SEED UNIT

Annual Report for 1992

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 18 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 focuses its research efforts on areas with a dry summer and where precipitation in winter ranges from 200 to 600 mm. 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, and pasture and forage crops and the associated farming systems.

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 are offered extending from residential courses for groups to advanced research opportunities for individuals. These efforts are supported by seminars, publications, and by specialized information services.

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jointly financed by

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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

To strengthen seed programs in West Asia and North Africa a special project "Development of National Seed Production Capabilities in West Asia and North Africa" is funded by the Governments of the Netherlands and the Federal Republic of Germany. Within ICARDA this special project has the status of a support unit (Seed Unit). The objective of the Unit is to strengthen the national seed production organizations in West Asia and North Africa through: (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 cereals, food legumes and medics for national programs, (4) dissemination of information, and (5) carrying out regional seed technology research.

The present report describes the progress achieved during 1992. Chapter 2 describes the activities aiming at strengthening the infrastructure for seed production. Chapter 3 summarizes the research work carried out, while Chapter 4 discusses the activities that are carried out to develop trained manpower. Chapter 5 describes the seed multiplication activities, and Chapter 6 centers on services carried out by the Unit.

Highlights

During 1992 the Seed Unit: (1) organized one workshop, (2) carried out one consultancy, (3) supervised four M.Sc. students, (4) conducted four roundtable discussions, and (5) conducted three in-country training courses, one long-term group training, three regional train-the-trainer courses, one regional course, one sub-regional course, and two international courses. Highlights of 1992 are:

Network established

- One of the most important developments was the establishment, during a workshop (June 22-25, Amman, Jordan) of a WANA seed network which aims at improving the national seed programs in the region. The network has initiated several activities that will assist national programs in improving their national seed programs.

Train-the-trainer courses

- The national train-the-trainer course is continuing its success in Egypt. The seven trainers of 1990 took again the lead in three 1992 field inspection methodology courses. More than 50 Egyptian seed staff benefitted from this program.

- A new regional approach of train-the-trainer was initiated; few selected regional seed staff were trained in; (a) seed testing techniques and (b) seed health testing and are expected to organize follow-up in-country training courses.

Seed health

- In March a seed health consultant joined the Unit. The consultant will deal with all seed health testing aspects in the Seed Unit.

Infrastructure strengthening

- The Head of the Seed Unit and the Seed Specialist of IAC visited the Republic of Yemen to advice on integration of the seed programs of the Northern and Southern Governorates.

- The Unit is successfully continuing its series of roundtable discussions. Roundtable discussions were conducted on: (1) seed quality control (Yemen, Ethiopia); (2) legume seed production (Egypt); and (3) standards for seed-borne diseases (Egypt).

- A working group has been formed to develop a manual for the production of seed of different food legume crops.

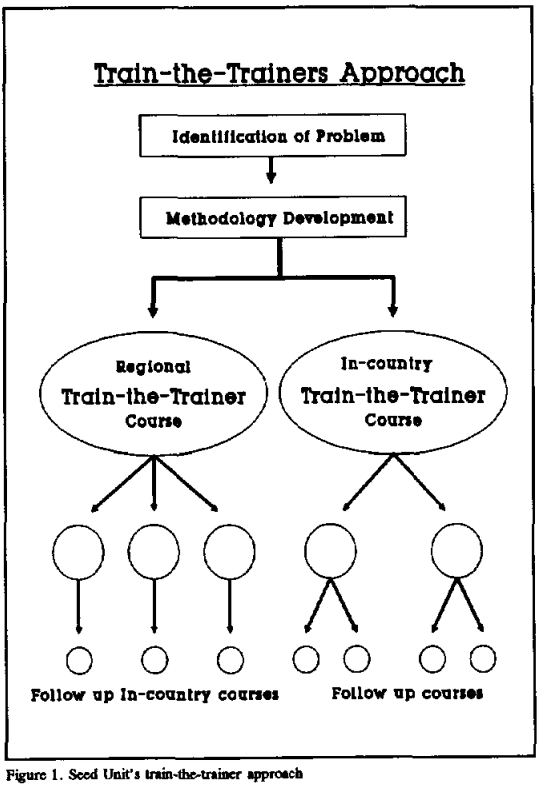

Figure 1. Seed Unit's train-the-trainer approach

M.Sc. students

- The Senior Research Assistant in the Unit obtained an M.Sc. degree at the Cukorova University, Adana, Turkey in June, 1992. The study investigated the presence, extent and cause for fumigant resistance in *Rhizopertha dominica* in seed storage facilities in Syria. Furthermore, three M.Sc. students are carrying out M.Sc. research with the Unit.

Courses

- Two international courses were successfully organized. The first course aimed at improving the ability of seed sector staff to evaluate agronomic performance (VCU) and to test distinctness, uniformity and stability (DUS) of new varieties. The second course was an international seed production course, organized by CIHEAM in collaboration with ICARDA.

- A seed processing course was exclusively attended by directors of seed processing plants in Egypt and funded by the Egyptian GTZ Seed Project. The course was an in-country course organized at ICARDA headquarter. This course is an example of how the national programs can use facilities built up at ICARDA.

Pre-release multiplication

- A pre-release multiplication was planted in Syria at the farm of the General Organization for Seed Multiplication (GOSM) using promising cereal lines.

2. STRENGTHENING SEED PRODUCTION INFRASTRUCTURE

Many countries in the region still have weak seed production infrastructure. In 1992, the Unit has contributed to the buildup of seed program infrastructure through: (1) establishing a WANA seed network, (2) conducting roundtable discussions, (3) assistance in seed health testing aspects, (4) preparing morphological variety descriptions, and (5) other activities.

2.1. WANA Seed Network

The Seed Network Workshop took place from June 22-25, 1992 in Amman, Jordan. In addition to a number of resource persons, twenty senior seed program managers from the following countries participated: Iraq, Cyprus, Turkey, Syria, Egypt, Jordan, Sudan, Algeria, Cyprus, Libya, Yemen and Morocco. The workshop was jointly financed by ICARDA and GTZ/-Jordan Seed Multiplication Project.

RECOMMENDATIONS

1) **A WANA Seed Network should be established**
2) **The WANA Seed Network should be coordinated by a WANA Seed Council**
3) **The WANA Seed Council should have representation from the majority of the WANA region countries.**
4) **The WANA Seed Council should be run by a Steering Committee**
5) **The Steering Committee should be composed of representatives from five different countries.**
6) **The Secretariat of the WANA Seed Council should initially be at ICARDA.**

The workshop was aiming at initiating a seed network in the region. Networking will help to team up groups of seed experts to tackle mutual problems to achieve common goals. During the workshop the following issues were discussed:

- Is there a need for a seed network in the WANA region?
- How should the network operate?
- What activities should the network undertake?
- Which countries could take the lead in which activities?

The most important recommendations of the workshop are presented in the text box on this page. The activities that the network will carry out and the countries which will take the lead are as follows:

Activities considered important	Lead countries
Regional referee testing, including seed health	Morocco
WANA seed newsletter	Secretariat
WANA seed directory	Egypt (Turkey)
Graduate study in seed science	Jordan (Iraq, Lebanon, Algeria)
WANA variety catalogue	Morocco
Standardized seed certification procedures	Turkey (Egypt, Morocco, Lebanon)
Catalogue of seed standards WANA countries	Syria (ICARDA)
Help develop uniform national seed policy	Sudan
Seed movement across national borders	Egypt (Lebanon)
Develop regional between-country seed trade	Sudan
Exchange information on programs etc	Yemen
Exchange information on weed seed	Cyprus (Yemen)
Develop and share technical publications	Algeria (Egypt, Sudan)
Studies of seed industry costs and economic benefits	Egypt, Algeria

ICARDA's Deputy Director General (Research) has approved the establishment of the WANA seed network and countries have started to implement the activities in which they would take the lead. Several activities (WANA seed directory, WANA referee testing system, WANA catalogue of seed standards, and WANA seed newsletter) have been initiated.
To further discuss activities and future prospects the Steering Committee of the network, consisting of Egypt, Iraq, Morocco, Sudan and Turkey, will meet in Egypt from January 19-21, 1993.

2.2. Consultancies

Evaluation of the seed program of Yemen
The Director of the Seed Program of the Ministry of Agriculture and Water Resources of Yemen requested ICARDA's Seed Unit to advise on different aspects of the seed

in the Republic of Yemen. The Head of the Seed Unit and the Seed Specialist of the International Agricultural Centre in Wageningen, the Netherlands visited the Republic of Yemen. The team addressed several issues of the seed program of Yemen such as: (1) integration of the seed programs of the Northern and Southern Governorates, (2) seed quality control and appropriate seed and field standards, (3) seed production practices, (4) seed marketing and distribution, and (5) training for seed sector personnel. The final report describes a proposal to set up a seed production system consisting of independent seed units that supply the whole country with quality seed.

2.3. Roundtable Discussions

Roundtable discussions are meetings with a few subject matter specialists; they emphasize one aspect of the seed program. The roundtable makes recommendations and initiates implementation. They have shown to be effective in improving seed production infrastructure. During 1992 several roundtable discussions have been conducted.

Seed quality control, Yemen

The objective of the meeting was to discuss the Yemen seed quality control system, to identify constraints, and to make recommendations to remove the constraints. The meeting recommended that a working group be established to: (1) propose realistic field standards for crops grown in Yemen, (2) propose a reliable and uniform field inspection methodology (field inspection handbook). The working group should also look into the possibility to produce larger amounts of Breeder Seed for further multiplication.

Seed quality control, Ethiopia

With participation of Ethiopian Seed Corporation (ESC), Institute of Agricultural Research (IAR), Ministry of Agriculture, Ministry of State Farms, Pioneer's Seed Company (Ethiopia Branch), ILCA and FAO a roundtable discussion was held to discuss the most appropriate seed quality control system for Ethiopia. The roundtable discussion was held on September 9, 1992. The meeting was particularly significant, because Ethiopia is at present, with the help of the World Bank, strengthening its seed program.

A low-key quality control system was proposed based on the FAO Quality Declared Seed system. This system makes use of resources already available in seed production organizations and was designed to provide a quality control system that is less demanding on government resources but is adequate to provide good quality seed. The system leaves the responsibility for the quality with the producer, while the government only checks a very limited part of seed production activities of the seed producers.

Standards for seed-borne diseases, Egypt

A roundtable discussion on standards for seed-borne diseases in field inspection and seed-borne pathogens in laboratory seed health testing and on seed treatment took place on December 1, 1992. The present standards were briefly discussed and it was agreed that they needed to be revised. New standards have been proposed for field inspection and for laboratory seed testing.

Legume seed production, Egypt

The objective of the roundtable was to discuss the improvement of the legume seed production program of Egypt with the different organizations involved in the agricultural

sector. In the first roundtable discussion on this topic a comprehensive set of recommendations had been prepared and it was decided to start implementing the recommendation that stated "Detailed guidelines covering all aspects of seed production for each variety of all legume crops should be developed". A first draft is prepared and will be discussed in the next session of the roundtable (January 1993).

2.4. Seed Health Activities

In March a Seed Health Consultant joined the Unit for a period of six months. The consultant will deal with all seed health testing aspects in the Seed Unit such as: (1) upgrading seed health testing stations in the region, (2) preparing a comprehensive training manual for seed health testing, (3) conducting seed health testing courses and supervising individual trainees/students. The seed health consultant has been actively involved in training and has: (1) conducted the regional train-the-trainer course in seed health testing, (2) participated in the legume seed production course, the seed certification course, the seed processing course, the regional train-the-trainer course on seed testing techniques, and the international seed production course organized by CIHEAM.
Furthermore, (a) one of the M.Sc. students of the Unit is supervised by the seed health consultant, (b) a roundtable on seed standards has been conducted, (c) contributions for the Manual on Legume Seed Production have been prepared, and (d) a start has been made with the manual on seed health testing. The consultant also visited a number of countries in the region to discuss and propose strengthening seed health laboratories.

3. RESEARCH

During 1992 the Unit has been carrying out a number of small research projects as a service to the commodity programs. Moreover, the research on seed vigor has continued and three M.Sc. students are working on different seed technology topics.

3.1. Testing of a Laboratory De-awner to Thresh Medic Pods

To investigate the efficiency of a de-awner to thresh pods of *Medicago*, 250 grams of pods of *Medicago rigidula* (accession number 1919) were de-awned for different periods of time (5, 10, 15, 20, 25 and 30 minutes) using a laboratory de-awner; as control a 250-gram sample was hand threshed. The weights and percentages of clean seed were determined after the de-awned samples were cleaned by an aspirator.
Hand threshing, carried out until all pods were threshed, resulted in 86.9 g of clean seed i.e. 34.8% of the total weight of the sample (Table 1). De-awning period, ranging from 5 to 30 minutes, resulted in percentages of clean seed between 25.3 (5 minutes de-awning) and 32.7 (30 minutes de-awning). The maximum weight of clean seed (82.8 g) was obtained after 25 minutes of de-awning (33.1% of clean seed); 20 minutes de-awning produced only marginally less clean seed (82.4 g i.e. 33.0%). If amounts of clean seed are compared with that obtained in the hand threshed sample, 20 to 25 minutes of de-awning resulted in an efficiency of 95%.

Table 1. The relation between de-awning period and percentage of clean seed obtained in *Medicago*

Sample no	De-awning period (min)	Clean seed (g)	Total weight (%)	Clean seed hand threshed sample (%)
Hand threshing	86.9	34.8	100.0	
1	5	63.2	25.3	72.7
2	10	75.0	30.0	86.3
3	15	79.0	31.6	90.9
4	20	82.4	33.0	94.8
5	25	82.8	33.1	95.3
6	30	81.7	32.7	94.0

Conclusion: medic seed can successfully be threshed using a laboratory de-awner. Twenty minutes of de-awning leads to almost 95% of the pods being threshed as compared with a hand-threshed sample. Longer de-awing periods are not advised because they may lead to damage of the seed.

3.2. Off-types in Multiplication of the Barley Variety Rihane-03

During regular seed multiplication the six-row barley variety Rihane-03 always had a rather large number of two-row off-types, even after careful application of the generation system and proper seed multiplication procedures. An experiment was carried out to detect the source of these impurities.

In the 1991/92 season at ICARDA's research farm, an experiment was planted with Rihane-03 seed from five different sources: (1) Rihane-03 seed from the Barley Group (CP, ICARDA) and (2) Rihane-03 seed obtained from Terbol station of ICARDA in Lebanon. The other three sources originated from seed harvested in the previous season on: (1) plants grown in the center of a square two hectares Rihane-03 multiplication plot, which was surrounded by two-row barley varieties, (2) plants grown in the border row of the Rihane-03 multiplication field next to the two-row variety Harmal, and (3) plants grown in the border row of the Rihane-03 multiplication field next to the two-row variety WI 2291. As a check for barley volunteers, a wheat variety (Lahn) was planted. Between flowering and maturity plots were inspected several times; the number of off-types (two-row barley plants) in each plot was recorded.

The 'Barley Group' seed lot and the 'Terbol' seed lot had clearly different numbers of off-type plants, i.e 0.25% and 0.02% respectively (Table 2). The plants grown from seed harvested from the borders had off-type percentages of 0.17%, while the seed harvested from the middle of the Rihane-03 seed multiplication plot had considerably less off-types (0.04%). The Lahn check plot did not show any off-types.

The results show that the off-types in Rihane-03 can not be explained by volunteers, because not a single barley plant was found in the Lahn check plot. A large proportion of the off-types in seed lots can be explained by out-crossing, because seed harvested from the middle of seed multiplication plots is much purer than seed harvested from the borders. This underlines the importance of ensuring that seed multiplication of Rihane-03 is carried out under adequate spacial isolation. The usual recommendation of one to three meter between two seed plots for self-fertilizing cereal crops should be adjusted for the variety Rihane-03. More research is needed, but a minimum of five meter should be used and seed should not be harvested from the first two or three meter borders.

The differences in genetic purity between the two seed lots of Rihane-03 can probably also be explained by differences in out-crossing percentages. The 'Barley Group' seed lot, which has much higher percentages of off-types than the seed that originated from ICARDA's Terbol research station in Lebanon, is probably produced in a 'barley-rich environment' while the 'Terbol' seed lot is produced under low foreign pollen pressure.

Table 2. Two-row barley plants in Rihane-03

Seed source	Percentage off-types
Lahn (check)	0.0
Barley Group	0.25
Terbol	0.02
Middle of plot	0.04
Next to Harmal	0.17
Next to WI 2291	0.17

3.3. Seed Vigor Experiments

In WANA rainfall is often very unreliable and large differences in environmental conditions exist from location to location and from year to year. Very often crops are grown under harsh conditions and this will have an influence on the different quality aspects of the seed. Experiments have been carried out in wheat to assess the extent of crop management (water and nitrogen) on: (1) seed size, (2) germination, (3) seed vigor, (4) field emergence, (5) yielding capacity in the next season, and (6) storability.

Experimental setup: In 1988/89 and 1989/90 FRMP had carried out line source sprinkler irrigation experiments. Two wheat varieties (Cham 1 and Cham 4), which were grown under six water levels (I_0, rainfed; I_1 up to I_5, 20% of water balance up to 100% of water balance) and four nitrogen levels (F_0, 0 kg/ha; F_1, 50 kg/ha; F_2, 100 kg/ha; and F_3, 150 kg/ha), were studied. Part of the seeds harvested were used for storage experiments. In 1989/90 seeds were planted at three different locations (Experiment 1, 2 and 3) and in the 1990/91 season again three experiments were planted (Experiment 4, 5 and 6). The results on seed size,

germination, seed vigor and yield have been reported in the 1991 Annual Report of the Unit. This report presents the results on storability and field emergence.

Crop management and storability of wheat seed

To study the influence of different crop managements (water and nitrogen) seed harvested from the 1988/89 line source experiment were stored under ambient conditions in the laboratory and germination was assessed at regular intervals. Two varieties were studied i.e. Cham 1 and Cham 4. The results are presented in Table 3 (different water levels) and Table 4 (different nitrogen levels).

Influence of water: Table 3 shows that the average germination percentage of Cham 4 and Cham 1 were reduced from 96.7 to 92.6 and from 92.7 to 87.7, respectively. The statistical analysis indicated further:

- No significant effect of the amount of water received (I_0 to I_5) during the growing season on the storability of the seed. In other words, seed grown under rainfed conditions stored as good as seed grown under irrigation.

- A clear variety effect i.e. germination after 34 months of storage is clearly lower in Cham 1 than in Cham 4.

- A clear storage effect i.e. storage reduces germination.

Table 3. Influence of different water levels (rainfed, I_0: 20% of water balance up to 100% of water balance, I_1 up to I_5) on storability (germination percentages after 6 months and 34 months)

Months after harvest	Water levels						
	I_0	I_1	I_2	I_3	I_4	I_5	average
Cham 4							
6	98.3	95.5	96.8	95.3	97.5	96.8	96.7
34	92.3	93.0	94.0	94.3	91.8	91.5	92.6
Cham 1							
6	95.3	92.5	93.3	92.0	92.8	91.3	92.7
34	83.5	90.3	90.3	88.5	86.3	87.3	87.7

Influence of nitrogen: Table 4 shows the effect of different nitrogen levels on the storability. The results can be summarized as follows:

- No significant effect of the amount of fertilizer received during the growing season on the storability of the seed.

- A clear variety effect i.e. germination after 34 months of storage is clearly lower in Cham 3 than in Cham 4.

- A clear storage effect i.e. storage reduces germination.

Table 4. Influence of different nitrogen levels (0 kg/ha, F_0; 50 kg/ha, F_1; 100 kg/ha, F_2; and 150 kg/ha, F_3) on storability (germination percentages after 6 months and 34 months)

Months after harvest	Nitrogen levels				
	F_0	F_1	F_2	F_3	Average
Cham 4					
6	97.2	95.8	96.0	97.7	96.7
34	89.2	94.0	92.2	95.2	92.6
Cham 1					
6	93.3	95.5	91.7	90.8	92.7
34	87.5	88.8	87.4	86.5	87.7

Crop management and field emergence

Vigor was measured as: (1) the average length of seedlings in laboratory tests (results have been reported in the Annual Report of 1991), and (2) the percentage of seed emerging in field experiments (results reported below).

Table 5. Relation between water level and field emergence (%) in wheat

Water level	Location					
	1	2	3	4	5	6
I_0	90.0	83.3	71.7	100.3	106.5	56.7
I_1	89.0	83.0	72.7	95.5	101.3	60.7
I_2	84.7	84.5	69.0	81.8	87.7	50.3
I_3	83.5	83.7	70.0	88.0	94.8	51.3
I_4	81.0	80.2	69.8	89.0	79.0	53.3
I_5	85.7	79.0	72.0	70.0	65.3	48.8

Table 5 presents the averages of the emergence percentages for the different water levels for the six different experiments. The results demonstrate that the plots that received 100% of

the water balance (I,) had the lowest percentages of seed emerging or in other words the lowest vigor. This confirms the results reported in earlier experiments i.e. seed grown under harsh conditions have a better vigor.

3.4. The Effect of Plant Spacing on Seed Quality and Yield of Chickpea

Improved seeds of new varieties released from research programs should be made available as quickly as possible to farmers. Unfortunately, the amount of Breeder Seed is always small and has to be multiplied through a generation system. During multiplication agronomic practices should be employed to ensure fast, efficient and economic seed production. Seed rate and row spacing are important management practices in seed multiplication for rapid increase. The objective of the present study was to investigate the effect of intra- and inter-row spacing of chickpea on the multiplication rate and other seed quality aspects.

Two chickpea cultivars (Ghab 1 and Ghab 2) with different growth habit were utilized to better understand the basis for optimum yield per unit of available seed. Preliminary results indicate an increase of the multiplication factor with increased spacing. Plant spacing at 10 and 15 cm gave 80% and 120% more yield per unit of seed than at 5 cm. The multiplication factor (MF) was significant between varieties and plant spacing, but not with row spacing. The multiplication factor of Ghab 1 and Ghab 2 was 18 and 15 respectively. The multiplication factor increased with increased plant spacing and factors of 10, 18 and 22 were obtained at 5, 10 and 15 cm respectively.

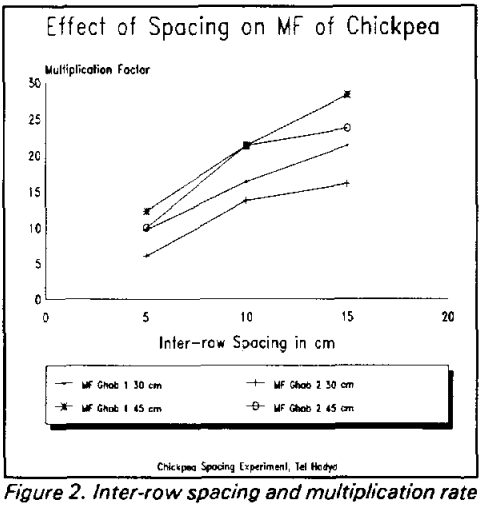

Figure 2. Inter-row spacing and multiplication rate in chickpea

Seed weight, germination and vigor were similar between row and plant spacings, but appeared to be influenced by variety.

3.5. Removal of *Orobanche* Seeds from Lentil Seed Lots by a Seed Cleaning Machine (research carried out by Dr. K.H. Linke)

Lentil seed, heavily infested by *Orobanche crenata*, was cleaned by an air-screen cleaner and 100 gram samples were taken at eight different stages of the cleaning process (Table 6). Samples were analyzed for *Orobanche* seeds using a technique developed for the recovery of *Orobanche* seed from soil samples.

The initial raw material and the final clean seed was analyzed in five replicates; for other stages only one replicate was used. The raw material taken from the combine had 136,610 *Orobanche* seeds/kg. The end product (clean lentil seed) contained only 6 seeds/kg. This demonstrates that:

- Cleaning of lentil seed by means of an air-screen cleaner reduces the infestation of the crop to almost zero, even in a highly infested seed lot. A second cleaning procedure would ensure clean seed material.

- The air system of the air-screen cleaner is responsible for the removal of the majority of the *Orobanche* seeds.

Table 6. Orobanche seeds in different fractions of an air-screen cleaner (Crop: lentil)

Fraction	Weight of material	*Orobanche* seeds/kg
Combine	903.5	136,610
Pre-aspiration	48.0	235,296
Waste bottom screen	60.0	54,000
Waste tail aspiration	9.0	260,400
Waste gravity separator*	8.0	50
Waste top screen	1.5	44,960
Waste gravity separator**	27.0	5,250
Cleaned lentil seed	740.0	6

* heavy material; ** light material

4. TRAINING

Training is still one of the major activities of the Unit, and the Unit has continued exploring new approaches. The new approaches initiated in 1992 were: (1) international courses with participation of self-funded students, (2) regional train-the-trainer courses, and (3) the use of ICARDA's facilities by national seed programs. An overview of the courses held during 1992 can be found in Table 7 and 8. Ten training courses have been organized and eight individual trainees came to ICARDA.

Since the initiation of the training program (mid-1985) an average of 90 seed staff from the WANA region has annually been trained. The surge in the number of staff trained in 1991 and 1992 can mainly be attributed to the train-the-trainer activities, which were initiated in 1990.

The Unit is also emphasizing graduate training and one M.Sc. student completed his work, while three M.Sc. students are working on seed technology research topics with the Unit.

Table 7. Training courses of Seed Unit

Name	Location	Date	No of participants
A. In-country Train-the-Trainer Course			
Wheat field inspection	Sids, Egypt	11/04 - 15/04	10
methodology	Sakha, Egypt		9
	Ismalia, Egypt		9
B. Regional Train-the-Trainers Courses			
Seed testing techniques	Amman, Jordan	18/10 - 29/10	10
Seed health testing	Amman, Jordan	18/10 - 29/10	8
C. International Courses			
International variety testing	Rabat, Morocco	11/05 - 29/05	15
Production de semences	Algers, Algeria	07/11 - 25/11	(31)
D. Regional Courses			
Seed certification	Amman, Jordan	26/04 - 05/05	22
E. Sub-regional Course			
Legume seed production	Cairo, Egypt	18/04 - 19/04	21
F. In-country Courses			
Seed quality control	Dhamar, Yemen	01/02 - 13/02	20
Seed processing & storage	Aleppo, Syria	15/06 - 25/06	12
Seed certification	Addis, Ethiopia	02/09 - 09/09	26
G. Individual Trainees	**Countries**		
General seed production	Syria, Yemen	03/04 - 18/06	3
Legume seed production	Syria, Turkey	10/06 - 28/06	4
Seed processing	China	17/11 - 19/11	1

4.1. M.Sc. Students

M.Sc. thesis: Phosphine resistance in Rhizopertha dominica

Because little information is available on phosphine resistance levels of storage insect pests in Syria and neighboring countries, the objective of this study was to investigate the presence, extent and cause for fumigant resistance in *Rhizopertha dominica*. Moreover, the study provided insight into the effects of poor fumigation practices on the buildup of resistance against a commonly used fumigant (phosphine). Seed stores, grain stores, open area stores, silos, grain mills, and seed processing plants in and around Aleppo were sampled and the resistance of the insects assessed. The results, which have been presented in an M.Sc. thesis at the Cukorova University, Adana, Turkey in March 1992, can be summarized as follows:

- Very clear differences, with regard to susceptibility to the fumigant Phostoxin, exist between strains from different locations in Northern Syria.

- Some strains are very resistant

The study provided valuable information with regard to resistance versus susceptibility in Northern Syria. It also shows the presence of resistance to phostoxin.

Table 8. Seed production staff of different organizations trained in seed courses of ICARDA

Organization	Number trained					
	1985-1987	1988	1989	1990	1991	1992
NARCs	21	22	27	35	39	44
IARCs	3	1	2	1	1	1
NSPOs		67	74	53	61	91122
SCs	4	1			1	2
Total	95	97	83	97	132	169

NARC= National Agricultural Research Center: IARC= International Agricultural Research Center; NSPO= National Seed Production Organization; SC= Seed Company.

Quality of seed used by farmers in Jordan

Two M.Sc. students from the University of Jordan study the quality of wheat seed used by farmers in Jordan. Until now no study was done to evaluate the quality of wheat seed used for planting, nor is information available where farmers obtain seed for planting. The objectives of this study are:

- Estimate the percentage of farmers in Jordan that use a) own-saved seed, b) other farmers' seed, and (c) Certified Seed for planting a wheat crop.
- Estimate the introduction rate of new varieties and the extent to which farmers are using traditional varieties.
- Evaluate the seed purity, germination, 1000-grain weight of seed used for planting.
- Compare the quality of the different seed sources that farmers use to plant a wheat crop.
- Assess farmers' appreciation of Certified Seed.
- Identify seed quality problems experienced by the farmers.

A seed survey (including a questionnaire) was carried out and more than 400 samples of wheat seed have been collected. One student studies purity (genetic and physical) and germination aspects, while the second student will assess the seed health status of the different samples.

Supervision of students is carried out jointly by University of Jordan staff and Seed Unit staff. Students are financially supported through the Jordan/German seed multiplication project.

Seed vigor in legumes

The third student will carry out his research work on seed vigor in lentil at ICARDA's research farm. The student arrived mid-December and is funded through ICARDA's GRTP program.

4.2. Train-the-Trainer Courses

Two types of train-the-trainer course have been carried out in 1992. Firstly, the national train-the-trainer course, whereby six trainers -trained in 1990- conducted three follow-up courses in 1992, and secondly the two regional train-the-trainer courses.

The main objective of the regional train-the-trainer courses was to train a few selected senior seed officers to acquire theoretical and practical knowledge to enable them to conduct similar type of in-country courses in their home countries.

In October 1992 two train-the-trainer courses have been conducted; one in seed testing techniques and one in seed health testing. The courses were funded jointly by GTZ (Jordan/ German seed multiplication project) and ICARDA's Seed Unit. The UoJ provided laboratory facilities and transportation during the course. The two courses were run at the same time (October 18-29, 1992), which was time- and cost effective and helped to add a variety of lectures to both courses.

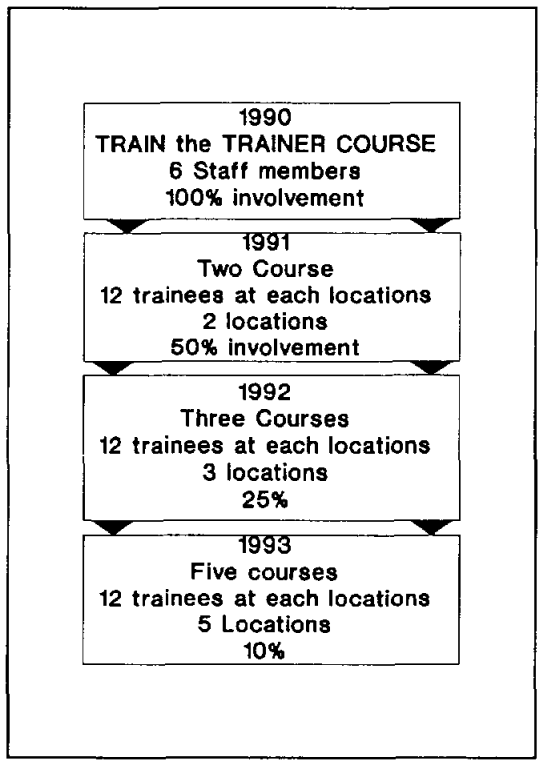

Figure 3. National train-the-trainer approach

National train-the-trainer course follow-up, Egypt (Fig. 3)

The wheat field inspection methodology courses were organized in cooperation with the CAS, ARC, GTZ, and NARP Seed Component as a follow-up of the train-the-trainer course conducted in 1990. The courses were conducted at the same time in three locations: Ismailya, Sakha and Sids. The objective was to train a large group of the national seed quality control staff in field inspection methodology. The seven trainers of 1990 took the lead in course organization and program coordination and were fully responsible to draw up the program and to carry out lectures and practicals. Compared to last year there was minimum input

from CAS, ARC, GTZ, NARP and ICARDA staff. This year a total of 28 participants from nine governorates attended the course, which brings the total number of trainees who benefitted from the course to 50 since the start of the program. In 1993 this course will be carried out at five locations.

Regional train-the-trainer course on seed testing techniques, Jordan

The objective of the regional train-the-trainer course on seed testing techniques was to train a few senior seed quality control officers to acquire theoretical and practical seed testing knowledge, which would enable them to conduct similar courses in their home countries. The course was attended by a total of 10 participants from the WANA region. Two participants each from Algeria, Egypt, Jordan, Sudan and Yemen.

Lectures covered various aspects of seed quality and related topics. Recent developments and concepts in seed quality control as well as organization and management of seed testing were covered in detail.

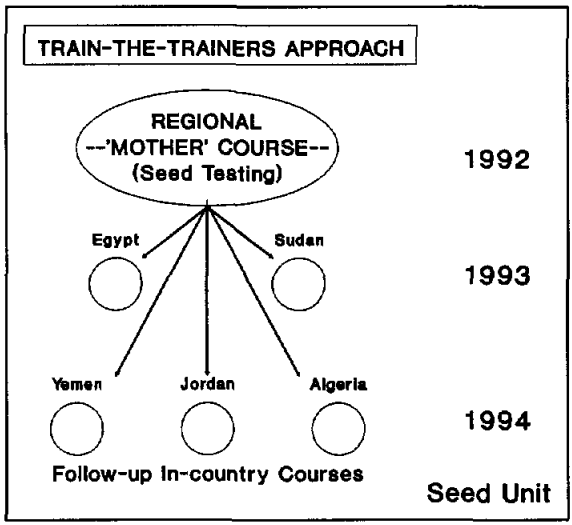

Figure 4. Regional train-the-trainer; seed testing

During the course participants were asked to prepare the program for their in-country follow-up courses and to indicate the date and the assistance required from ICARDA. Each program was presented to the group and all countries agreed to carry out the follow-up seed testing courses in 1993 (Egypt, Sudan), 1994 (Algeria, Jordan, Yemen) (Fig. 5). The trainers will deliver the majority of lectures and practicals with assistance from national staff from seed program, agricultural research, or university.

Regional train-the-trainer course on seed health testing, Jordan

The second regional train-the-trainer course, on seed health testing, was also conducted from October 18-29, 1992 in Amman, Jordan and aimed at training participants in basic methods of detection, isolation and identification of seed-borne pathogens, particularly fungi. The course was attended by a total of eight participants ; two each from Egypt, Ethiopia, Jordan and one each from Morocco and Turkey attended the seed health testing course.

Like in the seed testing course the participants were asked: (1) to prepare the program for their in-country follow-up courses, (2) to indicate the date and the assistance required from ICARDA, and (3) to present the program to the group. The seed health train-the-trainer course will result in four follow-up in-country courses in Egypt, Ethiopia, Jordan and Morocco (Fig. 5)

4.3. International Courses

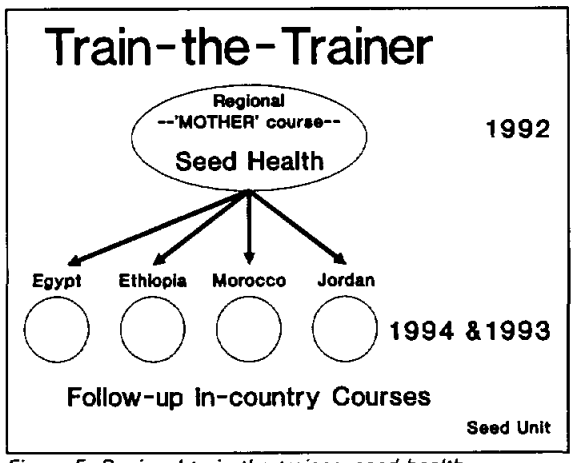

Figure 5. Regional train-the-trainer; seed health

Variety testing, Morocco

This international course was organized in cooperation with the International Agricultural Center (IAC, the Netherlands), and the Service du Contrôle des Semences et des Plantes (Morocco) and aimed at improving the ability of seed sector staff to evaluate agronomic performance and to test distinctness, uniformity and stability. Morocco had been chosen as the venue because of its strong seed program in general, and its well-developed variety research and seed quality control in particular. Participants from Egypt (1), Jordan (2), Kenya (2), Morocco (4), Sudan (1), Syria (1), Tanzania (2), and Zambia (2) participated in the course. Of the 15 participants 11 were sponsored by other organizations such as GTZ, FAO, SIDA and DGIS.

Seed production, Algeria

The International Center for Advanced Mediterranean Studies (CIHEAM) and the Ministry of Agriculture in Algeria, in collaboration with ICARDA and UPOV organized a three week's international course on seed production in Alger from November 1 - 25, 1992. The course was attended by 31 participants from the following countries: Algeria (15), Egypt (2), Lebanon (2), Morocco (2), Portugal (1) Spain (2), Tunisia (2), Turkey (4). From ICARDA, the senior research assistant in the Seed Unit participated. A large number of lecturers from Europe (France, Spain, the Netherlands, Switzerland) and the region (Tunisia, Morocco and Algeria) lectured to the participants. Lecturers came from government institutions, private seed companies (both horticultural and agricultural companies), quality control services, and international organizations (ICARDA, UPOV, FIS).

4.4. Regional and Sub-regional Courses

Legume seed production, Egypt

The sub-regional legume seed production course was conducted from April 18-29, 1992 in Cairo and Sakha, Egypt for participants from Nile Valley countries. The course was organized in close cooperation with ARC, CAS, GTZ and ICARDA (NVRP, LP and Seed Unit). The course was designed to give highlights on variety development, evaluation, release, description and maintenance as well as seed production, processing, storage and quality control of food legume crops. Emphasis was given to crop management and identification and detection of seed-borne diseases of economic importance during seed field inspection and laboratory seed health testing. A total of 21 participants from three countries attended the course: 11 from Egypt, seven from Ethiopia and three from the Sudan.

Seed certification, Jordan

The regional seed certification course was conducted from April 26 to May 5, 1992. The course was organized in cooperation with University of Jordan (UoJ), GTZ/Jordan Seed Project and the Seed Unit of ICARDA. The main objective of the course was to train participants in seed certification procedures to ensure the genetic purity and varietal identity of seeds during the seed multiplication phase. The course focused on uniform and reliable field inspection methods to assess seed quality. A total of 22 trainees from 11 countries attended the course: 1 each from Lebanon, Qatar, Sudan, Syria, Turkey and Uganda; 2 each from Algeria, Egypt, Iraq and Yemen and 8 from Jordan.

4.5. In-country Courses

Seed quality control, Yemen

The in-country seed quality control course was conducted from February 2-13, 1992 in Dhamar and Seiyun branches of the National Seed Center (NSC), Yemen. The course was organized in close cooperation with NSC and was sponsored by the EC Seed Project and the Seed unit of ICARDA. The objective of the course was to train participants in seed quality control measures to ensure quality of improved seeds distributed to farmers. The course focused on different aspects of control procedures with emphasis on field inspection for varietal certification and laboratory testing. Lectures and practicals covered various aspects of seed quality and related topics. Twenty participants representing different institutes from the national program attended the course: 16 from NSC (SMP and NSMC); 1 from Potato Seed Project; 2 from research (AREA); and 1 from MoA regional office.

Seed processing, ICARDA, Syria

The seed processing and storage course was organized exclusively for participants from Egypt. The course was organized at ICARDA headquarter on the request of the Central Administration for Seeds (CAS) and GTZ Seed Improvement Project in Egypt. This is a good example where a national program/project benefits from facilities built up at ICARDA.

The course with emphasis on design, operation and management gave an overview of seed processing and storage activities for efficient and effective use of cleaning capacity consistent with high seed quality. In addition a number of seed processing and storage related topics and laboratory testing methods to determine seed quality were also discussed. A total of 12 participants: 11 from Egypt and 1 from Ethiopia participated in the course. The participants are directors of seed plants in various governorates and are responsible for seed production, processing, storage and distribution activities of the national program. ICARDA's contribution to this course was limited to the provision of training facilities and materials for the course. This indicates the recognition and confidence on the activities of Seed Unit of ICARDA by the national seed program

Seed certification, Ethiopia

The in-country seed certification course was conducted from 2-9 September 1992 in the premises of the Ethiopian Seed Corporation (ESC) in Addis Ababa, Ethiopia. The course was organized by the ESC and the Seed Unit of ICARDA and financially supported by the FAO of the United Nations. The main objective of the course was to train participants in seed certification procedures to ensure high standards of quality during the seed multiplication phase. Different field inspection procedures followed by different certification schemes were presented, discussed and compared. Furthermore, participants were exposed to various

quality control systems operating in different parts of the world and other certification related topics. During the course several field trips were made (ESC basic seed farms, IAR research stations and the Herbage Seed Unit at ILCA). The course was attended by a total of 26 trainees from 6 organizations: 15 from ESC; 3 from MSFCTD (contract seed growers); 2 from IAR; 4 from MoA (extension); and 1 each from PGRC-E (conservation) and ESA (standardization).

4.6. Long-term Group Training

In 1991/92 a long-term group training course on seed production was organized for a period of four months at ICARDA. The course was designed to familiarize staff with the seed industry of cereals and legumes crops. It focused on the principles and procedures to produce high quality seed of these crops. Three participants, 1 from Syria and 2 from Yemen attended the course.
Lectures were followed by practicals in the field or in the laboratory to integrate theory with practical knowledge. During the first month the training was coordinated with the Cereal Program to have a general background on variety development and field experimentation. The trainees were exposed to different aspects of the seed programs and other related disciplines. After the first month the lectures and practicals were focused on seed production, seed certification, seed processing and storage, seed testing, and variety description. In addition the trainees were assigned to work on research projects where small experiments were conducted in the seed processing and/or testing laboratories. The results were summarized in a write-up and were presented to the group.

5. SEED MULTIPLICATION

5.1. Pre-release Multiplication

In 1990, jointly with the General Organization for Seed Multiplication (GOSM) in Syria, a pre-release multiplication was carried out using three promising varieties: Lahn (durum wheat), Nesser (bread wheat) and Rihane 03 (barley). In 1991, Nesser was released as Cham 6 and because of the pre-release multiplication some seed was available for further multiplication and release to farmers. In 1992/93 another pre-release multiplication has been initiated with the GOSM using the promising lines Arta (barley), Omrabi (durum wheat) and Gomam (bread wheat); one hectare of each of these promising lines has been planted at the farm of the GOSM.

5.2. Production, Processing and Distribution

The Unit is multiplying seed of varieties which have shown to be promising in one or more countries of the ICARDA region. The multiplication is meant to give such varieties an early start in the countries of the region; in case such varieties are released, some seed is available. At the same time the national program should start building up its Certified Seed supply. Furthermore, the seed is often used for research purposes (verification experiments etc.) and sometimes sent to countries in case of crop failure. Seed production is a national

responsibility and the project tries to stimulate seed production in the countries of the ICARDA region. The seed production fields and the seed processing plant also play an important role in the training activities of the Unit. The production of seed should be seen in this light.

Production and processing

The quantities of Breeder Seed, Pre-basic Seed, Basic Seed, Certified Seed, and Quality Seed produced in 1992 are indicated in Table 9. In total, 64.2 tonnes of seed was produced. Breeder Seed (160 kg) and Pre-basic Seed (3.7 t) was produced of 4 and 19 varieties respectively. A total of 21.6, 17.8 and 21.0 tonnes of Basic Seed, Certified Seed and Quality Seed respectively was produced for distribution to seed and research organizations in the countries of the region. Table 9 shows the distribution over the different crops; more than 75% of the seed is wheat and barley, while 23% is legume seed. In addition a very small amount of medic seed (76 kg) and vetch seed (300 kg) was produced. The production of small amounts of vetch seed is a new activity and was initiated in the 1991/92 season.

Distribution

Table 10 presents the data on distribution of seed. Not only the seed produced during this season, but also carry-over seed of last year is included in the table.

Table 9. Quantity (in kg) of seed harvested per multiplication category; figures include wheat, barley, chickpea, lentil and medic

Category	Crops						Total
	Wheat	Barley	Chickpea	Lentil	Medic	Vetch	
Breeder	80	80					160
Pre-Basic	1 520	1 350	710	16	76		3 672
Basic	9 250	12 300					21 550
Certified	6 950	10 100	750				17 800
Quality	1 750	5 250	11 950	1 808		300	21 058
Total	19 550	29 080	13 410	1 824	76	300	64 240

Breeder Seed and Pre-basic Seed are not included, because this seed is not meant for distribution. In 1992 more than 50 t were distributed i.e. 19.3 t wheat, 20.6 t barley, 2.0 t lentil, 8.4 t chickpea, 300 kg vetch and 15 kg of medic for the following purposes:

- 2.3 t for next year's plantings of the Seed Unit,
- 27.8 t to the countries of the ICARDA region,
- 6.0 t to the GOSM in Syria,
- 14.1 t for research and large-scale testing purposes, and
- 0.4 t for use at ICARDA's farm.

Table 10. Seed distribution in 1992 (in kilograms)

	Wheat	Barley	Lentil	Chickpea	Vetch	Medic	Total
Seed Unit	700	270	250	930	200	10	2 360
Region	9 300	16 700	400	1 420			27 820
GOSM	280	110	1 150	4 450			5 990
Research	9 020	3 520	200	1 250	100	5	14 095
ICARDA Farm				400			400
Total	19 300	20 600	2 000	8 450	300	15	50 665

5.3. Quality Control

All production, processing and storage activities of the Unit are carefully monitored by seed quality tests to ensure that seed that will be distributed is of good quality. For this purpose, in 1992, 268 quality tests were carried out (six physical purity tests, 214 germination tests, 36 varietal purity tests, and 12 moisture tests). The total number of tests, given in Table 12, includes tests carried out for training, experiments, and services.

Table 11. Number of samples tested in the seed testing laboratory since 1988

	1988	1989	1990	1991	1992	Total
Physical purity	158	283	149	28	70	688
Germination	290	822	531	1 069	833	3 545
Varietal purity	304	165	178	117	125	889
Moisture	8	148	178	143	153	630
Vigor			21	356	68	445
Seed weight			802	883	335	2 020
Total	760	1 418	1 859	2 596	1 584	8 217

6. SERVICES

Seed laboratory

The seed cleaning laboratory became operative in the middle of 1990 and has been extensively used ever since as a service to ICARDA commodity programs. The equipment

in the laboratory includes: air-screen cleaner, indented cylinder, gravity table, brushing machine, magnetic separator, belt grader, de-awnwer, spiral separator, aspirators, and a velvet roll. The following activities were carried out in the laboratory during 1992:

- For GRU 3000 samples of barley, 1765 samples of wheat, and 1000 samples of chickpea were cleaned.
- For CP 1438 samples of barley, one sample of triticale (600 kg), and 862 samples of wheat were cleaned, and 60 samples of barley, and 67 samples of wheat treated
- For FRMP 60 samples of wheat were cleaned and treated.
- For Seed Health Laboratory 100 samples of wheat and 200 samples of barley were cleaned.

All these activities are supervised by SU staff.

Table 12. Seed processed (in tonnes) since 1988

	1988	1989	1990	1991	1992
Seed Unit	80.6	31.5	20.8	42.0	65.7
ICARDA Services					
CP		1.6	5.8	0.3	1.8
PFLP	10.5	6.5	16.7	18.1	12.7
LP	3.1	4.3	1.8	8.9	14.7
FRMP	16.2	20.1	25.5	35.4	33.9
Stat. Op.	21.6	6.4	29.0	47.6	75.7
Others	0.9				
GOSM			108.3	218.7	94.7
Total	52.3	38.9	187.1	329.0	233.5
Total	132.9	70.4	207.9	371.0	299.2

Seed cleaning plant

The 1 tonne/hour seed cleaning plant of the Unit plays an important role in the activities of the Unit. In addition to cleaning the production of the Unit's seed production fields it assists ICARDA's commodity programs in cleaning the seed needed for planting. In 1992, 299 tonnes of seed have been cleaned i.e. 65.7 tonnes for the Seed Unit, 138.8 tonnes for commodity programs, and 94.7 tonnes as a service to GOSM (Table 12). The number of different crops cleaned has also been expanded and include wheat, barley, maize, chickpea, lentil, vetch, lathyrus, pea, medic, and oat.

Seed testing laboratory

The seed testing station also pays an important role in assisting other ICARDA programs. Germination room and other equipment of the Unit is regularly used by other programs.

7. PUBLICATIONS, STAFF, and CONSULTANTS

Publications

During the period under reporting the third issue of SEED INFO, the Newsletter for the participants of the WANA Seed Network, has been produced and distributed.
Furthermore, the training manual Seed Production Technology (edited by J.S. Srivastava and L. Simarski) has been translated into French and printed. This was made possible through a French grant.

Other publications:

Diekmann, M. (1992): Use of climate parameters to predict the global distribution of Ascochyta blight on chickpea. Plant Disease 76 409-412.

Diekmann, M. and Bogyo, T. (1992): Distribution of bacterial leaf blight of rice (*Xanthomonas campestris* pv. *oryzae* (Ishiyama) Dye) depending on climatological factors. Journal of Plant Diseases and Protection 99, 127-136.

Gregg, B., van Gastel, A.J.G., Homeyer, B., Holm, K., Gomaa, A.S.A., Salah Wanis, M., Ghanem, E., Abdel Monem, A., Gouda, A. and Shehata, O. (1992): Inspecting seed fields of self-pollinated crops. NARP, Giza, Egypt.

van Gastel, A.J.G., Bahl, P.N., Faki, H., Plancquaert, P., Nassib, A.M. and Snobar, B. (1993): Provisions for agronomic inputs for cool season food legumes in some developing countries. Paper prepared on the basis of discussions held in a working group during the International Food Legume Research Conference II, Cairo, Egypt; April, 1992.

Staff

Dr. A.J.G. van Gastel	Head of Unit
Mr. Zewdie Bishaw	Seed production specialist
Mrs. Maha Kabbani	Left in February 1992
Mr. Abdul Aziz Niane	Senior research technician
Mr. Ghazi Jabri	Research technician (quality control)
Mr. Naim Azrak	Research technician (processing)

Consultants/visitor

Dr. Marlene Diekmann	Seed health specialist/Seed pathologist, Aleppo, Syria (6 months during 1992)
Ir. H. Koster	Variety description expert, IAC, Wageningen, the Netherlands (May '92)
Ir. C. Hellingman	Seed specialist, IAC, Wageningen, the Netherlands (February and May '92)
Dr. R. Shachl	Seed testing specialist, Austria (November '92).
Dr. B. Gregg	Seed industry expert, Mississippi State University, c/o Cairo, Egypt (June '92)
Mr. S. Abd El Wanise M.	Under-secretary Seed, CAS, Cairo, Egypt (June '92)

Dr. B. Homeyer	Team Leader, GTZ Egypt Seed Project, Cairo, Egypt (June '92)
Mr. H. Plambeck	Seed processing expert, GTZ Egypt Seed Project, Cairo, Egypt (June '92)
Mr. B. Griffith	Head Seed Unit, ILCA, Ethiopia (June '92)
Mr. Z. Kayali	Establishment for Cereal Trade, Aleppo, Syria (June '92)
Dr. Serpil Konosor	Entomologist, Cukorova University, Adana, Turkey (February '92)
Dr. Ural Dinc	Head Plant protection Department, Entomologist, Cukorova University, Adana, Turkey (February '92)

List of Abbreviations

ARC	:	Agricultural Research Center, Giza, Egypt
AREA	:	Agricultural Research and Extension Authority, Yemen
CAS	:	Central Administration for Seed, Giza, Egypt
CIHEAM	:	International Center for Advanced Mediterranean Agricultural Studies, Zaragossa, Spain
CIP	:	Cereal Improvement Program, ICARDA
DGIS	:	Directoraat Generaal, Internationale Samenwerking, the Netherlands
DUS	:	Distinctness, Uniformity and Stability Experiment
EC	:	European Community
ESA	:	Ethiopian Standards Authority
ESC	:	Ethiopian Seed Corporation, Addis Ababa, Ethiopia
FAO	:	Food and Agriculture Organization
FIS	:	International Seed Trade Association
FRMP	:	Farm Resource Management Program, ICARDA
GECT	:	General Establishment for Cereal Trade, Syria
GOSM	:	General Organization for Seed Multiplication, Syria
GRTP	:	Graduate Research Training Program
GRU	:	Genetic Resources Unit, ICARDA
GTZ	:	German Agency for Technical Cooperation
IAC	:	International Agricultural Center, The Netherlands
IAR	:	Institute for Agricultural Research, Ethiopia
IARC	:	International Agricultural Research Center
ICARDA	:	International Center for Agricultural Research in the Dry Areas, Aleppo, Syria
ILCA	:	International Livestock Center for Africa, Addis Ababa, Ethiopia
LP	:	Legume Program, ICARDA
LTGT	:	Long-term Group Training
MoA	:	Ministry of Agriculture
MSFCTD	:	Ministry of State Farms, Ethiopia
MSU	:	Mississippi State University, Seed Technology Laboratory, Mississippi, USA
NARS	:	National Agricultural Research System
NARP	:	National Agricultural Research Project, Egypt
NCARTT	:	National Center for Agricultural Research and Transfer of Technology, Jordan
NSC	:	National Seed Center, Yemen
NSMC	:	National Seed Multiplication Center, Yemen
NVRP	:	Nile Valley Regional Program
PFLP	:	Pasture, Forage and Livestock Program, ICARDA
PGRC-E	:	Plant Genetic Resources Center-Ethiopia
SIDA	:	Swedish International Development Agency
SMP	:	Seed Multiplication Project, Yemen
UoJ	:	University of Jordan, Amman, Jordan
UNDP	:	United Nations Development Program
UPOV	:	International Union for the Protection of New Varieties of Plants
USAID	:	United States Agency for International Development
VCU	:	Value for Cultivation and Use
WANA	:	West Asia and North Africa

المركز الدولي للبحوث الزراعية في المناطق الجافة
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