SEED UNIT

Annual Report for 1993

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 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'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 1993

jointly financed by

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. Thus, the report was not prepared in accordance with the established format guidelines, nor was it edited by Communications, Documentation and Information Services staff.

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. The Seed Unit of ICARDA implements this project, which has the objective of strengthening 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 new varieties 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 made during 1993. The highlights of 1993 are:

- The project to establish an M.Sc. program in Seed Science and Technology at the University of Jordan (UoJ) has been approved by EC and the M.Sc. course will be announced in the near future. Ten students holding a B.Sc. degree in agriculture will be eligible for an EC grant.

- The Egypt national in-country train-the-trainers program has been completed; during a period of three years 111 field inspectors were trained in field inspection methodology as the direct result of Roundtable Discussions on Seed Quality Control organized in 1989 among experts from CAS, ARC, GTZ, NARP and ICARDA. This program has been an example of cooperation between national programs (CAS, ARC), donors (GTZ, NARP) and ICARDA. Moreover, this program has shown that, if the methodology is clearly defined and described, B.Sc and M.Sc. trainers can take the lead in technology transfer without much technical support from outside.

- The WANA seed network established in June 1992 is steadily progressing. It has participation from 17 countries in West Asia and North Africa and carries out activities which aim at improving national seed systems in the WANA region.

- The first Forage Seed Production Course was organized in cooperation with the International Livestock Center for Africa (ILCA).

2. STRENGTHENING SEED PRODUCTION INFRASTRUCTURE

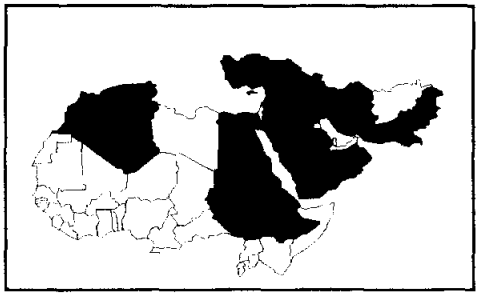
During 1993: (1) the WANA seed network was further strengthened, (2) additional attention was given to seed health aspects in national seed programs, (3) a train-the-trainers course in seed science and technology for university lecturers was conducted, (4) a consultancy study regarding alternative seed supply systems made, (5) a seed survey initiated in Syria, and (4) several other infrastructure strengthening activities

carried out (pre-release multiplication, post-control plots, field inspection, and variety description).

2.1. WANA Seed Network

The Wana seed network established in June 1992 is steadily progressing. It has participation from 17 countries in West Asia and North Africa (ANNEX I) and carries out a number of activities which aim at improving national seed systems in the WANA region (Table 1). Member countries carry out the major share of the work; ICARDA plays a stimulating and catalytic role, and holds the Secretariat. Several countries have been very active in carrying out their assigned tasks and almost all countries provide information to Lead Countries (countries responsible for a certain activity). Some countries have nominated assistant country representatives to assist in the activities related to the WANA seed network.

The first meeting of the Steering Committee of the WANA Seed Network Council was held, January 19 - 21, 1993, in Cairo at the Central Administration for Seeds. Except the representative from Turkey, all steering committee members participated in the meeting, including the Secretariat and three observers. The meeting discussed technical activities of the network and recommended that a project proposal be prepared to secure financial support to establish an effective network.



WANA SEED NETWORK COUNTRIES

Long-term network activities to summarize different seed policies in the region (lead country: Sudan), different certification systems (lead country: Turkey), regulations for variety release (lead country: Ethiopia), and description and information on weed seeds (lead country: Cyprus) are still under preparation. The final reports will not be expected in the near future, because of the hugh amount of work involved. The status of the short-term activities is as follows:

- Two issues of the WANA Seed Network Newsletter "SEED INFO" were prepared and distributed (Secretariat).
- The first draft of the WANA catalogue of seed standards is expected to be compiled and distributed before early 1994 (lead country: Syria).
- The report of the WANA referee test for germination and physical purity has been sent to participating seed testing stations (lead country: Morocco).
- WANA directory of staff involved in the seed industry, was expected to be published before the end of this year, but response from some countries has not been received yet. The Secretariat intends to distribute early 1994 the directory for those countries that have submitted information (lead country: Egypt).

Table 1. List of WANA network activities and lead countries

	Network Activities	Lead Countries
1.	Regional referee testing (a) Purity and Germination (a) Seed Health	Morocco
2.	WANA seed newsletter	Secretariat
3.	WANA seed directory	Egypt
4.	Under-graduate and post-graduate study in seed science (a) Overview of university training in WANA	Jordan, Iraq, Lebanon, Algeria
5.	WANA variety catalogue	Morocco
6.	Standardized seed certification procedures	Turkey
7.	Catalogue of seed standards of all WANA countries	Syria
8.	Development of uniform national seed policy	Sudan
9.	Seed movement across national borders; Develop regional between-country seed trade (a) plant quarantine measures (b) variety and seed registration regulations (c) laws governing investment, forming companies, joint ventures (d) seed import and trade regulations	Egypt, Sudan Secretariat Ethiopia
10.	Exchange information on seed programs	Yemen, Pakistan, Saudi Arabia
11.	Exchange descriptions, information on weed seed	Cyprus
12.	Studies of seed industry costs and economic benefits	Egypt, Algeria, Iran, Saudi Arabia
13.	Develop and share technical publications, etc.	Algeria, Egypt, Sudan
14.	WANA seed health testing lab; cooperation in seed health testing (a) List of seed health equipment and supplies (b) List of seed testing equipment and supplies	Pakistan, Saudi Arabia Secretariat Secretariat
15.	Emergency seed stocks	Pakistan
16.	WANA directory of seed available (yearly)	Iran
17.	WANA consultative group, to assist with problems	Iran, Saudi Arabia

- Information for the WANA variety catalogue (lead country: Morocco) has been requested from country representatives, and completion of the catalogue is expected to take more time.
- During 1993 a number of publications have been developed under the umbrella of the network (text box)

Publication No 1
Equipment and Supplies List: Seed Health Testing
by M. Diekmann

Publication No 2
Disease Descriptions for Field Inspection in Seed Production
by M. Diekmann and A.J.G. van Gastel

Publication No 3
Seed-borne Diseases in Seed Production
by M. Diekmann

Publication No 4
Equipment and Supplies List: Seed Testing
by Z. Bishaw and B. Gregg

WANA Seed Network Publication No 2/93 (Disease Descriptions for Field Inspection in Seed Production) is printed on heavy, water-proof paper for use in the field. Sheets are available for the following diseases: (a) loose smut of wheat and barley, (b) common bunt of wheat, (c) Ascochyta blight of chickpea, and (d) covered smut of barley. The publication 'Seed-borne Diseases in Seed Production' (WANA Seed Network Publication No 3/93) is a training manual for seed health in seed production. Under preparation are the following three network publications, expected to be ready mid-1994:

- Gregg, B., Salah Abd El Wanis, Z. Bishaw and A.J.G. van Gastel, 1994. Safe Seed Storage. WANA Seed Network Publication No 5/94.
- Gregg, B., A.J.G. van Gastel, Salah Abd El Wanis and Z. Bishaw, 1994. Seed Marketing. WANA Seed Network Publication No 6/94.
- Bishaw, Z., A.J.G. van Gastel, Salah Abd El Wanis and B. Gregg, 1994. Inspecting Seed Fields of Self-pollinating Crops. WANA Seed Network Publication No 7/94.

2.2. FAO Expert Consultation

The Head of the Seed Unit participated in a FAO expert consultation on seed technology in the Near East from March 30 to April 1, 1993. The expert consultation had the following objectives:

a) to perform an in-depth review of the status of the seed industry in the region,
b) to identify major problems and constraints which hinder full satisfaction of seed needs, and
c) to make proposals to develop the seed sector at national and regional levels.

In addition to FAO (Headquarter and Near East Regional Office), ICARDA, and AOAD (Headquarter, Khartoum) 12 countries from the WANA region participated in the meeting. The outcome of the meeting was: (1) a set of recommendations for improvement of the national seed industries, including privatization, and a Steering Committee (Lebanon, Libya, Pakistan, and Tunisia) to oversee implementation of the recommendations. The Steering Committee is different (country-wise) in its composition from WANA Seed Network Steering Committee. Initially the two steering committees will operate independently, but the aim is to have meetings at the same

time and merge the two committees in the future. FAO will be an observer in the WANA Seed Network Steering Committee, while ICARDA will be an observer in FAO's Seed Steering Committee.

2.3. Seed Health

During 1993 more attention was paid to seed health aspects in the national seed programs. A consultant worked for three months in the Unit and has:

- Assisted national seed health testing stations in upgrading their capabilities.
- Finalized a comprehensive training manual for seed health testing (WANA Seed Network Publication No 3/93).
- Prepared disease 'identification' sheets for important diseases in seed production fields (WANA Seed Network Publication No 2/93). These sheets are available for the following diseases: (a) loose smut of wheat and barley, (b) common bunt of wheat, (c) Ascochyta blight of chickpea, and (d) covered smut of barley.,
- Lectured in seed courses on seed health aspects, and supervised individual trainees/students.
- Prepared an equipment and supplies list for seed health testing (WANA Seed Network Publication No 1/93).

The Unit's seed health work is now carried out through the assistance of ICARDA's consultant Head of Seed Health Laboratory.

2.4. M.Sc. Seed Science and Technology

In 1992 the EC approved a pilot phase of one year (1993) for the project 'Establishing formal degree education in Seed Science and Technology'. This project is a joint project between the University of Tuscia (Italy), the University of Athens (Greece), the University of Jordan and ICARDA. The pilot phase (1993) had the following aims:

a) to train university lecturers (Ph.D. level) of regional universities in seed science and technology by offering a train-the-trainers course, and
b) to develop draft course syllabus for the M. Sc. degree in Seed Science and Technology to be offered, in the consolidation phase (1994/96), at the University of Jordan, Amman.

Pilot phase. The train-the-trainers workshop was held at the University of Jordan, Faculty of Agriculture, Amman, Jordan from April 22 to May 10, 1993; 19 participants from eight countries in the WANA region participated. Twelve participants had a Ph.D. degree, while seven participants were either in their post graduate programs or teaching at universities in their respective countries. Lecturers came from six countries (France, Greece, Italy, Jordan, Spain, the Netherlands) and from ICARDA.

During the train-the-trainers course discussions were held to develop the first draft of the content of the proposed M.Sc. course on Seed Science and Technology. In June a two-day meeting was held in Rome, Italy to prepare the project proposal for the first year of the consolidation phase (1994).

Box 2: M.Sc. Course in Seed Science and Technology, University of Jordan, Amman, Jordan

Duration: two years
Credit hours: 33 Total
15 compulsory course
9 optional courses
9 *thesis research.*
Courses

	Credit hours	Lect credits	Practical credits
Compulsory:			
Seed production	4	3	1
Protection of Seed	3	2	1
Processing and Storage	3	2	1
Quality Contr. and Cert.	3	1	2
Management of Seed Enterprises	2	2	
Optional (9 credits requires):			
Biology	3	3	
Genetics and Plant Breeding	3	2	1
Biometrics	3	2	1
Tissue culture	3	2	1
Horticultural crops	3	3	
Field corps	3	3	

The consolidation phase. The project to establish the M.Sc. in Seed Science and Technology at the University of Jordan (UoJ) has been approved by the EC and the M.Sc. course will be announced in the near future. Ten students holding a B.Sc. degree in agriculture will be eligible for an EC grant. Teaching for the M.Sc. course will be carried out by staff of the University of Jordan, ICARDA, the University of Athens, and the University of Tuscia. Furthermore, regional and EC consultants will be contracted to assist in the lecturing.

2.5. Alternative Seed Systems

Late-1993, a consultant was identified to work for a period of three months on the following:

a) *To review and summarize literature* on alternative seed supply and small-scale seed production schemes.

b) To assess small-scale seed production activities carried out in the WANA region and the role and importance of such schemes.
c) To recommend what activities ICARDA's Seed Unit should carry out to stimulate small-scale seed production and alternative seed supply.
d) To write a project proposal for the support of alternative seed systems and small-scale seed production schemes in the ICARDA region.

The consultant arrived at ICARDA early November and has made an extended trip in the region; the report is expected to be ready early-1994.

2.6. Seed Surveys

A seed survey is a useful instrument to study different aspects of the national seed industry. The 'simple' surveys (collecting seed samples and completing a questionnaire) carried out by the Unit are mainly aimed at assessing the quality of the seed used by farmers and farmers' appreciation of the national seed program. In 1986/87 a survey was carried out in Egypt (Annual Report 1989, Seed Unit). At present the Unit is working on the following surveys:

Syria. During November 1993 a small survey of the quality of wheat seed used by farmers in one of the districts of the Aleppo Province has been initiated. In each sub-district approximately 50% of the villages will be sampled and in each village two to three samples will be taken and the farmers interviewed. A total of 150 samples is expected to be taken. The seed survey is carried out in close cooperation with the staff of the General Organization for Seed Multiplication (GOSM) in Syria. Samples will be analyzed for seed quality aspects (purity, germination, health) and information from the questionnaires summarized.

Ethiopia. A similar survey has been carried out in Ethiopia where a total of 1185 samples of wheat (400), barley (400) and faba bean (385) were collected during the 1993 cropping season. Wheat and barley samples were collected from Arssi and Bale zones, whereas faba bean samples were collected from Gonder and Gojam zones. In the next six months the questionnaire will be analyzed and the samples tested for seed quality factors. Seed quality factors like purity, germination and grow-out tests will be conducted by the Ethiopian Seed Corporation (ESC). ESC will also conduct seed health tests in cooperation with the Institute of Agricultural Research (IAR) and the Plant Protection Research Center (PPRC).

Jordan. In 1990/91, jointly with GTZ's Seed Multiplication Project in Jordan and the National Center for Agricultural Research and Transfer of Technology (NCARTT), a survey was carried out in Jordan. The seed survey focused on wheat and the analyses of the questionnaires and the tests for seed quality are carried out by two M.Sc. students, studying at the University of Jordan, Amman. Preliminary results are presented in Chapters 3.2 and 3.3.

2.7. Pre-release Multiplication

Pre-release multiplication schemes multiply seed before a promising line has been officially released and are aimed at early availability of seed of the new variety at the farmers' level. Generally, a new variety is developed, entered into variety evaluation trials and released by the national release committee. Unfortunately, in developing countries no or hardly any seed is available at that stage because many national seed organizations are of the opinion that no seed multiplication can be initiated before official release. However, in highly competitive environments like Europe, every seed company will make sure that seed is available when a variety is released. Having no seed at the time of release would be a setback, because farmers' demand for the new variety will not be met. This implies that some seed of promising lines is multiplied before the variety is released. The official certification service may certify such seed and label them with a special label like 'VARIETY UNDER TEST'.

Variety/code	Pre-release multiplication initiated	Released
Barley		
Rihane 03	1990/91	*not released*
Arta	1992/93	presented for release 1993
Bread Wheat		
Nesser	1990/91	1991: CHAM 6
Gomam	1992/93	withdrawn
Durum Wheat		
Lahn	1990/91	presented for release 1991 possibly released in 1993
Omrabi 03	1992/93	presented for release 1993
Lentil		
ILL 5883	1992/93	presented for release 1993

ICARDA and the th General Organization for Seed Multiplication (GOSM) have initiated this approach in Syria, where in the past few years several promising lines have been multiplied at the multiplication farm of the GOSM. Of each promising line one hectare is planted and fields receive optimum cultural and management practices. Referring to the information provided in the text box it can be concluded that:

- The pre-release multiplication was successful for the bread wheat promising line Nesser, which was released as Cham 6; multiplication was one year ahead of schedule.
- The barley promising line Rihane 03 and the bread wheat line Gomam were not released.

- The impact of the pre-release multiplication will be much larger when one or more of the following promising lines will be released: ILL 5338 (lentil), Arta, (barley), Lahn and Omrabi (durum wheat); all these lines are strong candidates for release.

2.8. Field Inspection Systems

Seed certification is a seed quality control system to ensure that seed sold to farmers is of the indicated variety, sufficiently pure, of good germination capacity and free from diseases. One of the important steps in any seed certification is the physical inspection of the seed field. Uniform field inspection procedures are essential. The Unit has in the past -as a joint activity with the GTZ/Egypt Seed Project, Central Administration for Seed (CAS), and Agricultural Research Center (ARC)- developed a field inspection methodology which can be used for any crop in any country in the region. Egypt has adopted this approach in the past.

Sudan. In 1993 the Unit prepared a draft field inspection methodology for wheat and submitted to Sudan's National Seed Administration (NSA), which recently agreed to adopt the methodology. ICARDA's Seed Unit in cooperation with the NSA will now conduct a train-the-trainers course to instruct trainers in the new methodology; the course is planned early 1994 in Sennar, Sudan.

Ethiopia. A manual for wheat field inspection methodology was also prepared for the Ethiopian seed quality control system and submitted to the Ethiopian Seed Corporation (ESC).

2.9. Post-control Plots

Post-control plots (plots planted with seed taken from seed lots that were approved in the previous season) complete a certification system.

In the past the Unit has assisted the Egyptian national seed program to initiate post-control plots. In the 1993/94 cropping season plots, using seed from Foundation and Certified Seed, will be planted as a joint activity of the Seed Unit and GOSM in Syria. The post-control plots will be planted at the seed multiplication farm of the GOSM to monitor the quality of the seed as part of seed certification process.

2.10. Variety Description

Varietal descriptions play a crucial rule in seed programs and are one of the factors that determine the success of the seed program. In many developing countries the importance of varietal descriptions is not yet sufficiently realized and breeders are generally satisfied if an agronomic description of the variety has been made. Often no attention is given to the morphological description of new varieties.

The Unit is spending a considerable amount of time on training national staff in morphological variety description and on preparing preliminary variety descriptions.

Such descriptions can be used as a starting point from where national programs can take up the description of their varieties.

At ICARDA's research farm, data on the large number of morphological characters of wheat, barley, chickpea, and lentil have collected during the past five years. Several varieties of national programs were included in these experiments. All data have been summarized; reports have or will be sent to the following countries: Algeria, Egypt, Ethiopia, Syria, Yemen, and the Arabian Peninsula.

Cyprus. On request of the Seed Production Centre, Cyprus, wheat and barley varieties have morphologically been described during 1990/91 and 1991/92 seasons; a comprehensive report was prepared and sent to Cyprus.

Jordan. In Jordan, NCARTT is describing the lentil and chickpea varieties jointly with the staff of the Seed Unit. In the 1992/93 season three lentil and three chickpea varieties were planted at the research station near Madaba, Jordan and observation on a large number of morphological characters were taken. The first year results were analyzed and preliminary variety descriptions are available. In the 1993/94 crop season the experiment will be repeated to finalize the descriptions.

Egypt. Similarly, in Egypt the CAS, ARC and ICARDA's Seed Unit have initiated morphological descriptions of different faba bean varieties. In the 1993/94 crop season chickpea and lentil varieties are expected to be included in this program.

Syria. In the coordination meeting with staff from GOSM it was agreed to plant an experiment aiming at describing the Syrian cereal and legume varieties. The experiment will be planted at the seed multiplication farm of the GOSM and one GOSM staff member will be responsible for data taking. The experiment will be supervised by Seed Unit staff.

Arabian Peninsula. During the past years (1990-93) the Unit has been describing -as a joint activity with the Regional Program for the Arabian Peninsula- cereal varieties of the Arabian Peninsula. Varieties of Oman, Saudi Arabia, and Yemen were included in these experiments. A comprehensive report for each variety has been produced. The next step will be to prepare a booklet with color photographs of the most important characters of each variety. The booklet will include one page for each variety consisting of three sections: (a) general information on the variety (name, breeding pedigree, country, year of release), (b) a short description of the agronomic performance of the variety, and (c) a short description of the morphological characters.

DUS computer program. During 1993 a simple computer program was developed for the analyses of the large amount of data on morphological characters of wheat, barley, lentil and chickpea varieties and promising lines. The program:

a) calculates average scores over years and transfers the average to an appropriate wording,
b) assesses distinctness,

c) identifies standard varieties,
d) makes a short variety description based on morphological characters, and
e) assesses stability of characters.

The program can handle: (a) 5 years of data, (b) 25 species, (c) 100 varieties per species, and (d) 30 characters per species.

2.11. Distribution of Seed to Seed Organizations

The Unit is multiplying seed of lines 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 on case they are released. At the same time the national program should start building up its Certified Seed supply. In November, 2500 kg of chickpea variety FLIP 84-15, 100 kg of Ghab 2, and 500 kg of Ghab 3, as well as 500 kg of the lentil variety ILL 5883 were given to the General Organization for Seed Multiplication in Syria.

3. RESEARCH

The first three sections in this chapter are the reports of M.Sc. students working under the supervision of Seed Unit staff. The remaining sections describe other research carried out by the Unit.

3.1. Evaluation of Seed Vigor in Lentil

The objectives of the work on seed vigor evaluation in lentil are to:

a) compare different vigor tests,
b) examine the relationship between vigor tests and field emergence, and
c) determine the best test (or combination of tests) to predict field emergence.

Material and methods

Two sets of experiments were conducted: (a) in 1991/92 at Shambat, Sudan and (b) in 1992/93 at ICARDA, Syria. Materials used in these investigations consisted of seven cultivars in 1991/92 and fifteen cultivars in 1992/93. Cultivars were subjected to nine and twelve different laboratory vigor tests in 1991/92 and 1992/93 respectively. These tests are: (1) 100 seed weight, (2) standard germination test, (3) speed of germination, (4) seedling dry weight, (5) seedling growth rate, (6) vigor classification (strong, normal, and weak seedlings), (7) electrical conductivity, (8) accelerated aging test, (9) shoot length, (10) root length, (11) tetrazolium chloride test, and (12) the cold soil test.

c) identifies standard varieties,
d) makes a short variety description based on morphological characters, and
e) assesses stability of characters.

The program can handle: (a) 5 years of data, (b) 25 species, (c) 100 varieties per species, and (d) 30 characters per species.

2.11. Distribution of Seed to Seed Organizations

The Unit is multiplying seed of lines 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 on case they are released. At the same time the national program should start building up its Certified Seed supply. In November, 2500 kg of chickpea variety FLIP 84-15, 100 kg of Ghab 2, and 500 kg of Ghab 3, as well as 500 kg of the lentil variety ILL 5883 were given to the General Organization for Seed Multiplication in Syria.

3. RESEARCH

The first three sections in this chapter are the reports of M.Sc. students working under the supervision of Seed Unit staff. The remaining sections describe other research carried out by the Unit.

3.1. Evaluation of Seed Vigor in Lentil

The objectives of the work on seed vigor evaluation in lentil are to:

a) compare different vigor tests,
b) examine the relationship between vigor tests and field emergence, and
c) determine the best test (or combination of tests) to predict field emergence.

Material and methods

Two sets of experiments were conducted: (a) in 1991/92 at Shambat, Sudan and (b) in 1992/93 at ICARDA, Syria. Materials used in these investigations consisted of seven cultivars in 1991/92 and fifteen cultivars in 1992/93. Cultivars were subjected to nine and twelve different laboratory vigor tests in 1991/92 and 1992/93 respectively. These tests are: (1) 100 seed weight, (2) standard germination test, (3) speed of germination, (4) seedling dry weight, (5) seedling growth rate, (6) vigor classification (strong, normal, and weak seedlings), (7) electrical conductivity, (8) accelerated aging test, (9) shoot length, (10) root length, (11) tetrazolium chloride test, and (12) the cold soil test.

Field experiments (a randomized complete block design in 1991/92 and an α lattice design in 1992/93) were carried out to correlate the results of the different vigor tests with field performance. In 1991/92 only field emergence was assessed, while in 1992/93, field emergence, stand establishment, plant height, days to 50% flowering, days to maturity, number of pods/plant, yield/plant, and 100 seed weight were determined.

Results and Discussion of 1991/92 Data

Significant differences were observed among cultivars for the different vigor tests (Table 2). Almost all tests indicated that Giza 9 is of lower quality than the other six cultivars. This is clearly exemplified by the result of the standard germination test (37%), the cold test (2% germination), the electrical conductivity test, and speed of germination. The reason that Giza 9 is of lower quality may be found in the fact that Giza 9 is an old variety that has deteriorated considerably.

Correlations between the different tests were assessed and several tests were significantly correlated. A few example of the important correlations are:

- the standard germination test, speed of germination, seedling dry weight, and electrical conductivity test were strongly correlated;
- the cold soil test, seedling dry weight, and seedling growth rate were strongly correlated.

To find the best laboratory tests that predict field emergence simple correlation coefficients between the results of laboratory tests and field emergence were calculated. Field emergence was, among others, correlated with: (1) standard germination, (2) speed of germination, (3) seedling dry weight, (4) electrical conductivity.

Table 2. Mean values for seed vigor tests and field emergence (1991/92 experiment)

Cultivar	Stand. germ. (%)	Cold soil (%)	100 seed weight (g)	Seedl. dry weight (g)	Seedl. growth rate (mg/norm. seedl.)	Shoot length (cm)	Root length (cm)	Elect. conduct. (µmho/g)	Speed germ. (a)	Field emerg. (%) (b)	Field emerg. (%) (c)
ILL 795	98	28	2.36	0.228	10.3	13.5	13.0	0.157	24.8	93	97
ILL 813	97	34	2.32	0.288	11.8	19.3	18.0	0.162	24.2	87	94
ILL 818	97	25	2.39	0.283	11.8	16.5	16.0	0.154	21.1	90	97
ILL 6004	96	56	4.15	0.350	16.8	14.3	15.1	0.195	21.7	95	96
ILL 4605	99	33	3.64	0.337	15.5	13.8	15.5	0.174	22.8	96	96
Seliam	100	9	2.45	0.296	12.1	16.4	17.0	0.139	22.5	87	95
Giza 9	37	2	2.46	0.080	9.7	11.4	14.9	0.290	6.9	59	61
Mean	89	27	2.83	0.27	12.6	15.0	15.6	0.181	20.6	87	91
LSD (0.05)	*3.40*	*19.8*	*0.11*	*0.04*	*0.95*	*1.5*	*1.4*	*0.005*	*1.4*	*6.2*	*3.4*

(a) Summation of number of seed germinated on a given day, divided by the number of the day (day 1, day 2, etc.); (b) field emergence in clay; and in (c) silky loam soil.

Conclusion

The best vigor tests to predict field emergence in lentil is standard germination, speed of germination, seedling dry weight, and the electrical conductivity test.

3.2. A Survey of Wheat Seed Quality in Jordan

A farmer's crop depends on the quality of the seed used for planting. Seed quality mainly depends on environmental conditions and handling (harvesting, drying, cleaning, grading, etc.), and can be measured by genetical purity, physical purity, germination, vigor, seed health status, and size and uniformity. No information on the quality of wheat seed used for planting in Jordan is available and the study was conducted with the following objectives:

a) Estimate the percentage of farmers in Jordan that use: i) own-saved seed, ii) other farmers' seed, and iii) Certified Seed for planting a wheat crop.
b) Estimate the extent to which farmers are still using traditional varieties.
c) Evaluate varietal and physical purity, germination, 1000-kernel weight of seed used for planting.
d) Compare the quality of the different sources of seed that farmers are using to plant a wheat crop.
e) Assess farmers' appreciation of government produced Certified Seed.
f) Identify seed quality problems experienced by farmers.

Materials and Methods

In Jordan 60531 hectares of wheat are grown distributed over the North (40%), the Center (30%), the South (20%), and the Jordan Valley (10%). During the 1990 wheat planting season a total of 395 wheat growing farmers were surveyed (160 from North, 129 Center, 94 South and 12 Jordan Valley) and 405 seed samples collected shortly before planting. When a sample was taken a questionnaire was filled out to collect information on: (1) the source of seed planted, (2) management practices, (3) location, (4) acreage, (5) variety, and (6) seed handling.

Each sample (1 kg) was divided into two parts of 500 grams. One part was used for the analyses in the laboratory (physical purity, germination, varietal purity and 1000-kernel weight); the second part of the sample was used to plant a field trial to determine varietal purity and varietal identity.

Information from Questionnaire

Analysis of the questionnaires showed that farmers in Jordan obtain wheat planting stock from three sources: (a) own-saved seed, (b) seed from the Jordan Co-operative Organization (Certified Seed), and (c) seed from other farmers. The major source was own-saved seed (Table 3) and more than 70% of the farmers use traditional varieties.

Table 3: Number of samples collected from different sources

Source of seed	Number	%
Certified	138	34.1
Own-saved	236	58.3
Other farmers'	31	7.7
Total	405	100

Two planting methods, broadcasting (74.8%) and planting by seed drill (25.2%), were used. Only 46.4 % of the farmers use fertilizer.

With regard to cleaning, 36.5% of the samples was cleaned by JCO's seed processing plant, 39.8% was cleaned by hand, and 23.7% was not cleaned at all. Chemically treated was 74.8% of the samples.

The area planted with wheat ranged from 0.3 to 1000 ha, with 58.5% of the farmers planting less than 6 ha and 5.1% more than 50 ha.

Results of Seed Quality Analyses

Seed national minimum standards for wheat seed in Jordan are:

Physical purity (Minimum %)	95
Germination (Minimum %)	85
Other varieties (Maximum %)	3

Physical purity: Comparing the average data for physical purity (Table 4) with the national minimum standard (95%), all averages are above the standard. Certified Seed has a higher average purity percentage (99.4) than own-saved seed (96.8) and other farmers' seed (96.6). The percentage of samples that is below the national standard was, 41.8% for own-saved seed 34.5% for other farmers' seed (34.5). Certified Seed had 4.6% of the samples not meeting the standard.

Table 4: The relation between purity, germination, 1000-kernel weight and seed source

Source of seed	Number of samples	%	Purity average	Below-standard no.	%	Germin. average	Below-standard no.	%	1000-kernel weight average
Certified	130	34.3	99.4	6	4.6	85	50	38.5	42.9
Own-saved	220	58.1	96.8	92	41.8	88	49	22.3	39.9
Other farmers'	29	7.6	96.6	10	34.5	86	7	24.1	41.4
Total	379	100.0	97.7	108	28.5	87	106	28.0	40.0

Germination: The average germination percentages (Table 4) of own-saved seed (88%) and other farmers' seed (86) are above the national standard of 85%; the average germination (84.7%) of Certified Seed samples was just below the standard. Differences between the three sources were, however, not significant. The number of samples below the standard was alarmingly high; 22.3%, 38.5% and 24.1% of the *own-saved seed, Certified Seed and other farmers' seed samples* respectively did not meet the national standard.

1000-kernel weight: Certified Seed had significantly higher 1000-kernel weight followed by other farmers' seed; own-saved seed had the lowest 1000-kernel weight (Table 4).

Preliminary results of varietal purity indicate that more than 50% of the samples are either not sufficiently pure (the number of offtype more than 3%) or a mixture. Approximately 3% of the samples have a different varietal identity as the one indicated by the farmer. There are differences between sources; other farmers' seed has the *highest percentage of samples that were not sufficiently varietal pure*; Certified Seed had the lowest percentage.

Discussion

The majority of wheat farmers in Jordan has not adopted improved practices and are still using traditional methods and traditional varieties for wheat planting. More than 60% of the farmers is not using Certified Seed; 15% indicated that this was due to the fact that Certified Seed was not available at the proper time and lack of transportation; 5% had no idea that Certified Seed existed. With regards to seed quality, physical purity of Certified Seed is acceptable, but among own-saved seed and other farmers' seed a large amount of the samples were below the national standard. This is due to improper seed handling practices. Germination was often below the national standard, this may have been caused by improper handling of seed during processing and storage which lead to injury of the embryo and loss of germination. The low germination of Certified Seed may be explained by the fact that there was a considerable period between taking the sample and analyzing the sample. Certified Seed is usually treated and treated seed can not be stored for long periods.

3.3. Survey of Fungal Pathogens Transmitted by Wheat Seeds in Jordan

The seed health aspects of the survey mentioned in Chapter 3.2 are studied by a M.Sc. student at the University of Jordan, Amman, Jordan. The objectives of the study are to:

a) Survey the important fungal pathogens transmitted by wheat seed in Jordan.
b) Study the efficiency of the seed program to produce healthy Certified Seed.
c) Establish the relation between results of laboratory tests and infection in the field.

Material and Methods

A total of 369 seed samples of wheat were studied: 134 samples from the North, 113 from the Center, 83 from the South and 10 from the Jordan Valley. The weight of

each sample was 0.5 - 1 kg. A questionnaire was used to collect information about: source of seeds, variety, location, management practices of the farmer, seed treatment, diseases, etc.

Laboratory tests were carried out to determine the percentage of infection by fungal pathogens. The washing test was used to detect Tilletia caries and T. foetida the causal agent of common bunt; the freezing blotter test to detect pathogens such as Penicillium, Aspergillus, Septoria, Fusarium, Helminthosporium, Alternaria, Stemphylum, Cladosporium, and Rhizopus. The embryo test was used to detect Ustilago tritici. To study foliar diseases transmitted by seed, each sample was planted in plastic pots (40 x 40 cm) in sterilized soil.

Ten different varieties were studied which originated from three different sources i.e. Jordan Cooperative Organization, own-saved seeds, and seed purchased from neighbors.

Results

The embryo test showed that 69.3% of samples were infected with Ustilago tritici. The infection percentage was higher in own-saved seed and seed purchased from neighbors than in the samples from JCO.

The results of the washing test indicated that 43 % and 85% of samples were contaminated by Tilletia caries and T. foetida respectively. Infection was higher in samples collected as own-saved seed and seed from neighbors than in samples collected as Certified Seed.

There was variation among fungi isolated during the blotter test. The most common fungi are Penicillium, Aspergillus, Alternaria, Helminthosporium, Fusarium, Stemphylum, Cladosporium, and Rhizopus. Penicillium was found in all samples, but the percentage ranged from 3% - 100%. Rhizopus was found in most samples (1% - 78%). For other fungi the percentage of infection was less than 10%, except Helminthosporium where infection was less than 25%. High percentages of seed-borne fungi were recorded in samples collected as own-saved seed or seed from neighbors.

Discussion

The results indicate that most seed samples were contaminated to a rather high levels by fungi. Generally, seed obtained from the Jordan Cooperative Organization had lower infection percentages than seed saved by the farmer or purchased from neighbors. This is expected, because seed from the official government program (Certified Seed) is treated with chemicals before distribution.

3.4. Effect of Seed Source on Quality and Yield of Durum Wheat

Improved seed has to be replaced regularly. It is recommended to replenish seed of hybrids every year, open-pollinated crops every 2-3 years, and self pollinated crops every 4-5 years. A significant decline in yield was demonstrated for hybrids when

farmers save their own seed for planting purpose, but no precise information is available for open- and self-pollinated crops. The majority of small-scale farmers retain non cleaned farm-saved seed for planting.

From a seed survey conducted in Jordan (Chapters 3.2 and 3.3), four samples saved one, two, three and four year (1986-89) on-farm and one Certified Seed sample distributed in 1990 of two improved varieties, F8 and Hourani, were identified for the seed source experiment. The ten samples were tested for seed quality attributes such as purity, germination and 1000-seed weight and later planted in the field to estimate contamination with offtypes (and other varieties), other crops (bread wheat) and noxious weeds.

Table 5. Seed Quality Characteristics of Farm-saved Wheat

Variety	No of years saved	1000 seed weight	Physical purity	Germination capacity	Offtypes %	Other crops %	Yield (kgs)
F8	0	41.8	99.9	87	0.1	0.0	1915
	1	37.5	95.2	86	0.1	0.0	2126
	2	42.3	99.3	95	0.2	0.0	2170
	3	36.2	97.2	74	0.02	0.0	2097
	4	38.1	97.4	91	0.4	0.04	2342
Hourani	0	37.8	99.6	94	0.02	0.0	2447
	1	35.4	97.2	84	0.3	0.0	2319
	2	41.3	98.9	90	0.5	0.1	2519
	3	35.5	99.3	90	0.6	0.2	2453

All seed samples (except two) had maintained the physical purity and germination of over 95 % and 85 % respectively (Table 5). There is no significant difference in seed quality attributes and 1000-seed weight between varieties and within years. It seems that the quality of farm-saved seed is comparable to the wheat seed standards set for Jordan (purity, 95%; germination 85%).

The results of the field experiment (Table 5) showed an increase in the degree of contamination both for offtypes and other crops over the years. Contamination over the number of years saved by the farmers is significant both between varieties and within years. The improved wheat variety Hourani appeared to be slightly more contaminated with offtypes and other crops compared to F8, though initial level of impurity is not known when the seed was certified.

Certified seed supplied by the Jordan Cooperative Organization has a lower level of contamination for offtypes and other crops and meet the minimum national standards for both factors. However, all certified seeds purchased by farmers, but retained as farm-saved seeds over the years are below the standard of varietal purity and other crops contamination. No yield difference was observed within years except between varieties which could be better explained by varietal character than effect of management. No relationship between contamination and yield was established.

3.5. Seed Vigor and Storability in Wheat

In WANA rainfall is often unreliable and large differences in environmental conditions exist from location to location and from year to year. Crops are grown under harsh conditions and this will have an influence on the quality of the seed. Experiments were carried out in wheat and lentil to assess the effect of different levels of water and nitrogen during plant growth on: (1) seed size, (2) germination, (3) seed vigor, (4) field emergence, (5) yielding capacity in the next season, and (6) storability. Results on seed size, germination, seed vigor, field emergence, and yielding capacity have been reported in earlier Annual Reports. This report summarizes the storabilty results.

To study the influence of different water and nitrogen levels, seed harvested in two consecutive years (1990 and 1991), from a line source irrigation experiment (different plots receive different amounts of water depending on the distance from the water source) was threshed, cleaned and stored under ambient conditions in the laboratory. Germination was assessed at regular intervals. Two varieties were studied i.e. Cham 1 and Cham 4. The line source irrigation experiment in 1989/90 included five different water levels and four different nitrogen levels, while the 1990/91 experiment was designed with five different water levels and three nitrogen levels.

Table 6. **Influence of different water levels (rainfed, W_0; 20% of water balance up to 100% of water balance, W_1 up to W_5) on germination percentage after long-term storage in wheat.**

Months after harvest	Water levels W_0	W_1	W_2	W_3	W_4	W_5	average
Cham 1							
				1989/90			
6	95.3	92.5	93.3	92.0	92.8	91.3	92.7
52	87.5	85.8	85.0	88.8	85.0	83.0	85.9
				1990/91			
7	97.3	97.3	95.0	93.3	94.7	84.7	93.7
40	92.0	93.3	75.3	75.3	80.0	50.0	77.7
Cham 4							
				1989/90			
6	98.3	95.5	96.8	95.3	97.5	96.8	96.7
52	91.8	89.8	91.0	87.8	91.5	83.2	89.2
				1990/91			
7	98.7	96.3	96.7	95.3	97.3	83.3	95.1
40	91.7	93.7	92.7	88.0	90.0	73.5	88.3

Figure 1. **Influence of different water levels on germination percentage after long-term storage of wheat**

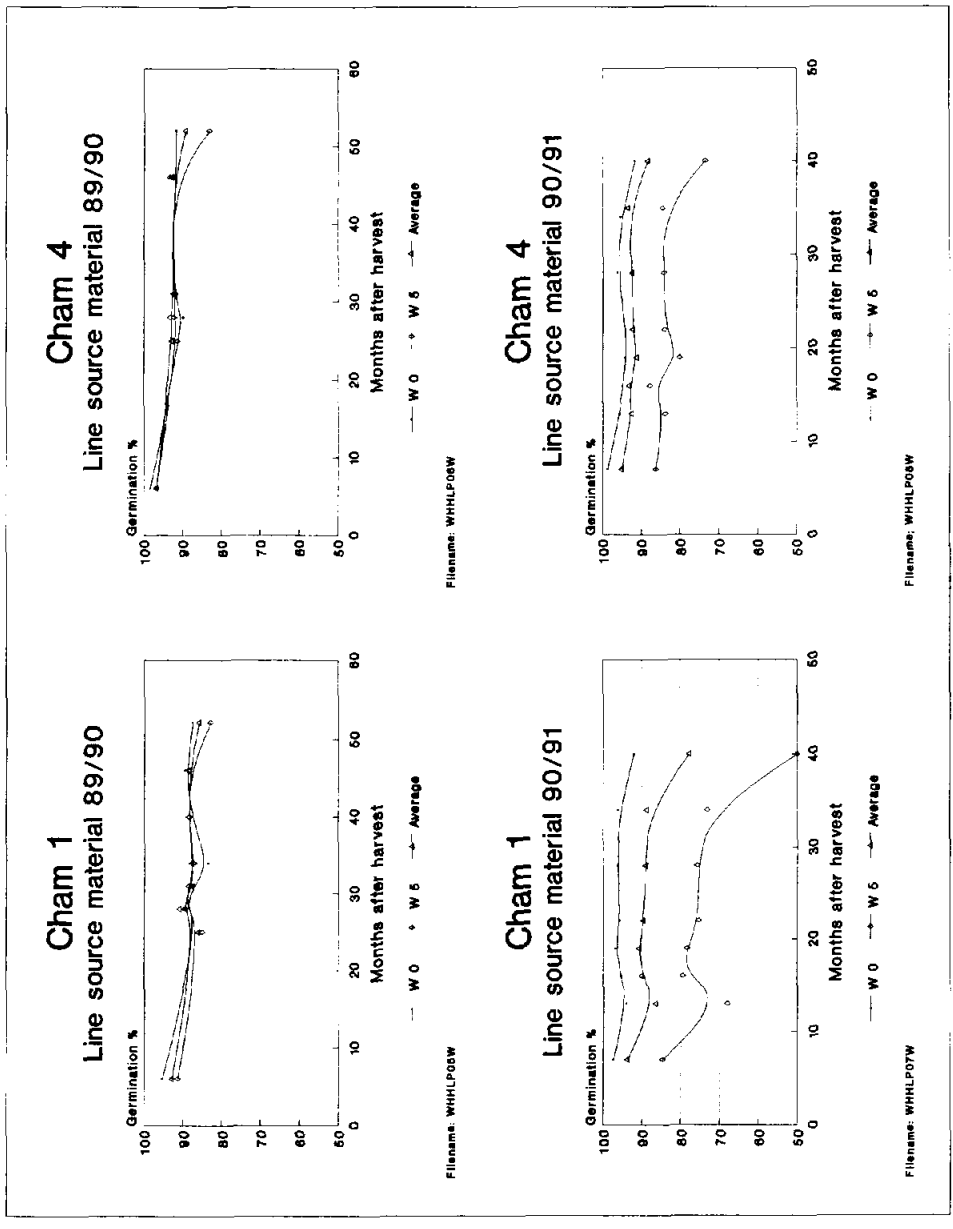
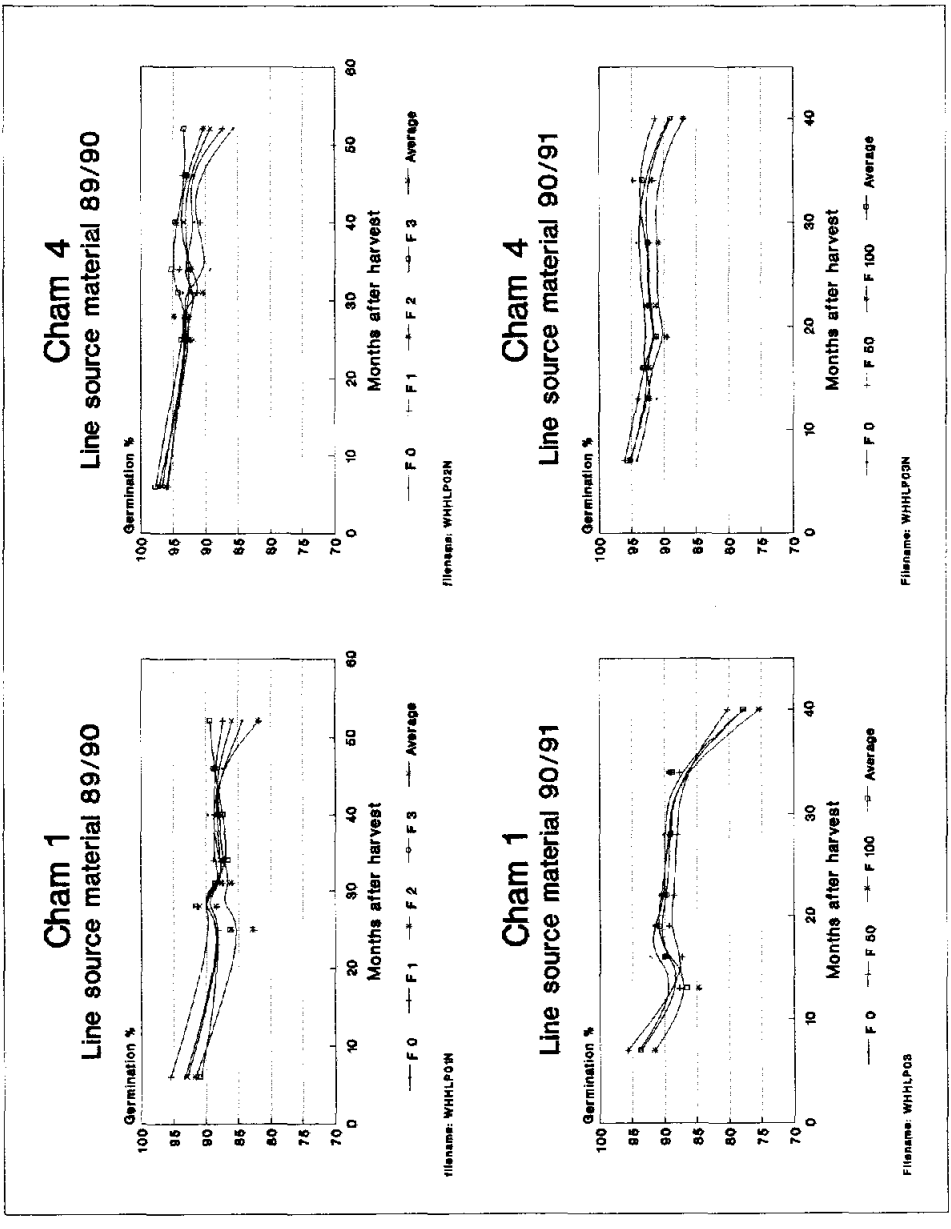


Figure 2. **Influence of different nitrogen levels on germination percentage after long-term storage of wheat**



Influence of water: The average germination percentages after over 4 year storage of Cham 1 were reduced from 92.7 to 85.9 and from 93.7 to 77.7 in the 1989/90 and 1990/91 experiments respectively (Table 6). For Cham 4 the germination was reduced from 96.7 to 89.2 and from 95.1 to 88.3. This shows that storing seed over longer periods has a negative effect on germination; this is certainly the case for the durum wheat Cham 1. Fig. 1 shows that after long-term storage the germination of seed harvested on plants grown under full water requirement (W_s) has a reduced germination percentage as compared to seed harvested on plants that obtained only 20% of the water balance. The effect is very clear in the 1990/91 experiment, both in Cham 1 and Cham 4. In Cham 4 germination was reduced from 91.7 to 73.5 % (40 weeks of storage); in Cham 1 the effect was more dramatic and germination was reduced from 92.0 to 50%.

The preliminary conclusion is that seed harvested on plants that were grown under sub-optimum water regimes have a better storability than seeds grown under full water requirements.

Influence of nitrogen: Table 7 and Fig. 2 show the effect of different nitrogen levels on the storability. No significant effect of the amount of fertilizer received during the growing season on the storability of the seed could be found, but a clear variety effect and a clear storage effect was detected.

Table 7. **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 germination percentage after long-term storage in *wheat***

Months after harvest	Nitrogen levels F_0	F_1	F_2	F_3	Average
Cham 1					
			1989/90		
6	93.3	95.5	91.7	90.8	92.7
52	84.3	87.3	81.8	89.3	85.7
			1990/91		
7	94.0	95.7	92.5		93.7
40	77.7	80.2	75.2		77.7
Cham 4					
			1989/90		
6	97.2	95.8	96.0	97.7	96.7
52	85.7	87.3	90.3	93.3	89.2
			1990/91		
7	94.2	96.0	95.2		95.1
40	89.3	91.4	87.0		89.1

3.6. Quick Assessment of the Phenol Reaction of Seed of Wheat Varieties

The phenol test is widely used for varietal identification of wheat varieties, as well as to assess varietal purity. The test requires soaking seed overnight in a 1% phenol solution and observation after a certain number of hours (often 24 hours are used for the final score).

Table 8. **Phenol coloration of modified and standard phenol test (wheat); 1 = very light, 3 = light, 5 = medium, 7 = dark, 9 = very dark.**

Variety	Modified phenol test						Standard phenol test	
	20°C			40°C				
	20m	30m	40m	20m	30m	40m	4 hrs	6 hrs
Cham 3	1	1	1	1	1	1	1	1
Cham 6	2	3	3	2	3	4	3	6
Seri 82	5	6	6	5	6	7	6	7

The standard phenol test for wheat identification was compared with a modified rapid phenol test (Journal of the Australian Institute of Agricultural Science, September/December, 1977). Three different wheat varieties were used i.e. Cham 3 (durum wheat), Cham 6 (bread wheat), and Seri 82 (bread wheat). In the standard phenol test seeds were soaked in water for 18 hours and then placed on filter paper wetted with fresh 1% phenol solution. The modified method was carried out by soaking seeds for 10 minutes in a fresh 1% phenol solution. After that, seeds were placed on a filter paper wetted with 1% fresh ammonia-phenol solution (1 g phenol and 1 ml concentrated ammonia solution (25%) in water, diluted to 100 ml) in a petri dish and incubated at 20°C and 40°C. The results were scored after 20, 30, and 40 minutes for the modified test and after 4 and 6 hours for the normal test.

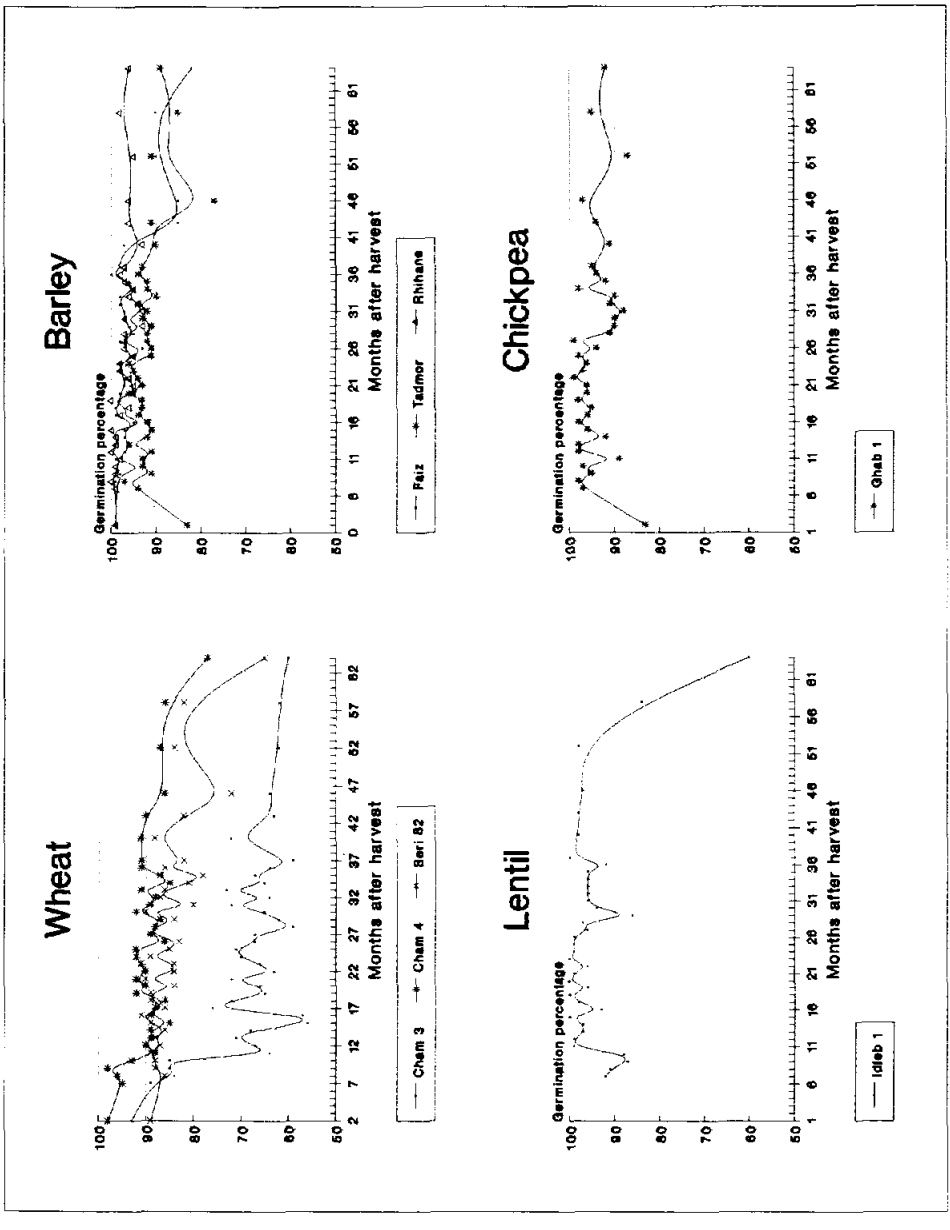
It can be concluded that the results (Table 8) of the modified phenol test are similar to those of the standard phenol test.

3.7. Monitoring Germination

As part of its task to manage the ICARDA seed store, the Unit monitors germination in the store. From Fig. 3 it can be concluded that germination in wheat and lentil is seriously reduced after five years of storage in the ICARDA seed store.

Also included in Fig. 3 is Cham 3 (a durum wheat variety). This variety shows a significant drop in germination after storage of nine months. The reason for this drop in germination is not known.

Figure 3. **Germination after long-term storage in the ICARDA seed store**



3.8. *Comparison of Medic Pod Threshers of Three Different Manufacturers*

To enable farmers to produce, harvest and thresh seed of medics, ICARDA's Pasture Forage and Livestock Program (PFLP) has developed small-scale machines such as a pod sweeper and a thresher. The ICARDA thresher was compared with other threshers and with hand-threshing. One kg of pods of two species (Medicago rigidula and M. rotata) was threshed with the different machines and physical purity, percentage of pods threshed, and threshing time were compared.

The test indicates that hand-threshing results in the highest purity (99.9%) and seed recovery (100%). The Australia manufactured thresher is faster and threshing time was 1-3 min as compared to 5-6 minutes for the ICARDA designed machine. The percentage of seed recovery is, however, lower as compared to the thresher designed at ICARDA (Table 9). Seed extraction of the ICARDA designed machine is generally better; purity is acceptable in all cases.

Table 9. Results of different threshers on 1 kg of *Medicago rigidula* and *M. rotata*

Manufacturers of threshers	Unclean seed (g.)	Purity %	Clean seed (g.)	% of seed recovery	Threshing time (min)
M. rigidula					
Hand	265.0	99.9	264.7	100	-
Australia-made	242.5	83.2	201.8	76.2	2.25
ICARDA-designed	247.5	89.5	221.5	83.7	6.00
M. rotata					
Hand	447.0	99.9	446.6	100	-
Australia-made	356.0	99.4	353.9	79.2	1.40
ICARDA-designed	407.5	97.9	398.9	89.3	5.10

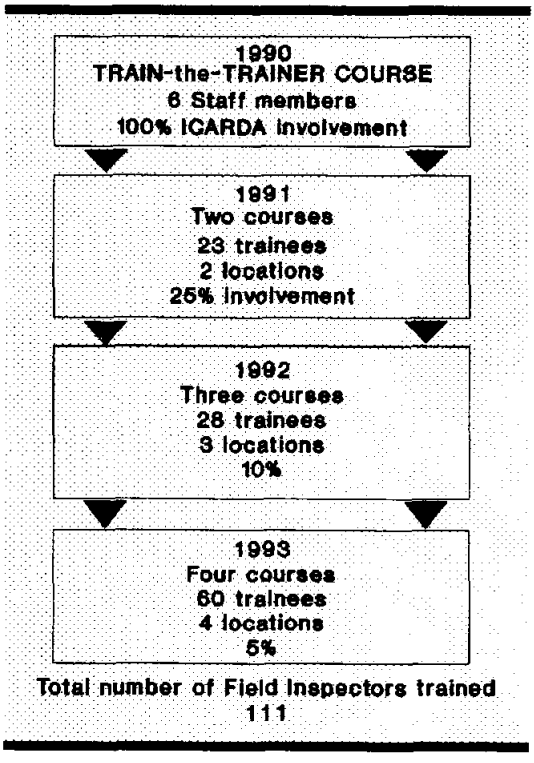
4. TRAINING

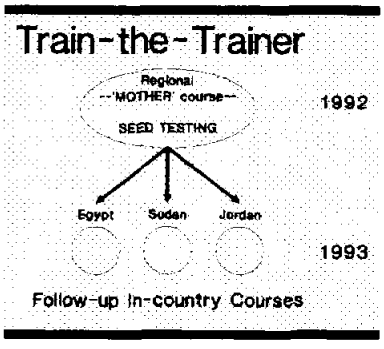
4.1. Introduction

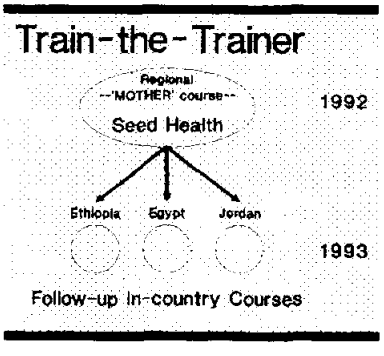
Training is the major activity and the Unit has continued exploring new approaches. An overview of the courses held in 1993 can be found in Tables 10 and 11. The Unit is also supervising three M.Sc. students; two from the University of Jordan and one from the University of Khartoum.

The Seed Unit, in collaboration with the National Seed Programs and Seed Projects in the region, is shifting emphasis from conventional to a novel approach to make training more effective and productive. Train-the-trainers courses are organized to

develop cadres of national staff that can transfer knowledge to seed staff in their countries. The train-the-trainers courses are aimed at training a small number of 'trainers' who are expected to conduct similar type of courses in the coming years for national seed staff in their respective home countries. The approach is also effective to reduce costs incurred by Seed Unit since the costs of all follow-up courses are covered by the national seed programs; ICARDA plays a supervisory role and supplies the training materials only.







The train-the-trainers approach has clearly defined objectives and the procedure is as follows: a) problem identification through roundtable discussions, seminars, workshops; b) methodology development in cooperation with NARS, seed projects; c) training a limited number of subject matter specialists as trainers; and d) conducting follow-up courses by the trainers. The primary advantage of such courses are their "multiplying effect" and "cost effectiveness" for human resource development.

In the past the Unit had organized two regional train-the-trainers courses (seed testing techniques and seed health testing) and one national train-the-trainers course. In 1993 most training courses were in-country follow-up courses of the regional and national train-the-trainers program carried out in previous years.

In addition to the train-the-trainers follow-up courses, three courses were organized on behalf of the Egyptian Seed Program, exclusively for senior Egyptian seed staff. Furthermore, in cooperation with ILCA, the Unit organized its first forage seed production course and several trainees were trained in the facilities of the Unit in Aleppo.

4.2. Regional Train-the-Trainers Programs

Two regional train-the-trainers courses (Seed Testing Techniques and Seed Health Testing in 1992) had been organized. These courses resulted in 1993 in 6 follow-up in-country courses in 4 countries whereby 64 national staff members were trained in a one year period in seed testing (36) and seed health (28). Country wise distribution is as follows: Egypt (22), Ethiopia (12), Jordan (11) and the Sudan (19).

In all these courses 'trainers' of 1992 took the lead in course organization and program coordination and were fully responsible to draw up the program and to carry out most of the lectures and practicals with national staff. There was minimum input from ICARDA staff.

It is assumed that the 'trainers' will continue to organize similar courses to strengthen the training activities of national seed programs. It is believed that the number of beneficiaries from these courses will increase.

General Seed Technology, Sennar, Sudan: This follow-up course was conducted from 13-19 March for participants from various national agricultural institutes of Sudan and organized in cooperation with National Seed Administration (NSA), the International Livestock Center for Africa (ILCA), and ICARDA. The course was planned as a joint activity with ILCA to cover food- and forage crops. On request of NSA it was redesigned as a general seed technology course and covered major elements of seed programs (variety development, evaluation, release and maintenance; seed production, processing, storage and marketing; and seed quality control). A total of 19 participants attended the course.

Table 10. **Seed production staff of different organizations trained in seed courses of ICARDA (NARC = National Agricultural Research Center; IARC = International Agricultural Research Center; NSPO = National Seed Production Organization; SC = Private Seed Company)**

Organizations	Number of staff trained							
	up to 1985	1985-87	1988	1989	1990	1991	1992	1993
NARCs	19	21	22	27	35	39	44	35
IARCs	2	3	1	2	1	1	1	1
NSPOs	16	67	74	53	61	91	122	150
SCs	-	4	1	-	-	1	2	1
Total	37	95	98	82	97	132	169	187

Table 11. Training courses of Seed Unit, 1993

Name	Location	Date	No of participants
A. International Courses			
Forage Seed Production	Addis Ababa, Ethiopia	24/10 - 05/11	18
B. In-country Train-the-Trainers Courses			
Wheat Field Inspection Methodology	Belbes, Egypt	11/04 - 15/04	15
	Melawi, Egypt		15
	Sakha, Egypt		15
	Sids, Egypt		15
C. In-country Courses (Follow-up of Regional Train-the-Trainers course)			
General Seed Technology	Sennar, Sudan	13/03 - 19/03	19
Seed Testing Techniques	Amman, Jordan	03/05 - 10/05	5
Seed Health Testing	Amman, Jordan	03/05 - 10/05	6
Seed Testing Techniques	Cairo, Egypt	12/06 - 22/06	12
Seed Health Testing	Cairo, Egypt	12/06 - 22/06	10
Seed Health Testing	Addis Ababa, Ethiopia	04/10 - 15/10	12
D. Courses on behalf of National Programs			
Seed Testing Techniques	Amman, Jordan	17/01 - 27/01	9
Seed Testing Techniques	Amman, Jordan	20/11 - 30/11	11
Seed Processing & Storage	Aleppo, Syria	17/05 - 26/05	12
Description of Varieties	Nakuru, Kenya	26/06 - 09/07	5
E. Individual Trainees			
General Seed Production	Algeria	23/04 - 21/05	1
General Seed Production	Syria	01/04 - 30/04 and 13/06 - 30/06	2
Morphological Variety Description (Cereals)	Syria	17/04 - 22/04 and 13/04 - 24/06	2
Morphological Variety Description (Legumes)	Egypt	12/06 - 24/06	1
Seed Testing techniques	UAE	2 days	1

Seed Testing and Seed Health, Baqqa, Jordan: Two in-country courses were carried out from 3-10 May as part of follow-up of regional train-the-trainers courses. Both courses were conducted at the National Center for Agricultural Research and Technology Transfer (NCARTT). The objectives were to train the national staff in

laboratory seed testing to guarantee seed quality and health respectively, particularly for early generation material produced on NCARRT farms. A total of 11 trainees i.e. five and six participants attended the seed testing and seed health courses respectively. All participants are from NCARTT regional service centers and were involved in production of different classes (breeder and basic) of seed.

Seed Testing and Seed Health, Cairo, Egypt: Two in-country follow-up courses were carried out from 12-22 June in Cairo, Egypt in cooperation with the Central Administration for Seeds (CAS), through financial support from GTZ. The objectives were to train the national staff in laboratory seed testing to guarantee seed quality and health respectively. To get practical experience the seed testing course primarily gave emphasis on purity, germination, vigor and moisture, whereas the seed health course focussed on detection, isolation and identification of seed-borne fungi, bacteria, nematodes and to a limited extent viruses. A total of 22 trainees, 12 and 10 participants attended the seed testing and seed health courses respectively. All trainees were from CAS regional seed departments where seed testing stations are located.

Seed Health Testing, Addis Ababa, Ethiopia: The Ethiopia follow-up course was conducted from 4-15 October, was organized in close cooperation with the Ethiopian Seed Corporation (ESC). The main objective of the course was -using staff trained in the 'mother course'- to train national staff in seed health testing techniques: detection, isolation and identification of seed-borne pathogens, and field inspection for diseases. The course was attended by 12 participants from different institutes involved in the national seed industry of Ethiopia.

4.3. National Train-the-Trainers Program (Egypt)

This in-country train-the-trainers program was a result of roundtable discussion on seed quality control organized in 1989 among experts from CAS, ARC, GTZ, NARP and ICARDA. The meeting recommended the development of a uniform field inspection procedure for wheat and to transfer the technical know-how to the national staff to improve the situation. The manual "Procedures for Wheat Field Inspection" was developed and the train-the-trainers approach initiated. In 1990 senior staff from CAS, ARC, GTZ, NARP and ICARDA trained seven people from CAS as trainers to take a lead in the transfer of the field inspection methodology to a wide range of quality control staff.

Three series of follow-up courses were organized in 2, 3 and 4 locations in 1991, 1992 and 1993 respectively. The number of trainees also increased substantially from 23 in 1991 to 28 in 1992 and to 60 in 1993. The number of trainees who benefitted from these courses reached 111.

Conclusion. In 1993 the in-country train-the-trainers program, which started in 1990, was completed. A similar train-the-trainers program will be initiated for legume field inspection methodology in Egypt and for wheat field inspection methodology in Sudan.

4.4 Training Activities on behalf of National Seed Programs

Apart from train-the-trainers follow-up courses, requests are emerging from national programs or seed projects to make use of the Unit's facilities and expertise available at ICARDA to train their national staff. The cost of such training activities is fully paid by the respective national program or project.

Seed Processing and Storage, Aleppo, Syria: On request of the Egyptian Central Administration for Seed (CAS) and the Egyptian GTZ Seed Project, ICARDA's Seed Unit facilities (seed cleaning plant) were used to conduct a course exclusively for Egyptian seed staff (senior engineers of seed plants in governorates). The course was held at ICARDA headquarter from 17-26 May 1993. The main objective was to train directors and engineers of seed plants on seed processing and storage. The course focused on design, operation, and management of seed plants and storage facilities. Considerable time was spent to emphasize the role of an internal quality control system to maximize output and maintain quality. A total of 12 participants attended the course.

Seed Testing Techniques, Amman, Jordan: Similarly, ICARDA was requested to train Egyptian directors of seed testing stations and senior quality control officers on concepts of modern laboratory testing techniques and management of seed testing stations. Two courses were organized in January (17-27) and November (20-30) 1993 exclusively for trainees from Egypt. The courses were organized in close cooperation with the University of Jordan and the Seed Unit of ICARDA. The former was for directors of seed testing stations, the latter for senior quality control officers working in CAS headquarter and Seed Departments in different governorates. The main objective of both courses was to train senior quality control officers on organization and management of Seed Testing Stations and on routine laboratory testing techniques in various attributes of seed quality. Lectures covered diverse aspects of seed quality and related topics focusing on recent developments, particularly amendments made in ISTA Seed Rules and Regulations. Operational management (administrative and technical) in seed sampling, sample registration, seed quality tests and reporting of test results were also covered. In addition designing and planning of seed testing stations as well as requirements for equipment and staffing were discussed. The course was attended by 9 and 11 participants in January and November 1993 respectively.

4.5. Other courses

Forage Seed Production Course, ILCA, Addis Ababa, Ethiopia: October 25 - November 5: The course was a joint effort of ICARDA's Pasture Forage and Livestock Program, ICARDA's Seed Unit, and ILCA's Herbage Seed Unit to strengthen forage seed production in ILCA's and ICARDA's regions (Sub-Saharan Africa and WANA). The course was the first forage seed production course organized by the Unit. A total of 18 participants attended the course. Theoretical sessions were held in Addis Abeba, while all practical sessions were carried out at ILCA's Debre Zeit sub-station, where facilities of the Herbage Seed Unit are located. Theoretical lectures were limited to basic principles and did not occupy more then 30% of the course time; a considerable

amount of time was spent on practical aspects of forage seed production. Participants had -for a selected number of species- to: (1) prepare experimental plots, (2) carry out seed preparation, (3) harvest plots, and (4) clean seed. Furthermore, each group of three trainees had to study all aspects of one grass species, one legume species, and one browse.

Description of Varieties, Kenya: June 26 to July 9: As part of the contribution of the Government of the Netherlands to the Government of Kenya, the International Agricultural Center (IAC), Wageningen, the Netherlands had requested the Seed Unit of ICARDA to assist the National Seed Quality Control Research Center (NSQCRC), Lanet, Kenya to conduct an in-service training program on description of varieties of the most important crops in Kenya. The objective of the course was to train personnel of the Variety Section and staff from other Kenya Agricultural Research Institutes and seed companies (Kenya Seed Company, Kenya Breweries, Oil Crop Development) in variety description and related aspects and to provide them with the required skills necessary in describing varieties.

4.6. Individual Training

Throughout the year, the Seed Unit facilities are used to conduct individual training. In 1993 seven trainees have been trained.

Long-term Group Training in General Seed Production: The long-term group training for two trainees from Syria was carried out in two phases: April and June, 1993. During the first phase the training focused on variety maintenance, description and agronomic practices of seed production. During the second phase the trainees were exposed to seed field inspection, harvesting, processing, and seed testing of cereals and legumes.

Individual Seed Production: In May an individual trainee from ITGC, Algeria spent one month at ICARDA to acquaint himself with techniques of cereal and legume seed production.

Short-term Group Training in Morphological Variety Description: The specialized short-term group training was organized for two staff from Syria on the request of the Cereal Program (ICARDA). They stayed with the Seed Unit for two weeks in two phases (17-22 April and 13-24 June, 1993). In addition one participant from ARC, Egypt also spent a period of two weeks (14-24 June) on morphological variety description of legumes. The theory of variety description was supplemented with practicals both in the field and laboratory. Morphological characters based on UPOV guidelines and IBPGR descriptors were scored and statistically analyzed for the description work. Sufficient time was spent on practicals to enable trainees to initiate variety description work.

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 1993 are indicated in Table 12. In total, 32 t of seed were produced i.e. Breeder Seed and Pre-basic Seed (255 kg), Basic Seed (9.7 t), Certified Seed (6.8 t), and Quality Seed (15.2 t). Of the total 18.9 t were cereals (60 %), 11.1 t legumes (35%) and 1.7 t vetch (5%). A small quantity of medic (215 kg) was produced. Comparing these results with the production figures of 1992 the amount of legume seed increased (24% in 1992) at the expense of cereal seed (76% in 1992).

Distribution. Table 13 presents the data on distribution of seed; seed produced during this season including carry-over seed of last year. Breeder Seed and Pre-basic Seed are not included, because this seed is not meant for distribution. In 1993 more than 35 t were distributed i.e. 13.6 t wheat, 11.6 t barley, 1.9 t lentil, 7.4 t chickpea, 1.2 t vetch and 110 kg of medic for the following purposes:

- 2.0 t for next year's plantings of the Seed Unit,
- 8.1 t to the countries of the ICARDA region,
- 4.0 t to the GOSM in Syria,
- 21.3 t for research and large-scale testing purposes, and
- 0.4 t for use at ICARDA's farm.

Table 12. Quantity of seed harvested per multiplication category in 1993 (kgs)

Seed Category	Crops						Total
	Wheat	Barley	Chickpea	Lentil	Medic	Vetch	
Beeder	60	40	120	10	15		245
Pre-basic				10			10
Basic	5500	1000	2980		200		9680
Certified	5130	1700					6830
Quality	1500	4000	5000	3000		1700	15200
Total	12190	6740	8100	3020	215	1700	31965

Quality Control. All production, processing and storage activities of the Unit are carefully followed by seed quality tests to ensure that seed produced and distributed is of good quality. Tests are also carried out for research, variety description work and other purposes (Table 14). In 1993, 2289 samples were analyzed for the following purposes: (1) monitoring of seed production, storage and distribution activities (939 samples; mainly germination tests), (2) research (1041; mainly vigor tests), (3) variety description work (66; mainly phenol tests), and (4) other purposes such as purity and germination test on Medicago species.

Table 13. Seed distribution in 1992 (kgs)

	Wheat	Barley	Lentil	Chickpea	Vetch	Medic	Total
Seed Unit	600	300	500	500	100	10	2010
Region	1250	3350	500	3000			8100
GOSM		100	600	3300			4000
Research	11550	7750	200	600	1100	100	21300
Farm	200	100	60				360
Total	13600	11600	1860	7400	1200	110	35770

Table 14. Number of samples tested in the seed testing laboratory since 1988

	1988	1989	1990	1991	1992	1993	Total
Physical purity	158	283	149	28	70	106	794
Germination	290	822	531	1069	833	1018	4563
Varietal purity	304	165	178	117	125	84	973
Moisture	8	148	178	143	153	26	656
Vigor			21	356	68	1001	1446
Seed weight			802	883	335	54	2074
Total	760	1418	1859	2596	1584	2289	10506

6. SERVICES

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. In 1993 for instance, the Genetic Resources Unit (GRU) cleaned 2500 samples of lentils, 2144 samples of Triticum and 2323 samples of barley.

A 1 ton/hour seed cleaning plant 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 seed. In 1993, a record amount of 486 t of seed has been cleaned i.e. 35 t for the Unit, 240 t for commodity programs, and 206 t as a service to Syrian seed organization, GOSM (Table 15). Table 16 provides information on the services that the laboratory gives to other programs and units.

Table 15. Seed processed since 1988 (tons)

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

Table 16. Service activities of the seed testing laboratory of the Seed Unit in 1993

Equipment	Program	Period	Samples	Total
Germination room	PFLP	172 days	563	
	LP	104 days	342	905
Other equipment	PFLP	66 days	4092	
	LP	2 days	100	
	CP	16 day	605	4797

7. PUBLICATIONS

The fifth issue of SEED INFO, the Newsletter for the participants of the WANA Seed Network, has been produced and distributed. Other publications produced are:

Diekmann, M., 1993. Equipment and Supplies List: Seed Health Testing. WANA Seed Network Publication No 1/93, ICARDA, Aleppo, Syria.

A 1 ton/hour seed cleaning plant 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 seed. In 1993, a record amount of 486 t of seed has been cleaned i.e. 35 t for the Unit, 240 t for commodity programs, and 206 t as a service to Syrian seed organization, GOSM (Table 15). Table 16 provides information on the services that the laboratory gives to other programs and units.

Table 15. Seed processed since 1988 (tons)

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

Table 16. Service activities of the seed testing laboratory of the Seed Unit in 1993

Equipment	Program	Period	Samples	Total
Germination room	PFLP	172 days	563	
	LP	104 days	342	905
Other equipment	PFLP	66 days	4092	
	LP	2 days	100	
	CP	16 day	605	4797

7. PUBLICATIONS

The fifth issue of SEED INFO, the Newsletter for the participants of the WANA Seed Network, has been produced and distributed. Other publications produced are:

Diekmann, M., 1993. Equipment and Supplies List: Seed Health Testing. WANA Seed Network Publication No 1/93, ICARDA, Aleppo, Syria.

Diekmann, M. and A.J.G. van Gastel, 1993. Disease Descriptions for Field Inspection in Seed Production. WANA Seed Network Publication No 2/93, ICARDA, Aleppo, Syria.

Diekmann, M., 1993. Seed-borne Diseases in Seed Production. WANA Seed Network Publication No 3/93, ICARDA, Aleppo, Syria.

Bishaw, Z. and B. Gregg, 1993. Equipment and Supplies List Seed Testing. WANA Seed Network Publication No 4/93, ICARDA, Aleppo, Syria.

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-031/500/April 1994