# SEED UNIT

Annual Report for 1994

# About ICARDA

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), which is an international group of representatives of donor agencies, eminent agricultural scientists, and institutional administrators from developed and developing countries who guide and support its work.

The CGIAR seeks to enhance and sustain food production and, at the same time, improve socioeconomic conditions of people, through strengthening national research systems in developing countries.

ICARDA's mission is to meet the challenge posed by a harsh, stressful, and variable environment in which the productivity of winter rainfed agricultural systems must be increased to higher sustainable levels; in which soil degradation must be arrested and possibly reversed, and in which the quality of the environment needs to be assured. ICARDA meets this challenge through research, training, and dissemination of information in a mature partnership with the national agricultural research and development systems.

The Center has a world responsibility for the improvement of barley, lentil, and faba bean, and a regional responsibility in West Asia and North Africa for the improvement of wheat, chickpea, forage and pasture—with emphasis on rangeland improvement and small ruminant management and nutrition—and of the farming systems associated with these crops.

Much of ICARDA's research is carried out on a 948-hectare farm at its headquarters at Tel Hadya, about 35 km southwest of Aleppo. ICARDA also manages other sites where it tests material under a variety of agroecological conditions in Syria and Lebanon. However, the full scope of ICARDA's activities can be appreciated only when account is taken of the cooperative research carried out with many countries in West Asia and North Africa.

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.

# SEED UNIT

## Annual Report 1994

a joint project of

The Government of the Netherlands
The Government of Germany

and

The International Center for Agricultural Research
in the Dry Areas (ICARDA)
P.O. Box 5466, Aleppo, Syria

This report was written and compiled by program scientists and represents a working document of ICARDA. Its primary objective is to communicate the season's research results quickly to fellow scientists, particularly those within West Asia and North Africa, with whom ICARDA has close collaboration. Due to the tight production deadlines, editing of the report was kept to a minimum.

# CONTENTS

# 1. INTRODUCTION

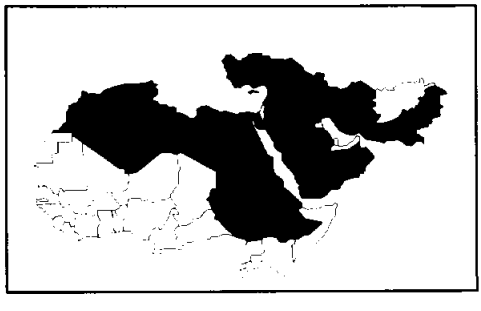
ICARDA's Seed Unit, with financial support from the governments of the Netherlands and the Federal Republic of Germany, assists national programs in West Asia and North Africa to strengthen their seed capabilities. The project carries out the following activities: (1) training regional seed production staff, (2) building up seed production infrastructure in the countries of the region, (3) making available limited quantities of high quality seed of new varieties of cereals, food legumes and forages for national programs, (4) dissemination of information, and (5) carrying out regional seed technology research.

# 2. STRENGTHENING SEED PROGRAMS

Many countries in the region still have weak seed production infrastructure. In 1994, the Unit has contributed to strengthening national seed programs through: (1) the activities of the WANA seed network, (2) a study on alternative seed supply systems, (3) two national seed surveys, (4) assistance in variety description, post-control plots, and pre-release multiplication, (6) a workshop on privatization of the seed industry, and on the seed status in the Central Asian Republics, (7) an evaluation study of the national seed program of Iraq, and (8) distribution of seed to seed organizations

## *2.1. WANA Seed Network*

The WANA SEED NETWORK -established in June 1992- encourages: (1) stronger cooperation in regional seed sector, (2) exchange of information, (3) regional consultation, and (4) inter-country seed trade. Eighteen countries from the region are now participating in the network: Algeria, Cyprus, Egypt, Ethiopia, Iran, Iraq, Jordan, Lebanon, Libya, Morocco, Pakistan, Oman, Saudi Arabia, Sudan, Syria, Tunisia, Turkey, and Yemen. The International Seed Trade Association (FIS), International Union for the Protection of New Varieties of Plants (UPOV), Association of Official Seed Certifying Agencies (AOSCA), and FAO have become observers in the network.



Each country in the network has appointed a senior seed program specialist as Country Representative who is the focal point for all network matters. A Steering Committee, elected during Network Council meetings, is composed of the Country Representatives of 5 network countries (Egypt, Iraq, Morocco, Sudan and Turkey) and the Secretariat. To achieve its objectives the network carries out a large number of activities. A Country Representative is usually responsible for implementation of an activity.

The second Steering Committee meeting of the WANA Seed Council was held from 22-24 March 1994 in Morocco and discussed activities and future direction of the network.

***WANA Seed Directory of Names***

The WANA seed directory, prepared by Egypt, has been finalized: information from 10 countries was included, while no information was received from 8 member countries. The first draft will be published. The example of the Cyprus section of the directory is given in ANNEX I.

***WANA Catalogue of Seed Standards***

The WANA catalogue of field and seed standards, prepared by Syria, has been finalized; information was received from 14 countries; only 4 countries did not respond. The draft will be published early 1995. The example of the Morocco section concerning cereals is given in Table 1.

***WANA Referee Testing***

The objective of the referee test is to standardize seed analysis methods used in the seed testing laboratories of the countries participating in the network, and to encourage exchange of experiences among seed laboratories. The first WANA Referee test was carried out to compare the results of the physical purity and the germination test for bread wheat. The Service de Contrôle des Semences et Plants in Morocco had sent two bread wheat samples, of known physical purity and germination, to 25 laboratories in 17 countries. Each laboratory had to analyze two replicates of 2 different seed lots of bread wheat harvested in 1992. The requested analyses were the germination test to assess percentages of normal seedlings, abnormal seedlings, hard seeds, fresh non-germinated seeds and dead seeds, and the physical purity test to assess percentages of pure seeds, seeds of other species, and inert matter.

Twenty laboratories had sent their results to the Service de Contrôle des Semences et Plants. In germination tests, the results of 12 laboratories were deviating from the results of the standard sample; in physical purity tests, only four laboratories had deviating results.

***WANA Network Newsletter***

Two issues of SEED INFO (no 6 and 7) and FOCUS ON SEED PROGRAMS (no 1 and 2), presenting the seed programs of Morocco and Sudan have been distributed.

Other on-going activities are: (1) exchange, description and information on weeds, (2) compilation of a WANA variety catalogue, (3) study of seed policies of the different WANA countries, (4) study of seed certification systems in the WANA region, (5) information on variety registration mechanisms, and (6) the development of publications. In 1994 three new network publications have been prepared and distributed i.e. on seed storage, seed marketing and field inspection.

**Table 1: WANA standards catalogue - MOROCCO**

Wheat, Barley and Oat

| Standards | Seed Classes | | | |
|---|---|---|---|---|
| | Pre-basic Seed | Basic Seed | Certified Seed 1 | Certified Seed 2 |
| Field Standards | | | | |
| Rotation (min. years) | | | | |
| Isolation (min. meters) | | | | |
| Other varieties (max. %) | 0.05 | 0.1 | 0.2 | 0.3 |
| Other species (max. no)[a] | 1/15000 | 1/10000 | 1/5000 | 1/2000 |
| Noxious weeds (max. no) | | | | |
| Infected plants (max. no)[b] | 1/10000 | 1/5000 | 1/2000 | 1/1000 |
| Seed Standards | | | | |
| Pure seed (min. %) | 99.0 | 99.0 | 98.5 | 98 |
| Other crop seed (max. %) | | | | |
| - Varieties (no/1000 seeds) | 1 | 1 | 2 | 3 |
| Weed seed (max. no/kg) | 6 | 8 | 20 | 30 |
| - Cereal species | 1 | 2 | 12 | 15 |
| - Wild oat[c] | 0 | 0 | 1 | 1 |
| - Noxious weeds[d] | 3 | 4 | 6 | 8 |
| Infected seed (max.) | | | | |
| - Live insects | 0 | 0 | 0 | 0 |
| - Insect damage (max. %) | 0.1 | 0.1 | 0.1 | 0.1 |
| Germination (min. %) | 85 | 85 | 85 | 85 |
| Moisture content (max. %) | 14 | 14 | 14 | 14 |
| Specific gravity (min.) | | | | |
| - Wheat | 79 | 79 | 79 | 79 |
| - Barley | 74 | 74 | 74 | 74 |
| - Oat | 50 | 50 | 50 | 50 |

a Impurities of other crop plants refer to all cereal species other than the crop in question. For example, in bread wheat: barley, oat, durum wheat, rye and triticale.
b *Ustilago* spp., *Tilletia caries* or *Helminthosporium gramineum* where applicable.
c Tolerance for wild oats in cultivated oat are 1,2,3 seeds/kg for Pre-basic, Basic, Certified 1 and 2 respectively
d Noxious weeds refers to *Emex spinosa, Galium tricornitum, Vaccaria pyramidata* and *Astragalus* spp.

Table 1: Field and seed standards for cereals in Morocco

## 2.2. *Alternative Seed Supply*

The number of varieties and the demand for high-quality seed will significantly increase because: (1) vigorous breeding programs are executed at the national and international level, and (2) more farmers will realize the benefits of the use of quality seed of different crops. Seed production organizations alone will most likely not be able to cope with this increase. It is, therefore, expected that in the future large areas will still be planted with seed produced by the farmers themselves. Alternative systems (systems whereby farmers produce seed for themselves or for neighbors) should be strengthened and/or developed to complement the formal seed systems. Both systems are needed, and the one cannot substitute for the other. During 1994 the project organized: (a) a workshop and (b) a consultancy to initiate activities in the area of alternative seed supply system.

***Workshop on Smallholder Seed Production, June 12 - 15, 1994, Ethiopia***
ICARDA and the International Livestock Center for Africa (ILCA) organized a workshop to determine required action of both institutions in the area of alternative seed supply. Crop-wise two groups participated in the meeting: (a) forage staff and (b) food crop staff. A major issue was the apparent difference in approach towards alternative seed supply of forages staff and food crops staff. In forages, local seed production rarely exists and the development of (alternative) seed supply systems mainly focusses on introduction of technologies in local farming systems (not only seed supply). For food crops, on the other hand, seeds have been produced for decades in more or less refined systems and developing (alternative) seed supply involves in many cases improvement of already existing methods. The workshop identified technical and socio-economic constraints as well as the necessary steps to remove these. It was also pointed out that very little is known and that farmer participation is indispensable. Full proceedings of the workshop will be available early 1995.

***Consultancy Alternative Seed Supply***
National seed systems have a formal and an informal component. The informal component plays an important role in supplying seed to low-income and resource-poor farmers in developing countries. In 1994 a consultancy study was made to assess the current situation and possible areas of support to Local Seed Systems (LSSs) in the WANA region. Some of the findings and recommendations are:

1. Inadequate seed supply is a major constraint to increased yield. The formal sector largely fails to develop varieties adapted to the needs of resource-poor farmers in the low-input sector. Moreover, high marketing and distribution costs to remote areas also limit rapid and wide-scale adoption of suitable varieties.

2. Minor changes in the formal seed sector will not be adequate to overcome the above inherent weaknesses. Methodologies, technologies and standards are not well adapted to serve traditional farming systems. A new approach is required for a sustainable solution.

3. Attempts to strengthen the informal seed sector by developing LSSs are based on community participation and use of local knowledge of traditional crop improvement and

seed production technology. The new approach, with its low cost, low technology and location specific, appears more sustainable and relevant to the target groups. However, extensive surveys in target areas are necessary.

4. The informal system is mainly pursued by Non Governmental Organizations (NGOs) on an *ad-hoc* basis. However, governments should formulate a national policy to stimulate and support LSSs development for marginal areas. The informal seed system should be considered as complementary, not as a replacement of or in competition to the formal system.

5. The institutional development of LSSs needs strong linkages between NGOs, formal research and the public seed sector. NGOs are the most experienced and appropriate to take responsibility for local organization of LSSs. However, they are often weak in professional expertise and in linkages with formal sector institutions.

6. At present most national research has weaknesses in dealing with resource-poor farmers in low-input systems because of: a) unsuitable breeding strategies, methodologies and criteria, b) aversion to farmers' participatory research, c) lack of coordination among breeders, farming system researchers and seed technologists in informal system development approach, and d) lack of funds to develop large numbers of adapted varieties required for the highly variable low-input farming sector.

7. The objectives, technologies and standards of the informal system differ from those of the formal seed system. Policy makers should recognize this and, when necessary, amend the existing national seed policy and legislation, to accommodate and integrate the informal sector in the national seed system with regard to varietal uniformity, variety release, quality control, seed standards, breeders' rights and genetic conservation strategy.

8. Formal research and NGOs should cooperate to sensitize policy makers to supply seed to resource-poor farmers and reform the formal sector to support the informal seed sector. This includes: a) development of heterogeneous varieties to ensure yield stability and specific adaptation, b) farmers free access to breeding materials at various stages, c) seed quality standards for low-input sector, and d) maintaining genetic diversity by releasing many varieties with different genetic background, but with specific local adaptation.

9. A LSSs variety development and testing strategy should be developed in which International Agricultural Research Centers (IARCs) concentrate on preliminary screening of large numbers of landraces and segregating populations from landrace-based crosses and their distribution to National Agricultural Research Systems (NARS). NARSs, after a minimal amount of further screening and selection, should release the materials to LSSs for final evaluation. Additional selection efforts could be made by cooperating farmers to improve feed back to breeders and make available better adapted materials for farmers.

10. The development and release of large number of varieties, each grown on a relatively small area, will create problems for the formal seed sector with regard to maintenance

and production. A separate specialized public institution could be established to take over these activities. Alternatively, LSSs should take these responsibilities particularly if the varieties are landraces. Moreover, the LSSs could take over much of the downstream multiplication and seed supply. This system would at the same time support *in situ* conservation.

11. More research is required to study: a) cost effectiveness and relevance of traditional and modern selection and seed production technology, b) improved selection and testing methodologies based on traditional knowledge, c) varietal adaptation and stability, d) potential of pure line mixtures, e) importance of varietal heterogeneity, uniformity and genetic purity on varietal deterioration and crop yield, and f) low-cost seed storage and processing technology under local farming conditions.

## *2.3. Seed Surveys*

In cooperation with national programs, the Seed Unit is carrying out standardized seed surveys to assess the quality of the seed at the farmers' level and to obtain information with regard to farmers' practices and appreciation of the different types of seed used by farmers. At present the seed surveys carried out in Syria and Ethiopia are analyzed, while an M.Sc. thesis is prepared using the results obtained in Jordan. Results are reported Chapter 3 (Research).

## *2.4. Variety Description*

The absence of morphological variety description is one of the commonest drawbacks of seed programs in the WANA region. Descriptions are essential for the production of quality seed. To assist national programs, the Unit has been carrying out the following activities:

Jordan: The National Center for Agricultural Research and Transfer of Technology (NCARTT), in cooperation with the Seed Unit, is describing the Jordanian lentil and chickpea varieties. In the 1992/93 season, lentil and chickpea varieties were planted at the research station near Madaba, Jordan and preliminary variety descriptions were made. In the 1993/94 crop season the experiment was repeated including 6 varieties of each chickpea and lentil. Final variety descriptions are prepared using the computer program developed by the Seed Unit.

Syria: In Syria an experiment has been planted at the farm of the General Organization for Seed Multiplication (GOSM) to describe the Syrian cereal varieties.

Pakistan: Jointly with the National Seed Registration Department (NSRD) in Pakistan a booklet will be published, which includes the description of all national wheat varieties.

Egypt: In Egypt, jointly with the Agricultural Research Center (ARC) and the Central Administration for Seed (CAS), an experiment has been planted for the second year to describe the Egyptian legume varieties.

## 2.5. *Pre-release Multiplication*

To ensure early availability of seed of new varieties, in the 1993/94 season a pre-release multiplication was planted at the farm of the General Organization for Seed Multiplication (GOSM) in Syria. The multiplication included 3 promising varieties, identified in on-farm testing experiments, one each of lentil, chickpea and barley. The barley variety Arta was released and some seed of this new variety was made available at an early stage through this scheme.

**Table 2: Pre-release seed multiplication in 1993/94 (Syria)**

| Crop | Promising lines | Amount of seed delivered (kg) | Area planted in hectares | Yield t/ha |
|---|---|---|---|---|
| Chickpea | FLIP-84-15c | 500 | 4.0 | 4.2 |
| Lentil | ILL 5883 | 500 | 7.2 | 8.4 |
| Barley | Arta | 100 | 1.0 | 5.0 |
| Total | | 1100 | 12.2 | 17.6 |

At T. Hadya, the Unit is also multiplies seed of lines which have shown potential in evaluation trials. The multiplication is meant to give such varieties an early start in the countries of the region in case they are released. At the same time the national program should start building up its Certified Seed supply. Of the bread wheat variety Nesser and the durum wheat variety Lahn, 1400 and 1900 kg were provided to Lebanon to possibly replace existing varieties that are susceptible to rust (Mexipak and Seri 82).

To the Syrian General Organization for Seed Multiplication 1 ton of the recently released durum variety Cham 5 and 2 tons of Ghab 3, a chickpea variety released a few years ago, were provided.

## 2.6. *Post-control Plots*

In the 1993/94 season a post-control system to monitor quality of the seed produced by the national seed organization has been initiated in cooperation with the GOSM in Syria. The experiment was planted at the farm of the GOSM near Aleppo. The system was found satisfactory and will be integrated in the seed quality control activities.

## 2.7. *Workshop on Privatization of the Seed Industry*

A workshop on Privatization of the Seed Industry was held, January 15 - 18, 1994, in Egypt. The main purpose of the organizers of the conference (GTZ), was to discuss privatization of the seed centers that were set-up by GTZ's Egyptian Seed Improvement Project. The proceedings of the workshop and recommendations can be obtained from the Central Administration for Seed, Cairo, Egypt.

## *2.8. Central Asian Republics*

A GTZ mission (May 16 - 28, 1994) was carried out to Uzbekistan, Kyrghystan and Kazachstan to make a preliminary study of the seed industry in the Central Asian States and to investigate possibilities for cooperation. The mission was completed by a regional seed sector workshop in Uzbekistan, October 2 - 8, 1994. The main aim of the workshop, in which participants from 4 countries participated (Uzbekistan, Kazachstan, Kyrkistan, and Tadjikistan), was to identify seed sector constraints and to identify projects that will strengthen the seed sector in the Central Asian states. The main three problems per republic are summarized in Table 3.

Kazachstan identified as most important project areas: (1) rehabilitation of equipment in the seed sector, (2) improvement of the cereal, oil crops and fodder crops seed programs, and (3) staff training. Kyrkistan considered: (1) seed potatoes, (2) alfalfa and sugar beet seed production, and (3) cereal seed sector improvement as the most important project areas. Uzbekistan project priorities are for: (1) seed potato, (2) cereal seed, and (3) vegetable seed production. Tadjikistan would prefer assistance in: (1) rehabilitation of research stations, (2) strengthening of the cereal seed sector, and (3) the production of virus-free potato seed.

**Table 3: Major constraints in seed industry in the Central Asian Republics**

| Kazachstan | Kyrkistan | Uzbekistan | Tadjikistan |
|---|---|---|---|
| Lack of funds | Lack of funds | Lack of funds | Rehabilitation of breeding stations |
| Lack of cleaning equipment | Lack of cleaning equipment | Insufficient development of new varieties | Lack of funds |
| No supply of elite seed of other states | No supply of elite seed of other states | | No access to breeding material of other states |

## *2.9. An Evaluation Study for the National Seed Program of Iraq*

In cooperation with the Mashreq project a study of the Iraq seed program was made. The objective of the study was to review the current status of the seed program, to carry out an in-depth analysis of its various components, and to make recommendations for improvement. The areas analyzed were: (a) the general agricultural policies in relation to seed matters, (b) varietal development, testing, registration and release, (c) the organizational structure of the seed production and processing systems, (d) the seed distribution and marketing activities, (e) the quality control aspects, and (f) the seed extension and training activities.

Deficiencies in the various operations were identified and the recommendations made were aimed at overcoming the causal factors of these deficiencies with the intention of improving the performance of the seed program activities. The consultancy report can be obtained from the Seed Unit.

## *2.10. Workshop on Organization and Management of Seed Programs*

Since 1985, the German Foundation for International Development (DSE) conducted annual training courses in Feldafing, Germany, for managers, senior scientists and senior agricultural officers of national seed programs. A number of these participants have been invited to the follow-up seminar entitled "Organization and Management of National Seed Programs", held at ICARDA's headquarters from 12 to 24 November 1994. The seminar was organized by DSE in collaboration with ICARDA's Seed Unit and GTZ (the German Agency for Technical Cooperation).

The seminar focussed on the economics and management of seed enterprises, privatization issues and the design of seed programs with special emphasis on alternative systems. Much emphasis was placed on active participation of participants. In addition to presentations by resource persons, participants presented and discussed their national seed activities. Working groups were formed on the following topics:

1. How to involve farmers, using their knowledge and skill, in the development of varieties with significant superiority under local conditions?

2. How to improve national variety release and registration policies and regulations in order to supply farmers with an adequate choice of good varieties?

3. How to improve seed health and seed quality within existing financial resources?

4. How can the informal seed sector contribute to the improvement of the seed supply system?

5. What will be the effect of implementing intellectual property rights (plant breeders' rights and patents) on the formal and informal seed sector?

6. How can a seed industry dealing with self-pollinating species become economically viable?

7. How can the private sector be encouraged to participate in the production of self-pollinated crops?

8. What are the effects of subsidies on the viability of the seed industry and agricultural production?

# 3. RESEARCH

A number of M.Sc. students is supervised by Seed Unit staff and the Unit is in the process of identifying additional students for the study of the economics of seed production in the region and for seed surveys.

## *3.1. Evaluation of Seed Vigor in Lentil* by Mohammed Makkawi, National Seed Administration, Khartoum, Sudan

One of the key factors in achieving the optimum plant population is the use of high quality seeds. The differences in field emergence among seed lots of similar quality is often attributed to differences in seed vigor. Little information is available about the relationship between seed vigor and field emergence in lentil. Hence, this study focuses on the evaluation of different seed vigor tests and their relationship to field emergence. The purpose of this study is to: (a) evaluate various seed vigor tests, (b) determine the association between vigor tests and field emergence, and (c) to determine the best tests that predict field emergence.

Two sets of experiments were carried out in two different environments, i.e. (a) in 1991/1992 at Khartoum University, Shambat, Sudan and (b) in 1992/1993 at ICARDA, Tel Hadya, Syria. Materials used in 1991/92 consisted of seven cultivars subjected to nine different vigor tests, i.e. standard germination, speed of germination, hundred seed weight, seedling dry weight, seedling growth rate, shoot length, root length, cold soil test and electrical conductivity. In the second season (1992/1993) fifteen cultivars grown at different supplementary irrigation levels were used. Cultivars were subjected to twelve different vigor tests, i.e. standard germination (rolled paper towels and on top of papers), speed of germination, hundred seed weight, seedling dry weight, seedling growth rate, cold soil test, accelerated aging, shoot length, root length, seedling classification (strong and weak seedlings), electrical conductivity and tetrazolium chloride.

***Experiment 1: 1991/1992 Season (Shambat, Sudan)***

Among the seven cultivars, Giza 9 frequently showed the lowest values in the vigor tests, especially in the following tests: cold soil, speed of germination, seedling dry weight and electrical conductivity. These results reflect a considerable degree of deterioration. Giza 9 showed, however, a high laboratory germination (93%), but field emergence was considerably reduced (59% in clay soil and 61% in silty loam soil). Several tests exhibited significant correlation with field emergence in clay and silty loam soil (Table 4); these tests were also correlated with each other.

Significant correlation was observed between standard germination and field emergence in silty loam soil, which is more favorable than crusted clay soil. Speed of germination, seedling dry weight and electrical conductivity were significantly correlated with field emergences in clay and silty loam soil and with each other. Among the vigor tests the best single test that predicts field emergence was speed of germination, followed by

seedling dry weight and electrical conductivity.

Multiple regression was used to determine the best combination of tests that can accurately predict field emergence. The model was constructed with the variables that correlated with each other and with field emergences. Field emergence can be described by the following equations:

Table 4: Correlation coefficients at Shambat, Sudan

| Parameter | Field emergence (clay) | Field emergence (silty loam) |
|---|---|---|
| Standard germination | 0.735 ns | 0.811 |
| Speed of germination | 0.931 | 0.971 |
| Seedling dry weight | 0.929 | 0.897 |
| Electrical conductivity | -0.832 | -0.935 |

ns= not significant, r=0.754 and 0.874 at 5% and 1%

**Field emergence (clay) = 45.76 + 1.058 * (speed of germination) + 70.9 * (seedling dry weight)**

**Field emergence (loam) = 47.58 + 1.592 * (speed of germination) + 39.4 * (seedling dry weight)**

***Experiment 2: 1992/1993 Season Crop (Tel Hadya, Syria)***

This experiment was subdivided into two sets. In Set 1 fifteen cultivars, that had received several levels of supplementary irrigation, were subjected to 11 different vigor tests. In Set 2 the 15 cultivars were grown under two levels of supplementary irrigation and were subjected to 12 different vigor tests.

Table 5: Correlation coefficients at Tel Hadya, Syria (Set 1)

| Parameter | Field emergence | Stand establishment |
|---|---|---|
| Standard germination 1 | 0.316 | 0.268 |
| Standard germination 2 | 0.434 | 0.418 |
| Seedling classification | 0.379 | 0.396 |
| Accelerated aging | 0.379 | 0.361 |
| Electrical conductivity | -0.338 | -0.260 |

r=0.232 and 0.302 at 5% and 1%

**Set 1:** Correlation coefficients revealed that standard germination in rolled towel papers (1) and standard germination on top of papers (2), seedling classification, accelerated aging and electrical conductivity were correlated with field emergence and stand establishment (Table 5); they were also significantly correlated with each other.

Multiple regression indicated that the best combination of tests that predicts field emergence and stand establishment are described by the following formulas:

**Field emergence = 53.32 + 0.2756 * (Germination 2) + 0.0801 * (Accelerated aging)**

**Stand establishment = 45.01 + 0.2752* (Germination 2) + 0.0781 * (Accelerated aging)**

**Set 2:** Correlation coefficients indicated that there were good correlations between many different vigor tests. The results showed that the best single tests that can predict field emergence and stand establishment were standard germination 1, standard germination 2, seedling classification, and electrical conductivity as shown in Table 6.

**Field emergence = 73.7 + 0.230 * (Germination 2) - 31.9 * (Electrical conductivity)**

**Stand establishment = 52.59 + 0.275 * (Germination 2) - 0.0322 * (Tetrazolium;6-8)**

Table 6: Correlation coefficients at Tel Hadya, Syria (Set 2)

| Parameter | Field emergence | Stand establishment |
|---|---|---|
| Standard germination 1 | 0.370 | 0.496 |
| Standard germination 2 | 0.513 | 0.565 |
| Strong normal | 0.376 | 0.488 |
| Electrical conductivity | -0.526 | -0.484 |

r=0.232 and 0.302 at 5% and 1%

### *3.2. Seed Survey in Syria* by A.J.G. van Gastel and Z. Bishaw

In Syria, in cooperation with the General Organization for Seed Multiplication, a seed survey was carried out to asses the quality of wheat seed used by farmers for planting and to identify seed related problems at farmers' level. The survey was carried out in the Azaz district of the Aleppo province. During the 1993 crop planting season, wheat growing farmers were surveyed, a sample collected from the seed to be used for planting (to assess varietal purity), and a questionnaire was filled out.

The seed survey covered 118 farmers in six subdistricts and the number of farmers per village ranged from one to four. The questionnaires were summarized regarding seed source, management practices, acreage, variety, etc. The samples were analyzed in the Seed Testing Laboratory of ICARDA for: (a) physical purity, (b) germination, and (c) varietal purity.

In survey area the majority (55.9%) of farmers use own-saved seed, while 18.6% and 25.4% purchase government produced Certified Seed and seed from other sources, respectively (Table 7).

Table 7: Farmers' seed sources

| Seed source | Farmers no. | Percent |
|---|---|---|
| Government | 22 | 18.6 |
| Neighbors | 30 | 25.4 |
| Own-saved seed | 66 | 55.9 |

Table 8: Seed rates used by farmers

| Seed rate | Farmers no. | Percent |
|---|---|---|
| < 120 kg/ha | 2 | 1.7 |
| 120 - 200 kg/ha | 64 | 54.2 |
| 200 - 300 kg/ha | 45 | 38.1 |
| > 300 kg/h | 6 | 5.1 |

***Seed Rate and Field Size***

The recommended seed rate for wheat is 100 kg/ha for bread wheat and 120 kg/ha for durum wheat. The average seed rate used was 225 kg/ha with no differences between different seed sources. Farmers are mainly using seed rates between 120 and 300 kg/ha, while a small percentage uses lower (1.7%) or higher (5.1%) seed rates (Table 8).

The average field size was 5.8 ha, but the majority of farmers has fields between 1 and 5 ha (Table 9). Largest fields were found among farmers using Certified Seed (average 9.5 ha); smallest fields among farmers who use own-saved seed (average 4.2 ha).

Table 9: Field size of farmers surveyed

| Field size | Farmers no. | Percent |
|---|---|---|
| < 1 ha | 16 | 13.7 |
| 1 - 2 ha | 31 | 26.5 |
| 2 - 5 ha | 39 | 33.3 |
| 5 - 10 ha | 17 | 14.5 |
| > 10 ha | 14 | 12.0 |

***Varieties***

Several varieties are grown (Table 10), but the most widely used varieties are Cham 1 (28%), Cham 4 (13.6%), Cham 3 (11.9%), Acsad 65, Bohouth 1, and Lahn (9.3%). Only 9.3% of the farmers was using traditional varieties; i.e. Hourani (6.8%) and Omki (2.5%). Cham 1 was the most widely used among all seed sources; while Lahn was also widely used among farmers who obtained seed for planting from other farmers. Farmers saving

their own seed use Cham 1 (24.1%), Cham 4 (16.7%), and Hourani (12.1%).

Only 3.4% of the farmers expected a yield of less than 1 t/ha and 10.2% expected higher yields than 6 t/ha. The average yield expectation was 4 t/ha (no significant difference among different seed sources). Lowest yield expectations were in the group of farmers who saved own seed; none of the farmers using government seed or neighbors seed expected less than 2 t/ha.

Table 10: Varieties and yield expectations

| Variety | Farmers no. | Percent | Yield t/ha |
|---|---|---|---|
| Cham 1 | 33 | 28.0 | 5.1 |
| Cham 4 | 16 | 13.6 | 3.0 |
| Cham 3 | 14 | 11.9 | 5.5 |
| Acsad 65 | 11 | 9.3 | 5.1 |
| Bohouth 1 | 11 | 9.3 | 3.9 |
| Lahn | 11 | 9.3 | 5.6 |
| Hourani | 8 | 6.8 | 2.0 |
| Siete Serros | 4 | 3.4 | |
| Cham 6 | 3 | 2.5 | |
| Omki | 3 | 2.5 | 3.3 |
| Bohouth 4 | 2 | 1.7 | 5.8 |
| Mexipak | 2 | 1.7 | 2.0 |

***Planting Method and Irrigation***

Sixty-five percent, 23.1% and 12.0% of farmers use a seed drill, practice hand-planting or use a fertilizer spreader, respectively for planting wheat (Table 11). The largest fields were found with farmers who use a seed drill; the smallest fields with farmers planting the crop by hand. Farmers broadcasting seed by fertilizer spreader expect the highest yield. Percentages are similar among different seed sources.

Approximately 50% of farmers irrigate the wheat crop. Highest yields were expected from irrigated crops (average 5.1 t/ha). The seed rates used to plant crops that will be irrigated are higher (average 266 kg/ha) than for fields were no irrigation will be used (192 kg/ha). Similar percentages are found among different seed sources.

***Availability of Credit***

Credit is available for seed (94.1% responded yes), fertilizer (97.1%), and to a lesser extent for pesticides (68.6%) and implements (67.1%). The inputs are available at the right time (98.1%), reasonable price (61.5%), and in the right quantity (77.1%).

***Seed purchased from Government***

Of the farmers who indicated that they had purchased government seed, 59% obtained the seed through a cooperative, 23% directly from the seed organization, and 18% from other sources. Seed is always available at the nearest distribution point (91%); was

properly cleaned (100%) and treated (100%). All farmers are satisfied with the quality. Half the number of farmers indicated that they buy seed every year; in other years they obtain seed from neighbors (31%) or use own-saved seed (46%).

Table 11: Relation between planting method, expected yield, seed rate, and field size

| Planting method | Farmers % | Expected yield t/ha | Seed rate kg/ha | Field size ha |
|---|---|---|---|---|
| Drilling | 65.0 | 3.6 | 228 | 7.1 |
| Spreading | 12.0 | 5.6 | 242 | 4.9 |
| Hand-planting | 23.1 | 3.9 | 211 | 2.9 |

***Seed bought from Neighbors***

When seed was bought from neighbors, 77% indicated that the neighbor was not a seed grower; 21% stated that they always purchase seed from neighbors. Also 77% indicated that they had purchased the seed more than four years earlier. Seed was usually not cleaned (87%), nor treated (90%). In case non-cleaned seed was purchased, 70% cleaned and 89% treated the seed before planting. Ninety-one percent of the farmers is satisfied with the quality of the seed they purchased from neighbors.

***Own-saved Seed***

The number of years that farmers are saving seed ranged from 1 to 20 years, with the majority of the farmers (50%) saving seed for one year, 26.6% saving seed for two years and 9% saved seed for three years. One farmer saved seed for 15 years and two farmers for 20 years (Table 13). Farmers generally clean (91%) and treat (91%) the seed before planting.

## Seed Quality Tests

Table 12 shows the results of the quality tests that were carried out in the laboratory for physical purity, germination and varietal purity. To establish varietal purity the phenol test was used and the number of offtypes was counted (in 60 seeds).

***Seed bought from Government***

The average physical purity was 98.7% and all government seed samples had purity percentages above the national standard (97%). The physical purity of government seed was significantly higher than that of neighbors seed and own-saved seed.

Government supplied seed had an average germination percentage of 84, which is significantly lower than the germination of neighbors seed and own-saved seed.

Varietal purity: the number of samples that was a mixture in government seed was nil.

***Seed bought from other Sources***

The average physical purity of seed that was purchased from neighbors was 94.1%; 80% of samples were below the standard (97%). Seed purchased from neighbors had an average germination percentage of 88; 6.6% of the samples were below standard. The number of samples that was a mixture was 3.3%.

Table 12: Relation between seed source and seed quality

| Seed source | Purity % | Normal seedlings % | Mixture % |
|---|---|---|---|
| Government | 98.7 | 84 | 0 |
| Neighbors | 94.1 | 91 | 3.3 |
| Own-saved seed | 95.4 | 90 | 9.1 |

***Own-saved Seed***

The average physical purity of own-saved seed was 95.4%; 62% of the seed samples were below the standard. With regard to germination, own-saved seed had an average germination of 89.6%; 6.0% of the samples were below standard. The number of samples that was a mixture was 9.1%.

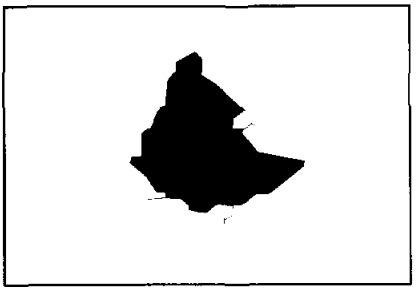
***Relation between Number of Years saved, Yield and Quality***

Table 13 shows the effect of saving the seed for a number of years. No significant effect was found on germination and physical purity. A decrease in varietal purity was observed, but could explained by the fact that the traditional varieties Hourani and Omki were included in the experiment. These varieties are usually scored as a mixture in the phenol test. If these varieties are excluded no increase in the number of offtypes after saving seed for longer periods is observed.

Table 13: Relation between number of years saved and yield and quality

| Years saved | % | Expected yield t/ha | Germination % | Physical purity % |
|---|---|---|---|---|
| 1 year | 50.0 | 4.9 | 88 | 95.8 |
| 2 years | 26.6 | 3.1 | 91 | 94.0 |
| 3 years | 9.4 | 3.3 | 91 | 97.0 |
| 4 years | 3.1 | 3.0 | 95 | 94.7 |
| 5 years | 3.1 | 4.5 | 95 | 95.3 |
| 8 year | 3.1 | 2.5 | 92 | 92.9 |
| 15 years | 1.6 | 2.0 | 95 | 99.3 |
| 20 years | 3.1 | 2.0 | 93 | 96.0 |

3.3. ***Seed Survey in Ethiopia*** by Z. Bishaw, A.J.G. van Gastel, Kassahun Shawel and Yonas Sahlu



The seed survey aimed to assess the quality of seed used for planting by farmers, to identify constraints for adoption of new technology, and to help in formulating future management guidelines. The survey assessed: a) adoption of modern varieties, (b) seed renewal rate, (c) quality of seed planted, (d) management of retained seed, (e) presence and distribution of seed-borne diseases, (f) seed storage practices and pests, and (g) the constraints to adoption. The survey was conducted as a joint activity between the Seed Unit of ICARDA and Ethiopian Seed Enterprise (ESE) in Addis Ababa. The Seed Unit assisted in formulating the survey, preparing a questionnaire and analyzing the collected data. ESE was responsible for coordinating the survey, collecting and testing samples for seed quality (purity, germination, health). The Institute of Agricultural Research assisted in carrying out the seed health tests.

Crops and Locations: The seed survey included wheat, barley and faba bean and focused on some major production zones of the three crops. The wheat and barley survey was carried out in Arssi and Bale zones, south-eastern Ethiopia. The faba bean survey was conducted in Gojam and Gondar zones, north-western Ethiopia.

The seed survey was conducted during July and August 1993. Farmers were randomly selected and directly contacted and the questionnaires were filled based on the interview. From each farmer a 500 gram seed sample was collected from the seed for planting, shortly before sowing. The samples were labelled, identified with the questionnaire and secured for seed quality tests.

A questionnaire was developed for the standardized interview with all farmers containing closed and open questions. The questionnaire was designed to gather as much information as possible about the source and quality of seed being planted; farmers' management practices; factors that may influence the adoption of improved seed. Other relevant socio-economic indicators such as holding size, grain price, credit facilities, and provision of inputs were collected.

Analysis of Survey Data: The questionnaires were summarized to study farmers' source of seed, management practices and their perception about improved varieties and seeds. Constraints that affect adoption of improved technology such as varietal acceptability, seed availability, seed quality, distribution of inputs, credit facilities, and farmers awareness were analyzed.

Laboratory Seed Testing: All samples collected during the survey were analyzed for seed quality such as physical purity, germination and seed health. The presence, distribution and level of contamination of seed-borne diseases were also determined.

Table 14: Field size

| Field size ha | Farmers no. | Farmers % |
|---|---|---|
| < 0.49 | 12 | 3.0 |
| 0.50 ≤x< 0.99 | 82 | 20.5 |
| 1.00 ≤x< 1.49 | 195 | 48.8 |
| 1.50 ≤x< 1.99 | 29 | 7.2 |
| ≥ 2.00 | 82 | 20.5 |
| Total | 400 | 100 |

Table 15: Seed rates (wheat) used by farmers

| Seed rate kg/ha | Farmers no. | Farmers % |
|---|---|---|
| < 149.9 | 7 | 1.7 |
| 150 ≤x< 199.9 | 5 | 1.2 |
| 200 ≤x< 249.9 | 365 | 91.3 |
| ≥ 250 | 23 | 5.8 |
| Total | 400 | 100 |

## Wheat

A total of 400 farmers were surveyed in Arssi (247) and Bale (153) zones of south-eastern Ethiopia. About 27 villages were covered.

***Field Size, Seed Rate and Fertilizer***

All farmers are subsistence cultivators and the field size is small (Table 14). The field size ranged from 0.25 to 4.0 ha with an average of 1.3 ha. More than 79.5% of farmers has less than 2 ha.

The farmers use seed rates which vary from 50 to 400 kg/ha with an average of 202 kg/ha (Table 15). Farmers' tendency to use higher seed rates is reflected in the survey where the majority plants more than a recommended rate of 125 to 150 kg/ha for planting of wheat. More or equal to 200 kg/ha is planted by 97.1% of farmers.

Fertilizer is positively adopted in Ethiopia, even in areas where modern agricultural technologies are least accepted. But it is critically in short supply and not available to all farmers in required quantity. The majority of farmers use di-ammonium phosphate (93.8%) and urea (5.2%) except three farmers who did not use fertilizer (1%). However, only 25.8% indicated how much DAP they apply, which varies from 20 to 150 kg/ha compared to general recommendation of 100 kg/ha.

***Varieties***

All farmers grow improved varieties of wheat, though 61.8% of farmers still use obsolete varieties long removed from the recommended list (Table 16). These obsolete wheat varieties are Dashen (33.8%), Israel (21.5%), 416 (4.3%) and Batu (2.3%).

The most popular recommended variety was Enkoy (25.5%), released in the 1970s and still grown by farmers. Enkoy is resistant to stem rust and moderately susceptible to yellow rust and leaf rust.

Boohai is the only durum variety (0.8%) reported in predominantly bread wheat growing areas of Arssi and Bale zones. Farmers generally preferred bread wheat because of higher yield and availability of adaptable varieties.

None of the new released varieties of wheat were found among the farmers surveyed.

From 366 farmers, 98.9% of respondents consider the varieties they grow as suitable in their area. From the 400 farmers interviewed 34 respondents did not indicate whether the varieties are suitable or not.

Table 16: Varieties planted by farmers

| Variety | Farmers no. | Farmers % |
|---|---|---|
| *Obsolete* | | |
| Dashen | 135 | 33.8 |
| Batu | 9 | 2.3 |
| Israel | 86 | 21.5 |
| 416 | 17 | 4.3 |
| *Recommended* | | |
| Enkoy | 102 | 25.5 |
| ET 13 | 9 | 2.3 |
| K6290 | 7 | 1.8 |
| k6295 | 14 | 3.5 |
| Pavon | 18 | 4.5 |
| Boohai | 3 | 0.8 |
| Total | 400 | 100 |

***Seed Sourcing and Retaining***

Farmers reported four sources of seed for planting: government (0.2%), own-saved (95.3%), neighbors (1.2%) and others 3.3% (mainly market).

Seed retaining indicates the number of years a seed of the same stock is saved by farmers after purchase of certified, commercial, or grain for planting purpose. Few farmers indicated retaining seed of the same variety continuously for up to 50 years. From all 388 respondents 77.9% retain seed from 1 to 9 years; and 19.3% from 10-15 years (Table 17).

Table 17: Farmers seed retaining period

| Years retained | Farmers no. | Farmers % |
|---|---|---|
| 1-3 | 124 | 31.9 |
| 4-6 | 142 | 36.6 |
| 7-9 | 36 | 9.3 |
| 10-12 | 73 | 18.8 |
| 13-15 | 2 | 0.5 |
| ≥ 50 | 11 | 2.8 |
| Total | 388 | 100 |

Since a large number of farmers are using older varieties, the period during which seed is retained by farmers is believed to be higher. However, farmers either under-reported the time seed was retained or replace seed of the older varieties from neighbors, relatives or markets.

***Seed Management***

In the survey area on-farm cleaning and treatment, was not a common practice

among farmers. It was found that only six farmers (1.5%) clean seed before planting, but without any seed treatment.

***Provision of Inputs and Credit***

All farmers (100%) indicated the provision of seed and related inputs (fertilizer, pesticides, implements) as one of the main constraints to adoption. There are no credit facilities for purchase of seed and other related inputs.

***Plant Diseases***

Smut and rust are the two most important diseases reported by farmers, though they are unable to identify the species. From 337 (for smut) and 315 (for rust) respondents 46.2% and 38% of farmers reported the problem of smut and rust, respectively. The presence of loose smut was confirmed in seed health tests.

***Storage Practices and Pests***

Farmers reported 'gotera' (2.6%) or sack (2.2%) or both (95.2%) for storage. A 'gotera' is a traditional bin made of bamboo/wood, covered by a conical bamboo/wood top, thatched with grass. The inner and outer wall are plastered with mud and located on a stone platform, a few cms above the ground.

Weevils and rodents were found the two most predominant storage pests in the area. From 366 farmers surveyed 3.5, 37.8 and 52.2% reported the problem of rodents, weevils, or both, respectively. However, 6.5% reported that they did not encounter any storage pest problems. Different pest control measures were practiced once infestation occurred, among 358 farmers 4.2% reported cleaning infested seed, 1.9% use of chemicals, and 10.1% fumigation.

***Seed Quality Tests***

About 87 seed samples were tested to determine seed quality attributes: physical purity, germination and seed health. Since samples from the same variety, but different sources and years were joined, it was difficult to compare seed quality among farmers. However, an estimate of average seed quality can be made particularly for obsolete or local varieties.

The overall physical purity appeared to be reasonable considering farmers' practice of using uncleaned seed. Almost 85 samples maintained the minimum requirement of 95% for commercial seed and none were below 90% (range: 93.7 - 99.1%). Germination was variable and less than half of samples (39) maintained a minimum standard of 85%. Seven samples gave less than 65% germination (range 33 - 64%).

## Barley

In barley, 396 farmers were surveyed in Arssi and Bale zones of south-eastern Ethiopia. During the survey 21 villages were covered, where 152 and 244 samples were collected from Arssi and Bale zones, respectively.

***Field Size, Seed Rate and Fertilizer***

The field size distribution shows a similar trend to that of wheat (Table 18). The average field size is 1.1 ha with a range from 0.25 to 5.0 ha. In total 117 farmers (29.5%) have less than 1 ha, whereas 64 (16.2%) have more than 2 ha.

Almost all farmers are using higher seed rate (Table 19) than recommended rate of 100 to 125 kg/ha for food barley (except one farmer). The survey shows that 78.5% and 18.7% of farmers use almost two or three times the recommended seed rate.

Fertilizer use shows a similar trend to wheat, whereby from 396 respondents, the majority of farmers use DAP (92.9%) followed by urea (5.8%), whereas few farmers do not apply fertilizer (1.3%). However, from those using fertilizer only 80 farmers (20.4%) indicated how much DAP they apply, which varied from 20 to 100 kg/ha. It is assumed that farmers apply lower rate because either fertilizer is in short supply or they may intend to apply what is available to all their fields.

Table 18: Field size

| Field size ha | Farmers no. | Farmers % |
|---|---|---|
| < 0.49 | 21 | 5.3 |
| 0.5 ≤x< .99 | 96 | 24.2 |
| 1 ≤x< 1.49 | 191 | 48.2 |
| 1.5 ≤x< 1.99 | 24 | 6.1 |
| ≥ 2.0 | 64 | 16.2 |
| Total | 396 | 100 |

Table 19: Seed rates used by farmers

| Seed rate kg/ha | Farmers no. | Farmers % |
|---|---|---|
| < 199.9 | 11 | 2.8 |
| 200 ≤x< 249.9 | 307 | 77.5 |
| 250 ≤x< 299.9 | 4 | 1.0 |
| ≥ 300 | 74 | 18.7 |
| Total | 396 | 100 |

***Varieties***

Almost all farmers (93.4%) grow the local landrace known as Arusso, whereas 6.3% plant improved malt barley varieties, Beka (6.0%) and Holker (0.3%). Beka and Holker are resistant to blotch, but susceptible to scald and barley shoot fly. Beka and Holker were released in the 1970s and still not replaced by new varieties.

Table 20: Varieties planted by farmers

| Variety | Year of release | Origin | Farmers no. | Farmers % |
|---|---|---|---|---|
| Arusso | | Local | 370 | 93.4 |
| Unknown | | Local | 1 | 0.3 |
| Beka | 1973 | France | 24 | 6.0 |
| Holker | 1979 | Ethiopia | 1 | 0.3 |
| Total | | | 396 | 100 |

Both zones belong to the major barley growing areas in Ethiopia. The use of improved barley varieties appeared to be low. So far the released food barley varieties like HB 42 and ARDU 12-60B did not yet reach the farmers.

178 respondents consider the varieties they grow as suitable in their area. The remaining did not indicate whether the varieties are suitable or not.

***Seed Sourcing and Retaining***

All 396 (100%) farmers surveyed used their own seed for planting (Table 21). From 59 respondents who use own-saved seed, 88.1% always use retained seed, 10.2% from other sources and 1.7% from government.

Table 21: Farmers' seed source

| Source | Farmers no. | Farmers % |
|---|---|---|
| Government | 1 | 1.7 |
| Own seed | 52 | 88.1 |
| Others | 6 | 10.2 |
| Total | 59 | 100 |

Table 22: Farmers seed retaining period

| Years retained | Farmers no. | Farmers % |
|---|---|---|
| 1-3 | 28 | 8.9 |
| 4-6 | 24 | 7.7 |
| 7-9 | 4 | 1.3 |
| 10-12 | 11 | 3.5 |
| 13-15 | 8 | 2.5 |
| 20 | 1 | 0.3 |
| ≥ 50 | 238 | 75.8 |
| Total | 314 | 100 |

Concerning local landrace, farmers indicated using the same seed for very long period (Table 22); as far back as 1950 or earlier. About 238 (75.8%) never changed seed, whereas the remaining farmers retained seed for less than 20 years. This indicates the possibility that farmers change seed even of local landraces.

Although the number of farmers using improved varieties is very low, the period seed of these varieties is retained on the farm seemed short. From 25 farmers who used improved varieties about 96% retained seed from 1 to 5 years (Table 23).

***Seed Management***

Seed cleaning and treating is not a common practice among farmers. Only five farmers indicated that they clean seed before planting, but without seed treatment.

***Provision of Inputs and Credit***

As in wheat, the provision of seed related inputs is a critical element for lack of adoption of new technology. Credit facilities for seed, fertilizer, pesticides and implements are not made available to farmers. High price and limited availability of inputs may discourage farmers from using new technology.

***Plant Diseases***

Farmers reported smut and rust as the two most important diseases of barley. From a total of 377 and 154 respondents 73.7% and 45.5% of farmers encountered the problem of smut and rust, respectively. It appeared that smut of barley is more serious as compared to wheat.

Table 23: Number of years seed saved by farmers

| Variety | Year of purchase | Farmers no. | Farmers % |
|---|---|---|---|
| Beka | 1993 | 1 | 4.0 |
| | 1992 | 8 | 32.0 |
| | 1991 | 5 | 20.0 |
| | 1990 | 2 | 8.0 |
| | 1989 | 7 | 28.0 |
| | 1980 | 1 | 4.0 |
| Holker | 1992 | 1 | 4.0 |
| Total | | 25 | 100 |

***Seed Storage and Pests***

The 197 respondents use bins (12.7%) or sacks (1.0%) or a combination of the two (86.3%) for storage which shows a similar trend as reported for wheat. A combination of 'gotera' and sacks are the most popular form of storage.

Among 393 farmers 35.3% reported rodents, 24.2% weevils or both (11.7%) as most predominant storage pests. In 28% of the cases farmers reported no pest problems. Farmers use sanitary measures (258) and spraying (7) to avoid infestation while the rest (128) do not take any measure to avoid pest infestations. The same farmers reported different control measures once infestation occurred: cleaning infested seed (5.1%), chemical spray (5.1%) and fumigation (4%). The remaining 367 (93.8%) farmers did not practice any control measures.

***Seed Quality Tests***

In barley, 85 samples were tested for seed quality attributes. Since 75 out of 85 samples were of local landraces the analysis may indicate a true average value of seed quality at farmers' level. About 35 samples maintained the physical purity standard of 95% for commercial seed. All samples had a physical purity of over 90% (range 90.1 - 98.7%). Germination of barley appeared to be better than that of wheat and 71 samples maintained the minimum germination of 85%. None of the samples were below 75% germination.

## Faba bean

A total of 380 farmers were surveyed from Gojam and Gondar zones of north-western Ethiopia. A total of 152 samples from east and west Gojam and 244 from south and north Gondar were collected covering 26 locations.

***Field Size, Seed Rate and Fertilizer***

The field size (Table 24) appears to be generally small as compared to wheat and barley. The range varies from 0.12 to 1.25 ha with an average of 0.61 ha. About 83.4% of farmers has less than 1 ha; and 41.1% and 25.8% of farmers has 0.5 and 0.75 ha, respectively.

Table 24: Field size

| Field size ha | Farmers no | Farmers % |
|---|---|---|
| < 0.5 | 63 | 16.6 |
| 0.5 ≤x< 1 | 254 | 66.8 |
| ≥ 1 | 63 | 16.6 |
| Total | 380 | 100 |

Table 25: Seed rates used by farmers

| Seed rate kg/ha | Farmers no. | Farmers % |
|---|---|---|
| < 50 | 1 | 0.2 |
| 50 ≤x< 100 | 115 | 30.3 |
| 100 ≤x< 150 | 223 | 58.7 |
| ≥ 150 | 41 | 10.8 |
| Total | 380 | 100 |

Seed rate (Table 25) for faba bean varies considerably (40 to 200 kg/ha) and contrary to general perceptions most farmers use lower seed rates then the recommended rate of 175 to 200 kg for improved varieties; 89.2% of farmers plant less than 150 kg/ha. The total number of farmers planting less than 175 kg is about 97.9%.

Fertilizer use on faba bean has not been reported by farmers.

***Varieties***

All farmers grow local landraces and no improved faba bean varieties were made available to them. So far, four varieties have been recommended for high elevation areas (1700 m). But the adoption rate is slow and none were found among farmers who are major producers of faba bean in the country. No seed is being produced on commercial scale and distributed in these zones.

***Seed Sourcing and Retaining***

Farmers in the surveyed area use their own seed for decades. Some farmers reported that they used the same seed for generations. It appeared that almost all farmers retain the seed for planting.

***Seed Management***
Farmers traditionally winnow or sieve grain after harvest, but before storage. Most faba bean growers do not clean or treat their seed except few farmers (12.1%) in north Gondar who clean their seed.

***Provision of Inputs and Credit***
Seed related agricultural inputs are generally not available in most of the surveyed area. All farmers indicated that there is no credit for seed and other inputs. As a result farmers can not afford to purchase a limited amount of available inputs.

***Plant Diseases***
It was difficult to recognize all faba bean diseases frequently reported by farmers, because no systematic survey of prevalent diseases has been conducted. A total of 293 (77.1%) reported chocolate spot and 366 (96.3%) indicated rust as the most important diseases. Chocolate spot and ascochyta blight were identified in seed health tests.

***Seed Storage and Pests***
All farmers reported 'gotera' as the only means of storage. However, poor sanitary measures appeared to make grain liable to attack by storage pests.

Table 26: Faba bean seed quality

| Quality (%) | No of samples | |
|---|---|---|
| | Purity | Germination |
| ≥ 95 | 24 | 9 |
| 90 ≤x< 95 | 18 | 26 |
| 85 ≤x< 90 | 7 | 9 |
| 80 ≤x< 85 | 3 | 6 |
| < 80 | 2 | 5 |
| Total | 55 | 55 |

Table 27: Pathogens observed and average infection level in faba bean

| Pathogens observed | Average infection level (%) |
|---|---|
| *Botrytis fabae* | 7.5 |
| *Ascochyta fabae* | 11.0 |
| *Fusarium avenaceum* | 3.0 |
| *Fusarium oxysporum* | 2.0 |
| *Fusarium solani* | 5.0 |

From 380 respondents, bruchids were reported to be a major storage pest by 49.7% of the farmers. The same farmers who reported storage pests use chemicals (97.3%) like Actellic to avoid infestation. Moreover, they use different control measures like chemical spray (92.1%), heating (0.5%) infested seed or both (7.4%) to control pests once infestation occurred. However, 50.3% indicated that they neither encountered pest problems nor practiced preventive or curative measures against pests.

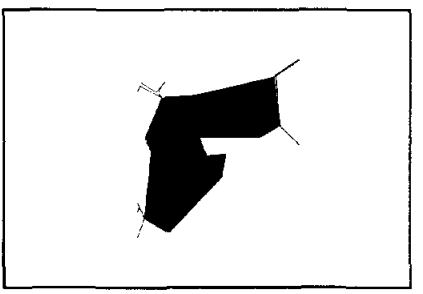
***Seed quality***
A total of 55 samples were analyzed (Table 26) and the results reflect the seed quality at farmers level. Faba bean seed is expected to be high in physical purity, but low in

germination. However, the purity appeared to be variable (range: 77.7 - 99.4%). Although 24 samples were over 95%, only four samples maintained the minimum requirement of 97% for commercial seed. The germination was relatively high except for five samples which were below 80% (range: 24 - 58%). Almost all samples maintained the minimum requirement of 75%.

For faba bean only 20 samples were tested for seed health and the results are presented in Table 27. Chocolate spot and ascochyta blight were the two important seed-borne diseases identified. Several diseases which are not seed-borne were recorded including *Aspergillus niger* and *A. flavus* which produce mycotoxins.

### *3.4. A Survey of Wheat Seed Quality in Jordan* by: Basema Hasan and Rami Youssef, University of Jordan, Amman, Jordan

A study on wheat seed quality in Jordan is conducted at the University of Jordan with the following objectives:



a) Estimate the percentage of farmers in Jordan that use: own-saved seed, other farmers' seed, or Certified Seed for planting.
b) Evaluate varietal and physical purity, germination, 1000-kernel weight of seed used for planting.
c) Assess farmers' appreciation of Certified Seed.
d) Identify seed quality problems experienced by farmers.
e) Survey the important fungal pathogens transmitted by wheat seed in Jordan.
f) Study the efficiency of the national seed program to produce healthy Certified Seed.
g) Establish the relation between results of laboratory tests and infection in the field.

A summary of results will be presented only; complete results will be reported in the thesis of Ms Basema Hasan. Seed health aspects are reported in the M.Sc. thesis of Mr. Rami Youssef entitled "Survey of fungal pathogens transmitted by wheat seeds in Jordan".

Sample collection: In Jordan on average 90 970 hectares of wheat are grown distributed over the north (40%), the centre (30%), the south (20%) and the Jordan Valley (10%). During the 1990 wheat planting season 395 farmers were surveyed throughout the country (160 in the north, 129 in the centre, 94 in the south, and 12 in the Jordan Valley). A total of 405 seed samples were collected by the National Centre for Agriculture Research and Technology Transfer (NCARTT). Samples were taken randomly, considering an even distribution of the samples over the different villages in the different areas.

Table 28: Reasons why farmers do not use Certified Seed

| Reasons | Number of farmers | Percentage (%) |
|---|---|---|
| Own-saved seed and other farmers' seed is usually available; variety satisfactory | 113 | 43.9 |
| Certified Seed is not available at planting | 52 | 20.2 |
| Cost of Certified Seed is high | 42 | 16.3 |
| Certified Seed is not suitable | 21 | 8.2 |
| Seed was certified few years ago | 19 | 7.4 |
| Not aware of existence of Certified Seed | 10 | 3.9 |
| Total | 257 | 100.0 |

Table 29: Reasons why farmers use Certified Seed

| Reason | Number of farmers | Percentage (%) |
|---|---|---|
| Cleaned, treated and high yielding | 125 | 90.6 |
| Not sufficient own-saved seed and source of Certified Seed is known | 10 | 7.3 |
| To change the variety | 1 | 0.7 |
| Change seed by Certified Seed every 3 years | 1 | 0.7 |
| Other | 1 | 0.7 |
| Total | 138 | 100.0 |

Table 30: Reasons why farmers use neighbors' seed

| Reason | Number of farmers | Percentage (%) |
|---|---|---|
| Available on time | 17 | 54.8 |
| Variety is appropriate under local environmental conditions | 6 | 19.3 |
| No own-saved seed available | 5 | 16.2 |
| No cash to purchase seed | 2 | 6.5 |
| No Certified Seed available from government | 1 | 3.2 |
| Total | 31 | 100.0 |

Questionnaire: When a sample was taken a questionnaire was filled out to collect information on: (1) the source of seed planted, (2) the reason for choosing this source, (3) management practices, (4) acreage planted, (5) variety used, and (6) seed handling (storage conditions, chemical treatment, cleaning, etc.).

Seed Tests: To assess the quality of the seed each sample was analyzed for the following quality attributes: (a) physical purity, (b) germination, (c) varietal purity, (d) varietal identity, and (e) thousand-kernel weight.

Table 31: Physical purity of different sources of seed

| Source of seed | Number of samples | Purity average | Below standard % |
|---|---|---|---|
| Certified | 130 | 99.4 | 4.6 |
| Other farmers' | 29 | 96.6 | 34.5 |
| Own-saved | 220 | 96.8 | 41.8 |
| Average | | 97.7 | 28.5 |

***Seed Source***

Farmers in Jordan obtain wheat seed from three sources; i.e., from the Jordan Co-operative Organization (Certified Seed), from other farmers, and own-saved. From 405 samples, 34.1% was Certified Seed, 7.6% other farmers' seed, and 58.3% was own-saved seed. The

questionnaire also gave an insight in the reasons why farmers use a specific seed source for planting (Tables 28, 29, and 30).

The main reason for farmers not to use Certified Seed (Table 28) was the fact that own-saved seed (or seed from neighbors) is available and that the varieties are considered to be suitable for the farmers' local conditions. Farmers replied that Certified Seed was not available at planting time (20.2%) or that the cost was too high (16.3%).

The fact that Certified Seed was properly cleaned, treated, and high yielding was the main reason for the purchase of Certified Seed (Table 29).

***Varieties***

The 405 samples included 11 different varieties. Traditional varieties such as Balady and Haurani account for 44.0% and 16.5%, respectively. All samples of Balady (178) were own-saved seed (87.6%) or other-farmers' seed (12.4%). The most widely used improved variety was Haurani nawani (13.3%), followed by F8 (9.1%). On average 50% of the seed of these improved varieties was certified.

***Cultural Practices***

Two planting methods are used, i.e. broadcasting (75.6%) and planting with a seed drill (24.3%). Farmers who use Certified Seed use a seed drill in 37.0% of the cases; while 19% of farmers, who used seed from neighbors or own seed, used a seed drill. Percentage of farmers applying fertilizers is 44.7%. Of the farmers who plant Certified Seed 73.2% use fertilizer, compared to 34.3% of the farmers who plant own saved seed and 19.4% who use seed obtained from neighbors.

The field size ranged from 0.3 to 1000 hectares with 58.5% of the farmers planting less than 6 hectares and 5.1% more than 50 hectares. A total of 39.5% of the farmers use seed rates lower than 100 kg/ha, which is the recommended rate. A total of 391 farmers (96.5%) grow under rainfed conditions while 14 farmers (3.5%) use irrigation.

Table 32: Germination of different sources of seed

| Source of seed | Number of samples | Germination average | Below standard % |
|---|---|---|---|
| Certified | 130 | 84.7 | 38.5 |
| Other farmers' | 29 | 86.3 | 24.1 |
| Own-saved | 220 | 88.3 | 22.3 |
| Average | | 86.9 | 28.0 |

***Quality Tests***

Physical Purity (Table 31): The average physical purity of Certified Seed was 99.4%, while other farmers' seed and own-saved seed had average purity of 96.6% and 96.8%, respectively. The percentages of samples that had a physical purity below 95% (the national standard for physical purity) was 4.6, 34.5, and 41.8% for Certified Seed, other farmers' seed and own-saved, respectively. The average physical purity was 97.1% for traditional variety, while it was 98.4% for improved varieties. The

percentage of samples with physical purity below 95% was 36.1% for traditional varieties; 14.9% for improved varieties.

Germination (Table 32): The average germination percentage of Certified Seed was 84.7, while other farmers' and own-saved seed had average germination percentages of 86.3 and 88.3, respectively. The percentage of samples that had a germination below 85% (the national standard for germination) for Certified Seed was 38.5%; other farmers' seed and own-saved seed had percentages of samples that had germination below 85% of 24.1 and 22.3, respectively.

The average germination was 87.8% for traditional varieties, whereas it was 85.0% for improved varieties.

# 4. TRAINING

The human factor is the most critical element for a successful implementation of a national seed programs. Many promising seed programs fail because of lack of a properly trained human resource base, even within the environment of correct national seed industry policy. As a seed program moves from early development to a more advanced stage, there will be a change in the type and number of trained personnel needed and the training required. It is in the interest of national seed programs to adapt to changing requirements and clearly establish goals and develop a comprehensive strategy how to achieve a sustainable human resource base.

Regional seed centers like the Seed Unit at ICARDA will collaborate with national seed programs to backstop research and training and provide networking mechanism for the development of coordinated strategies at both the national and the regional level. The Seed Unit has a well established and strong linkage with most national seed programs of the region and training was, is and will remain one of its major activities.

In 1994 it has assisted in establishing a M.Sc. program in Seed Science and Technology and conducted several seed technology courses. The Unit will continue to assist in a 'multi-training' approach to meet a wide range of needs for national seed programs and explore an innovative and effective strategy to develop a critical mass of trained staff in seed technology in the region. The number of staff trained over the past years is given in Figure 2. The drop in the number of trainees in 1994 is mainly due to the fact that, both in 1992 and 1993, several followup courses were organized, which have large numbers of participants, while in 1994 only initial Train-the-Trainer course, that have limited number of participants, have been organized.

In 1994 five courses with different objectives and approaches were organized (Table 33). Two conventional (1 sub-regional and 1 in-country) and three in-country train-the-trainers courses were conducted in which 65 staff members from national seed programs of 5 countries of the region participated. It was for the first time that the Seed Unit organized an in-country seed course in Iraq and Pakistan. In addition, five individual short-term in-service trainings were conducted for staff from Algeria and Syria ranging from one to three weeks.

## *4.1. M.Sc. Seed Science and Technology*

The M.Sc. program in seed science and technology at the University of Jordan has been approved by EU's MEDCAMPUS program and the M.Sc. has been initiated; 8 students have started their M.Sc. studies, which will be offered by the Department of Plant Production as a sub-specialization of Crop Science. The program is a joint effort of the University of Tuscia (Italy), the University of Athens (Greece), the University of Jordan, and ICARDA.

## *4.2. Train-the-Trainers Programs*

It is not possible to meet the training needs and train the whole range of staff from the national seed programs in the region. For sustainable human resource development, the train-the-trainers approach is more attractive (Figure 1), because it is more focused and problem-oriented and has a multiplier effect. The trainers remain as a core of specialists who will transfer the knowledge acquired and continue to assist as resource persons in future training endeavor of the national program.

**Table 33. Training courses of Seed Unit, 1994**

| Name | Location | Date | No of partici-pants |
|---|---|---|---|
| **A. Sub-regional Courses** | | | |
| Legume Seed Health Testing | Cairo, Egypt | 20/03-30/03 | 14 |
| **B. In-country Train-the-Trainers Courses** | | | |
| Seed Certification | Sennar, Sudan | 05/02-10/02 | 12 |
| Legume Field Inspection Methodology | Sids, Egypt | 26/03-30/03 | 8 |
| Legume Seed Production | Sahiwal, Pakistan | 05/04-14/04 | 11 |
| **C. In-country Courses** | | | |
| General Seed Technology | Baghdad, Iraq | 22/06-02/07 | 20 |
| **D. Individual Trainees** | | | |
| Seed Testing Techniques | Syria | 20/02-03/03 | 1 |
| Morphological Variety Description (Cereals) | Algeria | 24/04-12/05 | 1 |
| | Syria | 24/04-12/05 and 19/06-21/06 | 1 |
| | Syria | 02/07-14/07 | 1 |
| Seed Processing and Storage | Syria | 17/07 - 28/07 | 1 |

Former participants of the 'train-the-trainers' courses were responsible for the overall organization and coordination of the 1994 follow-up courses. Their contribution both technically and administratively during the entire period was significant and once again proved the sustainability of the approach for human resource development and its 'multiplying effect'.

***Seed Certification, Sennar, Sudan***

The course with particular focus on seed certification was organized from 5-10 February 1994, in the Sudan. It aimed at improving the skills of seed production and agricultural extension officers to strengthen the quality control in the formal and informal seed supply system. A mix of 12 participants was carefully selected representing different institutes of the Sudan seed industry: National Seed Administration, NSA (1), Pioneer Seed Co. (1), Agricultural development schemes (2), NGOs (1), Agricultural Bank (1), Extension service (5), and the University (1).

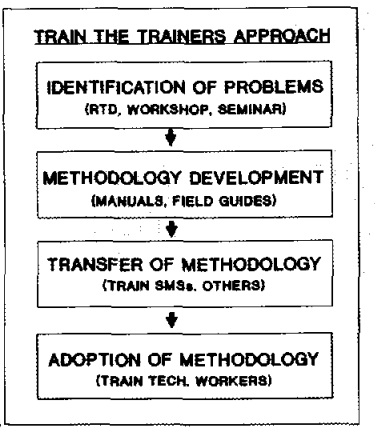



Figure 1. A train-the-trainers approach (RTD = Roundtable discussion; SMS = Subject matter specialist)

All organizations except the University are involved in formal and/or informal seed production and supply as part of agricultural development schemes or rehabilitation programs. The participants from the NGOs and Ministry of Agriculture, particularly where NSA activities are limited, will be expected to play a leading role in the awareness of seed among extension specialists and to encourage the informal seed supply system in their provinces.

Each staff, who participated in the course, is expected to organize a follow-up course in his respective institute. NSA will make available technical support staff and ICARDA will provide training materials for the courses.

***Legume Seed Production, Sahiwal, Pakistan***

The course was organized in cooperation with the Federal Seed Certification Department (FSCD) and the National Seed Registration Department (NSRD) of the Ministry of Food and Agriculture. The objective was to promote awareness and to strengthen the national legume seed industry which is a recent initiative in Pakistan.

Emphasis was given to management of seed production, field inspection techniques and detection of seed-borne diseases (both in field and laboratory) to create awareness and understanding among senior staff.

Eleven senior staff with wide technical and practical experience from public and private seed companies and seed certification departments attended the course: 8 from FSCD (4

deputy directors, 4 certification officers), 2 from Punjab Seed Corporation (public) and 1 from Kissan Seed Corporation (private). The presence of senior staff from different background led to exchange of information and sharing of experience. Several technical and practical issues as well as constraints to the legume seed industry were discussed from the Pakistan perspective.

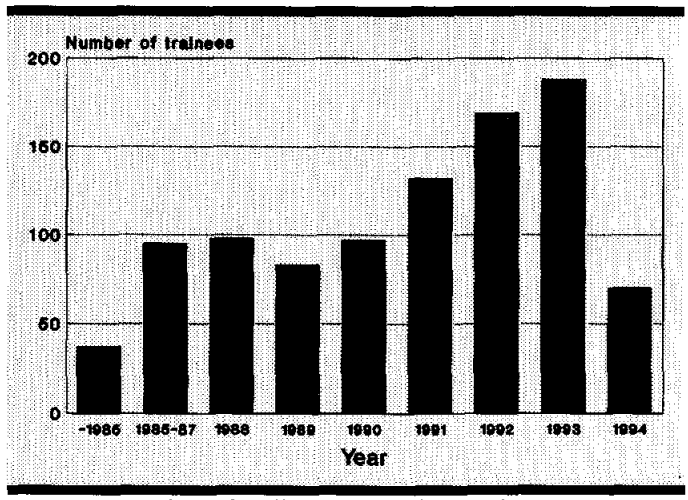


Figure 2. Number of staff trained by the Seed Unit

All participants who attended the course are expected to organize similar follow-up course in each province in the coming years. It is expected that the follow-up courses will strengthen a close working relationship and mutual confidence among public and private seed producers and seed certification department to realize the benefits of legume varietal improvement in the country.

The Federal Seed Certification Department organized from December 5 - 8, 1994 the first follow-up course of the above Train-the-trainers course. The course was organized in Islamabad.

***Legume Field Inspection Methodology, Sids, Egypt***

The course was organized in cooperation with the Central Administration for Seed (CAS) and GTZ from 26-30 March 1994. The course was initiated along a similar line to that of 'train-the-trainers' course on wheat field inspection methodology, which was successfully concluded in 1993. The course covered the constraints of legume seed industry, but strongly focused on field inspection techniques, variety description and seed-borne diseases from an Egyptian perspective.

Eight seed quality control officers from CAS Seed Departments in six major legume growing governorates of Egypt were carefully selected to be trained as 'trainers'. Consequently the 'trainers' will take the lead in course organization and program coordination and carry out lectures and practicals in the follow-up courses in coming years with minimum support from CAS, GTZ and ICARDA staff. It is anticipated that in 1995 at least two courses will be organized in two locations.

## *4.3. Sub-regional Training*

***Legume Seed Health Testing, Cairo, Egypt***
A sub-regional legume seed health testing course was conducted from 20-30 March 1994 in cooperation with CAS and ARC in Egypt. The objective was to address the problem of seed health, one of the main constraints for the development of strong legume seed industry and focused on detection, isolation, identification, field inspection and laboratory testing of seed-borne diseases of cool season food legumes.

The course was attended by participants from Egypt (7), Ethiopia (4) and the Sudan (3) who are involved in legume research, seed production or quality control in their respective institutes. The course created an opportunity for region-wide exchange of information and learning from each others experiences. Moreover, it promoted inter-institutional and inter-country contacts and consultations on the problems of seed-borne diseases within the context of the Nile Valley Region.

## *4.4. In-country Course*

***General Seed Technology, Baghdad, Iraq***
The general seed technology course, the first activity of the Seed Unit in Iraq, was conducted from June 23 to July 2, 1994. The course was organized in cooperation with several Iraqi National Programs through a financial of the Mashreq project.

The course was designed to train participants in different aspects of seed technology in cereal and legume crops. All seed program components were covered where the assurance of quality during seed production and supply were promoted.

A total of 20 participants attended the course: eight from IPA-Agricultural Research Center; four from the Iraqi Atomic Energy Commission; two each from Iraqi Company for Seed Production, Seed Testing and Certification Department, University of Baghdad; and one each from Plant Genetic Resources Unit and the State Board for Agricultural Research of Ministry of Agriculture. The participants are working in agricultural research (maintenance and foundation seed production), or with certified seed producing companies or national quality control agency.

## *4.5. Individual Training*

During in-service training trainees are working closely with the Seed Unit staff to acquire practical skills through learning-by-doing. Five participants, three in variety description (Algeria (1) and Syria (2)), one each in seed testing techniques and seed processing from Syria were trained in 1994.

# 5. SEED MULTIPLICATION

Seed production of promising lines is a routine activity aiming at producing limited quantities of seed for distribution to national programs and for research purposes. The seed production activities also play an important role in the training program of the Unit.

***Production and Processing***

The quantities of Breeder Seed, Pre-basic Seed, Basic Seed, Certified Seed, and Quality Seed produced in 1994 are indicated in Table 34. In total, 35.1 t of seed were produced i.e. Breeder Seed and Pre-basic Seed (330 kg), Basic Seed (5.9 t), Certified Seed (9.2 t), and Quality Seed (19.7 t). Of the total, 26.8 t were cereals (76.6%), 7.5 t legumes (23.4%). A small quantity of medic seed (323 kg) and vetch (500 kg) were produced.

***Distribution***

Table 35 presents the data on distribution of seed; it includes seed produced during this season and carry-over seed of last year. In 1994 more than 27 t were distributed i.e. 9.8 t wheat, 8.9 t barley, 1.4 t lentil, 5.7 t chickpea, 0.8 t vetch and 0.4 t of medic for the following purposes:

- 1.2 t for next year's plantings of the Seed Unit,
- 4.7 t to the countries of the ICARDA region,
- 3.9 t to the GOSM in Syria,
- 16.6 t for research and large-scale testing purposes, and
- 0.6 t for use at ICARDA's farm.

**Table 34. Quantity of seed harvested per multiplication category in 1994 (kgs)**

| Seed Category | Crops | | | | | | Total |
|---|---|---|---|---|---|---|---|
| | Wheat | Barley | Chickpea | Lentil | Medic | Vetch | |
| Breeder | 35 | 40 | | | 45 | | 120 |
| Pre-basic | 120 | | 80 | | 10 | | 210 |
| Basic | 5620 | | | | 268 | | 5888 |
| Certified | 2474 | | 1750 | | | | 9224 |
| Quality | 4735 | 8800 | 3800 | 1870 | | 500 | 19705 |
| Total | 17984 | 8840 | 5630 | 1870 | 323 | 500 | 35147 |

***Quality Control***

All production, processing and storage activities of the Unit are carefully monitored by seed quality tests (Table 36) to ensure that seed produced and distributed is of good quality. Tests are also carried out for research, variety description work and other purposes. In 1994, 1802 samples were analyzed for the following purposes: (1) monitoring seed production, survey, storage and distribution activities (1171 samples; mainly germination tests), (2) research (261; vigor tests), (3) variety description work (66;

mainly phenol tests), and (4) other purposes such as purity and germination tests on *Medicago* species.

**Table 35. Seed distribution in 1994 (kgs)**

| | Wheat | Barley | Lentil | Chickpea | Vetch | Medic | Total |
|---|---|---|---|---|---|---|---|
| Seed Unit | 260 | 350 | 300 | 300 | | 14 | 1224 |
| Region | 2500 | | 500 | 1700 | | | 4700 |
| GOSM | 1000 | 300 | 620 | 2000 | | | 3920 |
| Research | 5425 | 8300 | | 1690 | 800 | 400 | 16615 |
| Farm | 650 | | | | | | 650 |
| Total | 9835 | 8950 | 1420 | 5690 | 800 | 414 | 27109 |

**Table 36. Number of samples tested in the seed testing laboratory since 1988**

| | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | Total |
|---|---|---|---|---|---|---|---|---|
| Physical purity | 158 | 283 | 149 | 28 | 70 | 106 | 166 | 960 |
| Germination | 290 | 822 | 531 | 1069 | 833 | 1018 | 1005 | 5568 |
| Varietal purity | 304 | 165 | 178 | 117 | 125 | 84 | 302 | 1275 |
| Moisture | 8 | 148 | 178 | 143 | 153 | 26 | 20 | 676 |
| Vigor | | | 21 | 356 | 68 | 1001 | 261 | 1707 |
| Seed weight | | | 802 | 883 | 335 | 54 | 48 | 2122 |
| Total | 760 | 1418 | 1859 | 2596 | 1584 | 2289 | 1802 | 12308 |

# 6. SERVICES

The seed cleaning laboratory is also used to serve ICARDA commodity programs; in 1994 for instance, the Genetic Resources Unit (GRU) cleaned 2082 samples of barley, 1311 samples of *Triticum* and 1006 samples of chickpea. For Germplasm Program (GP) and Pasture Forage and Livestock Program (PFLP) 5083 samples of barley and 200 samples of medic were cleaned, respectively.

The seed cleaning plant plays an important role in the activities of the Unit. In addition to its training function and the cleaning of the production of the Unit's seed production fields (See Table 34), it assists ICARDA's commodity programs in cleaning seed. In 1994, 237 t of seed has been cleaned i.e. 29.3 t for the Unit, 167.7 t for commodity programs, and 40 t as a service to the Syrian seed organization, GOSM (Table 37).

**Table 37. Seed processed since 1988 (tons)**

| | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 |
|---|---|---|---|---|---|---|---|
| Seed Unit | 80.6 | 31.5 | 20.8 | 42.0 | 65.7 | 35.0 | 29.3 |
| ICARDA Services | | | | | | | |
| CP | | 1.6 | 5.8 | 0.3 | 1.8 | 28.8 | 3.2 |
| PFLP | 10.5 | 6.5 | 16.7 | 18.1 | 12.7 | 42.5 | 11.0 |
| LP | 3.1 | 4.3 | 1.8 | 8.9 | 14.7 | 5.6 | 19.0 |
| FRMP | 16.2 | 20.1 | 25.5 | 35.4 | 33.9 | 45.1 | 18.5 |
| St. Operations | 21.6 | 6.4 | 29.0 | 47.6 | 75.7 | 123.0 | 116.0 |
| Others | 0.9 | | | | | | |
| GOSM | | | 108.3 | 218.7 | 94.7 | 206.2 | 40.0 |
| Total | 52.3 | 38.9 | 187.1 | 329.0 | 233.5 | 446.2 | 207.7 |
| TOTAL | 132.9 | 70.4 | 207.9 | 371.0 | 299.2 | 486.2 | 237.0 |

Table 38 provides information on the services that the laboratory gives to other programs and units.

**Table 38. Service activities of the seed testing laboratory of the Seed Unit in 1994**

| Equipment | Program | Period | Samples | Total |
|---|---|---|---|---|
| Germination room | PFLP | 67 days | 375 | |
| | LP | 61 days | 327 | 729 |
| | Seed Health Lab. | 37 days | 27 | |
| Other equipment | PFLP | 37 days | 5273 | |
| | LP | 10 days | 1038 | |
| | CP | 6 days | 396 | 6707 |

# 7. PUBLICATIONS

The sixth and the seventh issue of SEED INFO, the Newsletter for the participants of the WANA Seed Network.

The first and second issue of FOCUS on SEED PROGRAMs, describing the seed programs of Morocco and Sudan.

Gregg, B., S.A. Wanis, Z. Bishaw and A.J.G., van Gastel. 1994. Safe seed storage. WANA Seed Network Publication No. 5/94.

Gregg, B., S.A. Wanis, A.J.G. van Gastel and Z. Bishaw. 1994. Marketing seed. WANA Seed Network Publication No. 6/94.

Bishaw, Z., A.J.G. van Gastel, B. Gregg and S.A. Wanis. 1994. Inspecting seed fields of self-pollinating crops. WANA Seed Network Publication No. 7/94.

Rami Youssef Abdel Fattah, 1994. Survey of fungal pathogens transmitted by wheat seeds in Jordan. M.Sc. Thesis, University of Jordan, Amman, Jordan.

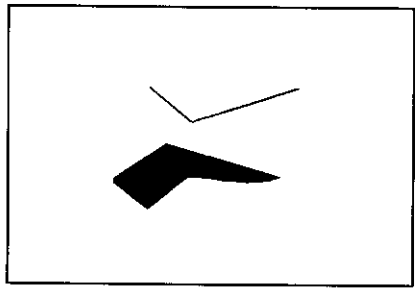
Youssef, O. 1994. Evaluation of the seed program of Iraq. Consultancy Mission Report, ICARDA, P.O. Box 5466, Aleppo.

van Amstel H. 1994. Improving the seed system of resource-poor farmers in the WANA region. Consultancy Mission Report, ICARDA, P.O. Box 5466, Aleppo.

van Gastel, A.J.G., Bahl, P.N., Faki, H., Plancquaert, P., Nassib, A.M. and Snobar, B. 1994. Provisions for agronomic inputs for cool season food legumes in some developing countries. In: Expanding the Production and Use of Cool Season Food Legumes (eds: Muehlbauer, F.J. & Kaiser, W.J.), Kluwer Academic Press, The Netherlands, pp: 495-503.

ANNEX I: WANA SEED DIRECTORY - CYPRUS

**SEED LAW IMPLEMENTING AGENCY**
Department of Agriculture, Nicosia, Tel: 02-303323, 02-3196, Tlx: 4660, Fax: 02-30 445156



**SEED CERTIFICATION AGENCY**
Agronomy Section, Department of Agriculture, Nicosia, Tel: 02-303323, 02-303196, Tlx: 4660, Fax: 02-445156

**SOURCES OF BREEDER & FOUNDATION SEED**
Agricultural Research Institute, P.O. Box 2016, Nicosia, Tel: 02-305101, Fax: 02-316770

**GOVERNMENT SEED PRODUCTION & PROCESSING PROGRAMS**
Seed Production Center, Department of Agriculture, Nicosia, Tel: 02-303196, Tlx: MINAGRI 4660, Fax: 02-445156

**PRIVATE SECTOR SEED PRODUCTION & PROCESSING COMPANIES**
Co-operative Carob Marketing Federation Paphos Ltd., 52 Apostolou Pavlou str. Paphos, Tel: 06-233802, Fax: 06-233802

P. Samaras Import - Export Ltd., 14 Arch. Makarios Ave., First Floor No: 26, Nicosia, Tel: 02-447867, Tlx: 2675, Fax: 02-447205

Frixos Constantinou & Son Ltd., 93 Evagoras Pallikarides Ave., Paphos, Tel: 06-233648, Tlx: 5989

Charalambos Tsintides Ltd., Mesogi Industrial Area, Paphos, Tel: 06-242330, Fax: 06-249706

**SEED IMPORTERS & EXPORTERS**
All the above seed processing companies and the following companies:

Andreas I Kostekoglou, 6 Meteoron str., Nicosia, Tel: 02-348532, Fax: 02-314074

Spyros Stavrinides Chemicals Ltd., P.O. Box: 1278, 28A Stasinou Ave., Nicosia, Tel: 02-446538, Tlx: 2375, Fax: 02-446902

N.K. Shacolas (Merchants) Ltd., P.O. Box: 1744, Nicosia, Tel: 02-482800, Fax: 02-485385

Demetres Soukiouroglou Ltd., P.O. Box: 1513, Nicosia, Tel: 02-482282, Tlx: 2297, Fax: 02-482331

Lambrou & Zorlakis, Prodromou, 107A, Strovolos, Nicosia, Tel: 02-477908, Tlx: 3595, Fax: 02-367157

Petros G. Mavrikios, 34 Gennadiou str., Limassol, Tel: 05-361211, Tlx: 3681, Fax: 05-356751

Alexandros Soleas & Son Ltd., 18 Poleodomias, Industrial Area Kaimakli, Nicosia, Tel: 02-437242, Tlx: 3545, Fax: 02-347980

S.P.E.A. Ltd., 27-29 K. Pantelidi Street, Larnaca, Tel: 04-655596, Fax: 04-659362

**LICENSED RETAIL SEED DEALERS & MERCHANTS**
All the above seed importers and exporters and the following companies:

**Famagusta**
Loizos Theodoulou, 1st Apriliou, Sotera

Michalis A. Katsiaris, Liopetri

New Cooperative Credit Society, 12 Philias, Derynia, Tel: 03-824442

New Cooperative Credit Society, Phrenaros, Tel: 03-821450

S.E.D.I.G.E.P., 195 Protaras Ave., Paralimni, Tel: 03-822550

S.E.D.I.G.E.P., Phrenaros, Tel: 03-821114

Solomos Isaak, 18 Stadiou, Paralimni, Tel: 03-821385

Spyros G. Spyrou, 58 Protara, Paralimni, Tel: 03-822077

Achna Cooperative Saving Bank, Dasaki Achnas, Tel: 04-721133

Cooperative Credit Society, 3 Platia Eleftherias, Sotira, Tel: 03-821451

Cooperative Credit Society, Tefkrou Anthia, Ayia Napa, Tel: 03-721980

Cooperative Credit Society, P.O. Box: 2, Liopetri, Tel: 03-942284

Cooperative Credit Society, Augorou, Christakis B. Sotiriou, 34 Anagenniseos, Derynia, Tel: 03-824650

***Lanarca***
Hawaii Greenhouse Ltd., 10-12 Arbishop Kyprianos

Georgios E. Gavrielides, 2 Ephestou, Tel: 04-652483

Georgios Hadjigeorgiou, 4 Demotikis Agoras, Tel: 04-656120

Spyros Stavrinides, 23 Galileou, Tel: 04-655279

Andreas Stylianou, Kiti, Tel: 04-422793

D.I. Soukiouroglou, 30 Michali Vrachimi, Xylophagou, Tel: 04-721041

Demetris Charmantas, Kiti, Tel: 04-422206

Panagiotis Papakyriakou, 17 Anastasi Manoli, Xylophagou, Tel: 04-725376

S.E.D.I.G.E.P. Lysis Ltd., Dromolaxia, Tel: 04-422970

Spyros Stavrinides, 4-5 Theophanous, Xylophagou, Tel: 04-725233

Spyros Stavrinides, Kiti, Tel: 04-422750

Cooperative Credit Society, 15 1st Apriliou, Xylophagou, Tel: 04-725203

Cooperative Credit Society, Kiti, Tel: 04-422133

**Limassol**
Hawaii Greenhouses Ltd., 142 Arch. Makarios Ave., Tel: 05-381153

Papadakis Agrochemical, Gladstonos Court, P.O. Box 24, Tel: 05-364189

Andreas Stavrinides, 111 Athan. Sakellariou, Tel: 05-363391

Andreas Charalamous, 20 Kanari, Tel: 05-354935

"Tamasos" Company, 30 Georgiou Gennadiou, Tel: 05-363262

Theodoros Kourris, 20 Tsianakale, Tel: 05-367761

Cosmas Politakis, 49 Ankyras, Tel: 05-368674

Lakis Geogiades, 154 Irinis

Nicos Mezos, 43 Georgiou Gennadiou, Tel: 05-366241

Nicos Nicolaou, 174 Paphou

Cooperative Carob Marketing Federation Ltd., 18 Kanigos Flat 1, Tel: 05-364622

Spyros Stavrinides Ltd., 24 Georgiou Gennadiou, Tel: 05-362098

Savvas Charilaou, P.O. Box: 281

Anthokipouriki Ltd., 75 Saripolou, P.O. Box: 3294, Tel: 05-366967

Nearchos Papadopoulos, Ypsonas, Tel: 05-393923

**Nicosia**
Elysee Flowers Ltd., 22 Chytron, P.O.Box: 4504, Tel: 02-450816

Hawaii Greenhouses Ltd., 19A, Omirou Ave., Tel: 02-476667

Sherelia Trading Co. Ltd., 65 Gregoriou Afxendiou, P.O. Box: 4208, Tel: 02-458038

Trimithia Farm Ltd., 28 Stasinou Ave., P.O. Box: 1421, Tel: 02-446538

Vepro Co., Ammochostou Ave., P.O. Box: 9541, Tel: 02-435949

A, Papasolomontos & Son, 42 Sophouli, Tel: 02-442292

Androula Ioannou, Akaki

Geochimiki Alevras Ltd., 11 Trikoupi

Georgios Amerikanos, 33 Onasagorou, Tel: 02-466039

Georgios Diakourtis, Astromeritis, Tel: 02-821708

Georgios Kapirtis, GEOFARM, 6C, Theokritou, Tel: 02-464467

Georgios Karaoli, 28 Digeni Akrita

D.I. Soukiouroglou, 1 Trikoupi

D.I. Tsaousis Ltd., 46-48 Phaneromenis, Tel: 02-447192

D.I. Tsaousis Ltd., 2 Omirou Ave., Tel: 02-462254

Evdokia Kleridou, kato Deftera

Th.K. Georgallides Ltd., P.O. Box: 1259, Ay, Omologites Nicosia

Kypros M. Milis, 147 Makarios III Ave., Pano Deftera

Costas Andreou, New Municipal Market, P.O. Box 3672

Michael Costekoglou & Co., 44-46 Granikou, P.O. Box: 1701, Tel: 02-472532

Michael P. Michaelides, 11 Digeni Akrita, Tel: 02-435131

Nicos Demosthenous, Galata

Nicos Kyriakides, 9 Eleftherias, Akaki, Tel: 02-821003

Spyros Stavrinides, Peristerona, Tel: 02-822996

Spyros Stavrinides, Galata

Cooperative Credit Society, 43 Arc. Makarios III, Akaki, Tel: 02-821311

Cooperative Credit Society, Peristerona, Tel: 02-821421

Savvas Phellas, 2B, Pindarou, Tel: 02-476017

Phanos Sophroniou, Akaki

**Paphos**
Alexis Michael & Co., 13 Agoras, Tel: 06-232430

Georgios Paroutis, 7 Andrea Tselepou

Kyriakos Demetriou, 33 Nicolaou Ellina

Loizos Chavouzaris, 18 N. Ellina, Tel: 06-232121, Tlx: 2828

Nikos Poumbouris, 23 Ippokratous, Tel: 06-233067

Patroklos Christou, 31 Agroas, Tel: 06-232396

Petros G. Mavrikios, 8 Andrea Geroudi, Tel: 06-235377

Spyros Stavrinides, 7 Ippokratous, Tel: 06-232659

Cooperative Credit Society, Polis Chrysochou, Tel: 06-321450

**GENETIC RESOURCE (GERM PLASM) BANKS**
CYPARI Genebank, Agricultural Research Institute, P.O. Box: 2016, Nicosia, Tel: 02-305101, Fax: 02-316770

**PLANT & SEED QUARANTINE OFFICES, STATIONS, LABS**
Plant Protection Section, Department of Agriculture, Nicosia, Cyprus, Tel: 02-302254, 02-303225, Tlx: 4660, Fax: 02-445156

Kornos Quarantine Station, c/o Plant Protection Section, Department of Agriculture, Nicosia

Plant Pathology Laboratory, Department of Agriculture, Nicosia, Tel: 02-302273, Tlx: 4660, Fax: 02-445156

**AGENCY WHICH CONTROLS SEED IMPORT & EXPORT**
Ministry of Commerce & Industry, Nicosia, Tel: 02-303441, 02-302846, Tlx: 2283, Fax: 02-366120

Plant Protection Section, Department of Agriculture, Nicosia, Tel: 02-302254, Tlx: 4660, Fax: 02-445156

**SEED TESTING LABS**
Seed Testing Laboratory, Department of Agriculture, Nicosia, Tel: 02-303323, Tlx: 4660, Fax: 02-445156

***REFEREE TESTING* LAB**
Seed Testing Laboratory, Department of Agriculture, Nicosia, Tel: 02-303323, Tlx: 4660, Fax: 02-445156

**SEED HEALTH TESTING LABS**
Plant Pathology Laboratory, Plant Protection Section, Department of Agriculture, Nicosia, Tel: 02-302273, Tlx: 4660, Fax: 02-445156

المركز الدولي للبحوث الزراعية في المناطق الجافة
إيكاردا
ص. ب. 5466 حلب ، سورية

INTERNATIONAL CENTER FOR AGRICULTURAL RESEARCH IN THE DRY AREAS
Box 5466, Aleppo, Syria

ICARDA-023 / 400 / April 1995