheh, Mashhad, Kermanshah, Karaj, Gachsaran and Gorgon.
**Design:** Lattice (planting plan attached).
**Observations:**

**Allelopathic data -**

a. weed population
b. weed density
c. weed biomass
d. allelochemical test for promising varieties.

**Agronomic traits in barley varieties -**

a. plant density
b. plant height
c. days to heading
d. days to maturity
e. tillers/ plant
f. spike length
g. grain yield.

**Soil properties -**

Analysis of soil from all locations for physico-chemical properties.

**Collaborating institutions :**

Plant Pests and Disease Research Institute (PPDRI)
Dryland Agricultural Research Institute (DARI)
Seed and Plant Improvement Institute (SPII)
ICARDA.

**Coordinating Scientist :** Dr. S. J. H. Rizvi (PPDRI)

# CEREAL PATHOLOGY- Workplan for 1998/99

1. Evaluation of breeding materials for resistance to the **prevailing diseases** under natural infection, supplemented by mist irrigation.
   Locations:Gorgan, Ahvaz, Gachsaran, Islamabad.

2. Monitoring the virulence pattern of yellow rust on samples collected in the dryland areas (Karaj). All pathologist in research stations are requested to collect spores of yellow rust from their location and send them to SPII.

3. Evaluation of resistance of DARI,s wheat advanced lines and cultivars to **Yellow rust** in field and greenhouse conditions.
   Locations: Maragheh, Miandoab, Hamadan, Zanjan, Gachsaran, Karaj.

4. Evaluation of resistance of DARI,s wheat advanced lines and cultivars to **Leaf rust** in field and greenhouse conditions.
   Locations: Ahwaz, Gorgan, Gachsaran.

5. Evaluation of resistance of DARI's advanced wheat lines and cultivars to **Stem rust** in field and greenhouse conditions.
   Locations: Broojerd, Khoramabad, Ahwaz.

6. Components of resistance of some wheat advanced lines and cultivars of dryland to two races of *Puccinia striiformis.*
   Locations: Karaj(SPII, greenhouse ), Maragheh and Miandoab (Field condition).

7. Evaluation of resistance of DARI's advanced wheat lines and cultivars to ***Septoria tritici*** in different part of Iran.
   Locations: Ilam, Ahwaz, Moghan, Gorgan.

7. Evaluation of resistance of DARI's advanced wheat lines and cultivars to **Common bunt.**
   Location:Maragheh, Uromieh, Sanandaj, Sararood, Zanjan.

8. Evaluation of resistance of DARI's advanced wheat lines and cultivars to **Dwarf bunt.**
   Locations: Maragheh, Uromieh, Sanandaj.

9. Study on the **virulence factors** of ***Tilletia laevis*** and ***T. controversa*** in western provinces of Iran.
   Locations:Maragheh(2), Uromieh(2), Sanandaj(2), Sararood(1), Hamadan(1),Zanjan(2), Lorestan(1).

10. Inheritance of resistance in some advanced lines of wheat with adult plant resistance to yellow rust.
    Location: Maragheh.

11. Identification and distribution of bacterial strains of leaf blight in Kohghilooyeh va Boyerahmad and differential response of wheat cultivars to them (will be continued).

12. Study on distribution and damage of *Tilletia controversa* causal agent of dwarf bunt in Zanjan. Location: Zanjan.

14. Candidates for release, advanced, and promising lines (barley) for evaluation against **barley leaf stripe** in greenhouse and field.

15. Candidates for release, advanced, and promising lines (barley) for evaluation against **barley scald** in greenhouse and field.

**Cereal Pathology Training , Visits and Needs**

1. National course on procedure of disease inoculation for field testing of cereal germplasm.

2. Participation in conferences/ Workshops/ Symposia.

3. 10 sets of equipment necessary for artificial inoculation of cereal pathogens in field (List has been forwarded to Dr. Tahir).

**4. Agronomy:**
(Package of production practices)
Most of the following experiments are being conducted by the scientists of DARI-Maragheh and were approved by the Dryland advisory committee.

1. Determination of nutritional requirements of wheat and barley under rainfed conditions
2. Determination of rates, time and sources of nitrogen fertilizer on rainfed wheat.
3. Effect of supplemental irrigation on dryland wheat and barley.
4. Studies on soil. Water and nutrient interaction in winter cereals under different moisture conditions.

5. Studies on moisture conservation and determination of suitable equipment.
6. Studies on rate and method of phosphorous fertilizer application on rainfed cereal cultivation.
7. Efficiency of tillage methods on moisture conservation and the productivity of winter cereals.
8. Crop rotation studies to optimize crop productivity and minimize soil and water loss.
9. Studies on Seed rate x Sowing Variety (wheat and barley)

The above mentioned experiments will be continued. These have been further refined (see under Farm Resource Management).

## 5. On-farm Testing and Seed Multiplication of Elite Lines

Advanced elite lines will be multiplied and tested in On-farm trials for possible commercial release to the farmers. On-farm trials are a key to effective confirmative testing and adoption of new lines/varieties. Although this is presently conducted at four centers (Karmanshah, Gachsaran, Sanandaj and Maragheh) it is recommended to strengthen this activity at other centers as well. Five to Ten sites should be used in each region. It is recommended to procure a mobile unit (pick-up, trailer, seeder, and plot combine) for the effective implementation of these on-farm trials. For details on varieties used, refer to the Breeding section (just before (Special Studies). Seed is multiplied by the respective centers. Implementation of on-farm testing and demonstration will depend on the availability of staff and other resources.

### Cereal Training and Visits

1. Scientific visit of three DARI scientists to select cereal germplasm in Syria, Turkey, and Kazakhstan, 10 days in each country.
2. Dr. H. Ketata to visit Iran for 14 days in June, to visit winter wheat research sites and deliver training on Agrobase for 3-4 DARI staff involved in field books and nurseries preparation.

# *II. LEGUME IMPROVEMENT*

**Introduction:**

Legumes are important in sustainable production of food and feed in the drylands of the Islamic Republic of Iran. They are important not only as a source of good quality protein in the diets of people and valuable as animal feed, but also in increasing and sustaining the productivity of the principal cereals by improving the soil fertility and reducing the chances of build-up of diseases, pests and obnoxious weeds. Whereas work has been going on for long, on the improvement of irrigated food legumes, work on dryland food legumes has not been as extensive in the past.
The objective of the legume improvement work in the project is, therefore, to develop improved cultivars and crop production and protection techniques for chickpea, lentil and important annual feed legumes for different agro-ecological conditions of the dry areas of Iran. The strategy is to make use of national and exotic germplasm for improvement of tolerance to various biotic and abiotic stresses and enhance adaptation of the crop to fit into existing and new cropping systems in the dry areas of Iran. To start with, emphasis is on strengthening research at the principal research stations in Maragheh and Kermanshah and then extending to other locations. The work planned calls for close collaboration between the breeders, agronomists, plant protection scientists and those involved in research in soil and water management. It also requires a close collaboration and strengthening of the on-going national legume improvement research program for irrigated areas and the work being carried on in other institutes.

**Summary of Research Results and Achievements; 1997-98.**

The Food and Feed Legume Committee (see Annex 1) discussed results of various experiments conducted at various research stations during the 1997/98 season. Results were presented and discussed on the 14 projects approved during the review and planning meeting of 1997/98. Plans for 1998/99 season were made, and problems encountered as well as training needs identified.

**Project 1: Introduction of lentil and chickpea germplasm for evaluation under different agro-ecological conditions.**

LENTIL

**LIYT-L (Lentil International Yield Trial - Large Seed)**

The trial was conducted at 5 locations; Maragheh, Kermanshah, Gazvin, Gachsaran and Ardebil. The results were not significant at Gachsaran and Kernanshah. At Gazvin, the results were significant and two test enteries (FLIP 84-149L, FLIP 96-2L) significantly superior to the check were identified. At Gazvin, 2 enteries (FLIP 84-149L, and FLIP 96-2L) were identified: At Ardebil, 8 enteries (FLIP 95-13L, FLIP 96-2L, FLIP 96-4L, FLIP 96-8L, FLIP 96-9L, FLIP 96-13L, and FLIP 96-15L) were identified.

**LIYT-S (Lentil International Yield Trial - Small Seed)**

The trial was conducted at only three locations; Gazvin, Kermanshah and Ardebil. The results were significant only at 2 locations, 8 entries (FLIP 95-39L, FLIP 95-40L, FLIP 95-49L, FLIP 96-20L, FLIP 96-22L, FLIP 96-23L, FLIP 96-30L, and FLIP 96-39L) at Gazvin, and 4 entries ( FLIP 95-15L, FLIP 96-22L, FLIP 95-34L, and FLIP 95-49L) at Ardebil were superior to the check.

**LISN-L (Lentil International Screening Nursery – Large Seed)**
The trial was conducted at six locations; Kermanshah, Gachsaran, Ardebil, Maragheh, Lorestan, and Shirvan. At Maragheh, two enteries (FLIP 97-7L, and FLIP 97-8L) and at Gachsaran, 17 entries (ILL 4400, FLIP 96-18L, FLIP 97-1L, FLIP 97-2L, FLIP 97-5L, FLIP 97-6L, FLIP 97-7L, FLIP 97-8L, FLIP 97-9L, FLIP 97-10L, FLIP 97-11L, FLIP 98-4L, FLIP 98-5L, FLIP 98-6L, FLIP 98-7L, FLIP 98-8L, and FLIP 98-10L) were statistically superior to the local check.

**LISN-S (Lentil International Screening Nursery – Small Seed)**
The trial was conducted at only three locations: Gazvin, Kermanshah and Zanjan. The results indicated that 3 entries (FLIP 98-27L, 97-28L, and FLIP 98-26L) at Gazvin, and 10 entries at Ardebil (FLIP 97-28L, FLIP 98-14L, FLIP98-17L, FLIP 98-18L, FLIP 98-21L, FLIP98-23L, FLIP 98-24, FLIP 98-26L, FLIP98-27L, and FLIP 98-29L) gave significantly superior yield as compared to the local check.

**EVALUATION OF IRANIAN LENTIL GERMPLASM**

Two hundred and eighty nine Iranian lentil accessions were evaluated at Ardebil and 260 accessions at Shirvan. The variation in different characters is presented as:

| Character | Range at Shirvan | Range at Ardebil |
|---|---|---|
| Seed yield(Kg/ha) | 30 to 740 | 42 to 820 |
| 100-seed weight | 2.9 to 4.0g | 3.8 to 5.6 |
| Days to flowering | 60 to 65 | 58 to 65 |
| Days to maturity | 84 to 91 | 87 to 94 |

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**CHICKPEA**

**CIYT-SP (Chickpea International Yield Trial - Spring)**
Trial was conducted at three locations; Maragheh, Sararood and Zanjan. One line (FLIP 94-88C) at Zanjan and all the test entries at Sararood were significantly superior to the check.

**CISN-WP**
The trial was conducted at five locations; Lorestan, Gachsaran, Shirvan, Gorgan and Sararood. Eleven entries at Sararood, one entry at Lorestan, 3 entries at Gachsaran, 44 entries at Shirvan were significantly superior to the check.

**CISN-SP(Chickpea International Screening Nursery-Spring Planting):**
Trial was conducted at two locations, Maragheh and Zanjan. One entry (S 95335) at Maragheh and 21 entries at Zanjan were statistically superior to the check.

**PIAT (Pea International Adaptation Trial)**
The trial was planted at two locations, Sararood and Gachsaran. One entry namely, 88P090-5-21 was statistically superir to the check at Sararood.

**Project 2: Breeding for cold tolerance for autumn sowing**

**LICTN-98 (Lentil International Cold Tolerance Nursery)**
The trial was planted at four locations; Lorestan, Sararood, Gazvin and Ardebil. Across locations, the entries, ILL 759, ILL 21, Sazak 21, AKM 357 were highly tolerant to cold and gave respective mean yields of 840, 881, 1157 and 1019 kg/ha.
All the entries at Margheh, 5 entries at Sararood, and 8 entries at Ardebil were highly tolerant to cold (with cold reaction equal or less than 3). The entries W.H. 80, ILL 323 and Sazak 91 gave highest seed yield of 1726, 1251, 1403 and 1130 kg/ha, respectively at Sararood, Lorestan, Ardebil, and Gazvin.

**CICT-N-98 (Chickpea International Cold Tolerance Nursery)**
Trial was conducted at three locatons; Maragheh, Sararood and Lorestan. The entries namely, S96097, SEL 93 TH24498, SEL 95 TH1716, SEL 96 TH11439, SEL 96 TH11485, SEL 96 TH11515, SEL 96 TH11516, and SEL 96 TH 11518 exhibited highly tolerant reaction at all the locations (Rating 3 or less than 3)

**CICTN-94 (Chickpea International Cold Tolerance Nursery):**
The trial was conducted to see the effect of time of planting on seed yield in chickpea. The CICTN-94 was used for the study. The entries were grown in R.C.B. in three different timings (Winter-Nov. planting; Entzari- December planting; and Spring- April planting). Forty nine entries were included in the study. The results revealed that at Maragheh there were non-significant differences between seed yield of different planting dates and the mean seed yields for winter, entzari and plantings spring were, 646, 696, 659 kg/ha, respectively. The highest yielding entry (ILC 71) at Maragheh in winter sown treatment gave highest yield of 1407Kg/ha as compared to its yield in spring sowing which was 978 Kg/ha.
The results revealed that at Sararood there were significant differences between seed yields at different planting dates and the mean seed yields for winter, entzari and spring were 1185, 884 , 747 kg/ha, respectively. The highest yielding entry (FLIP 82-245C) at Sararood in winter sowing gave highest yield of 1755Kg/ha as compared to its yield in spring planting, was (863 Kg/ha). The most cold tolerant line across locations included 96TH 11439, 95TH 1716, 93 TH 244498, 96TH 11485, 96TH 11515, 96TH 11516, 96TH 11518, and S 96097.

**Project 3: Preliminary evaluation of improved chickpea and lentil genotypes.**

**PYT-KC (Preliminary Yield Trial - kabuli chickpea)**
Trial was conducted at 8 experimental sites, Shirvan, Maragheh, Sararood (Winter and spring), Gachsaran, Lorestan, and Zanjan (two sites). Results revealed that 3 entries at Maragheh, 39 entries at Sararood (winter planting) 38 entries at Sararood (Spring planting), 2 entries at Shirvan, 7 entries at Loristan, 4 and 2 entries at Zanjan-1 and Zanjan-2, locations, were significantly superior to the respective local check.

**PYT-Desi Type (Preliminary Yield Trial - Desi chickpea)**
Trial was conducted at Sanadaj. Results revealed that 2 test entries were significantly superior to the local check.

**PYT-Lentil (Preliminary Yield Trial - Lentil)**
Trial was conducted at Maragheh, Lorestan, and Shirvan. Results revealed that 2 test entries at Maragheh, and 6 test entries at Shirvan were significantly superior to the local check.

**Project 4: Evaluation of improved genotypes in replicated yield trials (A and B tests)**

***Advance* Yield Trial Kabuli Chickpea -A test**
Trial was conducted at 2 locations, Maragheh and Shirvan, and results were not significant at any of the locations.

**Advance Yield Trial Kabuli Chickpea -B1 test**
Trial was conducted at 3 locations, Ilam, Gachsaran, and Shirvan, and the results indicated the superiority of 3, 4 and 5 entries, over the local check, respectively.

**Advance Yield Trial Lentil-A test:**
Trial was conducted at Maragheh, Irdebil (two tests, A1 and A2), and Gazvin. One entry in Maragheh, 7 in Ardebil (in A1 Test), 1 in Ardebil (in A2 Test), and 6 in Gazvin, were significantly superior to the respective local check.

**Advance Yield Trial Lentil-B1 test:**
Trial was conducted at Maragheh, and Gachsaran locations. Only one variety was significantly superior to the local check at Gachsaran.

**Advance Yield Trial Lentil - B2 test Large Seed:**
Trial was conducted at Maragheh, Ardebil, Gachsaran, and Kermanshah. Four entries in Maragheh, 3 in Ardebil, 1 in Gachsaran were significantly superior to the respective local check.

**Advance Yield Trial Lentil - B2 test Small Seed:**
Trial was conducted at Kermanshah but none of the test entries was significantly superior to the local check.

**Project 5: Multilocational evaluation of improved lentil and chickpea genotypes.**

**National Adaptation Trial on Lentil -B: (NAT-L)**
There were 10 test entries plus check. The trial was conducted at: Khoristan, Shirvan, Maragheh, Sararoud, Zanjan, Gachsaran, and Ardebil. At five locations; Shirvan, Sararoud, Zanzan, Gachsaran, and Ardebil, the results were significant and 1,4,5, and 8 entries respectively, exceeded the check by a significant margin. The trial was suggested to be repeated at all the locations and the seed of these to be multiplied for likely use in multilocational trials within a given province. Seed from the previous experiment to be used by the respective locations.

**National Adaptation Trial on Chickpea - Spring Season**
The trial was conducted at 5 locations, namely, Maragheh, Sararood, Khodasht, Ilam, and Oroumieh. At three locations, Sararood, Kohdasht and Ilam, 6, 6, and 2 entries respectively exceeded the respective local check by a significant margin. Only the entries which were early in maturity and high yielding will be tested next year along with a check variety. The seed yields (kg/ha) of the check in comparison to the top yielding entry for the different locations are:

| Yield of | Maragheh | Sararood | Kohdasht | Ilam | Oroumieh |
|---|---|---|---|---|---|
| Highest entry | 640 | 1015 | 1083 | 1345 | 650 |
| Check | 533 | 385 | 813 | 0 | 614 |

**National Adaptation Trial on Chickpea -Winter Season**

The trial was conducted at four locations; Sararood, Ilam, Gachsaran and Oroumieh. Fourteen, 3, 13, and 10 entries were significantly superior to the respective local check at Sararood, Ilam, Gachsaran and Oroumieh, respectively. The seed yields of the check in comparison to the top yielding entry are given in Table 1.

**National Adaptation Trial – Lentil**

The trial was conducted at 6 locations. At Maragheh and Ardabil, none of the test entries was significantly superior to the check. At Sararood, Zanjan, Gachsaran and Shirvan, 6, 3, 2 and 1 entries exceeded the local check by a significant margin. The seed yields of the check entries and the highest yielding entry in each location are also given in Table 1.

**Table 1. Yields of national adaptation trial of improved genotypes of chickpea and lentil**

| **1. Spring Cheickpeas** | | | | | | |
|---|---|---|---|---|---|---|
| **Location** | | **Maragheh** | **Sararoud** | **Kohdasht** | **Ilam** | **Uromieh** |
| No. significant | | 0 | 6 | 6 | 2 | 0 |
| Highest yield | | 640 | 1015 | 1083 | 1345 | 650 |
| Yield of check | | 533 | 385 | 813 | 0 | 614 |
| **2. Winter Chickpea** | | | | | | |
| **Location** | | | **Sararoud** | | **Ilam** | **Gach.** | **Uromieh** |
| No. Significant | | | 14 | | 3 | 13 | 10 |
| Highest Yield | | | 1288 | | 1184 | 1655 | 1214 |
| **Yield of check** | | | 210 | | 0 | 400 | 856 |
| **3. lentil** | | | | | | | |
| **Location** | **Maragheh** | **Sararoud** | **Zanjan** | **Gach.** | **Ardebil** | **Shirvan** |
| No. Significant | 0 | 6 | 3 | 2 | 0 | 1 |
| Higher Yield | 47 | 1420 | 511 | 2547 | 476 | 419 |
| Yield of check | 32 | 1045 | 379 | 1850 | 427 | 300 |

**Project 6: Combining desirable traits from different cultivars or lines for improvement in seed yield and other traits, and generation of new breeding material in chickpea and lentil.**

In chickpea 34 crosses were made and 65 crossed seeds were obtained from 210 emasculations at Maragheh; 33 crosses were made and 89 crossed seeds were obtained from 755 emasculations at Kermanshah.

No crossing program was undertaken in Lentil.

The seeds from the F1s were grown in the greenhouse at Kermanshah and in the field in Maragheh in 1996/97. Individual plant seed was collected which will be grown in progeny rows next season for purification and to advance the generation. The selections were made at Kermanshah from the CIF4N-MR segregating population nurseries from ICARDA and will be advanced. Kermanshah has

obtained the seed from Gorgan which is in F5 and F6 generation and will evaluate for yield and other traits during the next cropping season.

**Project 7: Evaluation of segregating populations for development of new genetic stocks**
Kermanshah has obtained breeding material from Gorgan which is in F5 and F6 generation, which will be grown in 1997/98 for advancement and selection. Selections were made from CIF4-N-MR-97 and will be grown next season in Kermanshah.

**Project 8: Survey of diseases and insect pests in various chickpea and lentil production areas in drylands**

*Overall objectives of the surveys*:

- Determine the prevalence and intensity of the major legume pests
- Prioritize their importance by region or province for targeted research
- Collect samples to characterize and use in resistance screening.

**Ascochyta blight and Fusarium wilt survey: 1997/98 season:**
Surveys were conducted in East and West Azarbaijan provinces.
In East Azarbaijan, a total of 65 farmers fields were surveyed in 5 chickpea production areas. Ascochyta blight was detected in 35% of the fields with disease severity ranges of 3-8. The Shabester area had a high intensity of the disease. Fusarium wilt was detected in about 20% of the fields surveyed with low disease incidence levels ranging from 5-15%.
In the West Azarbaijan province, 88 fields were surveyed. Fusarium wilt was detected in 18% of these fields with disease incidence ranges of 5-60%, while Ascochyta blight was found in only 1% of the fields surveyed. In the Bukan area there were fields with a high incidence of Fusarium wilt.

**Survey outputs:**

- Representative samples of Ascochyta blight and Fusarium wilt were collected from all provinces and areas as prevalent.
- The distribution and severity of the main diseases were determined and summarized by province and/or region as appropriate.
- Disease hot spots especially needed for Fusarium wilt, were identified for future use in field resistance screenings.

The insect surveys were not carried out.

**Project 9: Survey of rhizobium and collection of strains in chickpea and lentil growing areas and evaluation for the need for inoculation.**

Experiment 1
Using cultivar Kaka, rhizobial inoculation yielded (0.57 t $ha^{-1}$) significantly higher than that of control (0.36 t $ha^{-1}$). But this yield was similar to $P_2O_5$ (50 kg $ha^{-1}$) application (0.53 t $ha^{-1}$) This suggested that the native rhizobia were equally effective when phosphorus was available.With application of N alone yield (0.45 t $ha^{-1}$) was lower than that with rhizobial application (Table 2 indicating suppression of nitrogen fixation by the native rhizobia when N fertilizer was applied.[Note: the comments to be revisited when soil and nodulation data as and when becomes available after 15 Sept 1998 ]

**Table 2 Yield of chickpea in response to the application of $N/P_2O_5$ and rizobia.**

| Treatment | Mean yield (t $ha^{-1}$) | DMRT (5%) |
|---|---|---|
| Control | 0.36 | B |
| Rhizobial application | 0.57 | A |
| Inoculation + $P_2O_5$ | 0.53 | A |
| Inoculation + $P_2O_5$ + N | 0.48 | A |
| N | 0.45 | AB |
| $P_2O_5$ | 0.53 | A |
| N + $P_2O_5$ | 0.59 | A |
| Overall Mean | 0.50 | |
| CV (%) | 18 | |

Experiment 2

**Need for Inoculation in Lentil**

Using cultivar Ziba, inoculation plus $P_2O_5$ (50 kg $ha^{-1}$) yielded best (0.88 t $ha^{-1}$, Table 3 and was significantly higher than that of rhizobial inoculation (0.74 t $ha^{-1}$), and higher than that of control (0.80 t $ha^{-1}$). Wherever N was applied it seemed to have suppressed nitrogen fixation and grain yield (0.74 to 0.76 t $ha^{-1}$). [Note: the comments to be revisited when soil and nodulation data as and when become available after 15 Sept 1998, nodalation data to be added in the Table 2 (Action Mr. Mahmoudi)].

**Table 3: Yield of lentil entries Ziba in response to the application of $N_2$ $P_2O_5$ and rhizobia.**

| Factor | Seed Yield (t/ha) | DMRT (5%) |
|---|---|---|
| Control | 0.804 | ABC |
| $P_2O_5$ | 0.866 | A |
| Inoculation | 0.741 | BC |
| Inoculation + $P_2O_5$ | 0.883 | A |
| N | 0.758 | BC |
| N+$P_2O_5$ | 0.735 | C |
| Inoculation + N + $P_2O_5$ | 0.841 | AB |
| Overall Mean | 0.804 | |
| CV (%) | 8.5% | |

Experiment 3

**Evaluation of promising *Rhizobium* strains of chickpea**

Five rhizobial strains from ICRISAT were fielo evaluated at Maragheh. The uninoculated control and two strains (no.4 and 5) yielded low (0.44 to 0.47 t $ha^{-1}$). Strain (no. 3) yielded 9% greater than control and was highest (0.66 t $ha^{-1}$, Table 4). [Note: Mr Mahmoudi to provide names of strains]

**Table 4. Evaluation of chickpea rhizobia, Maragheh, 1997/98.**

| Strains | Nodule mass (mg plant$^{-1}$) | Grain Yield (t ha$^{-1}$) | DMRT (5%) |
|---|---|---|---|
| Control | | 0.46 | B |
| 1 | | 0.58 | AB |
| 2 | | 0.66 | A |
| 3 | | 0.44 | B |
| 4 | | 0.47 | B |
| 5 | | 0.63 | A |
| Overall Mean | | 0.54 | |
| CV% | | 23 | |

Experiment 4 (It was an additional experiment not planned for 1997/98)

**Response to rhizobial formulations of chickpea**

One particular combination of rhizobial formulation (No.3, comprizing strains ---- to be collected from Dr Sattari) and cultivar (Pirouz) yielded (1.42 t ha$^{-1}$) significantly higher than non-inoculated control (1.16 t ha$^{-1}$, Table 5). There was no response to applied N (30 kg ha$^{-1}$). From the available information, it was not clear if the interactions between rhizobia, applied N and cultivars (Dr Sattari and Mr Mahmoudi to provide statistical information).

**Table 5: Field evaluation of rhizobial formulations with three chickpea cultivars at two N levels*.**

| Rhizobual Formulations | Chickpea cultivars | | | |
|---|---|---|---|---|
| | JAM | PIROUZ | ILC 482 | Means |
| Control | 1.04 | 1.30 | 1.14 | 1.16 |
| Formulation 1 | 0.96 | 1.55 | 1.51 | 1.34 |
| Formulation 2 | 1.33 | 1.52 | 1.33 | 1.40 |
| Formulation 3 | 1.46 | 1.38 | 1.41 | 1.42 |
| SE+- | | - | | - |
| Means | 1.20 | 1.44 | 1.35 | |

**Note:** 1) Similar table on nodule mass per plant should be prepared by Dr. Sattari/Mr. Mahmoudi.

2) Information/highlights on the data on nodulation to be added when data becomes available.

3) Rhizobial strains of chickpea and lentil were isolated from soil and nodule samples collected from farmers fields. These were purified and evaluated for biochemical tests. These strains should be evaluated in glasshouse and/or field in 1998/99 for their usefulness as rhizobial inoculants.

Soil characteristic data to be looked at and commented upon as and when it becomes available.

**Recommendation**: The whole data be written as a full draft paper by Dr Sattari and Mr Mahmudi and shared with colleagues for comments. But its publication be deferred till 1999 when the results of the next year experiments become available.

**Project 10: Evaluation of different genotypes against Ascochyta blight and Fusarium wilt and insect pests under field and controlled conditions.**

**CIABN-A-98**

This trial was conducted at Shirvan, Gorgan, and Zanjan stations. Conditions were not suitable for disease development at Gorgan and Zanjan. The susceptible checks not infected at these locations. At Shirvan, 19 entries were rated as highly resistant while 12 were rated as moderately resistant. At Lorestan, 6 lines were highly resistant. The following entries were highly resistant at Shirvan and Lorestan: F 94-100C, F 94-108C and S 96147. All the highly resistant entries will be included in the CICTN-99 nurseries and screened for cold tolerance.

**CIABN-B**

Field screenings of this nursery were conducted at Kermanshah, Maragheh and Gachsaram. Environmental conditions did not favour disease development in the nusery at Maragheh. Even the susceptible check had a resistant reaction of 3. At Gachsaran, even though the susceptible check was rated 9, most of the other entries had a low rating of 3. Only 2 were rated with 9 and 5 with 5. At Kermanshah, there was good infection and 23 out of the 50 entries were rated resistant with a rating of equal or less than 3. Highly resistant entries identified were: F 91-60C, F 94-108C and F 95-52C.

**CIFWN-98**

This trial as recommended was planted at Kermanshah station and at 3 farmers' fields identified as "hot spots" during the 1996/97 survey. There was no infection at Kermanshah station since trial was planted on a non-infested field plot. There was unexpectedly also no infection at the 3 farmers' fields identified in 1996/97, possibly because temperatures were too cold for infection or the exact hot spots on the fields were missed.

**Evaluation of Desi and Kabuli chickpea lines for resistance to pod borer**

- Out of 41 desi lines evaluated for resistance to Heliothis spp. At Maragheh, none was rated as resistant since all showed a pod damage % above 40. However, 6 lines were rated as tolerant with % pod damage between 40 and 50.
- Out of 46 kabuli lines evaluated also at Maragheh, none was rated as resistant. Six lines were also identified as tolerant with a pod damage % between 40 and 50.

**Integrated Management of Heliothis**

There were no significant differences in % pod damage due to pod borers in the sole chickpea crop and in the strip plots with wheat and barley. There were, however, some differences in plot yields between the sole and strip cropping.

Since this was the 3rd year of the trial with no actual significant differences between pod damage in the treatments, it was decided that the trial be terminated. It seems from the results that strip cropping of chickpea with cereals increases plot yields but does not help to reduce pod damage by pod borers.

**Project 11: Management of weeds in chickpea and lentil**

**LWCT (Lentil weed control trial):**
It was conducted at Maragheh and Ardebil. Two herbicide treatments, cyanazine @1 kg a.i./ha and Persoid @ 1.25 kg a.i./ha gave significantly better yield than the nonweeded control. The seed yields were 251 kg/ha for the weedy check and 494 kg/ha with cyanazin and 385 kg/ha with Persoid.

**CWCT (Chickpea weed control trial):**
The trial was conducted at Maragheh and Gorgan.
- At Maragheh, Linoron @ 2L a.i./ha gave significantly higher yield as compared to the weedy
- check. The weedy check in Maragheh gave 338 kg/ha and with herbicide control gave 509 kg/ha.
- At Gorgan, 2 herbicide treatments, Linoran (2 L a.i./ha) and Lentagran (2L a.i./ha) gave superior yields when compared to the check. The weedy check gave 760 kg/ha and with herbicide treatments the seed yields were 1076 kg/ha (Linoram) and 1282 kg/ha (Lentagran).

As in 1997/98, the previous planned experiments were excluded. The results were not concluded. It was suggested to continue to identify and screen new herbicides for control of legume weeds along with the others tested and found effective in earlier studies.

**Project 12. To determine suitable dates of planting, plant densities and seeding depths in chickpea and lentil for maximum seed yields under different growing conditions.**

(The salient findings of this project are reported in the NRMP report).

**Project 13: On farm evaluation of improved chickpea and lentil cultivars**

On-farm trials on chickpea were conducted at three sites in Kaermanshah and one in Maraghah. The results are summarised on Table 6.

At Kermanshah, ILC 482 gave the highest seed yield both in the fall and spring plantings. The entry Bivany was generally infested with Ascochyta blight.
At Maragheh, the yields were very poor for all the entries and thus trial was not concluded.
The on-farm trial on lentil was not conducted.
The on-farm work needs strengthening to arrive at certain inferences.

**Table 6. Seed yield of chickpea On-Farm Trials conducted at Kermanshah and Maragheh during autumn and spring of 1997/98 season.**

| Location | | | | | |
|---|---|---|---|---|---|
| KERMANSHAH | | | | MARAGHEH | |
| Variety | 1 (Fall) | 2 (Fall) | 3 (Spring) | Variety | SeedYield (kg/ha) |
| Biranig | 54(kg $ha^{-1}$) | 52 | 281 | JAM | 143 |
| Hashem | 757 | 376 | 17 | Hashem | 58 |
| ILC 482 | 968 | 578 | 344 | ILC 482 | 156 |
| 1260-31 | 109 | 135 | 294 | 1260-31 | 141 |

**Project 14: Evaluation of promising annual forage legumes as potential species for fallow replacement in the dry areas.**

The trials with different Vetch and Lathyrus species were conducted at various locations and the results for seed yield and sun dry biomass are summarised in Table 7.
All the trials were with 15 test entries. The results pertaining to the performance of different species at various locations are as follows:

**Ardebil** : The highest seed yield was obtained for LC, and was followed by VE, LS.

**Sararoud** : Seed yields were not recorded. VE gave highest biomass and was followed by LS and VN.

**Shirvan** : Highest seed yield was obtained for LC and was followed by VE. Other species gave very poor yield at this location.

**Maragheh** : The highest seed yield was obtained for LC, and was followed by LS, VD, VE, VN, and VS.

**Gascharan** : At this location seed yields were very high as compared to other locations. The highest seed yield was obtained for LC and was followed by LS, VN, VE, and VS.

**Kohdasht** : In general, seed yield levels were poor. Highest yield was obtained for LS and was followed by VS, VN, LO, and VD.

**Lorestan** : The highest seed yield was obtained for LC, and was followed by VS.
As these species are performing well at various locations there is need to explore the possibilities of these species for feed and forage legumes.

**Tables 7. Biomass and Grain Yield in Kg/ha for the highest seed yielding entry in each trial.**

| Trial | Shirvan | Ardebil | Sararoud | Sanandaj | Gachsaran | Maragheh | Kohdasht | Lorestan |
|---|---|---|---|---|---|---|---|---|
| **a. Biomass Yield** | | | | | | | | |
| **IVAT** | | | | | | | | |
| VS | 1354 | | - | - | 4556 | 1358 | 600 | 1905 |
| VN | 1108 | | 1166 | - | 5222 | 1667 | 774 | - |
| VE | 1300 | 1469 | 1447 | - | 4056 | 1472 | | |
| VD | - | 1354 | - | - | -3694 | 996 | - | |
| **ILAT** | | | | | | | | |
| LS | | 1243 | 1261 | - | 4722 | 1806 | 1249 | - |
| LO | - | - | | - | - | - | 445 | - |
| LC | 1267 | 1193 | - | - | 4611 | 1493 | - | 1664 |
| **b. Seed Yield** | | | | | | | | |
| **IVAT** | | | | | | | | |
| VS | 321 | - | - | - | 1378 | 341 | 367 | 492 |
| VN | 313 | - | - | - | 2024 | 374 | 298 | - |
| VE | 708 | 763 | - | - | 1663 | 465 | - | - |
| VD | 321 | - | - | - | - | 555 | 251 | - |
| **ILAT** | | | | | | | | |
| LS | - | 757 | - | - | 2250 | 767 | 553 | - |
| LO | - | - | - | - | - | - | 261 | - |
| LC | 1267 | 1193 | - | - | 4611 | 1493 | - | 1664 |

**Project 15: Drought tolerance in chickpea and lentil**

Twenty genotypes of Desi chickpea from ICRISAT and a local check variety (Pirouz) were evaluated at the Kurdistan Agricultural Research Station for tolerance to drought. Rainfed and irrigation were the two main treatments in four replications. Seed yield was assessed as gm/m$^2$. A sub-sample of plants from -- m$^2$ was used for assessing number of primary branches per plant, secondary branches per plant, No. of seeds per pod, plant height, and 100 seed weight. For days to 50% flowering the plots were visited regularly. Stress susceptibility index (SSI) was calculated involving yield of strress plot (rainfed plots) and irrigated plots. Cultivars ICCV 92944 and ICCV 94918 had low susceptibility to drought (Table 8).

**Table 8. Field evaluation of checkpea for drought tolerance, Kurdistan, 1997/98.**

| No. | Entry Name | Seed Yield (g/m$^2$) | | SSI | Yield difference (g/m$^2$) |
|---|---|---|---|---|---|
| | | Rainfed | Irrigated | | |
| 1 | ICCV 92065 | 58.7 | 115.9 | 1.037 | 572 |
| 2 | ICCV 92503 | 74.9 | 121.4 | 0.805 | 46.5 |
| 3 | ICCV 92944 | 84.1 | 119.2 | 0.619 | 35.1 |
| 4 | ICCV 93301 | 61.9 | 114.6 | 0.966 | 52.7 |
| 5 | ICCV 94911 | 57.0 | 95.5 | 0.847 | 38.5 |
| 6 | ICCV 94912 | 68.1 | 121.8 | 0.926 | 53.7 |
| 7 | ICCV 94913 | 67.0 | 115.6 | 0.883 | 48.6 |
| 8 | ICCV 94914 | 57.6 | 122.0 | 1.109 | 64.4 |
| 9 | ICCV 94916 | 50.8 | 115.1 | 1.173 | 64.3 |
| 10 | ICCv 94918 | 87.0 | 111.3 | 0.459 | 26.3 |
| 11 | ICCV 94220 | 60.3 | 111.3 | 0.963 | 53.0 |
| 12 | ICCV 94923 | 55.6 | 116.7 | 1.100 | 61.1 |
| 13 | ICCV 94924 | 51.4 | 121.4 | 1.21 | 70.0 |
| 14 | ICCV 94926 | 49.8 | 99.5 | 1.049 | 49.7 |
| 15 | ICCV 94927 | 51.7 | 107.4 | 1.089 | 55.7 |
| 16 | ICCV 4958 | 48.6 | 118.4 | 1.239 | 69.8 |
| 17 | Annigeri | 46 | 113.2 | 1.242 | 67.2 |
| 18 | ICCV 93050 | 56.4 | 89.9 | 0.783 | 33.5 |
| 19 | ICCV 93217 | 41.9 | 92.7 | 1.151 | 50.8 |
| 20 | ICCV 94202 | 46.7 | 89.7 | 1.007 | 43.0 |
| 21 | Loc Check Pirouz | 36.5 | 100.2 | 1.336 | 63.7 |

A positive and highly significant correlation was recorded between SSI and days to 50% flowering (r=0.820) and between SSI and seed yield (r=0.887) (Table 9).

***Table 9:* Correlation between different charecteristics, field evaluation of chickpea for drought tolerance, Kurdestan, 1997/98.**

| Trait | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| X1 Seed yield (I) | X1 | | | | | | | |
| X2 Seed yield (D) | 0.456* | X2 | | | | | | |
| X3 SSI | -0.002 | 0.887** | X3 | | | | | |
| X4 DF | -0.492* | -0.820** | 0.787** | X4 | | | | |
| X5 No. PB | 0.265 | 0.681** | -0.640** | -0.615** | X5 | | | |
| X6 No. SB | 0.207 | 0.828** | -0.385* | -0.395* | 0.327* | X6 | | |
| X7 Seed/pod | 0.176 | 0.417* | -0.356 | -0.253 | 0.406* | 0.194 | X7 | |
| X8 PHT | 0.283 | 0.367 | -0.278 | -0.291 | 0.299 | 0.112 | 0.252 | X8 |
| X9 100SW | 0.522** | 0.312 | -0.105 | -0.312 | 0.185 | 0.179 | 0.236 | 0.486* |

[Note: Gaps in this report to be filled-in by Mr Humayun Kanouni, the report was written after his departure and document provided by him did not have the missing information.]

**Project 16: Training and Visits:**

During the year 1997/98 the following activities for training and visits took place in Iran.

**A. Individual training at ICARDA and ICRISAT**

**ICARDA:**

Visits were made as proposed to the following units:
1 IPM training, and 1 for Legume breeding

**B. Visits of scientists From ICARDA:**

Drs. C. Akem, and R.S. Malhotra came to evaluate and discuss on-going trials at the stations. Dr. Akem also conducted as planned, extensive surveys on chickpea diseases in East and West Azarbaijan provinces with national colleagues.

# LEGUME IMPROVEMENT:- RESEARCH PLANS FOR 1998/99

## INTRODUCTION:

Legumes are important in sustainable production of food and feed in the dry lands of the Islamic Republic of Iran. They are important not only as a source of good quality protein in the diets of people and valuable as animal feed, but also in increasing and sustaining the productivity of the principal cereals by improving the soil fertility and reducing the chances of build-up of diseases, pests and obnoxious weeds. Whereas work has been going on for long, on the improvement of irrigated food legumes, work on dry-land food legumes has not been as extensive in the past.

The objective of the legume improvement work in the project is, therefore, to develop improved cultivars and crop production and protection techniques for chickpea, lentil and important annual feed legumes for different agro-ecological conditions of the dry areas of Iran. The strategy is to make use of national and exotic germplasm for improvement of tolerance to various biotic and abiotic stresses and enhance adaptation of the crop to fit into existing and new cropping systems in the dry areas of Iran. To start with, emphasis is on strengthening research at the principal research stations at Maragheh and at Kermanshah and then extending to other locations. The work planned calls for close collaboration between the breeders, agronomists, plant protection scientists and those involved in research in soil and water management. It also requires a close collaboration and strengthening of the on-going national legume improvement research program for irrigated areas and the work being carried on in other institutes.

## PROJECT 1:
## INTRODUCTION OF GERMPLASM FOR EVALUATION UNDER DIFFERENT AGRO-ECOLOGICAL CONDITIONS.

### a) Lentil:

1. Lentil International Screening Nursery- Large Seed
   Locations: Ardebil, Ghazvin, Gachsaran, Zanzan
2. Lentil International Screening Nursery- Small Seed
   Locations: Ardebil, Ghazvin, Sararood
3. Iranian Lentil Germplasm
   Locations: Shirvan (Mashhad), Ardebil
   50 top lines with tall growth habit and high yield from the lentil germplasm evaluated in 1997/98 season will be grown for seed increases for conduct of Advance Yield Trial-Lentil in 1999/2000.

### b) Chickpea:

1. Chickpea International Screening Nursery- Winter-99
   Locations: Kermanshah, Gorgan, Ilam, Shirvan, Lorestan
2. Chickpea International Screening Nursery- Spring
   Locations: Maragheh, Zanjan

3. Iranian Chickpea Germplasm
   Locations: Kermanshah (Evaluation of chickpea germplasm will depend on the availability of human resoources.

**c) Dry Pea:**
*As the area of drypea in Iran is negligible, there has been no interest for conduct of pea trial. Thus this trial will be abandoned and the only one line 88 P090-5-21 found significantly superior to the check in the Pea International Adaptation Trial-98 will be multiplied at Sararood and given to the Vegetable Department for further use.*

**PROJECT 2. Breeding for cold tolerance for autumn sowing.**

The main objective of this project is to advance the planting date from the traditional spring to autumn to increase yield through water use efficiency. The result of experiment on chickpea revealed the superiority of winter sowing over traditional spring sowing. *Three year results of chickpea will be compiled by Mr. Fraiedy and the entries which have high mean seed yield under winter sowing will be identified. These entries will also be used for ascochyta blight testing and seed increases for conduct of multilocation trial during 1999/2000.*

**Experiments:**

1. The lines found tolerant to cold in LICTN-98 and CICTN-98 will be tested for Ascochyta blight and will be evaluated for reconfirmation of cold tolerance in 1998/99. The seed of these lines will also be multiplied for yield evaluation in 1999/2000. Locations: Loristan, Sararood, and Ghazvin.
2. Lentil International Cold Tolerance Nursery -99 (LICTN-99):
   Locations: Shirvan, Ardebil, Zanzan.
3. Chickpea International Cold Tolerance Nursery 099 (CICTN-99): Locations: Loristan, Maragheh, Shirvan

**PROJECT 3. Preliminary evaluation of improved genotypes of chickpea and lentil:**

1. Entries found were statistically superior to the respective checks in different trials (from ICARDAand ICRISAT) were selected and will be used for seed increases rather than conducting Preliminary Yield Trials (PYTs). Mr. Shahab will coordinate for all the seed increases for all the selected entries in different trials in different projects. The list of the entries is available with Mr. Shahab.

**Note: in coordination meeting emphasis was laid to increase efforts to achieve this goal.**

2. The seed of desi lines received from ICRISAT should be multiplied for testing AYT in 1999/2000.

**PROJECT 4. Evaluation of Improved genotypes in replicated yield trials (A & B tests)**

The selected materials from preliminary yield trials (PYTs) will be evaluated for seed yield and other traits in replicated large plots (Design: RCB with 4 reps)

The following Advance Yield Trials (AYTs) are planned for 1998/99 season:

1. AYT Kabuli Chickpea - A test
   Locations: Sararood, Maragheh, Zanzan
   Note: Seed from Shirvan-2 lines, Kohdasht-7 lines, and Zanzan-6 lines will be sent to Maragheh for preparation of seed for Maragheh and Zanzan. Sararood will conduct the trial with their own seed.
2. AYT Kabuli Chickpea - B2 test
   Five superior entries from Shirvan, 3 from Ilam, 4 from Gachsaran will be pooled to comprise the AYT-B2 test. Gachsaran will coordinate to prepare the nursery.
   Locations: Shirvan, Gachsaran, Ilam
3. AYT Desi Chickpea - B1 test
   Ten entries from ICRISAT received earlier and 2 new superior entries from PYT-Desi-98 will comprise the B-test.
   Locations: Sanandaj
4. AYT Lentil - A test
   Two lines from Maragheh and 6 lines from Shirvan from PYT-Lentil-98 will comprise the material.
   Locations: Maragheh, Shirvan (Mashhad)
   **Note: Maragheh will coordinate.**
5. AYT Lentil- B1 Test
   Six entries from Gazvin will be sent to Maragheh, Ardebil, and Gachsaran to make trials for each location. Thus Maragheh will have 7 entries in total, Ardebil will havce 14 entries in total, and Gazvin and Gachsaran will have 7 entries each for this trial. All these locations willo add the local check.
   Locations: Maragheh, Ardebile,Gazvin, Gachsaran
6. Seed Increase for Lentil Adaptation Trial for 1999/2000:
   The seeds from 5 best entries each from B2-Test-Large seed from Ardebil, Gachsaran, Maragheh and used in sararood 1999/2000. (Total 20 entries) will be incresed in Gachsaran in 1998/99.

**PROJECT 5. National Adaptation Trial of improved genotypes of chickpea and lentil:**

**Spring chickpea:**

The adaptation Trial in chickpea has been conducted for three years. The results should be combined for three years and the best entries with aschochyta blight resistance and large seed size should be selected for testing under farmer's condition on a large scale at least at one size Oroumieh, Kermanshah, Maragheh, Ilam, and Sanandaj and seed increase should be done simultaneously for conduct of on-farm trials in 1999/2000.
Locations: Oroumieh, Kermanshah, Maragheh, Ilam, Sanandaj

**Winter chickpea:**

It will contain 14 test entries plus one check and will be grown at four sites. (This will be the

*third year* of trial). These entries should also be tested separately for Fusarium wilt and Ascochyta blight reaction by the pathology group.
Design: RCB with 4 replications.
Locations: Gachsaran, Sararood, Ilam, Gorgan

**Lentil:**

This trial will contain thirteen test entries and one check.
Design: RCB with 4 replications.
Locations: Ardebil, Shirvan, Sararood, Maragheh, Gachsaran, Zanjan, Gazvin.

Note:
1. The material at Shirvan, Sararood, Gachsaran, Gazvin should be grown both in winter and spring.
2. The seed should be multiplied for conduct of on-farm trials/large scale testing. (Dr. Malhotra should help to provide some basic seed of lentil entries for multiplication.

The entry list should be provided by from Maragheh)

**PROJECT 6.Combining desirable traits from different cultivars or lines for improvement in seed yield and other traits, and generation of new breeding materials.**

The hybridization programs involving local landraces and other lines with desirable traits were followed at Maragheh and Kermanshah. 128 putative seeds from 31 crosses at Kermanshah, and 23 putative seeds from 7 crosses at Maragheh were obtained. Because of limited success these crosses will be attempted again during 1998/99.
The crosses made at Maragheh (65 seeds of 34 crosses) were advanced and F2 will be grown this season, but those made at Kermanshah (89 seeds of 33 crosses including reciprocals) during 1996/97 were not planted as these were not handed over by the previous Legume Coordinator to Mr. Jahangiri.

**PROJECT 7. Evaluation of segregating populations for development of new genetic stocks.**

Since the local segregating populations are not yet available at any of the DARI-research station, the following segregating population nurseries for lentil and chickpea from ICARDA will be grown for selection this season.

**Lentil Breeding Materials**:
The individual plant selections made from Lentil International $F_3$ Nursery Large seed -98 were made at Ardebil, Kermanshah, Ghazvin will be grown for F4 generation at these areas.
During 1998/99 the following segregating populations nurseries will be grown for evaluation and selection of breeding materilas:
Lentil International $F_5$ Nursery Large seed -99: Ardebil, Sararood, Ghazvin.
Lentil International $F_5$ Nursery Small seed -99: Ardebil, Ghazvin
Lentil International $F_5$ Nursery Cold Tolerant -99: Ardebil, Ghazvin

**Chickpea Breeding Materials:**
The individual plant selections made from Chickpea International F4 Nursery -98 were made at Kermanshah, and Maragheh will be grown for F5 generation. During 1998/99 Chickpea International $F_4$ Nursery will be conducted at Kermanshah (Winter), Loristan (Winter), and Maragheh ( Spring) for evaluation and selection of breeding materilas.
Selections made from segregating populations at various locations during 1997/98 season will be advanced to the next generation.

**PROJECT 8. Characterization and integrated management of diseases and insect pests in various chickpea and lentil production areas in dry lands.**

**a. Characterization of Fusarium wilt pathogen isolates from major chickpea growing areas of Iran.**
Isolates will be characterized using morphological features in the laboratory and standard host differential sets under controlled conditions to race levels. This shall be undertaken as a collaborative activity between DARI and PPDRI.
Location: PPDRI and Kermanshah

**b. Study of root and collar diseases of lentil.**
(In collaboration with PPDRI).
This was planned but not carried out during in 1997/98 season and is being re-scheduled for 1998/99 season.

A survey will be conducted and samples collected from infected lentil fields in different lentil-growing areas of Iran. Lab and greenhouse characterization of causal agents will be carried out at the Plant Pest and Disease Research Institute (PPDRI).
Infected lentil plants shall be collected from fields from different parts of the country. The fungal agents shall be isolated from roots and collar regions and their pathogenicity tested on susceptible checks under greenhouse conditions. Screening for resistance to identified pathogens shall be initiated. This shall be a collaborative research activity between PPDRI and DARI.
Location: PPDRI
In charge: PPDRI pathologist (Dariush Shariari).

***Determine the potential of using animal manure and chemical fertilizers to manage root rot pathogens of chickpea under rainfed conditions:***

- Isolate and identify the major pathogens involved in the root rot complex of chickpea.
- Establish the pathogenicity of these pathogen isolates singly and in combinations under controlled conditions.
- Determine the effect of animal manure and chemical fertilizers singly and in combinations on the suppression of chickpea root rot pathogens under controlled conditions.

Location: Maragheh station
In charge: DARI pathologist (Y. Fazlali)
***Survey of pod borers, leaf miners and other important insect pests in the chickpea growing areas:***

*This* was a planned but not executed activity during the 1997/98 season.
The survey shall concentrate in Kermanshah and Maragheh areas.
In charge: N. Bahrami (Kermnshah); S.M. Hashemi (Maragheh).

***Determine the populations of pod borers on winter and spring planted chickpea:***
Eight selected chickpea varieties of both kabuli and desi types shall be used in the trial.
Location: Maragheh
Design: RCB with 3 replications
Plot size: 4 rows x 4 m long.
In charge: M. Hashemi

**PROJECT 9. Survey of *Rhizobium* and collection of strains in chickpea and lentil growing areas and evaluation for " Need for Inoculation" in lentil and chickpea.**

Microbiology work in Iran in 1997/98 was conducted with inputs/collaboration of Dr Sattari of Jehad daneshgahi Organization of Tehran University. Nodules of chickpea and lentil were collected from farmers fields. Rhizobia were isolated, purified and evaluated at the University. Based on these evaluations, three strains of chickpea were identified for field studies. Five rhizobial strains of chickpea, and a publication on visual rating of chickpea for survey of nodulation at farmers fields were sent from ICRISAT.

**A. Following two experiments will be conducted during 1998/99:**

**1. Response of chickpea to different rhizobia formulations of chickpea**
Locations: Maragheh, Sanandaj and Kermanshah

This will be a repeat of the experiment conducted at Maragheh in the spring of 1998. But it will have following changes.

i) Nitrogen will not be a treatment factor
ii) One single strain that performed well in the Experiment 3 in 1997/98 will be included as one of the level so that its performance could be compared with the three formulations (mixture of three (?) strains).

Note: Basal application of 50 kg $P_2O_5$ will be made to all treatment plots.

**2. Chickpea nitrogen fixation survey at farmers fields.**

At least 20 fields (preferably 40 fields) will be evaluated for nodulation (an indicator of nitrogen fixation) status at flowering stage in farmers fields. Farmers and any one field owned by a given farmer, will be randomly selected. Twenty plants will be sampled from each field. The selected field will be divided in four parts (to be considered as four replications) and any five plants will be uprooted from each of the four parts. These five plants should be from a given patch of land. Data from the four spots (parts) will be maintained separately and used as replications. Also, soil samples will be collected from the same four spots per field and brought to the research station for chemical analyses.

**Observations:**

a) Visual rating scale for nodulation
b) Kjehldahl-N
c) Available-P

**B. Following experiments were proposed but deffered to a later date as and when Mr H. Mahmodi returns after completing his M.Sc.**

**1. Evaluation of promising *Rhizobium* strains of chickpea**

Design: RCB with four replications
Treatments (at least nine):

Three (of Five) best strains (based on 1997/98 experiment) supplied from ICRISAT in 1998; One (or more) local strains plus all strains used in the formulations of the Experiment 1 (above)
Non-inoculated control

Note: Basal application of 50 kg $P_2O_5$ will be made to all treatments.

**2. Evaluation of promising *Rhizobium* strains of lentil**

Design: RCB with four replications
Treatments (at least seven):

Five strains supplied (will be sent to Dr Sattari) from ICRARDA (Attn. Dr R S Malhotra) in 1998/99
One (or more) local strains
Non-inoculated control

Note: Basal application of 50 kg $P_2O_5$ will be made to all treatments.

**Highlights of work accomplished in 1997/98**

**PROJECT 10: Evaluation for resistance to Ascochyta blight, Fusarium wilt and insect pests under field and controlled conditions.**

The following nurseries will be evaluated:

Chickpea International Ascochyta Blight Nursery - 98 - Kabuli ***(CIABN-A-98)***
**Location:** Farmer's field in Shabester area.
**In charge:** M. Mahdieh.

Chickpea International Ascochyta Blight Nursery - 99 (Kabuli & Desi) ***(CIABN-99).***
**Location:** Sararood station, Kermanshah

Chickpea International Fusarium Wilt Nursery-99 (CIFWN-99)
This shall be screened in potted field soil from infested farmers' fields under greenhouse conditions.
**Location:** Sararood station, Kermanshah.

*Fusarium* wilt sick plot development. The development of a Fusarium wilt sick plot shall be initiated at Sararood station in Kermanshah following procedures to be outlined by Dr. C. Akem.
**Location**: Sararood station, Kermanshah.

Evaluation of resistance in chickpea varieties to prevalent races of Ascochyta rabiei in Iran. (In collaboration with PPDRI)
Advanced and promising entries of chickpea will be evaluated against prevailing races of A. rabiei collected from different areas of Iran, under greenhouse conditions.
**Location**: Kermanshah, Gorgan and Gachsaran
**In charge**: PPDRI and DARI pathologists.

Evaluation of chickpea genotypes for tolerance to pod borer (Heliothis spp.)
Twenty eight kabuli and desi type chickpea genotypes from different sources planted in winter shall be evaluated for their tolerant reactions to pod borers under field conditions.
**Location**: Maragheh
**Design**: RCB (Factorial) with 3 replications.
**Plot size**: 4 rows x 4m long .
**In charge**: M. Hashemi.

**PROJECT 11. Management of weeds in chickpeas and lentils.**

Two separate weed control trials developed for chickpea and lentil will be conducted. In addition to the previous chemicals used, Linurex will also be included as an additional treatment.

**1.Lentil Weed Control Trial:**
**Locations:** Maragheh and Ardebil
**Note**: Lantagran as post-emergence herbicide shall be included in the herbicide treatments.

**2.Chickpea Weed Control Trial:**
**Locations:** Maragheh, Gorgan and Oroumieh
**Note:** Economic analyses of various weed control treatments shall also be done.

There is need to continue to identify and screen herbicide for weed control in legume crops (Dr Rajabi's guidance will be requied).

**PROJECT 12. To determine suitable dates of planting, plant densities and seeding depths in chickpea and lentil for maximum seed yields under different growing conditions.**

This trial shall be conducted with seeding depths of 5 and 10 cm. Discussion on the conduct of this trial with respect to mechanization of sowing was held and it was decided to conduct this trial by machine and plot size changed. Longer row lengths and more numbers of rows were proposed. Mr. Eskandari shall help in the conduct of this trial.
For 1998/99 this trial shall be conducted at one location, Kermanshah.

**Treatments:**
**Dates of planting:** Autumn, Entzari, Spring
**Plant density (per $m^2$):** 13,26,33,45
**Seeding depth (cm):** 5, 10
**Variety:** ILC 482

**PROJECT 13. On-farm evaluation of improved chickpea and lentil cultivars**

The On-Farm Trial for winter sowing should be conducted only at mild winter environments.

Chickpea on Farm Trial-A:

**Entries:** JAM, 12-60-31, ILC482, Hashem (FLIP 84-48C)
**Sowing dates:** Autumn
**Experimental design:** RCB with 4 reps.
**Plot size:** 12 rows 10 m long per entry.
**Population density:** 33 seeds/$m^2$
**Fertilizer:** 100 kg DAP/ha
**Herbicide:** Fortrol or Turbutryne as pre-emergence and fusilade as post emergence.
**Method of planting:** Machine planting
**Locations:** 4 farmer's fields and one research station field in Kermanshah

**PROJECT 14. Evaluation of promising annual forage legumes as potential species for fallow replacement in the dry areas.**

The promising entries from different International Adaptation Trials conducted during 1997/98 will be used for advanced yield trials at different locations:

A.From International Vetch Adaptation Trial -98 (IVAT-98)

IVAT - *Vicia sativa*
Locations: Maragheh, Sanandaz, Loristan, Gachsaran, Shirvan
IVAT - *Vicia narbonensis*
Locations: Maragheh, Shirvan, Kermanshah, Sanandaj, Gachsaran
IVAT - *Vicia ervillia*
Locations: Maragheh, Ardebil, Shirvan, Kermanshah, Gachsaran
IVAT - *Vicia dasycarpa*
Locations: Maragheh, Sanandaj, Shirvan

**B. From International *Lathyrus* Adaptation Trial-98 (ILAT-98)**
ILAT - *Lathyrus sativus*
Locations: Ardebil, Maragheh, Sanandaj, Gachsaran, Kermanshah
ILAT - *Lathyrus cicera*
Locations: Maragheh, Ardebil, Gachsaran, Shirvan, Loristan
ILAT - *Lathyrus ochrus*
Locations: Sanandaj

The following new nurseries will be conducted the different locations mentioned as under:
A. International Vetch Adaptation Trial -99 (IVAT-99)

1. IVAT - *Vicia sativa*-99
Locations: Sanandaj, Ardebil
IVAT - *Vicia narbonensis*
Locations: Ardebil, Sanandaj
IVAT - *Vicia ervillia*
Locations: Sanandaz, Ardebil

**B. International *Lathyrus* Adaptation Trial-99 (ILAT-99)**

ILAT - *Lathyrus sativus*
Locations: Maragheh, Sanandaj

**PROJECT 15. Drought tolerance in chickpea and lentils**

The sources of resistance to drought will be evaluated under Iranian conditions.
Chickpea Drought Tolerance Nurseries:

**ICRISAT MATERIALS:**
The promising drought tolerant lines from 1997/98 experiment conducted at Kurdistan along with 5 new entries from ICRISAT (tolerant to Fusarium wilt and drought) will be tested for drought tolerant at Kurdistan. Dr. Rupela will arrange to send 5 new lines to DARI.

**ICARDA MATERIALS:**
The promising drought tolerant lines selected on the basis of drought tolerance score and early vigour will be used to reconfirm the sources.
Locations: Zanjan, Shirvan

**PROJECT 16. Training needs for DARI:**
**A. Individual training:**

At ICARDA:
Legume Pathology -2 (1 to15 May)
Legume entomology - 1 (1 to 15 May)
Chickpea breeding - 2 (1-31 May)
Lentil Breedig-2 (1-31 May)
Forage Breeding - 2 (1-31 may)
Mechanisation-1 (one week)

**At ICRISAT:**
Microbiology - 1 (2 Months, Jan-Feb)
IPM of insects - 1 (2 Months, Between Nov. and Feb)
B. Visit of Scientists:

**ICARDA:**
C. Akem: IPM Research planning with PPDRI and station trials visit
(Early June - 10 days).

K. Makkouk: IPM Research planning with PPDRI
(Early June - 1 week)

A.A. Moneim: Feed legume evaluation
(First week of June - 1 week)

R.S. Malhotra Lentil and chickpea trials evaluations
(Second week of June - 10 days)

**ICRISAT**
N.P. Saxena Drought tolerance
(Second week of June - 10 days)

Problems encountered during the 1997/98 crop season and suggested solutions:

- Kermanshah which is made as the main center of legume improvement research is very weak even in basic facilities (both human resources and laboratories), needs special attention
- Major problem faced during the season was lack of human resources for On-farm evaluation.
- Need for green/plastic house and rain shelters at Kermanshah and Maragheh,
- Immediate need for substitute of Mr.Sabhagpur.
- Immediate and urgent need for English training for Legume Staff of DARI.
- The mechanization of planting for research experiments should be addressed quickly to
- Increase the efficiency and efficacy.
- Plot planters and harvesting equipment need special emphasis.
- Seed counters should be purchased

## *III.* Oilseed Crops Improvement

### INTRODUCTION

The total edible oil requirement of Iran is approximately 850,000 tons annually. The self-sufficiency level of this important food ingredient is only 12-15%. The preliminary studies carried out to investigate the possibility of increasing domestic oilseed production have been very encouraging and showed tremendous potential of growing various oilseed crops in different ecological regions. At present total area under oilseed crops is 219000 ha out of which only 81500 ha are in the dryland areas. The possibility of increasing area under oilseed crops in the irrigated region is limited due to scarcity of water. However, in the rainfed regions a very large hectarage of cultivated area is kept as fellow, therefore, there is considerable potential to increase area under oilseed crops if suitable crop varieties and production technology developed for different agro-ecological region.

Traditionally, six oilseed crops, i.e., sunflower, safflower, rapeseed, soybean, sesame and groundnut are grown in Iran. However, out of these six crops, only the first three seem to hold promise in the dryland areas.

Sunflower (*Helianthus annuus* L.): Due to non-availability of suitable varieties and lack of production technology the average yield is only 350 kg/ha. Because of this un-economical yield only 500 ha of sunflower are grown in the dryland areas of Iran.

The research on the identification of suitable oilseed varieties and develop a package of production practices to realize economical yields of sunflower, safflower and rapseed has been underway at Dryland Agricultural Research Institute's research stations in different ecological regions for the last three years. The research results of this endeavor are briefly described and discussed in the following pages.

### SUMMARY OF ACHIEVEMENTS DURING 1997-98

During the last three years the research efforts have been geared to develop genetic stocks of sunflower varieties through single plant selections and selfing out of heterogeneous populations of: cv. Record, Prodovik, Armavirsky, Progress, Zaria, Armavires and Vinimik 8931. The seeds of the best single plant populations will be multiplied and yield tested in the coming years.

**Agronomic performance of elite sunflower varieties under dry farming conditions.**
Twelve improved varieties of sunflower were tested at Gachsaran, Sararood and Maragheh for their seed yield and other agronomic characteristics. The data from Gachsaran and Sararood are presented in Table 1. The seed yield ranged from 674 kg/ha (Vinimik 8931) to 1197 kg/ha (cv. AS-503) at Gachsaran. Five varieties yielded more than a ton/ha. From the data it appears that the two top yielding lines, i.e. AS-503 and Chernianka (1168 kg/ha) had 1000 seed weight of 44 and 45 gms, and matured in 160 and 149 days, respectively. Both these varieties had similar head size, and stem diameter but different in plant height, leaves/plant, days to flowering and maturity. It seems that high yield in variety Chernianka is due to its drought escape or tolerance because it had less number of leaves/plant and was the earliest maturing variety among all the tested lines.

**Table 1: Agronomic performance of elite sunflower varieties at Gachsararn, Sararoud, 1997-98.**

| Gachsaran | | | | | | | | | | Sararoud |
|---|---|---|---|---|---|---|---|---|---|---|
| Ent. | Variety | PH | HD | SD | L/P | DF | DM | TKW | Yield | Yield (kg/ha) |
| 1 | Gabour | 183 | 12.6 | 20 | 33 | 158 | 181 | 32 | 949 | 710 |
| 2 | Louch | 155 | 12.4 | 17.2 | 32 | 151 | 180 | 29 | 932 | 738 |
| 3 | Record | 167 | 12.8 | 17.8 | 30 | 154 | 183 | 34 | 843 | 542 |
| 4 | Progres | 134 | 13 | 17.5 | 25 | 126 | 154 | 44 | 1053 | 478 |
| 5 | Chernianka | 92 | 13 | 15.7 | 20 | 125 | 149 | 46 | 1168 | 487 |
| 6 | Armaverisky | 166 | 12.1 | 14.8 | 34 | 158 | 182 | 37 | 776 | 706 |
| 7 | Azar Gol | 136 | 12.1 | 15.2 | 23 | 123 | 156 | 52 | 832 | 830 |
| 8 | Zaria | 146 | 12.8 | 16.8 | 25 | 129 | 161 | 46 | 1018 | 556 |
| 9 | Vinimik 8931 | 163 | 10.7 | 15.3 | 32 | 161 | 182 | 31 | 674 | 807 |
| 10 | Golshid | 101 | 10 | 12 | 17 | 122 | 154 | 46 | 743 | 945 |
| 11 | AS-503 | 118 | 13.1 | 15.8 | 30 | 130 | 160 | 44 | 1197 | 748 |
| 12 | AS-508 | 132 | 13 | 17.5 | 28 | 140 | 173 | 43 | 1003 | 808 |
| **CV%** | | | | | | | | | **18.1** | **22.0** |
| **LSD at 5%** | | | | | | | | | **245** | **216** |

PH= Plant Height; HD= Head Diameter (cm); SD= Stem Diameter mm); L/P= No. of Leaves per Plant; DF= Days to Flowering; DM= Days to Maturity; TKW= Thousand Kernal Weight; Yld= Yield (kg/ha); Varieties Nos. 11 and 12 at Sararoud were Perdovic and Vinik 640.

From these data it appears that there is high potential to increase sunflower production in Gachsaran region.

This trial was also conducted at Sararood. However, the varieties which toped at this location were Golshid, Azargol, Vinimik 6540 and Vinimik 8931 with yield of 945, 830, 808 and 807 kg/ha, respectively. None of the high yielding varieties gave high yield at both the locations indicating specific adaptability of these varieties. However, some of the varieties such as Azergol, Zaria had similar yield indicating their wider adaptation but were not the highest yielding varieties. The top yielding line Chernianka at Gachsaran (1168 kg/ha) was the lowest yielding at Kermanshah (487 kg/ha). This is most probably due to earliness, heat and drought tolerance at Gachsaran where as at Kermanshah it might have suffered due to low temperature. Therefore, to obtain high yield it is suggested that germplasm with diverse genetic make up should be evaluated in different ecological regions to identify suitable varieties for each region.

**Effect of planting time on the performance of sunflower**

To study the effect of planting time on the seed yield and yield components of sunflower an experiment was conducted at Gachsaran by using two cultivars: Zaria and Azargol. Three planting dates as mentioned in Table 2 were used. The data on yield and agronomic traits are presented here. Highly significant yield of 1304 kg/ha was obtained in variety Azargol when planted on December 8. Both the varieties, Zaria and Azargol, also gave high yields of 1248 and 1128 kg/ha, respectively when planted on November 22 which was not statistically different from the highest yielding treatment i.e., Dec. 8 for Azargol.

**Table 2. The effect of planting date on the yield and yield component of sunflower, 1997/98.**

| No. | Variety | Sowing | PH | HD | SD | L/P | DF | DM | TKW | Yield | Class |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Zaria | 22-11-97 | 83 | 12 | 9.8 | 22 | 137 | 165 | 46 | 1248 | AB |
| 2 | Zaria | 8-12-97 | 80 | 10.1 | 10.5 | 24 | 122 | 148 | 39 | 993 | B |
| 3 | Zaria | 22-12-97 | 88 | 9.8 | 11 | 24 | 130 | 155 | 30 | 980 | B |
| 4 | Zaria | 8-1-98 | 103 | 9.5 | 8.7 | 27 | 122 | 144 | 21 | 483 | C |
| 5 | Azargol | 22-11-97 | 82 | 10.7 | 11 | 19 | 135 | 163 | 55 | 1128 | AB |
| 6 | Azargol | 8-12-97 | 79 | 10.3 | 9 | 18 | 119 | 147 | 51 | 1304 | A |
| 7 | Azargol | 22-12-97 | 88 | 11.8 | 11.1 | 22 | 133 | 154 | 38 | 995 | B |
| 8 | Azargol | 8-1-98 | 95 | 10.5 | 8.5 | 25 | 121 | 141 | 30 | 612 | C |
| CV (%) | | | | | | | | | | 17.9 | |
| LSD at 5% | | | | | | | | | | 254.7 | |

In the subsequent late planting treatments a linear decrease in seed yield of both the varieties was observed when the planting was delayed. The data on yield component indicate that in the early planting dates, i.e. November and early December the 1000 seed weight was the highest. In late planting the seed weight decreased linearly. Other agronomic traits were not effected significantly, except in variety Zaria, the plant height increased when planted very late (January 8). The plant height in variety Azargol was also increased in the late planting.

From these studies it can be concluded that to obtain highest yield of sunflower the best planting time is late November to early December.

Studies on the effect of row spacing and plant density on the agronomic performance of sunflower.

To determine the appropriate row to row ( R ) spacing and plant to plant (P) distance in realizing the optimum yield in sufflower an experiment was conducted at Gachsaran and Sararood Agricultural Research Stations. Two row spacings (50 cm and 75 cm) and four treatments of plant to plant distance, i.e., 20, 25, 30, 35 cm were used. The varieties employed were cv. Progress in Gachsaran and cv. Record in Sararood. The data from both the stations are summarized in Table 3. The highest yield of 1072 kg/ha in Gachsaran was obtained from R=50cm-P=20cm treatment followed by R=75-P=20 cm- (972 kg/ha) and R=50-P=35 cm (962 kg/ha). There was linear decrease in yield in treatments with bigger row spacing (75 cm) and increased plant to plant distance. However, in Sararood the highest yield of 786 kg/ha was realized in 75-20 cm treatment, followed by 735 kg/ha in row spacing of 50 cm, and plant to plant distance of 30 cm. No major differences in other agronomic traits were observed.
From these studies it can be concluded that row to row spacing of 50 and 75 cm with plant to plant distance of 20 cm are the best for obtaining the highest yield.

**Table 3: The effect of row spacing and plant density on the agronomic traits of sunflower.**

| Ent. | Treatment | PH | HD | SD | L/P | DF | DM | TKW | Yield (kg/ha) |
|---|---|---|---|---|---|---|---|---|---|
| **A. Gachsaran** | | | | | | | | | |
| 1 | 50-20 | 115 | 12 | 8.7 | 21 | 103 | 132 | 39 | 1072 |
| 2 | 50-25 | 106 | 11 | 10.3 | 23 | 106 | 134 | 39 | 828 |
| 3 | 50-30 | 104 | 11 | 10.9 | 21 | 106 | 134 | 46 | 655 |
| 4 | 50-35 | 112 | 14 | 10.1 | 23 | 105 | 132 | 47 | 962 |
| 5 | 75-20 | 114 | 14 | 10.8 | 25 | 105 | 131 | 49 | 972 |
| 6 | 175-25 | 106 | 11 | 11.1 | 25 | 105 | 132 | 46 | 567 |
| 7 | 75-30 | 110 | 14 | 12.8 | 23 | 105 | 131 | 44 | 568 |
| 8 | 75-35 | 114 | 13 | 10.3 | 23 | 107 | 134 | 50 | 536 |
| CV (%) | | | | | | | | | 18.0 |
| LSD at 5% | | | | | | | | | 203 |
| **B. Sararood** | | | | | | | | | |
| 1 | 75-20 | 128 | 9 | 15 | 23 | 106 | | 36 | 786 |
| 2 | 75-25 | 127 | 10 | 20 | 25 | 105 | | 35 | 681 |
| 3 | 75-30 | 126 | 10 | 14 | 30 | 107 | | 47 | 596 |
| 4 | 75-35 | 133 | 12 | 17 | 28 | 106 | | 40 | 539 |
| 5 | 50-20 | 125 | 8 | 14 | 24 | 107 | | 35 | 491 |
| 6 | 50-25 | 129 | 10 | 16 | 29 | 106 | | 39 | 592 |
| 7 | 50-30 | 119 | 11 | 15 | 28 | 107 | | 40 | 735 |
| 8 | 50-35 | 131 | 11 | 15 | 27 | 106 | | 42 | 699 |
| CV (%) | | | | | | | | | 18.1 |
| LSD at 5% | | | | | | | | | 169 |

PH= Plant Height, HD= Head Diameter (cm), SD= Stem Diameter (mm), DF= Days to Flowering, DM= Days to Maturity, TKW= Thousand Kernel Weight (gms).

Effect of supplementary irrigation on sunflower yield.

Sunflower is normally planted in early spring in dryland areas when the temperature is still low. By the time the temperature start rising in late spring and early summer (end May) the rains stop and the crop has to complete its life cycle on residual moisture. The crop, therefore, is assumed to suffer seriously due to drought from flowering to maturity. An experiment was carried out to determine the effect of supplementary irrigation on the performance of three sunflower varieties: Armavirесky, Zaria and Azargol with three irrigation treatments: 1. No. irrigation-check, 2. irrigation at flowering, 3. Irrigation at the end of flowering.

All the three varieties responded differently to the supplementary irrigation. Variety Armavirесky gave the highest yield when irrigated at the end of flowering; where as cv. Zaria and cv. Azargol gave the highest yields of 1174 kg and 1578 kg/ha, respectively, without irrigation.

**SAFFLOWER**

Agronomic Performance of Safflower Varieties in Regional Yield Trial.

Twenty best varieties selected during the previous years were evaluated in the Regional Yield

*Trials along* with two check cultivars in Gachsaran and Sararood. Though a large number of lines/varieties significantly surpassed in yield as compared to check No. 967 but the data on agronomic performance of top seven lines/varieties from each location are presented in Table 4.

**Table 4: Characteristics of five top yielding safflower varieties in the Regional Yield Trial, 1997-98.**

| Ent. No. | Variety | Origin | PH (cm) | HP (No.) | SH (No.) | DF | DM | TKW (gm) | Yield (kg/ha) |
|---|---|---|---|---|---|---|---|---|---|
| **A. Gachsaran** | | | | | | | | | |
| 6 | Cyprus Local | Cyprus | 133 | 16 | 30 | 144 | 1174 | 42 | 1281 |
| 17 | P1 301055 | Turkey | 136 | 16 | 33 | 140 | 175 | 40 | 1280 |
| 19 | P1 537598 | USA | 135 | 17 | 44 | 140 | 176 | 37 | 1170 |
| 21 | Syrian Hama | Syria | 126 | 13 | 52 | 137 | 171 | 52 | 1169 |
| 18 | Syrian-1 | Syria | 140 | 12 | 39 | 137 | 171 | 40 | 1140 |
| 4 | Gila | USA | 131 | 14 | 54 | 145 | 178 | 35 | 1140 |
| 14 | P1 251982 | Turkey | 142 | 14 | 42 | 139 | 174 | 37 | 1101 |
| 22 | No. 967-Check | | 141 | 11 | 32 | 145 | 178 | 31 | 588 |
| Range in yield= 436-1281 kg/ha | | | | | | | | | |
| CV% | | | | | | | | | 16.7 |
| LSD at 5% | | | | | | | | | 236 |
| **B. Sararood** | | | | | | | | | |
| 16 | P1 301055 | Turkey | 56 | 8 | 16 | 88 | 203 | 36 | 1417 |
| 18 | P1537598 | USA | 49 | 7 | 15 | 85 | 199 | 36 | 1343 |
| 14 | P1 251984 | Turkey | 52 | 10 | 18 | 87 | 204 | 38 | 1269 |
| 13 | P1251982 | Turkey | 54 | 8 | 17 | 85 | 200 | 43 | 1255 |
| 20 | Syrian Hama | Syria | 54 | 8 | 20 | 85 | 201 | 38 | 1248 |
| 15 | P1 258417 | Portugal | 52 | 9 | 16 | 89 | 203 | 34 | 1218 |
| 17 | Syrian 1 | Syria | 55 | 9 | 20 | 87 | 201 | 35 | 1222 |
| Range in yield= 926-1417 kg/ha | | | | | | | | | |
| CV % | | | | | | | | | 13.4 |
| LSD at 5% | | | | | | | | | 246 |

PH= Plant height, HP= Heads/Plant, SH= Seeds/Head, DF= No. of Days to Flowering, DM= Days to Maturity.

A very large amount of genetic variability was observed among the tested varieties at Gachsaran as the yield ranged from 436 kg to 1281 kg/ha in the tested varieties. On the other hand the range in yield at Sararood was much less, i.e., from 926 kg to 1417 kg/ha among the tested varieties. A number of varieties which gave low yield at Gachsaran but not at Sararood is probably due to their winter growth habit and cold requirement which could not be fulfilled at Gachsaran because of warm climate during the growing period. Therefore, it is suggested to classify the safflower germplasm for its growth habit and only spring type varieties should be evaluated in warm regions. However, it is very interesting to observe that out of seven top yielding lines/varieties at both the locations, five were top yielders at both the test sites indicating the wide adaptability of those varieties. Interestingly four top yielding lines originated from Turkey and Syria from areas very similar to Gachsaran and Sararood.

The plant height at Sararood was considerably reduced for all the varieties as compared to Gachsaran. The difference can be attributed to much longer growing period and high rainfall at Gachsaran as compared to Sararood. At Sararood the growth of the plants stops during winter months due to low temperature, which is not the case at Gachsaran.

From these studies it is obvious that there are a number of safflower varieties with high yield potential, wide adaptation which can be grown commercially by the farmers.

**Evaluation of safflower Observation Nurseries:**

Two sets of Safflower Observation Nurseries (SON) were obtained from ICARDA comprising of 85 and 150 entries each, which were planted at Gachsaran and Sararood, respectively. In the SON planted at Sararood the first 85 entries were the same as in Gachsaran.

**Table 5: Yield and Thousand Kernel Weight of top yielding varieties/lines out of Safflower Observation Nursery, 1997-98.**

| Gachsaran | | | | Sararood | | | |
|---|---|---|---|---|---|---|---|
| Ent. No. | Variety | TKW | Yield | Ent. No. | Variety | TKW | Yield |
| 15 | S-541.2 | 40 | 4540 | 1 | Dinger 118 | 36 | 4680 |
| 1 | Dinger 118 | 39 | 4420 | 24 | World Balk | 39 | 3900 |
| 20 | Syrian | 47 | 4300 | 105 | Unknown | 23 | 3700 |
| 6 | Dinger | 42 | 3820 | 11 | Lesaf-14 | 35 | 3500 |
| 30 | 252041(PAK) | 37 | 3620 | 51 | 250842 | 32 | 3350 |
| 3 | 307060(PAK) | 39 | 3140 | 40 | 250187 | 37 | 3300 |
| 17 | S-541 | 34 | 3000 | 28 | 250835 | 43 | 3200 |
| 60 | 253564(POR) | 41 | 2960 | 31 | 198290 | 42 | 3150 |
| 24 | World Balk | 37 | 2960 | 15 | S-541-2 | 32 | 3150 |
| 33 | 199885(IND) | 43 | 2900 | 16 | 5209-C | 33 | 3150 |
| 35 | 199886 (IND) | 40 | 2740 | 7 | Gila | 38 | 3120 |
| 46 | 250496 (PAK) | 36 | 2720 | 19 | Sind-DH | 39 | 3050 |
| 50 | 250840 (IRN) | 38 | 2620 | 58 | 253522 | 38 | 2950 |
| 75 | 407610 (TUR) | 45 | 2620 | 56 | 251988 | 35 | 2900 |
| 85 | Syrian-II | 40 | 2620 | 59 | 253528 | 33 | 2900 |
| Total Entries: 85<br>Yield range: 680 –4540 kg/ha | | | | Total Entries: 150<br>Yield range: 200-4680 kg/ha | | | |

The entries were planted in one meter rows with 50 cm spacing between rows. The plot yield was converted on hectare basis. Though a very large number of entries were found to be excellent in their agronomic traits, but for brevity of space the data on thousand kernel weight (gm) and yield of the top 15 entries from each location are presented in Table 5. The yield of all the tested entries ranged from 680-4540 kg/ha and 200-4680 kg/ha, at Gachsaran and Sararood, respectively.

The yield of the top 15 lines/varieties ranged from 2620-4540 kg/ha at Gachsaran; and 2900-4680 kg/ha at Sararood.

During the next crop season the best entries will be yield tested in replicated trials and others will be further evaluated in preliminary yield trials.

## Rapeseed

Effect of initial irrigation on the performance of rapeseed varieties.

Eight winter type varieties of rapeseed were employed to determine their agronomic performance by planting them in fall. Due to late start of rains in fall the experiment was irrigated at the time of planting to get the seeds germinated before the start of winter, so that the vernalization and cold requirement of the test varieties can be met.

The data on plant height (PH), Pods/Plant (P/P), No. of Days to Maturity (DM), Seeds Per Pod (S/P), Thousand Kernel Weight (TKW) and Yield (kg/ha) were recorded.

The mean data from four replications are summarized in Table 6. Variety Bronor gave significantly high yield of 2085 kg/ha. Though five other varieties, i.e. Regent (1806 kg), Cobra (1865 kg), Blinda (1846 kg), Ceres (1760 kg) and Diadm (1813 kg/ha) were statistically at par with cv. Bronor but their yield was 10.6% to 15.6% less. No major differences among varieties in other agronomic characteristics were observed except the number of pods/plant in variety Bronor was the highest. It seems the number of pods/plant play a major role in overall seed yield of a rapeseed variety.

In dryland farming the yield is normally less than one ton/ha. This remarkable increase in yield with one initial irrigation is highly economical. The initial irrigation gave a good start to the crop before the winter and the total crop growth period gets extended which results in high yields. In other experiments on planting date it was also observed that when the sowing is delayed after November, a linear decrease in yield occurs. Therefore, early sowing with one initial irrigation, where winter rains start late, is very useful to obtain high yield.

**Table 6: The agronomic characteristics of rapeseed varieties when irrigated at the time of planting at Sararood, 1997-98.**

| No. | Variety | F.P | PH | P/P | DM | S/P | TKW | Yield | Class |
|---|---|---|---|---|---|---|---|---|---|
| 1 | OLYMP | 28.75 | 109.8 | 64.5 | 240.8 | 21.5 | 4.74 | 1348 | CD |
| 2 | QUALITY | 26.75 | 114.0 | 95.3 | 250.0 | 17.8 | 4.09 | 1133 | D |
| 3 | RECENT | 28.50 | 119.8 | 91.5 | 245.8 | 24.3 | 3.14 | 1806 | AB |
| 4 | COBRA | 25.25 | 107.8 | 58.0 | 247.8 | 24.5 | 4.05 | 1865 | AB |
| 5 | BLINDA | 26.25 | 112.0 | 72.8 | 246.0 | 22.5 | 3.65 | 1846 | AB |
| 6 | SERES | 25.50 | 109.0 | 57.0 | 247.3 | 24.5 | 3.39 | 1760 | AB |
| 7 | DARMOR | 26.00 | 106.0 | 95.5 | 247.5 | 25.8 | 3.19 | 1677 | ABC |
| 8 | GLOBAL | 26.75 | 104.0 | 68.0 | 245.3 | 24.0 | 3.52 | 1629 | BC |
| 9 | BRONOR | 28.50 | 115.8 | 102.3 | 245.0 | 23.3 | 3.63 | 2085 | A |
| 10 | DIADM | 24.75 | 112.5 | 49.0 | 249.0 | 26.0 | 3.42 | 1813 | AB |
| CV (%) | | | | | | | | 15.1 | |
| LSD at 5 % | | | | | | | | 373 | |

**Evaluation of exotic rapeseed and mustard germplasm at Sararood, 1997-98.**

Fourteen varieties of rapeseed and mustard procured from Canada (Agri. and Food Agri.Canada, Genebank, Saskatoon) were evaluated in an observation nursery at ARS-Sararood in an un-replicated trial with $3m^2$ plot size. The data on: days to maturity (DM), seeds/pod (S/P), pods/plant (P/P), plant height (PH), thousand kernel weight (TKW in gm) and yield/plot (gm) were recorded and presented in Table 7.

**Table 7: performance of exotic rapeseed and mustard germplasm at Sararood, 1997-98.**

| No. | Variety | COMM.NAME | DM | S/P | P/P | PH | Yield | TKW |
|---|---|---|---|---|---|---|---|---|
| 1 | LETHBRIDGE22A | Oriental, Mustard | 249 | 15 | 114 | 118 | 800 | 2.98 |
| 2 | TORCH | Low Erucic Rapeseed | 243 | 15 | 63 | 88 | 290 | 2.12 |
| 3 | MIDUS | Low Erucic Rapeseed | 241 | 19 | 85 | 99 | 590 | 4.10 |
| 4 | AC PARKLAND | CANOLA | 242 | 23 | 115 | 98 | 280 | 2.78 |
| 5 | LANDRACE | BROWN MUSTARD | 249 | 17 | 91 | 96 | 730 | 2.42 |
| 6 | AC VULKAN | ORIENTAL, MUSTARD | 249 | 16 | 151 | 128 | 1290 | 2.46 |
| 7 | AC ELECT | CANOLA | 241 | 22 | 116 | 62 | 400 | 2.88 |
| 8 | WESTAR | CANOLA | 244 | 15 | 48 | 87 | 320 | 3.86 |
| 9 | CUTLASS | ORIENTAL MUSTARD | 249 | 14 | 109 | 122 | 850 | 2.44 |
| 10 | GOLDEN | RAPESEED | 241 | 22 | 47 | 75 | 370 | 3.72 |
| 11 | ECHO | RAPESEED | 242 | 17 | 101 | 80 | 500 | 2.14 |
| 12 | BLIND A | RAPESEED | 251 | 21 | 107 | 103 | 630 | 3.02 |
| 13 | AC EXCEL | CANOLA | 241 | 20 | 84 | 110 | 650 | 2.90 |
| 14 | TOBIN | CANOLA | 243 | 21 | 80 | 68 | 590 | 2.30 |

The mustard varieties; AC Vulcan (1290 gm), Cultass (850 gm), Lethbridge -22A (800 gm) and Landrace (730 gms/plot) gave the highest yields. The rapeseed (Canola) varieties were low yielding as compared to mustard under the dryland conditions of Sararood. It seems that mustard is more suitable to conditions where moisture stress is prevelant, as compared to rapeseed.

**Rapeseed Observation Nursery (RON), 1997-98.**

A large number of varieties/lines from different countries were first evaluated at ICARDA-Tel-Hadya for their different agronomic traits. The selected 38 lines/varieties were included in RON for regional testing. Two sets of RON were planted at Sararood and Gachsaran for their agronomic evaluation and yield performance. A number of entries were observed to possess good agronomic traits. Those selected varieties will be further evaluated at both the locations in the coming years.

## *Oilseed* Crops Improvement- Reseach plan for 1998/99

## INTRODUCTION

Edible oil is an important food item for Iranian families. In Iran the per capita consumption of edible oil is 14 kg and the annual requirement of edible oil is about 850000 tons. The consumption requirement of edible oil is rising rapidly at a rate of 8-9 percent annually. The local production of edible oil is about 12-15% of the total requirements. Iran imports about 700,000 tons of edible oil and a large quantity of oil cake to feed the animal), at a cost of more than US$ 900 millions.

The total cultivated area under oilseeds in Iran is about 210,000 ha, (82,000 ha in dryland areas and 118,000 ha in irrigated conditions).

Major oilseed crops grown are: Sunflower (*Helianthus annuus*) (105000 ha), Soyabean (*Glycine, max*), Sesame (*Sesamum indicum*) rapeseed (*Brassica napus*) Groundnut (*Arachis hypogean*). Soybean, Groundnut and Sesame are cultivated only under irrigation but sunflower, rapeseed and Safflower are cultivated under irrigated and dryland conditions. About 80% of Sunflower cultivated area is in dryland. Sunflower and rapeseed has a small cultivated area in dryland. The total area and production under oilseeds in Iran is given in Table 1.

The major factors limiting production of oilseed of crops under dryland farming are abiotic stresses such as drought and cold in winter planting. Among the biotic stresses diseases and insects effect oilseed crops adversly. Important diseases in Sunflower are plasmopara (*Plasmopara helianthi*), (*Sclerotinia scleroto*) and important pest is *Agrotis spp.*

Safflower does not have important disease but important pest is safflower fly (*Acanthiophilus helianthi*) and *Oxythyrea, cinctella.*

**Table 1. Area and production of oilseed crops in Iran.**

| Crops | Area (ha) | | | Production (tons) | | |
|---|---|---|---|---|---|---|
| | Irrigated | Rainfed | Total | Irrigated | Rainfed | Total |
| Sunflower | 25000 | 80000 | 105000 | 30000 | 32000 | 62000 |
| Safflower | 1500 | 500 | 2000 | 2500 | 350 | 2850 |
| Rapeseed | 9000 | 1000 | 10000 | 14000 | 7000 | 21000 |
| Soybean | 80000 | - | 80000 | 110000 | - | 110000 |
| Seasame | 20000 | - | 20000 | 10000 | - | 10000 |
| Grounnut | 2000 | - | 2000 | 14000 | - | 14000 |
| Total | 137500 | 81500 | 219000 | 170500 | 39350 | 209850 |

**Other Constraints of oilseed production in dryland:**

- Lack of oilseed improved varieties for dryland farming.
- Lack of production technology- traditional cultivation practices.
- Lack of cold tolerant sunflower varieties for early spring planting.
- Bird damage in sunflower.
- Shattering in rapeseed.
- Lack of cold tolerant rapeseed varieties for winter planting in dryland farming.

**Statement of objectives:**

1. To develop new sunflower, rapeseed and safflower varieties with better yield and oil content for different dryland regions of Iran.

2. To investigate the biotic (diseases and insects) and abiotic (environmental) stresses depressing the productivity of oilseed crops.

3. To develop an improved package of production practices for the farmer.

The research plan presented in the following pages in intended to achieve the aformentional objectives.

## I. SUNFLOWER

**Title 1: Develop genetic stocks of sunflower for drought tolerant hybrids and varieties.**

**Objectives:** Produce parental genetic material for sunflower breeding.
**Locations:** Sararood, Gachsaran.
**Planting Mehod:** Selected heads from rows will plant in one or two rows and the best plants will be select and self to produce the $S_4$ generation.
**Fertilizer:** N50 and $P_2O_5$ 30 kg/ha

**Title 2: The effect of supplementary irrigation and time of irrigation on sunflower seed yield.**

**Objectives:** Determine the best time of supplementary irrigation in sunflower.
**Locations:** Sararood, Gachsaran.
**Design:** Factorial in R.C.B.D. with 4 rep.
**Treatments** i - Irrigation at the begining of flowering.
ii - Irrigation at the end of flowering.
iii - Without irrigation .
**Varieties:** Gachsaran, Armavirisky, Chernianka, Zaria, Sanandaj, Maragheh, Sararood=Azargol, Golshid, Vinimik.
**Plot size:** 5 rows with 6.6 meter long and 60 cm distance between rows and 30 cm between plants in rows. The three middle rows after omitting the first and last plants will be harvested.

***Observation***: Height of plant, head diameter, stem diameter, No. of leaves, No. of days from germination to flowering, No. of days from sowing to flowering and maturity, 1000 seed weight, oil content and seed yield.

**Fertilizer**: N50 & $P_2O_5$ 30 kg/ha

**Note**: To be done if manpower available.

**Title 3: Evaluation of sunflower varieties under dry farming condition.**

**Objectives**: Identify high seed yield variety for dry farming condition.
**Locations**: Sararood, Gachsaran, Maragheh, Kharkeh, Gonbad, Shirvan.
**Design**: R.C.B.D. with 4 rep.
**Varieties**: Zaria, Armaviresky, plus varieties to be tested.
**Plot size**: 4 rows with 5.5 meter long and 60 cm distance between rows and 30 between plants in rows. Two middle rows after omitting the first and last plants will be harvested.
**Observation**: Height of plant, head diameter, stem diameter, No. of leaves, No. of days from germination to flowering, No. of days from sowing to flowering and maturity, 1000 seed weight, oil content and seed yield.
**Fertilizer**: N50 & $P_2O_5$ 30 kg/ha

**Note: Experiment at Maragheh, Kharkeh, Gonbad and Shirvan will be done if manpower becomes available.**

**Title 4: The effect of sowing methods on sunflower seed yield.**

**Objectives**: Determine the best sowing method and soil moisture conservation in sunflower cultivation.
**Locations**: Maragheh, Sararood, and Sanandaj.
**Design**: Strip plot with 4 rep.
**Treatments**: (Vertical plot):
- Fall ploughing+spring sweep+sowing by planter.
- Fall ploughing+sowing by planter in spring.
- Direct planting by planter in previous furrows (mainly cereals). (Horizontal plots) in spring.
- Three sunflower varieties, Armavirsky plus test two varieties.

**Plot size**: 30 m long and 10 m wide, 60 cm distance between rows and 30 cm between plants in rows.
**Observation**: Height of plant, head diameter, stem diameter, No. of leaves, No. of days from germination to flowering, No. of days from flowering to maturity, 1000 seed weight, oil content and seed yield.
**Fertilizer**: N50 & $P_2O_5$ 30 kg/ha

**Note: At Maragheh and Sanandaj, experiment will be conducted if resources bocome availabe.**

**Title 5: Effcet of plant density on sunflower agronomic traits and seed yield.**

**Objectives:** Determine the best plant density to obtain the highest seed yield.
**Locations:** Maragheh, Sararood, Gachsaran, Shirvan, Sanandaj and Gonbad.
**Design:** Factorial in R.C.B.D. with 4 rep.
**Treatments:** Distance between rows 60 and 40 cm distance between plants 20, 25, 30, 35 cm One variety for each location that have the best seed yield.
**Plot size:** 8 rows, 40 cm, apart from each other 6 m long, six middle rows after omitting the first and last plants will be harvested. 6 rows, 60cm row distance and 6 m long, four middle rows after omitting the first and last plants will be harvested.

**Observation:** Height of plant, head diameter, stem diameter, No. of leaves, No. of days from germination to flowering, No. of days from sowing to flowering and maturity, 1000 seed weight, oil content and seed yield.
**Fertilizer:** N50 & $P_2O_5$ 30 kg/ha.

**Note:** Experiments at Maragheh, Shirvan, Gonbad and Sanandaj will be done if manpower becomes available.

**Title 6: Effects of sowing date on sunflower seed yield under dry farming condition.**

**Objectives:** Determine the best date of sowing to optimize seed yield.
**Location:** Gachsaran, Sararood, Maragheh, Kharkeh.
**Design:** Factoril R.C.B.D. with 4 rep.
**Treatments:** Varieties: Azargol, Progress. Date of sowing: 21st Nov., 5th Dec., 20th Dec., 4th Jan.
**NOTE:** For Maragheh and Kherkeh sowing dates would be 21$^{st}$ Nov, 10$^{th}$ Dec. Mid March and First April.
**Plot size:** 5 rows with 6.6 meter long, 60 cm distance between rows and 30 cm between plants in rows. Three middle rows after omitting the first and last plants will be harvested.

**Observation:** Height of plant, head diameter, stem diameter, No. of leaves, No. of days from germination to flowering, No. of days from flowering to maturity, 1000 seed weight, oil content and seed yield.
**Fertilizer:** N50 & $P_2O_5$ 30 kg/ha.

**Note:** Experiment at Maragheh and Kharkheh will be done if resources become available.

**Title 7: Study the seed density of sunflower in Entezari method.**

**Objectives:** To determine the best seed rate in sunflower Entezari method.
**Location:** Maragheh, Kharkeh.
**Design:** Factorial R.B.C. with R.B.C.D in 4 Rep.
**Treatments:** Three rate of seed 6, 9 and 12kg/ha, three varieties,one sowing dates. (Dec. 10).

***Plot size:*** 6 rows, 6 meter long each.
**Observation:** Height plant, head diameter, stem diameter, No. of days from flowering to maturity, 1000 seed weight, oil content and seed yield.
**Firtilizer:** N50 P30 kg/ha.

**Note**: This experiment will depend on the availability of manpower.

**Title 8: Study the effect of Bees on sunflower fertility and seed yield.**

**Objectives:** To identify the performance of bees on seed set fertility and seed yield of sunflower in dryland condition.
**Location:** Sararood
**Treatments:** Armaviresky and one more variety caltivated on about 5000 $m^2$. each 1) Beehives in the field; 2) Plants protected from cross pollination by bees.
**Observation:** 1000 Seed weight, No. seeds/head and seed yield.

## II. RAPESEED

**Title 1: Yield trial of rapeseed with supplementary irrigation for germination.**

**Objectives:** Determine high seed yielding variety or varieties for each location.
**Locations:** Sararood, Gachsaran, Ilam, Gonbad.
**Design:** R.C.B.D. with 4 rep.
**Varieties:** 7 winter or intermediate and 7 spring types of rapeseed varieties
**Plot size:** 5 rows with 6.6 meter long and 50 cm distance between rows and 5cm between plants in rows. 3 middle rows after omitting 50 cm from beginning and end of each row will be harvested.
**Observation:** Height of plant, frost and winter damage, time of rosette formation, No. of days from germination to flowering, No. of days from sowing to flowering and maturity, No. of seeds per pod, No. of pods per plant, 1000 seed weight, oil content and seed yield.
(Trial in Gonbad and Ilam will be cunducted if manpower available)

**Title 2: Effect of sowing date on rapeseed seed yield and other agronomic traits in dry farming condition.**

**Objectives:** Determine the best date of sowing to optimize seed yield.
**Location:** Gachsaran, Gonbad and Sararood.
**Design:** Factorial R.C.B.D. with 4 rep.
**Teratments:** (Varieties) Oro, Rafael at Sararood and Regent and Midus at Gachsaran/Gonbad. (Date of sowing) 21th Nov., 5th Dec., 20th Dec., 4th Jan.
**Plot size:** 5 rows with 6.6 meter long and 50 cm distance between rows and 5cm between plants in rows. 3 middle rows after omitting 50 cm from beginning and end of each row harvested.
**Observation:** Height of plant, frost and winter damage, time of rosette formation, No. of days

from germination to flowering, No. of days from sowing to flowering and maturity,
No. of seeds per pod, No. of pods per plant, 1000 seed weight, oil content and seed yield
(Trial in Gonbad and Gachsaran will be conducted if manpower becomes available).

**Title 3: Evaluation of elite rapeseed varieties/line for agronomic performance in different ecological regions.**

**Objectives:** Identify high yielding variety with good quality oil.
**Locations:** Sararood, Gachsaran, Ilam and Sanandaj.
**Design:** RCBD with 3 replications.
**Treatmentsw:** 16-24 varieties.
**Plot size:** 6 Rows of 5 meters each and 50 cm, between rows.
**Observation:** Date of emergence, crop stand (%), time of rosette formation, Days to flowering and maturity, No. of seeds/pod, No. of pods/plant, 1000 seed weight, oil content and seed yield, diseases and insects.

Note: The experiment at Ilam and sanandaj will depend on availability of manpower.

**Title 4: Evaluation of mustard varieties for yield in the dryland areas.**

**Objectives:** Identify high yielding variety with good quality oil.
**Locations:** Sararood, Gachsaran, Gonbad and Ilam.
**Design:** RCBD with 3 replications.
**Treatmentsw:** 16-24 varieties.
**Plot size:** 6 Rows of 5 meters each and 60 cm, between rows.
**Observation:** Date of emergence, crop stand (%), time of rosette formation, Days to flowering and maturity, No. of seeds/pod, No. of pods/plant, 1000 seed weight, oil content and seed yield, diseases and insects.

**Note: Experiment at Gonbad and Ilam will depend on availability of manpower.**

**Title 5: Expension of genetic base for rapeseed and mustard improvement.**

**Objective:** Rapeseed and musterd germplasm from other countries such as Canada, India will be obtained and tested under Iranian conditions.
**Location:** Kermanshah.
**Design:** Augmented design with systematic checks- 4 rows-5 meter each.
**Treatments:** No. of varieties will depend on suppliers of germplasm.
**Observations:** Germination data, time of rosette formation, No. of days to flower and maturity, No. of seeds/pods, No. of pods/plant, 1000 seed weight, oil content and seed yield; disease and insects.

*Title 6:* **On-farm testing of promising rapeseed varieties.**

**Objectives:** determine the yield potential rapeseed varieties in different ecological regions under farmers conditions.

**Locations:** Two location in each province (Kohkileyeh, Khuzestan, Sanadaj, Golestan, Kermanshah).

**Treatments/Plot size:** 50m x 10m, with two replications and four varieties.

**Observations:** Stand of the crop, Days to flowering and maturity, 1000 seed weight, yield and oil content.

**Note: Only to be done if resources are availabe.**

## III. SAFFLOWER

**Title1: Expansion of genetic base of safflower-evaluation of local and exotic germplasm.**

**Objectives:** To identify high yielding disease and insect resistant varieties of safflower for direct or indirect (hybridization) use.

**Locations:** Sararood and Gachsaran. (Maragheh should test at least 1000 varieties of safflower).

**Design:** Augmented, 4 rows-5 meter each.

**Treatments:** A large number of safflower varieties from the gene back will be procured for eveluation.

**Observation:** Plant height, time of rosette formation, days to flowering and maturity, No. of seeds/head No. of heads/plant, 100 seed wieght, oil content, seed yield, disease and insect.
(Dr. E. Sadeghi, D.G. of DARI to request seed from National Gene bank-Karaj).

**Title 2: Evaluation of safflower varieties in dry farming condition.**

**Objectives:** Determine high seed yielding variety or varieties for each location.

**Locations:** Maragheh, Sararood, Gachsaran.

**Design:** R.C.B.D. with 4 rep.

**Varieties:** 24 winter type safflower varieties selected out of observation nursery 1997-98.

**Plot size:** 5 rows with 5.5 meter long and 50 cm distance between rows and 10cm between plants in rows. 3 middle rows after omitting 50 cm from beginning and end of each row harvested.

**Observation:** Height of plant, frost and winter damage, time of rosette formation, No. of days from germination to flowering, No. of days from flowering to maturity, No. of seeds per head, No. of heads per plant, 1000 seed weight, oil content and seed yield, disease and insects.

**Title 3: Performance of elite safflower varieties under in dry farming condition.**

**Objectives:** Determine safflower variety or varieties which have water stress (drought)

tolerance and give high seed yield.

**Locations:** Maragheh, Sararood, Gachsaran, and Shirvan (Depending on manpower).

**Design:** R.C.B.D. with 3 rep.

**Varieties:** 24 safflower varieties include 5 best spineless varieties.

**Plot size:** 6 rows with 6 meter long and 50 cm distance between rows and 10cm between plants in rows. 4 middle rows after omitting 50 cm from beginning and end of each row harvested.

**Observation:** Height of plant, frost and winter damage, time of rosette formation, No. of days from germination to flowering, No. of days from flowering to maturity, No. of seeds per head, No. of heads per plant, 1000 seed weight, oil content and seed yield, diseases and insects.

**Title 4: Safflower yield trial under intezari planting system in dry farming condition.**

**Objectives:** Determine safflower variety or varieties that have water stress tolerance and high seed yield.

**Locations:** Maragheh, Shirvan, Sanandaj.

**Design:** R.C.B.D. with 3 rep.

**Varieties:** 20 winter type safflower varieties will be planted in this fall.

**Plot size:** 6 rows with 6 meter long and 30 cm distance between rows and 10cm between plants in rows. 4 middle rows after omitting 50 cm from beginning and end of each row harvested.

**Observation:** Height of plant, No. of days from germination to flowering, No. of days from flowering to maturity, No. of seeds per head, No. of heads per plant, 1000 seed weight, oil content and seed yield, diseases and insects.

**Note: Experiment at Shirvan and sanandaj will depend on availability of manpower.**

**Title 5: Regional uniform yield trials of safflower varieties:**

**Objectives:** To identify high yielding, drought, diseases and insect resistant varieties for different regions.

**Locations:** Sararood, Gachsaran, Ilam, Gonbad, Maragheh, Kharkeh, Shirvan.

**Design:** RCBD with 3 replications.

**Varieties:** 12 high yielding varieties.

**Plot size:** 6 rows of 6 meters length each, and 30 cm distance between rows.

**Observation:** Germination data, plant height, days to flowering/maturity. no. of seeds/head, no. of heads/plant, 1000 seed weight, oil/content, diseases and insects; and seed yield.

**Note:** Experiment at Ilam, Gonbad, kharkeha and Shirvan will depend on availability of manpower.

**Title 6: On-farm testing of promising safflower varieties in dry land yield.**

**Objectives:** Determine the yield potential of elite safflower varieties under farmers.

**Location:** Kohkileyeh, Khouzestan, Fars, Ilam, Golestan.

***Treatments*/Plot size:** 50 X10mm with 2 Rep. and four varieties.
**Observation:** Same as in No. 5.
(To be deferred until 1999/2000 crop season).

ENTOMOLOGY

**Title:** **Survey of important insects of oilseed crops in dryland areas.**

**Objectives:** 1. Determine the insects of rapesed, sunflower and safflower.
2. Determine economic loss at farm level.
3. Priority research and initiate research to develop screening techniques.

**Locations:** Maragheh, Kermanshah, Sanandaj, Ilam, Gachsaran.
East Azerbaijan, Kordestan, Kermanshah and Kohgiloyeh.

**Duration:** 5 years.

## A. Seed exchange

1. Seed samples of rapeseed (winter and spring type) and cold resistant varieties should be procured from Canada/India.
2. Winter and spring safflower varieties and spineless varieties to be obtained from National Gene bank.
3. Sunflower varieties (O. P. and hybrids) and resistant lines to Plasmopara disease may be procured from other countries (Russia, Hungary, and Bulgaria).

**Note:** There is serious technical manpower. The research work will depend on the availability of technical manpower, e.g. at present there is no on to conduct research at Kermanshah or Maragheh.

## B. Equipments need:

Due to expansion in the oilseed crops programs it is necessary to establish a laboratory for qualitative analysis. The equipments needed are listed below:

1. N.M.R. set for determination of oil precentage.
2. Sucselate with its heater (at least three sets).
3. G.C. set for determining fatty acid specially in rapeseed.
4. Informatic equipment for determining oil protein and moisture (N.I.R.).
5. Protein analyzer.
6. Equipment for measurement of seed moisture/seed counter.

## C. Training

1. Special training and short visit to oilseed crops improvement programs in Canada (Canola), Bulgaria (sunflower).

**D. Books, journals, scientific paper and periodical list of papers on oil crops are needed.**

# IV. NATRURAL RESOURCE MANAGEMENT

**Objectives:**

1. To determine the effects of climatic factors on dry farming
2. To study the factors in land use management and sustainable agriculture under rainfed conditions
3. To determine guidelines for evaluating land suitability for rainfed crops
4. To study cropping systems (crop sequence including food and forage legumes, oilseed crops, lay farming and fallow in rotation with cereals)
5. To determine the suitability of supplemental irrigation systems, water collection structures and water conveying systems for supplemental irrigation
6. To study suitable methods of soil management (tillage) and to increase water use efficiency (WUE) in dryland farming
7. To study the land use systems, ownership pattern, technical and socio-economic constraints of dryland areas
8. To study the suitability of local and imported machinery and also the problems of mechanization in dryland areas.

**2. Achievements in Research and Training Program of 1997/98:**

**1. Climate-soil-crop relationship**

**1.1. Determining the effects of climatic factors on crops in dryland farming**

The Long-term climate, soil and crop production data needed for the project has not been completed in the other station except in Sararood (Kermanshah) for 15 years. The research work carried out at Sararood on wheat by Mr. Talai has revealed:

1. Long-term mean annual rainfall of Kermanshah is 463 mm. October and June precipitation is correlated positively with each other. April and May rainfall is correlated positively with crop yield. However, last precipitation in May had the greatest effect on crop yield.

2. Most rainfall comes in spring and is more effective than fall rainfall for yield increase.
3. Year to year variation is the most in November and April rainfall.
4. Spring rainfall shows a decreasing trend in recent years.
5. Minimum of 20 years data is needed to estimate an optimum planting date in relation to sufficient rainfall amount needed.

Last year suggestions of a) research plan be formulated at national level involving all rainfed research stations; b) cooperation with plant Breeders be developed to obtain complete crop development data; c) use INSTAT package to enter long term (16 years) data and their interpretation were still not undertaken. The researchers stated that there are problems in collecting data because of inadequate staff. However, it was proposed that data on soil and crop production should be collected by the principal staff of stations in coordination with Agronomic Research Coordinator, A. Haghigati. Climate data would be collected in coordination with A. A. Taliee.

**1.2. Determination of the effective rain on emergence and yield of rainfed wheat in north of Khorasan.**

The study had 6 wheat varieties (Sardari, Sabalan, Melagani, Sarkha, Kelseven, Kelali) with grain yield of 1.71, 1.31, 1.51, 1.27, 1.56 and 1.56 t/ha, respectively.

8.23 mm rainfall is needed for emergence of all varieties.

However, since there is a need for 20-year data set as it was suggested above it will be incorporated to item 1.1 and deleted as a separate study.

**2. Long-term Crop Rotation Studies**

These studies have been carried out in Maragheh and Gachsaran and was planned to be expanded to cover Kermanshah this year. However, Kermanshah planned to have wheat/sunflower, wheat/ safflower, wheat rapeseed, chickpea/sunflower, chickpea/safflower, chickpea rapeseed, fallow/sunflower, fallow/safflower and fallow/rapeseed. This did not seem logical in the group, because it considered oilseed as a main crop and rotated them with wheat, fallow and chickpea. So wheat/chickpea, wheat/fallow and wheat /wheat rotations were proposed and delete oilseed rotations with wheat, chickpea and fallow, but keep oilseeds rotations with chickpea. TKW and wheat quality analysis (If it is possible) should be determined in each station. Summarized results are in Table 1:

**Table 1: Mean wheat yield in different rotation treatment.**

| Rotation treatment | Wheat Grain Yield (Ton/ha) | |
|---|---|---|
| | Maragehe | Gachsaran |
| Wheat/Chickpea | 1.52 | 3.26 |
| Wheat/Lentil | 1.74 | 3.59 |
| Wheat/Vetch | 1.60 | 3.79 |
| Wheat/Wheat | 1.35 | 2.74 |
| Wheat/Rapeseed | 1.29 | 3.33 |
| Wheat/R. Fallow | 1.67 | 4.05 |
| Wheat/Safflower | 1.28 | 3.57 |
| Wheat/Spring Barley | 1.62 | 2.77 |
| Wheat/t.Fallow | 1.33 | - |
| Wheat/Sunflower | 1.57 | 4.10 |
| Wheat/Medic | 1.15 | 3.73 |

Data from Gamloo (Sanandaj) was not reported (It was said that it is not harvested yet as similar to last year). It was suggested for the next year that whatever harvested should be presented and the oil crops could be added later.

Results show after 4 years that fallow is not more productive than wheat following other crops to be considered replacing fallow.

Soil data and production cost and crop price data has to be considered as well before it is too late. Standard chemical and physical properties of soil has been analyzed but aggregate stability have not been determined which is absolutely necessary at the end of experimental

period. Soil moisture data have to be measured in the next two seasons (1998/99 and 1999/2000) at planting, flowering and harvest of each crop at 0-5, 5-15, 15-30, 30-60, 60-90, 90-120 cm of the soil profile.
BNF was not measured because of lack in expertise although it was recommended during last year coordination meeting. Microbilogists are needed to handle this work. Economic analysis will be considered next year. Crop phenology has been recorded at all sites. Disease and insects incidences will be observed in the coming two seasons.

3. **Supplemental Irrigation for Stabilizing Crop Production in Dryland Areas.**
3.1. **Title: wheat production under supplemental Irrigation in Dryland areas.**

This research was conducted in Maragheh, Sararood, Uroumieh and Gamloo stations using Sabalan bread wheat variety. However, Organization has sent a letter to each station not to continue the trials in the middle of the season. Therefore, no results are available from Maragheh, Sararood and Uroumieh stations. Gamloo station received the letter after they have applied the water and they got the yield results. Yields of 2.1, 2.5, 2.64, 3.15 and 2.4 t/ha were obtained by rainfed, 50 mm, 100 mm, 150 mm irrigation at later growth stages and 50 mm irrigation at planting, respectively.

This study will not be conducted continue anymore in 1998/99 season and a new plan will be applied as Dr Oweis proposed (see future plans).

**3.2. Profitability of wheat and food legumes under supplemental Irrigation in Dryland Areas** (3rd and final year)
This study was conducted in Maragheh, Sararood and Uromeih Stations. Summarized yield results are in Table 2.

**Table 2: Mean crop yield in supplemental irrigation.**

| Crops | Sup. Irrigation | Grain Yield (t/ha) | | |
|---|---|---|---|---|
| | | Maragheh | Sararood | Orumieh |
| Wheat | Rainfed<br>100mm Irr | 1.38<br>1.84 | 3.19<br>3.91 | 2.76<br>3.25 |
| Chick pea | Rainfed<br>100mm Irr | o.64<br>0.74 | 0.34<br>0.88 | 0.70<br>1.24 |
| Lentil | Rainfed<br>100mm Irr | 0.94<br>0.16 | 0.13<br>0.44 | 0.30<br>0.83 |

From these results it is evident that maximum yield increase took place at Sararood and Orumieh in all the crop species with 100 mm of supplementary irrigation. The studies on cost: benefit analysis are underway and will be reported this season. However, this will be have a limited value when 100 mm water is available for farmers to opt between wheat and legume crops to apply supplemental irrigation during the water deficient growth stages. It will not continue for the next season.

3.3. **Supplemental Irrigation need of new wheat variety in Ghachsaran (1st year).**
Trial has not been conducted because of limited time of the staff member available. However, trial had similar design of trial 3.1 and it is already closed, there is no need for the continuation of this trial. We have to look for the new proposal of Dr Oweis in supplemental irrigation project across different agroecological regions of Iran.

3.4. **Supplemental Irrigation needs of new wheat varieties in Maragheh, Sararood and Uroumieh (1st year).**

Five new varieties, Sabalan/1-27..., Anza, KVZLTm71..., Ogosta/Sefid and Sabalan (check) were tested under: a) SI (50 mm) at planting; b) SI (50 mm at flowering, and c) just rainfed, at Maragheh, Sararood and Uroumieh. Summarized results are given in Table 3, 4 and 5 respectively.

**Table 3 Responses of wheat varieties to supplemental irrigation at Maragheh.**

| Varieties | Rainfed | 50 mm SI at planting | 50 mm SI at Flowering | Mean yield (t/ha) |
|---|---|---|---|---|
| Sabalan/1-27... | 1.28 | 1.97 | 2.16 | **1.80** |
| Anza | 1.29 | 1.74 | 1.95 | **1.66** |
| KVZLTm71... | 1.41 | 1.88 | 2.05 | **1.78** |
| Ogosta/Sefid | 1.34 | 1.56 | 2.15 | **1.68** |
| Sabalan (check) | 1.51 | 1.65 | 1.80 | **1.65** |
| Mean yld (t/ha) | **1.37** | **1.76** | **2.02** | |

**Table 4. Responses of wheat varieties to supplemental irrigation at Sararood.**

| Varieties | Rainfed | 50 mm SI at planting | 50 mm SI at Flowering | Mean yield (t/ha) |
|---|---|---|---|---|
| Sabalan/1-27... | 2.60 | 2.80 | 2.70 | **2.70** |
| Anza | 2.70 | 2.50 | 2.50 | **2.60** |
| KVZLTm71... | 2.40 | 2.80 | 2.40 | **2.50** |
| Ogosta/Sefid | 2.50 | 2.90 | 2.80 | **2.70** |
| Sabalan (check) | 2.40 | 2.50 | 2.60 | **2.50** |
| Mean yld (t/ha) | **2.50** | **2.60** | **2.70** | |

**Table 5. Responses of wheat varieties to supplemental irrigation at Uroumieh.**

| Varieties | Rainfed | 50 mm SI at planting | 50 mm SI at Flowering | Mean yield (t/ha) |
|---|---|---|---|---|
| Sabalan/1-27... | 1.59 | 2.28 | 2.58 | **2.15** |
| Anza | 2.24 | 2.55 | 2.94 | **2.57** |
| KVZLTm71... | 2.53 | 2.59 | 3.26 | **2.79** |
| Ogosta/Sefid | 2.28 | 2.78 | 3.16 | **2.74** |
| Sabalan (check) | 2.02 | 2.86 | 3.62 | **2.83** |
| Mean yld (t/ha) | **2.13** | **2.61** | **3.12** | |

The results show that irrespective of variety of wheat, 50 mm SI increase the yield significantly compared with rainfed conditions. The highest response was in Uroumieh because of higher drought spell in the late season. Varieties did not differ from each other. The trials will continue one year more and closed in the light of the new SI proposal.

### 3.5. The effect of supplemental irrigation and its methods on SXL/Glenson, Sabalan and Sardari wheat varieties in Hamadan region (1st year)

Different methods of irrigation and amount of SI has been tested on SXL/Glenson, Sabalan and Serdari wheat varieties as compared with rainfed conditions. Irrigation methods did not show significant differences but SI increased the yield significantly compared with rainfed conditions as expected However, varieties yield similarly.
This trial should continue for another year and therefore replaced with the new proposal for SI. Summarized results are given in Table 6.

**Table 6. Responses of wheat varieties to method and amount of supplemental irrigation in Hamadan.**

| Method of Irrigation | Supplemental Irrigation | Serdari | Sabalan | SXL/Glenson | Mean yield (t/ha) |
|---|---|---|---|---|---|
| None | Rainfed | 0.93 | 0.87 | 1.00 | 0.93 |
| Gun irrigation | 50 mm after palanting | 1.42 | 1.36 | 1.40 | 1.39 |
| | 50 mm at flowering | 1.60 | 1.61 | 1.38 | 1.53 |
| Wheel irrigation | 50 mm after palanting | 1.41 | 1.70 | 1.53 | 1.55 |
| | 50 mm at flowering | 1.53 | 1.85 | 1.68 | 1.64 |
| Sprinkler irrigation | 50 mm after palanting | 1.55 | 1.56 | 1.40 | 1.50 |
| | 50 mm at flowering | 1.80 | 1.81 | 1.75 | 1.79 |
| Mean yld (t/ha) | | 1.46 | 1.54 | 1.45 | |

## *4. Soil* Management Studies.

### 4.1. The effect of sowing date, seeding depth and seed rate on chickpea production in Kermanshah (3rd year)

This study had autumn, entezari and spring planting with two seeding depth and four seed rate treatments for Bevanej chickpea variety which is proposed by Food Legume Breeders. However, unfavorable weather conditions created an epidemic of Ascochyta which killed autumn and entezari planted chickpea so the data is available only for spring chickpea. There is no differences between 5 and 10 cm seeding depth on chickpea yield (mean is 0.51 t/ha) but 15, 30, 45 and 60 seeds/m2 densities provided 0.65, 0.60, 0.47 and 0.32 t/ha yields, respectively. This is expected for spring chickpea, because temperature and moisture in early spring is favorable for low seed rates to allow emergence of all seeds. Drought spell later in the season does not leave sufficient moisture to support the higher plant density to give high yields.
The experiment was conducted for three years, but since winter-sown crop was killed by Ascochyta blight it will be repeated again in cooperation with AERI.

### 4.2. The effect of wheat stubble management during fallow and N application on the following wheat in Gamloo-Sanandaj (4th year).

This study has been conducted on wheat/fallow rotation with single entry, therefore yield results are obtained in every two years. It started in 1994/95 with fallow and first results were obtained in 1995/96 and 1997/98. The season of 1998/99 will be fallow and the third and final results will be analyzed after the harvest of 1999/2000 season. Summarized results are given in Table 7.

**Table 7. Effect of stubble management and N application on wheat production.**

| Stubble management | 30 kg N/ha | 60 kg N/ha | Mean yield (t/ha) |
|---|---|---|---|
| Control (all residue left on surface) | 1.32 | 1.51 | 1.41 |
| All residue grazed | 1.12 | 1.68 | 1.40 |
| All residue plowed at harvest | 1.53 | 1.87 | 1.67 |
| Chopping residues and plowed at harvest | 1.61 | 2.07 | 1.84 |
| Burning all residues at harvest | 1.46 | 1.85 | 1.65 |
| Mean yield (t/ha) | 1.41 | 1.79 | |

Chopping all residues and incorporating them into the soil has provided the highest yield compared to residues grazed or left on the surface. Organic matter has been measured and also infiltration rate. The lowest infiltration rate was from the control and burned plots (0.74 cm/min) compared with other treatments provided a mean of 2.5 cm/min.
Allelophatic substances may be analyzed in collaboration of Dr S. J. Rizvi (PPDRI).

### 4.3. The effect of different initial autumn tillage and spring mulch system during *fallow* season on the following Sardari wheat production in Uroumieh (3rd year).

The mean yields of initial tillage of autumn chisel (1.02 t/ha) and spring semi-moldboard (1.15 t/ha) were not significantly different. However, secondary operations in spring-summer with no till (0.99 t/ha), ducks foot (1.23 t/ha) and chemical weed control (1.04 t/ha) were significantly different. The 3rd year result indicates that autumn tillage is unnecessary and it is better not to till the soil when it is dry and wait for spring conditions when the soil is wetter to start initial tillage on fallow period. Secondary operations is best by ducks-foot cultivator which is available to farmers locally. No-till and chemical fallow in summer are not good choices.
This trial will continue one year more and finalized.

### 4.4. Comparison of tillage and sowing methods for chickpea production in Maragheh (3rd year)

This study was carried out for three years and final report should be prepared and should be stopped. Direct drill by John Sherer in spring (0.95 t/ha), moldboard+discharrow in fall and John Sherer planting in spring (0.93 t/ha), Moldboard in fall and Broadcast seed and cover by discharrow in spring (0.70 t/ha) and Broadcast seed and cover by moldboard in spring (0.63 t/ha) were compared. First two methods were significantly different from the last two farmers' methods. Direct drilling is the best practice for chickpea production if available.

### 4.5. The effect of soil compaction on moisture conservation for rainfed wheat production in Uroumieh (1st year)

It was not approved by the Provincial committee in 1996/97 season but approved for 1997/98 season when the new station is available. However, since the station was not available the study was not conducted. It should be conducted in 1998/99 if manpower is available.

### 4.6. The effect of sowing method on wheat varieties in dryland farming in Hamadan(1st year)

The trial has been conducted in Hamadan to compare the effects of sowing methods on Serdari, Sabalan and SXL/Glenson wheat varieties under dryland conditions.
The trial will continue next year. The results are summarized in Table 8.

**Table 8. Effects of sowing methods on yields of wheat varieties in Hamadan.**

| Sowing methods | Serdari | Sabalan | SXL/Glenson | Mean (t/ha) |
|---|---|---|---|---|
| Hasia drill | 0.87 | 0.98 | 1.18 | 1.01 |
| 50% broadcast + 50% Hasia | 1.15 | 0.97 | 1.37 | 1.16 |
| John Sherer | 1.23 | 1.00 | 1.28 | 1.17 |
| Hasia in two direction drill | 1.19 | 1.09 | 1.41 | 1.23 |
| Mean yield (t/ha) | 1.11 | 1.01 | 1.31 | |

There are no differences among the varieties. Hasia in two direction planting provided higher yield but cost should be considered. However, it is not seen as very crucial by the committee that this trial should have a priority in continuation. Therefore, it was decided to discontinue in 1998/99 season.

### 4.7. The effect of different tillage implements during fallow on soil moisture conservation and wheat production in north of Khorasan (1st year)

Members in Farm Resource Management Group reported that Provincial committee did not approve this study for their region. In addition Mr Minbashi has left the station and no manpower was available in case of approval. Therefore it is deleted from the plan of work for the future.

## 5. Nutrition and seed rate requirements in crop production

### 5.1. Seed rate and fertilizer requirements of barley variety (Sahand) in Kermanshah and Sanandaj regions (1st year).

This study was conducted in Sararood and Gamloo stations to determine the seed rate and fertilizer requirements of winter barley. However, results in Sararood wee not presented to the meeting because the analysis was not done yet. Since all the analysis have been brought to meeting in published form then it is difficult to understand the reason. There is no difference between the seed rates of barley for the grain yield. Crop response to fertilizer is significant. However, it is not clear whether it is coming from N or phosphorus application since the rates are both increases. It is most probably the effect of N application because of mostly sufficient amount of P in soils. P analysis is needed to clarify such situations. Results are summarized only for Gamloo in Table 9.

**Table 9. Seed and fertilizer requirement of Sahand winter barley in Gamloo**

| Seeds/m2 | Fertilizer application (kg N and P2O5/ha) | | | Mean yield (t/ha) |
|---|---|---|---|---|
| | N20-P15 | N40-P30 | N60-P45 | |
| 250 | 2.48 | 2.56 | 2.93 | 2.66 |
| 350 | 2.57 | 3.01 | 3.12 | 2.90 |
| 450 | 2.59 | 2.73 | 3.26 | 2.86 |
| Mean yld (t/ha) | 2.55 | 2.77 | 3.10 | |

### 5.2. Seed rate requirements of bread and durum wheat varieties (1st year)

This study was planned to be conducted in Mogan to identify seed rate requirements of Zagros, Atilla, Niknejad (bread) and Seimareh (durum) varieties comparing 200, 300, 400 and 500 seeds/m2. However, there was no staff available to carry out this trial in Mogan. This type of work has been left for promising varieties to be conducted when sufficient manpower is available.

### 5.3. Seed rate and phosphate requirement in dryland barley production in Khorasan (1st year)

This study was conducted in Khorasan to see the effect of seed rate and DAP (diamonium phosphate) fertilizer on yield of Sahand (winter barley). Seed rate did not show any significant effect on barley yiled but DAP affected the yield significantly. However, similar to the trial in section 5.1, it is not clear whether the effect is coming from P or N in DAP. Soil Olsen-P value is needed to judge on it. The results are summarized in Table 10.

**Table 10. Seed rate and fertilizer requirements of Sahand barley variety in Khorasan**

| Fertilizer, DAP (kg/ha) | Seed Rate (kg/ha) | | |
|---|---|---|---|
| | 100 | 125 | 150 |
| 100 | 1.67 | 1.65 | 1.89 |
| 120 | 1.81 | 1.88 | 1.80 |
| 140 | 1.78 | 1.97 | 1.84 |
| 160 | 1.76 | 1.76 | 2.04 |
| 180 | 1.98 | 2.02 | 2.14 |
| Mean yield (t/ha) | 1.80 | 1.86 | 1.94 |

### 5.4. The effect of seed rate and method of fertilizer placement on dryland barley production in north of Khorasan (1st year)

There has not been any difference between local barley and Sahand, but fertilizer placed 9 cm under the seed provided significantly higher yield in local barley. However, placement of fertilizer (DAP in particular) may be a problem in sandy soils but not in clay soils. If there is implement available to place the phosphate in deeper layer it will be an opportunity for earlier seedlings to utilize the directly available phosphorus in the root vicinity. The work will continue next year. The results are given in Table 11.

**Table 11. The effect of seed rate and method of fertilizer placement on local and Sahand barley in Khorasan.**

| Fertilizer Placement method | Local barley (Kara arpa) | | | | Sahand (improved) | | | |
|---|---|---|---|---|---|---|---|---|
| | Seed rate (kg/ha) | | | Mean (t/ha) | Seed rate (kg/ha) | | | Mean (t/ha) |
| | 100 | 125 | 150 | | 100 | 125 | 150 | |
| Fertilizer + Seed | 1.51 | 1.71 | 1.86 | 1.69 | 1.80 | 1.83 | 1.99 | 1.87 |
| 9 cm below seed | 1.90 | 1.67 | 1.93 | 1.84 | 1.74 | 2.15 | 1.99 | 1.96 |
| Mean (t/ha) | 1.71 | 1.69 | 1.89 | | 1.77 | 1.99 | 1.99 | |

### 5.5. The seed rate and phosphate requirements of Sahand barley in Ardebil (1st year)

This study was carried out in Ardebil to identify the needs of Sahand barley (improved) for seed rate and phosphate fertilizer. No significant effect of seed rate or phosphate on yield was

*observed.* However, without knowing the available P in soil insignificant response to P can not be explained. Seed rate does not differ because of the elasticity of the barley with higher tillering ability at lower seed rates. The trial is in its first year and should continue next year taking the phosphate level of the soil into account. Olse-P level should be lower than 6 to expect any difference in crop response to P. Results are summarized in Table 12.

**Table 12. The effect of seed rate and phosphate on Sahand barley in Ardebil.**

| Phosphate (kg P2O5/ha) | Seed rate (seeds/m2) | | | Mean yield (t/ha) |
|---|---|---|---|---|
| | 300 | 350 | 400 | |
| 0 | 2.42 | 2.57 | 2.38 | 2.46 |
| 20 | 2.15 | 3.05 | 2.99 | 2.71 |
| 40 | 2.98 | 2.66 | 2.60 | 2.75 |
| 60 | 2.44 | 2.54 | 2.82 | 2.60 |
| Mean yield (t/ha) | 2.50 | 2.71 | 2.68 | |

**5.6. Study the effects of different tillage methods on weed control in dryland chickpea-kabuli type (1st year)**

The study was conducted in Maragheh to find out proper tillage method for weed control in spring chickpea production. Fall plowing did not effect either chickpea yield or weed density significantly compared with No-tillage in fall. However, direct planting in spring caused the highest weed density as well as the lowest chickpea yield. Use of sweep or disc harrow for planting provided higher yield compared with other tillage methods. The trial should continue next year. Results are given in Table 13.

**Table 13. The effects of tillage practices on chickpea yield and weed density in Maragheh.**

| Fall tillage | Spring tillage at planting | No of weeds in 4m2 | Yield (t/ha) |
|---|---|---|---|
| Fall plowing | 1. Sweep + planter | 19 | 0.522 |
| | 2. Disc harrow + planter | 21 | 0.669 |
| | 3. Planter + herbicide | 18 | 0.457 |
| | 4. planter | 43 | 0.358 |
| | 5. Broadcast seed + plowing | 24 | 0.457 |
| | 6. Broadcast seed + disc harrow | 27 | 0.426 |
| | **Mean** | **25** | **0.480** |
| No plowing | 1. Sweep + planter | 20 | 0.551 |
| | 2. Disc harrow + planter | 25 | 0.615 |
| | 3. Planter + herbicide | 14 | 0.506 |
| | 4. planter | 46 | 0.433 |
| | 5. Broadcast seed + plowing | 23 | 0.422 |
| | 6. Broadcast seed + disc harrow | 22 | 0.385 |
| | **Mean** | **22** | **0.480** |
| | **General Mean** | **23.5** | **0.480** |

**5.7. Study the performance of cereal drills on bread wheat yield in dryland (1st year)**
This study was planned last year to be conducted in Hamadan to find out the interaction between seed drills (Hassia, John Shearer, Amazone placing fertilizer below seed, Amazone placing fertilizer above seed and broadcast by centrifuge) and seed rates (250, 300, 350 seeds/m2). However, staff in the meeting reported that Provincial Committee did not approve this trial as their priority area of research.
However, Research Committee at DARI considered it again for the next year, thus it will continue.

**5.8. Study the effects of Zinc and Nitrogen on wheat yield in warm areas (1st year)**
This study was conducted in Gechsaran to find out whether Zinc application (0, 5, 10, 15 and 20 kg ZnSO4/ha) would improve the wheat yields in the relatively warmer areas. Zn application was applied in combination with different amount of Nitrogen (0, 40 and 80 kg N/ha).
There was no response to Zn application (2.92 t/ha yield at 0 level compared to 3.16 t/ha at 20 kg of ZnSO4 application). However, there is no report of Zn status of the soil where the experiment is conducted. Therefore, it is difficult to judge on the experimental results. Most probably, soil had no deficiency of Zn. But there is a clear response to increased amount of N. The highest yield was obtained by 80 kg N/ha and yield was linearly increased from 0 (2.52 t/ha) to 40 kg N/ha (3.05 t/ha) and 80 kg N/ha (3.52 t/ha). So, Nitrogen seems to be more important area of study than Zn. However, in the light of new proposal this year on microelement study it was decided that this work should discontinue next season. It needs soil analysis to conduct any study on micro or macro nutrient elements.

**5.9. Study the effects of long-term Nitrogen fertilizer application on chemical properties of soil in wheat-chickpea rotation (1st year)**
This study is conducted in Maragheh to find out the interactions of different types of Nitrogen fertilizers applied in fall (40 kg N/ha) and spring (20 kg N/ha) on wheat yield. Yield was 0.99 t/ha when no N was applied. Types of fertilizer did not show any difference in affecting yield (mean of 1.4 t/ha) when applied in fall. However, Ammonium Nitrate (AN) significantly increased wheat yield (1.51 t/ha) compared with Urea (1.35 t/ha) or Sulfur coated-urea (1.33 t/ha) when applied in spring.
This study will continue next season on wheat following chickpea. At the same time experiment field for wheat will be planted with chickpea to see the residual effect of N applied on wheat to be able to achieve the objectives of the study.

**5.10. Chickpea mechanization: 1. Comparison of different tillage methods and their effects on chickpea yield (1st year)**
This study was carried out in Maragheh and Sararood stations in collaboration with AERI. Tillage methods used either in fall or in spring did not give any significant differences in chickpea yield at both locations. Yields were higher than farmers' fields in Maragheh (0. 5 t/ha) and Kermanshah (0.4 t/ha) although the crop phased more than 2 month dry spell at flowering and podding stage. The trials will continue next year as discussed also with AERI staff (Mr. Sherifi) with addition of two control plots (see next year plan). Results are given in Table 13.

***Table 13.*** **Effects of Tillage methods on Chickpea yield in Maragheh and Sararood.**

| Tillage methods | Chickpea yield (t/ha) | |
|---|---|---|
| | Maragheh | Sararood |
| 1. Moldboard in fall +disc harrow and planting in spring by drill | 0.65 | 0.49 |
| 2. Chisel in fall +disc harrow and planting in spring by drill | 0.66 | 0.52 |
| 3. Moldboard in fall + leveler and planting in spring by drill | 0.63 | 0.50 |
| 4. Chisel in fall + leveler and planting in spring by drill | 0.65 | 0.41 |
| 5. Moldboard in fall +power harrow and planting in spring by drill | 0.65 | 0.51 |
| 6. Chisel in fall + power harrow and planting in spring by drill | 0.65 | 0.43 |
| Mean yield (t/ha) | 0.65 | |
| CV% | 11.6 | |

## 6. On-farm trials

### 6.1. Maragheh Region

#### 6.1.1. Wheat variety x seed rate.

This study was carried out at 3 locations. Cultivar Sardari (150 kg/ha) was compared with Sabalan (100, 150, 200 kg/ha seed rate). The differences in grain yield were not significant as 1.63, 1.76, 1.7 t/ha with increasing seed rate in Sabalan compared with 1.81 t/ha for Serdari with 150 kg seed/ha. Our aim was to show that there will not be any difference between 150 or 200 kg seed rate. Therefore in the last three years we achieved our aim. This trial should be conducted in more places in close collaboration with extension services.

#### 6.1.2. Fertilizer use on wheat

Different levels of urea and DAP were compared in 3 locations. There is no difference between the fertilizer with very low yield levels as reported by Mr. Haghigati that there was 35% shattering. Therefore, results are not yet conclusive and it needs to be conducted also next year. However, it was recommended that soils samples should be taken from farmers fields and new trials should be conducted in fields with low Olsen-P.

#### 6.1.3. Tillage during fallow season for wheat production

This study was conducted in 3 locations to compare recommended two tillage methods with two farmers' methods. Recommended tillage with drill planting provided the highest wheat yield (1.73 t/ha) followed by recommended tillage combined with broadcast +disc harrow planting (1.48 t/ha). The other two farmers' method caused significant yield reductions as 1.36 t/ha (spring moldboard plowing +broadcast +disc harrow) and 1.15 t/ha (spring moldboard plowing +broadcast +moldboard). This work will continue next year and more involvement of extension services is needed for more effective technology transfer to farmers.

#### 6.1.4. Weed Control in Wheat

Previous two seasons provided positive results of using herbicides controlling weeds in farmers' fields. However, last season work has not been approved by the ministry in the light of farmers' awareness of the technology and unavailability of chemicals and equipment to apply. However,

another reason for this work was to keep the awareness of farmers in weed problems. It is recommended that extension service should be encouraged to take over this work to make the equipment and chemical available for needy farmers.

### 6.1.5. Barley variety x seed rate for winter barley

This study was carried out in 3 locations. Sahand, Yesevi and Kara Arpa (local) have been tested with 75 and 150 kg/ha seed rates. Sahand geve the highest mean yield which is significant (0.82 t/ha) compared vith Yesevi (0.68 t/ha) and Kara Arpa (0.6 t/ha). Higher seed rate was significantly better (0.85 t/ha) than low seed rate (0.55 t/ha) in barley yield. Results are low because of broadcast method of planting due to difficulty in carrying drill to farmers fields, but the aim is to show the variety and seed rate differences for winter barley growing. Mr. Zamani who conducts these trials indicated that he can not continue to carry this on-farm trial anymore, committee favored for the continuation of the work next year.

### 6.1.6. Chickpea variety x sowing method for spring planting

This work was conducted in 3 locations for the second season. Improved chickpea variety gave the highest yield in both seasons (0.71 t/ha in 1996/97 and 0.38 t/ha in 1997/98) when broadcast and covered by disc harrow. Because of a long dry spell in spring of 1997/98 season the overall yield was low. However, using moldboard to cover the seeds causes significant yield reductions in both varieties.

### 6.1.7. Chickpea variety x seed rate for winter and spring planting

Winter planting has not been successful because low tolerance of new varieties to cold and Ascochyta .Blight, therefore only spring planted chickpea was evaluated in 3 locations for the 3rd year. Both improved and local chickpea varieties provided the same yield (0.3 t/ha). Seed rate of 50 kg/ha gave similar yield to that of 100 kg/ha. Spring plantings can provide a good environment for seed emergence but can not provide enough moisture for higher plant densities later because of low or no rain at the later growth period. This work will not continue next year because of unavailability of improved varieties resistant to cold and Ascochyta. Winter planting of chickpea should be demonstrated in larger plots collectively when new resistant varieties are available.

### 6.1.8. Study on fertilizer placement on wheat production by modified planter (1st year)

This work has been conducted in 3 locations for the first year. Fertilizer placement at 9 cm below the seed by modified planter gave the highest wheat yield (1.54 t/ha) compared with placing fertilizer at 6 cm below the seed (1.31 t/ha) and fertilizer application together with the seed (1.16 t/ha). This is parallel to the results of research conducted earlier on station. The work will continue next year with only 9 cm placement and the control (fertilizer and seeds together) to show the best placement method with farmers' practice.

### 6.1.9. Study the effect of fertilizer placement on Sahand barley production (1st year)

This work is the same as the above work and conducted at 3 locations. Fertilizer placement at 9 cm below the seed by modified planter gave the highest barley yield (1.58 t/ha) compared with placing fertilizer at 6 cm below the seed (1.37 t/ha) and fertilizer application together with the seed (0.89 t/ha). The work will continue next year with only 9 cm placement and the control to show the best placement method with farmers' practice for barley production.

### *6.2. On-farm* trials in Kermanshah region

Researchers have reported that on-farm trials were not approved by the Ministry because this work is not considered as research. However, it has been discussed in the Coordination Committee and recommended that these are not demonstrations but multi-location and multi-season researcher-managed non-replicated trials in farmers' fields. Then it was decided to keep them in the next year plan for a possible approval of the work by the Ministry. The title of the work could be Researcher-managed technology transfer through multi-location and multi-season activities.

## Natural Resource Management Research Plan for 1998/99:

### 1. Climate, soil and crop relationships

**1.1. Title:** **Determining the effects of climatic factors on cereals and legumes in dry farming.**

**Objectives:**
1. To investigate the effect of annual rainfall and its distribution on the yield of dryland field crops.
2. To assess the effect of mean, maximum and minimum temperatures in combination with rainfall amount and distribution on crop development and final product.
3. Initiate dynamic modeling on the basis of daily weather, soil and crop data (this is for future work).

**Locations:** Ardebil, Gachsaran, Gamloo, Maragheh, Sararood, Uroumieh and Hamadan.

**Data:**
- Long-term weather data from the nearest Met station including daily rainfall, max/min temperatures and radiation (if possible). If daily data is not available weekly or monthly data should be collected.
- Crop production data for different rainfed field crops under given managements for the years of weather data.
- Soil data (profile depth, field capacity, permanent wilting point, bulk density and organic matter%, slope, texture, pH, $CaCo_3$ %, and other available soil data (if any) associated with the available crop production data. Also soil moisture and mineral-N data of any experiments at planting time would be needed for modeling purposes.

**Principal staff:** Talie, Mahmoudi, Absalan, Najmadini, Hajiloi, Belson and Zenoorian from DARI, Mrs. Moghadesi from Meteorology

### 1.2. New Project: Agro-ecological Characterization

The dryland areas of Iran, are characterized by considerable weather variability, as well as major abiotic stresses, in particular drought and cold. The intensification of crop production in these areas therefore needs to address these major environmental constraints.

From a research perspective it is vital, in the first place, to assess the effect of climate on crop production. New varieties will be needed that are tolerant to drought and cold, or avoid these constraints though farming practices that make optimal use of the available and variable growing season.

The first questions to be addressed by agroecological characterization are:
- Where do the different types of environmental stresses occur?
- How important are they?
- What farm practices or new technologies can minimize their impact?

The climatic pattern itself has regional but also local dimensins. Topography, in particular altitude aspect, can strongly modify the regional climatic pattern. This is of particular importance in hilly areas, where at the local level major differences in suitability for different rops cultivars may exist. Also soils are important because they either reinforce or accentuate climatic constraints, particularly drought.

To make proper recommendations for optimal land use, climate and soils can therefore not be studied in isolation. There is a need to study the interactions between soils, climate and crops (including fodder crops), and this will require simulation modeling. At the same time the different farmer environments must be described in an integrated manner. This requires an agroecological zones approach.

Modelling by itself is unlikely to yield good recommendations, unless there is some form of ground truthing. This ground trutling can be undertaken by researchers, using standard methodologies and data from experimental stations, but will lead to far better results if farmers are involved. Farmer involvement in land quality assessment characterization, whereby information is obtained from farmers about local agroecologies, is a noval approach, called participatory agroecological characterization. This information will allow a much better understanding of the variability of local environments and allow reseachers to develop optimal packages for these environments.

**Outline of a proposed activity in AEC**

- Identification of Iranian researchers to collaborate with ICARDA AEC project,
- In-country training course as appropriate.
- Preparation of inventory of existing climate, soil, water resources, land use and farming systems data.
- Definition of study area.
- Compilation of soil maps, climatic data, water resources, land use and farming systems information for the study area.
- Acquisition of necessary data from other AREEO institutions, if not available at DARI, SWRI, Metaorological Organization.
- Initial identification of agroecological zones and description of their main attributes, environmental constraints and recommendations for different land use types.
- Participatory agroecological characterization to assess local variations within farmer environment.
- Use of crop modelling techniques to study expected performance of current or new crop varieties the different local environments identified from the agroecological zones study.
- Recommendations based on crop and waterbalance modeling for optimal water management under irrigation.

The expected duration of this proposed research plan is 4 years. ICARDA-coordinated training activities may be anticipated through the research program if and when necessary.

To initiate this research plan it is proposed that the Manager of ICARDA's AEC Project, Dr.

EddyDe pauw, will visit Maragheh and other project areas in the period mid to end May 1999.

This project will be part of the national endeavor on AEC by DARI, SWRI and Meteorological Organization of Iran.

This period, which is the time of maximum vegetative growth, is preferred because to develop a joint AEC program of agroecological characterization, it will be necessary to tour the area around DARI during the growing season. Soil maps and climatic data will be needed.

## 2. Long-term Crop Rotation Studies

**2.1. Title:** **Studies on fallow replacement by legumes and oilseed crops in fallow-cereal rotation in the dry areas (5th year).**

**Objectives:**

1. To investigate the effect of introducing annual food and feed legumes and oilseed crops into the fallow-wheat rotation on the productivity.
2. To study the effect of introduction of above mentioned crops on soil organic matter and nitrogen content.
3. To quantify biological nitrogen fixation by legumes and determine their contribution to the nitrogen nutrition of cereals.
4. To assess the profitability of crop sequences compared with fallow-cereal rotation in a system context.

**Locations:** Maragheh, Gamloo, Gachsaran, Kermanshah (KS).

**Note:** KS included from 1997/98 season because of high potential of introducing oilseed crops in crop rotation with cereals.

**Treatments:** Following two-course rotations will be tested in the first three sites:

1. Fallow-wheat (farmers' management)
2. Fallow-wheat (recommended management)
3. Lentil-wheat
4. Chickpea-wheat
5. Vetch-wheat
6. Medic-wheat
7. Wheat-wheat
8. S. barley-wheat
9. Sunflower-wheat
10. Safflower-wheat
11. Rapeseed-wheat

In Kermanshah, it is suggested that wheat-chickpea, wheat-fallow, wheat-wheat, wheat-sunflower, wheat-safflower, wheat-rape seed. Station staff has also suggested chickpea-sunflower, chickpea-safflower and chickpea-rapeseed rotation. However, both chickpea and oilseed crops are for the fallow replacement crops in rotation with wheat. Therefore, it was questioned at the Resource management committee but needs further discussion in the Ministry.

**Design:** Randomized block design, with two phase entry (crop phase and wheat phase) with 3 replications.

**Plot size:** 10 m x 15 m

***Fertilizer***: Wheat phase receives 50 kg $P_2O_5$ and 30 kg N per ha.
Other crop phase:
Wheat, spring barley and oilseed crops receive 30 kg N per ha and no phosphate. Legume crops receive 15 kg N per ha and no phosphate.

**Tillage**: Fallow tillage will follow (a) farmers' method and (b) the method recommended for the local areas.

At the end of the crops phase, plots will be tilled with a ducksfoot as soon as possible after harvest. If this is not possible, each plot will be tilled by offset-disk equipment between harvest and the planting of wheat phase.
Following wheat phase, plots will be plowed in the fall and cultivated in the spring before planting the legumes and oilseed crops and spring barley.

**Sowing**: All crops to be drilled, with a 17.5 cm row spacing for cereals and feed legumes and 35 cm row spacing for food legumes and oilseed crops.
Wheat will be planted in the fall, while spring barley and other crops will be planted at proper time in the spring, all at the recommended seed rate.

**weed control**: Appropriate herbicide will be used for wheat, inter-row cultivation or and weeding will be done in other crops. If any appropriate herbicide is available for legumes, then it will be used. However, Kerb (pronamide) will be avoided in legumes because of residual effect on cereal crops.

**Observations**: Weather: daily rainfall, maximum and minimum temperature and radiation (if possible), soil temperature at surface, 5 cm and 10 cm depth.
Soil:

1. Standard soil analysis in 10 soil profiles (chemical and physical) representative of the whole experimental field at the beginning.
2. Aggregate stability in 0-15 cm and 15-30 cm of top soil at the beginning of the trial in about 10 samples and repeat after 5 years in each plot.
3. Bulk density, field capacity, permanent wilting point, total N, organic matter, and texture will be determined in the 10 samples (where aggregate stability is measured)of soil profile at the beginning. Slope of the trial should also be recorded.
4. Aggregate stability, total N and OM will be measured in each profile after 5 years.
5. Soil moisture status (when neutron probes become available) should be measured by hand auger if possible.
6. BNF will be recorded and contribution of Rihyzobium to soil nutrition determined.
7. Economics worked out every year of different rotations.

Crop:

1. Crop penology: date of emergence, flowering/ anthesis, maturity.
2. Crop stand/m row length at 3 spots/plot at complete emergence.
3. Plant height at maturity.
4. Yield attributes; spike/$m^2$, seeds/spike, seeds/$m^2$, 1000 seed weight etc. depending on time availability.

5. Seed and straw yield from the net plot harvested.
6. Observation on diseases, insect pests and weeds, frost/cold effect, bird damage and lodging effect in each treatment.

Input cost and output price:

1. Cost of each fallow tillage operation.
2. Cost of other tillage after crop harvest
3. Unit cost of seed and fertilizer.
4. Weed control cost.
5. Labor cost for any operation.
6. Harvest cost for each crop.
7. Grain and straw price of each crop.
8. Oil and meal price of oilseed crops.

**Rotation:**

| | 1994/95 | 1995/96 | 1996/97 | 1997/98 | 1998/99 | 1999/2000 |
|---|---|---|---|---|---|---|
| Phase 1 | Wheat | Crops | Wheat | Crops | Wheat | Crops |
| Phase 2 | Crops | Wheat | Crops | Wheat | Crops | Wheat |

**Note:**

1. The experiments will have to be conducted for a long period of time to be able to see treatment differences in rotation to changing environmental conditions. The interpretation of results will depend on good collection of data on weather conditions as well as soil conditions. Good records of crop penology and biotic/abiotic stresses should be kept for further assistance in the data interpretation.
2. There may be need to replace genotypes and/or agronomic practices as experience is gained over the years.
3. After the crops are established for 1-2 years, micro-plots with $N^{15}$ will be put in the legume plots to quantify biological nitrogen fixation.

**Principal staff:** Hagigati, Najmadini, Nareki, Ferri, Vosoughi (for economic analysis)

## 3. Supplemental Irrigation (SI)for Stabilizing Crop Production in Dryland Areas

### 3.1. Improving and Stabilizing Yields and WUE in the Rainfed Areas of Iran by Supplemental Irrigation
**(1st year)**

**Background:** Potential annual water resources of Iran are about 105 bill. Cubic meter in surface and 37 bill. Cubic meters in ground water. Expansion in irrigation was very fast over the last decade and indications of over-use of aquifers are reported. Ambitious plans for irrigation development can only be achieved if efficiency of water application and use is improved. FAO report presented at the Iranian Second Congress on Soil and Water in

*Feb.1997* (by A.P. Koohafcan) indicated low efficiencies in surface irrigation and over utilization of ground water resources. The fist priority in the country's strategy on water is increasing efficiency. So the priority of research for developing technologies for improved water use efficiency is very high at all levels. Supplemental irrigation (SI) is a potential practice for higher and more stable rainfed yields and for improving WUE. The practice is apparently relevant to many areas of Iran.
Some research results have been cited in several areas of Iran. However, the available information is mainly from isolated trials usually addressing a site-specific problem. Problems associated with this practice in various agro-climatic zones are not well identified and the requirements for optimal management are unknown for the various rainfed areas of Iran.
In summary, although SI practice is rapidly expanding, there is neither enough information as to quantify its potential, or to advise on the optimal schedules and management in relation to other crop production parameters. Considering the fact that the areas concerned are very extensive and that water resources and irrigation systems are anyway under development for other crops, any proven technology for improving and stabilizing crop yields will definitely has a large impact on farmers wellbeing.

**The objective of the proposed research is:**

Improved and stabilized crop yield and water use efficiency in the rainfed areas of Iran through optimal management of supplemental irrigation as integrated with other components of the farming systems.

The research project will address SI issues in the major Agro-ecological zones of the rainfed areas. Areas between 250 to 600 mm with elevations ranging from that of Maragheh down to the lowest possible may be considered. Since DARI research stations are distributed over different zones it would be convenient to carry the work in these stations. The research may be conducted in three phases:

Phase one: Starts in 1998/1999 and includes two major activities:

Assessment of current situation and problem identification in existing and potential areas of SI. This phase includes a study on secondary data from selected potential sites such as climate, water resources, soils, crops, agricultural and irrigation practices and socio-economical aspects. The use of existing models at ICARDA-NRMP will help in characterizing the soil-water-plant system under rainfed and SI at various agro-ecological zones and define periods and magnitudes when soil moisture is a constraint to improved and stabilized yields. Once potential areas and problems are identified, trials to address them will be designed and implemented in the appropriate sites. Training of key personnel in the selected stations will be conducted on the required activities in Tel Hadya/Aleppo under the supervision of T. Oweis. A report summarizing all above may be produced by end of 1999. Details of the workplan, data to be collected and required analysis are presented in Appendix I.
Parallel to the activities in (a) an experiments at Maraghe station (and may be two or three other stations) may be implemented in 1998/1999 season to investigate the effect of potential management alternatives on yields and WUE of rainwater and SI water. This is possible at this time since some work has been done in this area and some of the problems are already

identified. The results of the first season may also be useful to run the model in (a). Treatments may include planting date with SI and levels of water and fertility for one or two crops. The design and the details of this trial are presented in Appendix II.

Phase Two: Starts when the results of the study in Phase 1 are obtained. It includes planning and implementing trials in representative locations covering the agro-ecological zones with promising potential for SI. The trials will address the questions raised by the study completed in Phase 1. At least 3 years of data may be needed and results to be evaluated annually. The output of this stage would be information on the optimal management of SI in the selected areas. Packages on optimal irrigation scheduling, fertility levels, dates of planting, varieties and cultural practices for each areas may be developed based on the research results.

Phase Three: In this phase a program for technology transfer to farmers my be formulated and start implementing. Recommendations and or technologies at each site to be put in transferable form and passed through extension to farmers. Demonstration fields and other extension tools may be used to help implementing these technologies.

**Research Requirements**: Most of the requirements for conducting the research work seem to be available within the Iranian National Program. However two important deficiencies need to be dealt with in order to do the work. These are:

a. Soil-water measurement devices. This is urgent issue since measurement of water is the basis for any improvement in water use efficiency and other water related aspects. Each of the stations should, at least, have two devices able to monitor soil moisture fairly frequently. For the conditions prevailing in DARI stations and the type of research expected, I recommend the neutron probes with enough access tubes and accessories as best choice. Other equipment is needed in the labs of the stations to determine soil texture, soil water at different matric potentials and soil infiltration rate.
b. Capacity building of junior staff: the engineers expected to follow up on the day-to-day activities will need training on aspects such as soil moisture monitoring and determination of water use, water measurement and data analysis in addition to management of water related trials. We can provide this training in Tel Hadya as individual trainees. One engineer from each participating station may spend up to 4 weeks, as an individual trainee, with ICARDA Water Management team in Aleppo during the winter season of 1998/1999 to get trained on all the needed operations.

Collaboration with other Iranian institutions such as IAERI and the Soil and Water Institute would benefit very much the water management research of DARI. I recommend that this collaboration be further enhanced.

Appendix I. Study of SI potential and constraints in Iran.

(To be faxed from Aleppo)

Appendix II. SI trial No 1.

*Title:* **Response of rainfed wheat to levels of supplemental irrigation (SI) and nitrogen.**

**Background:** Optimizing supplemental irrigation requires information on the yield and crop water use at different levels of water application. Also the interaction between water at various levels and levels of nitrogen application is of major importance. Such information is not available.

**Objectives:** Information on wheat response to full and deficit SI and to levels of nitrogen and their interactions for optimizing the practice in the relevant areas of Iran. Established methodologies ana capable human resources to conduct water management research in DARI stations.

**Locations:** Maragheh, Sanandaj, Uroumieh, Kermanshah

**Design:** Split plot in three replicates

**Treatments:** 1. Four water treatments:
Rainfed = no SI
Full SI = SI to fulfill 100% of crop water requirements,
1/3 SI = SI to fulfill one third of water applied in the Full SI treatment
2/3 SI = SI to fulfill two third of water applied in the full SI treatment.
2. Four nitrogen treatments: (in Maragheh, in some stations four wheat varieties may be used)
N0 = no nitrogen application,
N50 = application of 50 kg N/ha,
N100 = application of 100 kg N/ha,
N150 = application of 150 kg N/ha.

**Irrigation system:** Small basins. Each basin is one plot with area of 25 $m^2$ (5mx5m).

**Wheat Variety:** Sabalan in Maragheh, Sardari in the other stations

**Methodology:**

Flat land to suit basin irrigation is to be selected. The total experiment area will then be planted dry in regular planting time in the area with 350 seeds /m2 (about 150 kg/ha) using planter at row spacing 15 to 20 cm. Land will then be divided into plots of 25 m2 (5x5m) according to the experiment design. Buffer between water treatments should be 1.5m and between N treatments of 0.5m. Levees of 0.30-0.40m should be built around each basin. Half of the N should be added at planting and the other half at tellering in the spring. Soil moisture should be measured before planting to a depth of 1.5m (20-cm intervals). Soil physical (texture, FC, WP) and chemical (N mineral and total, P, K) properties and organic matter should be determined before planting.

Irrigation will be determined over the growing season based on soil moisture level. Measurements of soil moisture at the Full SI treatment will be taken weekly during the spring for a depth of 1.5 m. Wheat root zone will be estimated the depth of water in the root zone will be determined. Irrigation is given when the soil moisture in the root zone of the Full SI treatment is down to 50% of the Available Moisture (50% of the difference between field capacity and wilting point). Measurements are to be taken in one replicate and averaged over the four N treatments. Amount of irrigation to be applied will be determined for the Full SI treatment to bring soil moisture in the root zone back near field capacity. 2/3 and 1/3 of these amounts will be given at the same time to the other two treatments.

Soil moisture measurements are needed in at least in one replicate. If a neutron probe is available an access tube should be installed in each plot to a depth of 1.5 m. Soil moisture

should be measured before and after each irrigation, after each rain event and at suitable intervals over the growing season (weekly or biweekly). The purpose is to determine irrigation time and amount, effective root zone depth, actual crop water use and levels of moisture stress over the growing season and water use efficiency under each treatment.
Measurements other than the soil moisture includes time of emergence, tillering, stem elongation, flowering, grain filling, and maturity according to Zadok scale. Leaf area index, plant height, and total dry matter at these phynological stages. N% in plant samples at these stages. Grain and straw yield determined from 3-4 $m^2$ in the middle of each plot. 1000 seed weight, and N% in grain and straw.
All the nutrients will be applied on the basis of soil analysis which will be taken care by SWRI.

**Principle staff:** Tavakoli, Toshih, Belson and Shirvani or Ferri in Cooperation with SWRI and ICARDA (T. Oweis and M. Pala)

### 3.2. Title: Supplemental irrigation need of new wheat varieties in Maragheh, Sararood and Uroumieh (2nd year)

**Objectives:** To find out the responses of new wheat varieties to a limited supplemental irrigation.
**Locations:** Maragheh, Sararood and Uroumieh
**Treatments:** Varieties: 1. Sabalan/1-27..., 2. Anza, KVZLTm71..., 3. Ogosta/Sefid, 4. Sabalan (check)
Water application: 1. Rainfe, 2. 50 mm at planting, 3. 50 mm at planting
**Design:** Split plot with 3 replicates
**Plot size:** 5 m x 10 m.
**Fertilizer:** 60 KG P2O5/ha at planting, 50 kg N/ha at planting and 50 kg N/ha as top dressing in spring. In very dry years 50 kg N/ha at planting should be sufficient for rainfed plots.
**Observations:**
1. Soil moisture status during cropping season
2. Meteorological data
3. Crop phenology: date of emergence, heading, flowering, milky stage, physiological maturity.
4. Seed and straw yield from the net plot harvested.
5. Seed and straw yield from 1 $m^2$ area sampled for yield attributes and for chemical analysis of seed and straw for N.

**Principal staff:** Tavakoli, Ferri, Belson

### 3.4. Title: The effect of supplemental irrigation method and amount on bread wheat varieties in dryland farming (2nd year).

**Objectives:**
1. to stabilize wheat yield ensuring autumn emergence,
2. to define the best method of irrigation,
3. to choose the best adapted varieties under autumn irrigation

**Location:** Hamadan
**Treatments:** Main Plots(Methods of SI): 1. Irrigation by rain gun, 2. by wheel move,

| | |
|---|---|
| | 3. by portable solid set.<br>Sub-plots (Time of SI): 1. 50 mm after planting, 2. 50 mm at flowering,<br>3. rainfed Sub-sub plots(varieties):Sardari, Sabalan, SXL/Glenson (must be treated with fungicide as this line is highly susceptible to common bunt). |
| **Design:** | Split-Split plot with 3 replications |
| **Plot size:** | 10 m x 20 m. |
| **Observations:** | Date of emergence, plant/m2,winter kill, (%) soil moisture measurement, plant height, grain and straw yields, 1000 seed weight. Frost/cold damage on tillers/spikes. |
| **Principal staff:** | Zelnoorian |

**4. Soil Management Studies**

**4.1. Title: Effect of sowing date, seed depth and seed rate in chickpea production in Kermanshah region (4th year)**

| | |
|---|---|
| **Location:** | Sararood |
| **Treatments:** | Main Plots(Sowing date): 1. Fall planting, 2. Entezari, 3. Spring planting.<br>Sub-plots (Sowing depth): 1. 5 cm, 2. 10 cm<br>Sub-sub plots(seed rate): 1. 15 , 30, 45, 60 seeds/m2 |
| **Design:** | Split-Split plot with 3 replications |
| **Plot size:** | 5 m x 15 m. |
| **Observations:** | Date of emergence, plant/m2, winter kill, plant vigor, plant height, grain and straw yields, 1000 seed weight. |
| **Principal staff:** | Yaveri in cooperation with AERI |

**4.2. Title: The Effect of Wheat Stubble Management during Fallow and N application on the following Wheat in Gamloo, Sanandaj (4th year).**

| | |
|---|---|
| **Location:** | Gamloo |
| **Treatments:** | Main Plots(Stubble management): 1.Control (all residue left on surface), 2. All residue grazed, 3. All residue plowed at harvest, 4. Chopping residues and plowed at harvest, 5. Burning all residues at harvest<br>Sub-plots (N application): 1. 30 kg N/ha. 2. 60 kg N/ha<br>Treflan is applied in spring of fallow season and plowing before planting. |
| **Design:** | Split plot with 3 replications |
| **Plot size:** | 10 m x 20m (main plots), 5 m x 10 m (sub plots) |
| **Observations:** | Date of emergence, plant/m2, plant vigor, crop phenology (date of different crop stages), plant height at those stages, grain and straw yields, 1000 seed weight. |
| **Principal staff:** | Toshih. |

**4.3. Title: The Effect of Different Initial Autumn Tillage and Spring Mulch Systems During Fallow Season on the following Sardari wheat production in Uroumieh (4th year).**
(See the achivement section for the treatments)

**4.4. Title: The effect of soil compaction on moisture conservation in soil on rainfed wheat production (1st year).**

Not carried out as it was not approved in the provincial committee. This experiment may be conducted this year when new station is available.

| | |
|---|---|
| **Location:** | Uroumieh |
| **Treatments:** | Main plots: Compaction before planting, Compaction after planting and no compaction Sub-plots: Heavy compaction, 1.154 kg/cm2 Light compaction, 0.890 kg/cm2 |
| **Design:** | Split plot with 3 replications |
| **Plot size:** | 6 m x 20 m. |
| **Observations:** | Soil moisture, field capacity, permanent wilting point, porosity and bulkdensity in soil, grain and straw yield |
| **Principal staff:** | Tabiehzad |

**4.5. Title: The effect of sowing method on wheat varieties in dryland farming (2nd year).**

| | |
|---|---|
| **Location:** | Hamadan |
| **Treatments:** | Varieties: Sardari, SXL/Glenson and Sabalan; Sowing methods: 1. Planting with Hasia drill, 2. Distribution of half the seed rate by Centrifuge and planting the rest with Hasia drill, 3. Sowing by Hasia drill in 2 cross direction (half vertical, half horizontal) |
| **Design and Plot size:** | RCBD with 4 replication in 10 m x 20 m plots. |
| **Observations:** | Date of emergence, plant/m2, head/m2, plant hight, grain yield, straw yield, 1000 seed weight. |
| **Principal staff:** | Saati |

**4.6. Title: Comparison of different tillage methods on wheat yield following chickpea crop in dryland areas (1st year)**

| | |
|---|---|
| **Objectives:** | Tillage results are available in wheat-fallow rotation. Thus there is a need to study the tillage needs for wheat production in wheat-chickpea rotation systems |
| **Locations:** | Sararood, Maragheh, Shirvan |
| **Treatments:** | Application before rain:<br>1. Moldboard plough + disc harrow<br>2. Moldboard plough + Rotavator + roller (power harrow)<br>3. Chisel plough + Disk harrow<br>4. Chisel plough + Rotavator + roller(power harrow)<br>5. Sweep +spike tooth harrow<br>6. Broadcasting + Moldboard covering<br>7. Broadcasting + Disk harrow covering |

Application after rain:
8. Broadcasting + Disc harrow covering

9. Broadcasting + Molboard covering

**Plot size:** 5 m x 20 m
**Seed rate:** 160 kg/ha
**Fertilizer:** based on soil analysis
**Planting:** Amazone drill placing fertilizer 9 cm below.
**Principal Staff:** Yaveri and Talei, Eskandari, Azimzadeh

### 4.7. Stubble management and its effect on soil moisture and wheat yield in wheat-fallow systems (1st year)

**Locations:** Maragheh

**Treatments:**

1. Chopping and mixing residues with chisel in fall + sweep in spring + drill planting

2. Chopping and mixing residues with semi-moldboard plough in fall + sweep in spring + drill planting

3. Check (Semi-moldboard in spring + Disc harrow at planting + broadcast and disc harrow planting

4. Bale straw + semi-moldboard in spring + disc harrow leveling + drill planting

5. Sweep +spike tooth harrow

**Plot size:** 15 m x 50 m (Two phase entry with fallow and wheat blocks)

**Seed rate:** 160 kg/ha

**Fertilizer:** based on soil analysis
**Observations:** Soil moisture, aggregate stability (at the end of trial), OM%, Total N%, Compaction, Bulk density in soil, and date of emergence, plant height at flowering and harvest, tiller numbers (fertile and unfertile), Plant/m2, grain and starw yield, 1000 seed weight, N% in grain and straw
**Principal Staff:** Asghari

## 5. Nutrition and Seed Rate Requirements in Crop Production

### 5.1. Title: Seed rate requirements of barley (Sahand) in Sanandaj and Kermanshah region (2nd year).

These trials are similar to those seed rate and fertilizer requirements of previous variety of wheat or barley. Seed rate: 250, 350 and 450 seeds/m2; Fertilizer rates: 1. 20 kg N/ha +15 kg P2O5/ha, 2. 40 kg N/ha +30 kg P2O5/ha, 3. 60 kg N/ha +45 kg P2O5/ha.
Note: Bahman Abdulrahmani proposed to study the same for Sahand barley in Maragheh for the firs year. If it is accepted than it should be the same as this.
**Principal staff:** Toshih, Ferri

### 5.3. Title: The seed rate and fertilizer (DAP) requirement in dryland barley production in Khorasan (2nd year).

**Location:** Shirvan
**Treatments:** Seed rate: 100, 125, 150 kg seed/ha
Fertilizer: 100, 120, 140, 160 and 180 kg DAP/ha
**Principal scientist:** Ahmedi

### 5.4. Title: The effect of sowing depth and method of fertilizer placement on dryland barley production in north of Khorasan (2nd year).

**Location:** Shirvan
**Treatments:** Varieties of barley: 1. Local (Kara arpa), and 2. Sahand
Fertilizer placement: 1. Seed and fertilizer together, 2. Fertilizer placed cm under Seed rate: 100, 125 and 150 kg/ha
**Principal Staff:** Azimzadeh, Ahmedi

### 5.5 Title: The seed rate and Phosphate requirements of Sahand barley in Ardebil (2nd year)

**Location:** Ardebil
**Treatments:** Fertilizer: 0, 20, 40, 60 kg P2O5/ha
Seed rate: 300, 350, 400 seeds/m2
**Principal staff:** Gholamreza Abediasl

### 5.6. Title: Study the effects of different tillage methods on weed control in dryland chickpea-kabuli type (2nd year)

**Objectives:** Find proper tillage method for weed control in chickpea production.
**Location:** Maragheh
**Treatments:** A: Autumn operation
$A_1$: Mouldboard plow
$A_2$: Without any tillage
B: Spring operation
$B_1$: Sweep+planter

$B_2$: Disc-harrow+planter
$B_3$: Chemical application+planter
$B_4$: Direct drilling
$B_5$: Broadcasting+covering by disc-harrow
$B_6$: Hand broadcasting+covering by mouldboard plow

**Design:** Split plot
**Plot size:** 4m x 10m
**Observation:** No. of weeds 30-40 day after chickpea emergence, dry weight of weeds before harvesting, date of emergence of chickpea, plant vigor, plant height, grain and total yield.
**Principal Staff:** Bazzazi, Vosooghi (economic analysis)

**5.7. Title: Study the performance of cereal drills on bread wheat yield in dryland (1st year).**

**Note:** It was not approved by Provincial committee but at the coordination committee in Maragheh, it was decided that it should continue

**Observation:**
1. Selection of proper cereal seeding drill for Hamadan region.
2. To choose the best seed rate for each drill.

**Location:** Hamadan
**Treatments:** Planting Methods:
1. Planting by Hassia
2. Planting by John shearer
3. Amazon planter placing fertilizer below seed
4. Amazon planter placing fertilizer above seed
5. Planting by centrifuge

**Seed rate:** 250, 300, 350, seed/$m^2$.
**Design:** RCBD with 3 replication
**Plot size:** 15m x width of each planter and for centrifuge 3 m.
**Principal staff:** Saati

**5.8. Title: Study the effects of long-term Nitrogen fertilizer application on chemical properties of soil in wheat rotation (2nd year).**

**Objectives:**
1. Evaluation recycling of fertilizer
2. Evaluation of desalinization effect of Nitrogen fertilizer and effect of increasing EC.
3. Determination of suitable Nitrogen fertilizer in dryland farming.
4. Determine effects of Nitrogen fertilizer on soil PH.

**Location:** Maragheh.
**Treatments:**

| Autumn application | Spring application |
|---|---|
| A.N | A.N |
| Urea | Urea |
| SCU | SCU |
| Check (no fertilizer) | Check (no fertilizer) |

**Note:** 60 kg N/ha is considered as a total application. 40 kg N/ha is applied at planting and 20 kg N/ha is top dressed in spring at tillering for each type of N sources.

**Design:** RCBD Factorial with 3 replications
**Plot size:** 4m x 4m
**Observation:** Chemical characteristics of soil, dry matter +grain yield, protein content, desalinization in long-term, emergence, plants/$m^2$, heads/$m^2$, seeds/head.
**Principal staff:** Mahmoudi

**5.9. Title: Chickpea mechanization: 1. Comparison of different tillage methods and their effects on chickpea yield.**

**Objectives:**
1. Improvement of soil physical condition (Smoothness of soil surface) for mechanical harvesting
2. To assess the effect of tillage methods on grain yield of crop.

**Location:** Maragheh and Kermanshah
**Treatments:**
1. Moldboard in fall +disc harrow and planting in spring by drill
2. Chisel in fall +disc harrow and planting in spring by drill
3. Moldboard in fall + leveler and planting in spring by drill
4. Chisel in fall + leveler and planting in spring by drill
5. Moldboard in fall +power harrow and planting in spring by drill
6. Chisel in fall + power harrow and planting in spring by drill
7. Moldboard in Fall + broadcast with disc harrow planting in spring (Check 1)
8. No tillage before +Broadcast and disc harrow planting in spring (Check 2)

The depth of moldboard plowing is 20 cm (Conventional tillage) and chisel plowing is 15 cm. The two checks were added in 1998/99 season.
**Design:** Randomize complete block design.
**Plot size:** 30x30 (Main plot)
**Observation:** Soil strength (Cone index)-clod mean weight and diameter (0-10 cm depth) after planting, final emergence, plants/m2,type of plant canopy-width of canopy at the time of flowering, distance between the soil surface to the lowest pods, yield, 1000 seed weight.
**Principal staff:** Rahimzade, Yaveri in collaboration with AERI (Sharifi)

**5.10. Title:** **Lentil mechanization: 1. Comparison of different tillage methods and their effects on chickpea yield.**
**Objectives:**
1. Improvement of soil physical condition (Smoothness of soil surface) for mechanical harvesting
2. To assess the effect of tillage methods on grain yield of crop.

**Location:** Gazvin
**Treatments:**
1. Moldboard in fall +disc harrow and planting in spring by drill
2. Chisel in fall +disc harrow and planting in spring by drill
3. Moldboard in fall + leveler and planting in spring by drill
4. Chisel in fall + leveler and planting in spring by drill
5. Moldboard in fall +power harrow and planting in spring by drill
6. Chisel in fall + power harrow and planting in spring by drill

The depth of moldboard plowing is 20 cm (Conventional tillage) and chisel plowing is 15 cm.

| | |
|---|---|
| ***Design:*** | Randomize complete block design. |
| **Plot size:** | 30x30 (Main plot) |
| **Observation:** | Soil strength (Cone index)-clod mean weight and diameter (0-10 cm depth) after planting, final emergence, plants/m2,type of plant canopy-width of canopy at the time of flowering, distance between the soil surface to the lowest pods, yield, 1000 seed weight. |
| **Principal staff:** | Legume agronomist in collaboration with AERI (Sharifi) |

**5.11. Determination of critical level of micronutrients in soil using soil analysis and Wheat varieties, Serdari and Sabalan in dryland regions of Iran (1st year)**

| | |
|---|---|
| **Objectives:** | 1. Identification of micronutrient levels of dryland soils of Iran.<br>2. Identification of critical levels of some micronutrients using cv. Sardari. |
| **Locations:** | Maragheh, Sararood, Gamloo, Uroumieh |
| **Phase 1:** | Soil sampling in all the region in cooperation with SWRI and analysis of all micronutrients (Zn, Cu, Fe, B, Mo, Mn) |
| **Phase 2:** | Conduct experiment on Serdari and Sabalan wheat varieties o find out the critical levels of each nutrients |
| **Treatments:** | The details of the micronutrient treatments should be discussed after the analysis of the soil samples obtained in cooperation with SWRI staff |
| **Observations:** | Date of crop phenological development (Zadok scale; emergence, tillering, stem elongation, heading, flowering, grain filling, maturity), grain and straw yield, 1000 seed weight. |
| **Principle staff:** | Feizi asl, Talie, Toshih, Tabiehzad |

**5.12. Study the effect of urea spraying with herbicide in dryland wheat production of Iran (1st year)**

| | |
|---|---|
| **Locations:** | Maragheh, Sanandaj, Uroumieh, Kermanshah |
| **Treatments:** | 1. Check<br>2. Spraying at tillering<br>3. Spraying at stem elongation<br>4. Spraying at flag leaf stag<br>5. Spraying at flowering<br>6. Spraying together with<br>7. application as tank-mix |
| **Observations:** | Date of emergence, and the other phenological stages, leaf samling from all treatments for N measurement, .grain and straw yield, 1000 kernel weight, N% in grain and straw at harvest. |
| **Principle staff:** | Feizi asl, Toshih, Alizadeh, Talie |

**5.13. Study the effect of seed rate on three new varieties in dryland areas (1st year)**

| | |
|---|---|
| **Locations:** | Maragheh, Uroumieh, Ilam |
| **Treatments:** | Varieties: 1. KVZ/Tm71/3/, 2. Sbn//Trm/K253, 3. Sbn/1-27-56-4<br>Seed rate: 250, 300, 350, 400 seeds/m2 |

| | |
|---|---|
| **Design:** | Split plot with 4 replications |
| **Measurements:** | Standard as in the previous variety x seed rate trials |
| **Principle staff:** | Haghigati, Tabiehzad, Ebrahim |

**5.14. Study the effect of Nitrogen on three new varieties in dryland areas (1st year)**

| | |
|---|---|
| **Locations:** | Maragheh, Uroumieh, Ilam |
| **Treatments:** | Varieties: 1. KVZ/Tm71/3/, 2. Sbn//Trm/K253, 3. Sbn/1-27-56-4<br>Nitrogen rate: 0, 30, 60, 90 kg N/ha |
| **Design:** | Split plot with 4 replications |
| **Measurements:** | Standard as in the previous variety x seed rate trials |
| **Principle staff:** | Haghigati, Tabiehzad, Ebrahim |

**5.15. The study the effects of green manure on physiological and chemical properties and soil productivity**

| | |
|---|---|
| **Location:** | Maragheh |
| **Treatments:** | Uniform planting of Ray will be turned over and used:<br>1. 0 nitrogen, 2. 10 kg N/ha and 20 kg N/ha |
| **Measurements:** | Chemical soil properties, physical properties, OM%, Total N%, aggregate stability, Permeability, date of emergence, plants/m2, Grain and straw yields, 1000 seed weight. |
| **Principle staff:** | Abdoulrahmani |

**5.16. Study the effect of seed rates and fertilizer rates on yield of new promising barley (Chicem/An57)/Albert in Kermanshah (1st year)**

| | |
|---|---|
| **Location:** | Sararood |
| **Treatments:** | Seed Rate: 200, 300, 400, 500 seeds/m2<br>Nitrogen rate: 0, 30, 60 and 90 kg N/ha |
| **Design:** | RCBD with 4 replicates in 2.4 m x 5 m plots |
| **Observations:** | Emergence date, plants/m2, date crop phenological stages, plant hight at those stages, tiller (fertile and total)/m2, grain and straw yield, 1000 seed weight. |
| **Principle staff:** | Ferri |

**TRANSFER OF TECHNOLOGY:**

**6. On-Farm Research Trials on Problems identified during the Farm Surveys**

**6.1. Title: On-Farm Trials derived from Farm Survey in Hashtrood and Maragheh rainfed areas**

**Objectives:**

1. To improve the linkages between researchers, extension agent and farmers.
2. To increase farmers awareness of improved production systems,

3. To test improved production practices in multiple locations under farmers' conditions.

**Location:** Maragheh and Hashtrood Farmers' fields

**Background:** During farm survey conducted in May 1995 in Hashtrood and Maragheh region, production problems of farmers were identified. The majority of farming system of the survey area is based on cereal/livestock in a rotation of wheat-fallow. Chronic problem is the low yields even in good years according to farmers. Since about the half of the area is under fallow, its proper preparation is one of the most important management practice. Most farmers practice only single late tillage which is not proper and sufficient. Secondary tillage is also very late and mostly by moldboard when applied. Timely first tillage by moldboard, second and third tillage by sweep+harrow should be applied. Sowing is mostly done by hand and moldboard is used for covering seeds. Seed rate is low for barley, lentil and chickpea and even for wheat. Local varieties are dominating, thus improved ones have to be disseminated. Fertilizer application should be re-considered, machinery (drills, spraying equipments etc.) should be made available. Their production problems have been studied for several years by SPII and SWRI staff under dryland conditions. Therefore, station research should be directed only to detailed and strategic methodology development, and on-farm trials should be emphasized as given below according to survey data evaluation.

**Note:** Breeders, pathologists and entomologists have to be consulted in selection of proper varieties not only for on-farm trials but also for all other on-station experiments.

### 6.1.1. Wheat Variety X Seed Rate Trial

| | | | |
|---|---|---|---|
| Sabalan | Sardari | Sardari | Sardari |
| 150 kg/ha | 150 kg/ha | 200 kg/ha | 100 kg/ha |

**Plot Size** : 10m x 30-50 m.
**Location** : 5-10 (Depending on resources): Maragheh province.
**Tillage** : As recommended.
**Sowing Method** : Broadcast+disc harrow or drill if possible.
**Fertilizer** : 100 kg DAP/ha at planting
150 kg Urea/ha as top dressing.
**Weed control** : As recommended by herbicide.

**Principal staff:** Salek Zamani

### 6.1.2. Fertilizer Use On Wheat

| | | | | |
|---|---|---|---|---|
| 0 DAP<br>+<br>25 Urea | 0 DAP<br>+<br>100 Urea | 50 DAP<br>+<br>50 Urea | 50 DAP<br>+<br>100 Urea | 100 DAP<br>+<br>100 Urea |

**Plot Size** : 10m x 30-50 m.
**Location** : 5-10 (Depending on resources): Maragheh province.
**Tillage** : As recommended.
**Sowing Method** : Broadcast+disc harrow or drill if possible.
**Variety** : Sardari.
**Seed Rate** : 150 kg/ha.
**Weed control** : As recommended by herbicide.
**Principal staff** : Haghighati.

### 6.1.3. Tillage During Fallow Season For Wheat Production

| | | | |
|---|---|---|---|
| (a)<br>1. Recommend.<br>(Drill) | (b)<br>1. Recommended<br>(broadcast+<br>disc harrow) | 2. Farmers-I | 3. Farmers-II |

**lot Size** : 15m x 50 m.
**Location** : 5-10 (Depending on resources)-Maragheh province.
**Variety** : Sardari.
**Fertilizer** : 100 kg DAP/ha at planting
50 kg Urea/ha as top dressing.
**Seed Rate** : 150 kg/ha.
**Weed control** : As recommended by herbicide.
***Tillage treatments*** :
1. Recommended: Fall moldboard (18-20 cm)
Sweep at 10-12 cm in June (1. or 2. week)
Sweep at 8-10 cm in September or October (1 week before planting)
Drill for planting (a)
Broadcast+disc harrow for planting (b)
**Principal staff:** Asghari

*6.1.4.* **Barley Variety X Seed Rate planting for winter.**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Local Kara Arpa 75 kg/ha | Local Kara Arpa 150 kg/ha | New* 75 kg/ha | New* 150 kg/ha | Yesivi 75 kg/ha | Yesivi 150 kg/ha | Sahand 75 kg/ha | Sahand 150 kg/ha |

**Plot Size** : 10m x 50 m.
**Location** : 5-10 (Depending on resources)- Maragheh province.
**Tillage** : As recommended for wheat.
**Fertilizer** : 100 kg DAP/ha at planting
50 kg Urea/ha as top dressing.
**Sowing Method** : Broadcast+disc harrow
**Weed control** : As recommended by herbicide if needed.
**Principal staff** : Salak Zamani

**6.1.5. Chickpea Variety X Sowing Method for Spring Planting**

| | | | |
|---|---|---|---|
| Local + Moldboard | Improved + Moldboard | Local + Disc harrow | Improved + Disc harrow |

**Plot Size** : 10m x 50 m.
**Location** : 5-10 (Depending on resources)-Maragheh.
**Tillage** : No tillage after wheat harvest.
**Seed rate** : 100 kg/ha.
**Fertilizer** : 100 kg DAP/ha at planting.
**Weed control** : By hand if needed.
**Principal staff** : Vesoogh

**6.1.7. Study on fertilizer placement on wheat production by modified planter.**

**Location:** Maragheh.
**Objectives:** 1. To transfer technology to the farmers.
2. To improve crop production in the region.
**Treatments:** 1. Seed and fertilizer mixed in seed bed.
2. Distance between seed fertilizer-9 cm below the seed.
**Design:** RCBD with 5 replication.
**Principal staff:** Eskandari, Mahmoudi.

### 6.1.8. Study the effect of fertilizer placemen on Sahand barley production.

**Treatments:** 1. Distance between seed and fertilizer=4 cm (Fertilizer below).
2. A @ A @ =8 cm (Fertilizer below).
3. Seed and fertilizer mixed in seed bed (Check).

**Location:** Maragheh

**Design:** RCBD with 4 replication.

**Principal staff:** Reza Rahimzadeh.

### 6.2. Title: On-Farm Trials derived from Farm Survey in rainfed areas of Kermanshah

**Objectives:**
1. To improve the linkages between researchers, extension agent and farmers,
2. To increase farmers' awareness of improved production systems,
3. To test improved production practices in multiple locations under farmers' conditions.

**Location:** Farmers' fields in Kermanshah

**Background:** During farm survey conducted in July 1996 in Kermanshah region, production problems of farmers were identified. The majority of farming system of the survey area is based on cereal/livestock in a rotation of wheat-legumes. Yields are general low for all crops. Using local or old improved crop varieties with mostly low seed rate for legumes is a common practice. Improper tillage has been practiced for seedbed preparation. Sowing is done mostly by hand broadcasting method and covered by improper implement such as moldboard. Late sowing of chickpea needs reconsideration. Fertilizers are not available in time. Soil analysis needs to be applied for proper rate of fertilizer applications. Lack of machinery, fertilizer use and time and implement of tillage were ranked by farmers as the most important factors affecting crop productions. However, their production problems have been studied for several years by SPII and SWRI staff under dryland conditions. Therefore, station research should be directed only to detailed and strategic methodology development, and on-farm trials should be emphasized as given below according to survey data evaluation.

**Note:** Breeders, pathologists and entomologists have to be consulted in selection of proper varieties not only for on-farm trials but also for all other on-station experiments.

*6.2.1.* **Time and implement of tillage for cereal production following legumes**

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| | | | | | |

**Plot Size** : 10m x 20m (3 reps) or
15m x 50m (1 rep) (4 measurement in each plot).
**Location** : Research station
**Variety** : Sardari.
**Fertilizer** : 100 kg DAP/ha at planting
50 kg Urea/ha as top dressing.
**Sowing date** : Early October
**Seed Rate** : 125-150 kg/ha (or 300 seeds/m2).
**Weed control** : As recommended by herbicide.

Tillage treatments (implements available for farmers should be used):

1. Moldboard after legume harvest (18-20 cm)
   Disc-harrow in fall (10-12 cm)
   Disc-harrow before planting (8-10 cm)
   Drill planting
2. Moldboard after legume harvest (18-20 cm)
   Disc-harrow in fall (10-12 cm)
   Broadcast seed and fertilizer + Moldboard
3. Moldboard after legume harvest (18-20 cm)
   Disc-harrow in fall (10-12 cm)
   Broadcast seed and fertilizer + Disc-harrow
4. Moldboard after legume harvest (18-20 cm)
   Broadcast seed and fertilizer + Moldboard
5. Moldboard after legume harvest (18-20 cm)
   Broadcast seed and fertilizer + Disc-harrow
6. Sweep or disc-harrow before planting (12-15 cm)
   Drill planting

**Note:** This is important experiment but will be carried out when manpower/ resources/equipment became available, therefore since then it is deferred.

**6.2.2. Time and implement of tillage and Seed Rate for chickpea production following cereals**

| 1 | | 2 | | 3 | | 4 | | 5 | | 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 100 | 50 | 100 | 50 | 100 | 50 | 100 | 50 | 100 | 50 | 100 |

**Plot Size** : 10m x 20m (3 reps) or
15m x 50m (1 rep) (4 measurement in each plot).
**Location** : Research station (Not done) but conducted On-farm at Two locations.
**Variety** : Proper chickpea
**Fertilizer** 100 kg DAP/ha at planting
**Sowing date** : Early spring
**Seed Rate** : 50 and 100 kg/ha as shown in the plan above
**Weed control** : Hand weeding

Tillage treatments (implements available for farmers should be used):

1. Moldboard in fall before rain (18-20 cm)
   Disc-harrow in spring before planting (10-12 cm)
   Drill planting
2. Moldboard in fall before rain (18-20 cm)
   Disc-harrow in spring before planting (10-12 cm)
   Broadcast seed and fertilizer + Disc-harrow
3. Moldboard in fall before rain (18-20 cm)
   Broadcast seed and fertilizer + Disc-harrow
4. Moldboard in fall before rain (18-20 cm)
   Broadcast seed and fertilizer + Moldboard
5. Broadcast seed and fertilizer + Moldboard
6. Broadcast seed and fertilizer + Disc-harrow

Note: To be deferred until manpower becomes available at Sararood.

### 6.2.3. On-Farm Fertilizer Use By Wheat

| | | | | | |
|---|---|---|---|---|---|
| 0 DAP<br>+<br>50 Urea | 100 DAP<br>+<br>100 Urea | 0 DAP<br>+<br>25 Urea | 0 DAP<br>+<br>100 Urea | 50 DAP<br>+<br>100 Urea | 50 DAP<br>+<br>50 Urea |

**Plot Size** : 10m x 30-50 m.
**Location** : 5-10 (six locations)- Depending on resources.
**Tillage** : As recommended in Tillage No. 1 above (Study 1).
**Sowing Method** : Broadcast+disc harrow or drill if possible.
**Sowing Date** : Early October
**Variety** : Sardari.
**Seed Rate** : 100-150 kg/ha.
**Weed control** : As recommended by herbicide.
**Principal staff** : Talai

### 6.2.4. On-Farm Fertilizer Use By Chickpea and Lentil following Wheat

| Chickpea | | | | Lentil | | | |
|---|---|---|---|---|---|---|---|
| 100 DAP + 0 Urea | 0 DAP + 0 Urea | 100 DAP + 50 Urea | 0 DAP + 50 Urea | 100 DAP + 0 Urea | 0 DAP + 0 Urea | 100 DAP + 50 Urea | 0 DAP + 50 Urea |

**Plot Size** : 10m x 30-50 m.
**Location** : 5-10 (To be deferred until manpower become available)
**Tillage** : Moldboard in fall before rain (18-20 cm).
**Sowing Method** : Broadcast seed and fertilizers + disc-harrow.
**Sowing Date** : Early spring
**Varieties** : Proper chickpea and Lentil.
**Seed Rate** : 100 kg/ha.
**Weed control** : Hand weeding.

**Important note:** Soil analysis is needed from about 25 farmers' fields in different environments. Then, trials should be conducted where P-Olsen values less than 7 ppm.

### 6.2.5. Mechanical and Chemical Weed Control for Chickpea on Station

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|

**Plot Size** : 10m x 20m (3 reps) or
15m x 50m (1 rep) (4 measurement in each plot).
**Location** : Research station- Sararood
**Seed rate** : 100 kg/ha.
**Fertilizer** : 100 kg DAP/ha at planting.

Tillage, sowing date and method and weed control methods:

1. Moldboard in fall after rain (18-20 cm)
   Disc-harrow after Moldboard (12-15 cm)
   Drill planting in Late November-early December (50 cm row space)
   Weed control by inter-row cultivation by sweep
2. Moldboard in fall before rain (18-20 cm)
   Disc-harrow in spring before planting (12-15 cm)
   Drill planting in early spring (50 cm row space)
   Weed control by inter-row cultivation by sweep

3. Moldboard in fall after rain (18-20 cm)
   Disc-harrow after Moldboard (12-15 cm)
   Drill planting in Late November-early December (30 cm row space)
   Pre-emergence herbicide (2 kg terbutryne + 0.5 kg pronamide/ha)
4. Moldboard in fall before rain (18-20 cm)
   Disc-harrow in spring before planting (12-15 cm)
   Drill planting in early spring (30 cm row space)
   Pre-emergence herbicide (2 kg terbutryne + 0.5 kg pronamide/ha)
5. Moldboard in fall after rain (18-20 cm)
   Disc-harrow after Moldboard (12-15 cm)
   Drill planting in Late November-early December (30 cm row space)
   Pre-emergence herbicide (2 kg terbutryne/ha)
   Post-emergence herbicide (0.25 l Fusilade/ha)
6. Moldboard in fall before rain (18-20 cm)
   Disc-harrow in spring before planting (12-15 cm)
   Drill planting in early spring (30 cm row space)
   Pre-emergence herbicide (2 kg terbutryne/ha)
   Post-emergence herbicide (0.25 l Fusilade/ha)

**Principal staff:** Sabaghpoor.

### 6.2.6. Supplemental Irrigation for Wheat in Farmers' Fields

**Note:** During 1996.97 not done properly due to lack of equipment, therefore, will be repeated.

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|

**Plot Size** : 10m x 30-50 m.
**Location** : 5-10 at Maragheh and Sararood, each.
**Tillage** : As recommended in Tillage No. 1 above (Study 1).
**Sowing Method** : Broadcast+disc harrow or drill if possible.
**Sowing Date** : Early October
**Variety** : Sardari.
**Seed Rate** : 100-150 kg/ha.
**Weed control** : As recommended by herbicide.

**Supplemental Irrigation:**
1. Rainfed
2. 50 mm irrigation at planting
3. 50 mm at flowering stage
4. 50 mm at planting + 50 mm at flowering stage
5. 50 mm at planting + 50 mm at flowering + 50 mm at grain filling
6. 50 mm at planting + 50 mm at heading + 50 mm at flowering + 50 mm at grain filling

**Principal staff:** Tavakoli, Shirvan

*6.2.7.* ***Introduction of Forage to Farmers' Fields***
(To be deferred until manpower becomes available)

| Wheat | Chickpea | Vetch | Lathyrus |
|---|---|---|---|

**Plot Size** : 10m x 30-50 m.
**Location** : 5-10.
**Tillage** : Farmers' methods for all crops
**Sowing Method** : Broadcast+disc harrow
**Sowing Date** : Wheat in early October
Chickpea in early spring
Vetch in early October
Lathyrus (early October if winter-hardy variety is available; otherwise in early spring with chickpea planting)
**Variety** : Wheat (Sardari), chickpea (local), Vetch (Hungarian Vetch), Lathyrus (Winter or spring type as available)
**Seed Rate** : 100-150 kg/ha (Wheat), 100 kg/ha (Legumes)
**Weed control** : Herbicide (Wheat), Hand weeding (Chickpea)

**6.3. Title:** **Study on Farmer practice in dryland areas of Shirvan and Quchan by Farm Survey Methodology**
**Note:** This study will be done in two years with 400 Farmer

**Principal Staff:** M.Azimzadeh

**Training/Visits in Natural Resourcd Management during 1998/99.**

1. One person deom DARI to be trained in water management and WUE.
2. To implement new experiments on supplementary irrigation it is suggested to send Two researchers to ICARDA for 2-3 months to work with ICARDA researchers.
3. Visit of ICARDA scientists to Iran: Dr. M. Pala and Dr. T. Oweis for one week, each.
4. ICARDA will assist in the participation of Iranian researchers in International/Regional meetings/conferences/symposia.

## V. Human Resources Development

**a. In-country Training Courses:**

1. Seed processing and seed quality (20-30 June). Attended by 13 researchers.
2. Application of molecular marker technolgy (6-18 June). Attended by 18 researchers.

**b. Long term Training at ICARDA (4 months):**

1. Durum Wheat Improvement (Mr. A. R. Haghparast).
2. Barley Improvement (SPII-Researcher).

**c. Individual Training at ICARDA:**

Eleven researchers were trained in specialized disciplines (WUE, mulecular marker technology; non-pathogenic disorder; IPM; seed health, chieckpea-entomology & breeding; mechanical harvesting of legumes, experimental stations management.

**d. Scientific Visits:**

1. Nine Provincial Director Generals of Agriculture visited ICARDA for one week.
2. Fifteen Directors of Production visited ICARDA to acquaint themselves with new technology and mechanisms of its transfer to farmers.
3. 100 progressive farmers visited ICARDA to see new production technolgies for dry farming.
4. One reseacher sent to Turkey (Mr. Ahmed Hayderi) for selection out of cereal materials.

**e. Ph.D. level training:**

1. Two Iranian researchers, Mr. Golzar and Mr. Azimzadeh, completed their Ph.D. thesis research at ICARDA under the supervision of Dr. Baum and Dr. Pala.
2. Four more researchers left for Ph.D. (two-India, one-U.K. and one Canada).

**f. Scientific Meetings/Conferences/Workshops:**

1. One scientist attended meeting on water in Niger (Dr. Pazira).
2. Three scientists (Dr. Torabi, Mr. Attari and Mr. Amiri) attended cereal workshop in Central Asia.
3. One scientist attended 9$^{th}$ IWGS-Saskatoon, Canada (Six were sponsored but other five could not attend).

**g. Scientific Publications:**

1. Helped Iranian researchers in scientific writing of research results-Five scientific papers published.
2. A review of Cereal Improvement in dryland areas of Iran (in press).

## *VI.* Coordination Meeting with PPDRI, SPII, AERI, SWRI and ICARDA.

A. **Plant Pest and Diseases Research Institute (PPDRI):**

**1. IPM (Cereal Improvement):**

a. Program development, equipment and, training in IPM: Since it is very broad request, it is agreed that the Head of IPM Program at PPDRI should go to ICARDA for training and get information on IPM to develop plan of work.

b. Two scientists (one cereals; and one legume) should go to ICARDA for training and cover all the aspects of IPM for 6 months. (January 1-June 30, 1999).

c. ICARDA scientists involved in IPM research (one on legumes diseases and other on cereal diseases) at ICARDA should visit PPDRI, Tehran for one week in June/July, 1999.

**2. Biotechnology:**

1. Need Equipment/Chemicals (List will be provided) (10-15K$).
2. Training: two persons to be trained in: a) Molecular markers; b) DNA sequencing and cloning (During 1999: duration to be determined by Dr. M. Baum).
3. ICARDA scientists to visit PPDRI- (Dr. M. Baum-Biotechnologist).
4. **Research program:**

a) Study of genetic diversity of *Ascocyta rabiei* in Iran by RAPD markers: Part of the work will be done at PPDRI and ICARDA. The PPDRI Biotechnologist will go to ICARDA to carry out part of the work.

b) Phenotypic and morphogenic study of isolates of Ascochyta using multivariate statistical methods.

c) Identification of *Fusaruim oxysporium* spp. isolates of Iran by molecular markers. Iran will supply isolates for characterization through ICARDA's collaborations with advanced institutions.

d) One person from PPDRI to be trained in non-pathgenic disordered at ICARDA.
e) Weed management Workshop to be held in Iran (Kermanshah) in collaboration with Agri. Canada.

**B. Seed and Plant Improvement Institute (SPII):**

1. Oilseed germplasm needed.
2. Two persons to be trained in Seed health with special emphasis on virus detection.
3. Training in sunflower in Bulgaria and Yogoslavia –Novisad (one).
4. Training in Soybean at IITA (Two).

5. Germplasm of Soybean for hot areas from IITA.
6. D.G. or Director Crop Improvement Division of IITA to be invited.
7. Two persons to be trained in variatal description based on electrophoresis.
8. Cereal improvement:

a. Drought, cold and heat tolerance studies in cereal (Details to be worked out).
b. Relationship between physiological phases of plant development and cold tolerance in winter cereals.
c. Breeding of hulless barley (see under barley)
d. Allelopathy in wheat and barley (see under Wheat & Barley).
e. Training of Cereal scientists at ICARDA (Disciplins to be specified).
f. Visiting Scientists to ICARDA-Two. Their discipline and duration will be communicated by SPII to Dr. M. Tahir.

**C. Agricultural Engineering Research Institute (AERI).**

Plan of work-See under Natural Resource Management.

D. Soil and Water Research Institute (SWRI).

Plan of work-see under Natural Resource Mangement.

**List of Participants in the Coordination Meeting with SPII, PPDRI, AERI, SWRI and ICARDA.**

The meeting was held under the Chairmanship of Dr. A. Keshavarz, Deputy Minister of Agriculture and Head of Agricultural Research, Education and Extension Organization, The Ministry of Agriculture, Iran.

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2. Dr. R. S. Malhotra
3. Dr. H. Ketata
4. Dr. M. Pala
5. Dr. C. Akem
6. Dr. T. Oweis
7. Dr. O. P. Rupela (ICRISAT)

**SWRI**
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2. Mr. Baybourdi

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2. Mrs. M. Aghajani

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