SEED UNIT

Annual Report 1996

ICARDA

About ICARDA

Established in 1977, the International Center for Agricultural Research in the Dry Areas (ICARDA) is governed by an independent Board of Trustees. Based at Aleppo, Syria, it is one of 16 centers supported by the Consultative Group on International Agricultural Research (CGIAR), which is an international group of representatives of donor agencies, eminent agricultural scientists, and institutional administrators from developed and developing countries who guide and support its work.

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

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

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a joint project of

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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. Owing to the tight production deadlines, editing of the report was kept to a minimum.

CONTENTS

INTRODUCTION

The Seed Unit of ICARDA, with financial support from the governments of the Federal Republic of Germany and the Netherlands assists and strengthens seed production and supply systems in West Asia and North Africa (WANA) region.

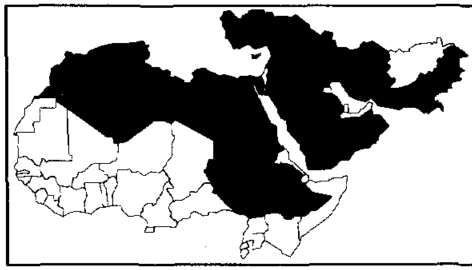
The Unit has continued to expand in scope and staff strength in response to increasing and changing patterns of need in the national programs. Economics of Seed Production was introduced in 1996 as a new area of activity, while interviews were held for the post of training officer to coordinate current diverse and specialized training requirements. Interviews were also organized for a new head of the Unit to replace Dr Tony van Gastel who left ICARDA after 11 years of service.

A major, but rewarding preoccupation of staff time during 1996 was the development of a new Medium-term Plan for 1998-2000 for incorporation into the center-wide plan for ICARDA. New directions for the Unit's activities during this period will include collaborative work with national programs in seed production and distribution activities within the predominant informal seed sector. This requires an approach, which integrates disciplines in seed science and technology, policy and economics. This does not imply an exclusive shift in emphasis to the informal sector, but one which establishes a close linkage between the informal and formal seed sectors. In addition, since many countries in WANA seek cost-effective seed system alternatives, the Unit will increasingly provide technical and policy guidance in privatization and similar efforts.

This report discusses work carried out during 1996 within the main activity areas of the Unit: (1) WANA Regional Seed Network, (2) Economics of Seed (3) Seed Security, (4) Research, (5) Training, (6) Workshops, and (7) Production of Seed, and (8) Publication, Staff and Consultants.

1. WANA REGIONAL SEED NETWORK

Membership of the Seed Network comprises 18 countries from the WANA region. In addition, there are 11 regional and international organizations that are observers of the Network. Several initiatives have been undertaken through regional cooperation, coordination and implementation of seed-related activities among member countries to ensure the development of sustainable seed supply systems. These activities include developing uniform seed policies and regulatory frameworks that could harmonize seed production and quality control, formulating procedures and operations to integrate national seed systems and stimulate regional seed trade.



Activities undertaken by the Network require collaborative effort by all member countries. The Steering Committee and the Secretariat help guide and coordinate these activities.

1.1 Steering Committee Meeting

The Steering Committee comprises country representatives of five Network member countries (currently Cyprus, Egypt, Lebanon, Morocco and Syria) and the Secretariat based at ICARDA. The Committee meets once every year to review the overall progress of the Network and guide member countries and the Secretariat in implementing on-going activities. The fourth annual meeting of the Steering Committee was held at ICARDA, Aleppo, Syria in March 1996, and was attended by all members. During this meeting the committee reviewed progress and performance of the Network activities, which are summarized in Table 1.

1.2 Highlights of Network Activities

Each of the 18 members acts as a lead country in a specific activity under the umbrella of the Network. The Steering Committee assists the Secretariat to coordinate and guide these activities. The Seed Unit staff follows up and monitors the progress of Network activities with the respective country representatives by visiting national programs. As much back-stopping as possible is provided during these visits in order to ensure implementation of decisions taken by the Steering Committee and/or Network Council.

Table 1 Progress of Network activities

Activity	Lead country	Progress made
Seed industry costs	Algeria	Questionnaire revised and data collection in progress
WANA list of cultivated species	Cyprus	Draft prepared and circulated for comment
WANA list of weed seeds	Cyprus	Draft prepared and circulated for comment
WANA seed directory	Egypt	Directory being revised for publication in 1998
WANA variety release mechanisms	Ethiopia	Some information collected; draft to be developed
Seed technology courses	Iraq	Little information collected
Rules and regulations for seed import and export	Jordan	Questionnaire revised and data collection in progress
Database on seed publications and sharing of training courses	Lebanon	Questionnaire revised and data collection in progress
Regional variety evaluation system	Libya	Questionnaire circulated for comment
WANA catalogue of varieties	Morocco	Draft prepared and circulated for comment
WANA referee seed testing	Morocco	Seed samples dispatched for referee testing
Database on variety description	Pakistan	Little information collected
Uniform seed policy	Sudan	Information collected; draft to be developed
WANA catalogue of seed standards	Syria	Catalogue being revised for publication in 1998
Database on seed import and export	Tunisia	Questionnaire revised and data collection in progress
Seed certification systems	Turkey	Information collected and ready for compilation
Rules and regulations for investment in seed sector	Yemen	Questionnaire revised and data collection in progress

Lead countries undertook the following activities during 1996:

- Algeria, Jordan, Tunisia and Yemen developed questionnaires on seed production costs, regulations for seed trade, database for seed import/export, and investment laws in seed sector respectively. These questionnaires were reviewed and approved by the Steering Committee and sent to country representatives for collecting information from member countries. The lead countries were to assemble the information received.

- Sudan collected and summarized information on seed policies while Turkey completed the collection of information on seed certification systems. Country representatives of both Sudan and Turkey were requested to develop draft models on seed policy and seed certification respectively.

- Egypt and Syria revised the WANA Directory of Names and Organizations, and the WANA Catalogue of Field and Seed Standards, respectively. The former includes the list of seed specialists, while the latter provides information on field and seed standards for cereal, legume and some vegetable crops. A standard for *Quality Declared Seed* developed by FAO will be included as an appendix to the revised catalogue.

- Ethiopia, Iraq, Libya, Lebanon and Pakistan were requested to further pursue their activities on variety release procedures, higher education in seed technology, regional variety performance, training and information sharing, and database for variety description, respectively. Ethiopia agreed to develop a draft model on variety release based on a questionnaire developed for circulation to member countries.

- Morocco dispatched seed samples for referee testing to laboratories in member countries. The laboratories carried out the tests, the results of which will be published in Network reports.

1.3 Network publications

The Secretariat has published a model decree for plant variety protection for discussion and further improvement. The publication could be useful reference material for countries formulating laws for variety protection. Comments received from country representatives and observers will be incorporated into the revised document in line with the 1991 Act of the UPOV Convention.

In addition, draft publications of WANA Catalogue of Weed Species, WANA Catalogue of Cultivated Species, and WANA Catalogue of Varieties were prepared for circulation to country representatives and observers for comments and suggestions. The catalogues of weeds and cultivated species were prepared by the country representative of Cyprus, while the catalogue of varieties was prepared by the country representative of Morocco. The full list of Network publications is presented in Table 2.

The regular newsletter of the Network, SEED INFO (Nos. 11 and 12) and another 3 country studies in the series FOCUS on SEED PROGRAMS (Egypt, Turkey and Yemen), were also published and distributed in 1996.

1.4 Network Country Offices

It is hoped eventually to establish a Network office in each member country, which is equipped with basic facilities. An administrative assistant will run each office and implement Network activities under the supervision of the Country Representative. As a first step in this process, during 1996 all member countries were each provided a computer and printer to assist their Network functions.

Table 2. WANA Seed Network Publications

Diekmann, M. 1993. Equipment and supplies list: Seed health testing. WANA Seed Network publication No. 1/93.

Diekmann, M. and A.J.G. van Gastel. 1993. Disease descriptions for field inspection in seed production for (a) Loose smut of wheat and barley, (b) Common bunt of wheat, (c) Ascochyta blight of chickpea, and (d) Covered smut of barley. WANA Seed Network Publication No. 2/93.

Diekmann, M. 1993. Seed-borne diseases in seed production. WANA Seed Network Publication No. 3/93.

Bishaw, Z. and B. Gregg. 1993. Equipment and supplies list: Seed testing. WANA Seed Network Publication No. 4/93.

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

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

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

WANA Secretariat. 1995. WANA catalogue of field and seed standards, 1994. WANA Seed Network Publication No. 8/95.

WANA Secretariat. 1995. WANA seed directory of organizations and names. WANA Seed Network Publication No. 9/95.

Tourkmani, M. 1995. WANA referee test - Bread wheat. WANA Seed Network Publication No. 10/95.

Tourkmani, M. 1995. WANA referee test - Lentils. WANA Seed Network Publication No. 11/95.

Gregg, B., S.A. Wanis, Z. Bishaw and A.J.G. van Gastel. 1996. Plant variety protection: Decree under national seed law of a country of West Asia and North Africa. WANA Seed Network Publication No. 12/96.

WANA Secretariat. 1996. WANA catalogue of weed seeds. WANA Seed Network Publication No. 13/96.

WANA Secretariat. 1996. WANA catalogue of cultivated crops. WANA Seed Network Publication No. 14/96.

WANA Secretariat. 1996. WANA catalogue of varieties. WANA Seed Network Publication No. 15/96.

1.5 New Membership

The IITA/GTZ Seed Promotion and Marketing Project confirmed its interest in participating as an observer in the WANA Seed Network. There were changes in the country representatives for Yemen and Sudan due to new personnel occupying the relevant positions. In Ethiopia the function of country representative was transferred from the Ethiopian Seed Enterprise (ESE) to The National Seed Industry Agency (NSIA).

2. ECONOMICS OF SEED

With the appointment of Dr Sam Kugbei in February 1996 as Seed Economist, the Economics of seed production was included as a new component of the Seed Unit to reinforce activities in training and networking with an overall objective of strengthening seed production institutions in the WANA region. The recognition given to economics is against the background of recent changes taking place in many WANA countries where commercialization of seed production forms part of national economic reform policies. It is intended that principles of economics applied in seed production will be used widely to help in developing sustainable and effective seed systems.

2.1 Visits to National Programs

Initial visits were made by the Seed Economist to the national programs of Egypt, Ethiopia, Jordan, Morocco, Tunisia and Yemen to familiarize with these programs and to explore areas for collaborative work. During these visits discussions were held mainly with officials involved in the commercial aspects of seed production to obtain an overview of the seed industry, identify potential features that need strengthening in economics and give possible suggestions for improvement.

2.2 Collaborative Research in Economics

Proposals were developed for collaborative work between the Seed Unit of ICARDA and the national seed programs of Ethiopia and Morocco. The objective of these studies is to make a comprehensive assessment of the efficiency of the seed delivery system in terms of margins and other incentives, which motivate the movement of seed from producers to the end users. Questionnaires were designed for collecting data at three levels in the production - distribution - use chain (i.e. at the contract grower, seed enterprise and final seed user). Both ICARDA and the national programs of Ethiopia and Morocco reviewed the proposals, questionnaires and procedures. To enable comparative analysis and a more efficient outcome, similar studies are envisaged for other WANA countries.

2.3 Economics as a component in seed courses

Besides a specialized course in Economics of Seed Production (section 5.1.1) an attempt was made to introduce economics into relevant courses organized by the Seed Unit. Lectures on commercial analysis of seed systems given during the seed courses were found to be very useful. Arrangements were made to continue contributing to future training courses as a means of complementing technical knowledge already available in seed production.

3. SEED SECURITY

A study on seed security was initiated to develop a conceptual framework and assemble existing experiences in disaster-preparedness through improved availability of planting materials of cereals and legumes following natural or man-made disasters. Country case studies were completed in five WANA countries: Eritrea, Ethiopia, Pakistan, Sudan and Yemen. The original plan to include Afghanistan was dropped due to security problems. The study was focused on: (a) assessing availability of varieties and seeds; (b) preparing a catalogue of varieties, seed producers, and distributors; (c) summarizing regulations on plant quarantine, varieties, seed import and export; and (d) preparing a list of NGOs or private voluntary organizations (PVOs) involved in agriculture and relief operations. The study was supported by the USDA/USAID Famine Mitigation Activity. Information contained in the individual country reports was compiled into a main document on the overall assessment of the seed security situation. The following conclusions and recommendations are summarized from the study:

- Drought is a recurrent event in all countries causing crop failure and death to livestock. In recent years drought situations have worsened, often recycling within short periods of time and making it difficult for national governments to cope up with frequent disasters. In severe drought situations, farmers consume grains and saved seed, thus disrupting crop production for the following season.

- Past experiences show that agricultural research has focused on the development of crop varieties and crop husbandry technologies aimed at high potential areas. The less-endowed areas have been neglected in the acquisition of modern crop production technologies. Continuous environmental degradation of areas makes it necessary to pay more attention to drought vulnerable agricultural lands upon which several millions of people depend for their livelihood.

- Seed systems are heavily dependent on parastatal seed enterprises (e.g. Ethiopia and Pakistan) and government departments (e.g. Eritrea, Sudan and Yemen). The private sector has not yet developed and plays a minor role in seed supply in the staple crops. The overall quantity of seed supplied by the formal sector is very small to influence increased production. It is also observed that, whatever quantity of seed is produced from the formal seed sector is directed towards the high potential areas. The marginal areas susceptible to droughts and other natural stresses are to a large extent neglected. The active involvement of the private sector in seed supply is essential for a sound seed system to serve the farming community. The national governments are encouraging the participation of the private sectors as in Ethiopia through the establishment of the National Seed Industry Agency for the promotion of the development of the entire national seed system. Similar efforts are underway in Pakistan and Sudan.

- The parastatal seed enterprises and government department-managed seed organizations have been operating under heavy subsidy by national governments and are characterized by over-staffing and bureaucratic management which are costly and slow. To-date these countries are realizing the need to commercialize the seed business to operate along profit lines. In Ethiopia, the Ethiopian Seed Enterprise (ESE) has been operating at a loss until 1991 because the seed price is fixed by the government preventing the enterprise from making profit. However, ESE is now allowed to determine its seed price under a market economy system. In Sudan some steps have been taken to decentralize the National Seed Administration (NSA) allowing the Plant Propagation Administration (PPA) some autonomy. The PPA is now partially recovering the cost of seed production.

- The majority of farmers in the countries under study use farm-saved seeds, which is an age-old production practice. The use of farm-saved seed of local landraces is more marked in the drought-prone areas, for instance in Eritrea, Ethiopia, Sudan, and Yemen. The practice of using local cultivars improves stability production but with no increased production.

- The seed distribution and marketing channels in the countries in question are inadequate in terms of the number of marketing outlets and distribution mechanisms. The distribution of seeds including other inputs favors farmers only in accessible areas.

- A Seed quality control and certification system is in place in Pakistan and Sudan. In Ethiopia, draft seed regulations submitted to the Council of Ministers have been approved. Provision for seed quality control and certification is made in the Regulations. Yemen has no official seed quality control or certification system but currently an internal seed quality control system exists. A draft Seed Act has already been submitted to the Parliament pending ratification. In general, the quality of seeds distributed to farmers in these countries is poor, thus negatively affecting the planting value of seed lots.

- All countries have quarantine stations at ports of entry with the lists of prohibited and restricted plant species. However, quarantine regulations exist for seeds and other plant materials in Ethiopia, Pakistan and Sudan but not in Eritrea and Yemen. The Ministry of Agriculture and Water Resources of the Republic of Yemen has submitted draft quarantine laws pending ratification. However, the quarantine stations in Eritrea and Yemen are organized on an ad-hoc basis, thus lacking effective control over material entering or leaving the country.

- None of the countries has a national or regional seed reserve system in operation to counteract deficiencies in seed for planting during disaster situations. Following crop failures, not only is grain for consumption in short supply, but also shortage of seed for planting is encountered. Relief operations in disaster situations tend to disregard the kind of cultivars and quality of planting materials for distribution. National governments and NGOs usually tend to supply seeds from any source, farmers often receiving unadapted varieties and poor quality seed resulting in reduced yield and sometimes crop failures. Community seed banks have been tried in Ethiopia and Sudan, but very few make an impact at national or regional level. NGOs and international development organizations heavily assist these seed banks through funding and technical support.

- The following measures are proposed for a seed security system:
  - Strong exchange of information system among WANA Seed Network member countries on seed availability (crop type, variety, source, etc)
  - Conducting cooperative trials on cultivars developed by ICARDA, ICRISAT, NARS and other sources. The cooperative trials must be coordinated by ICARDA including identification of varieties, preparing trial sets, supply of seeds for trials, evaluation formats, etc
  - Keeping a crop/variety register book by ICARDA every year including commercial and pedigree names of varieties under commercial use in the WANA Region.
  - Initiating farmer-managed seed production systems for drought-prone areas by selecting reasonably suitable areas for seed production. Farmer-managed seed systems are required to operate along business lines with some profits serving localized farm communities. Encouraging successful farmer-managed seed systems to grow into seed enterprises in the long run.
  - Providing external assistance to develop seed quality control and certification systems along with setting seed standards. Although it will be difficult to make similar standards for all the countries, but minimum seed standards may be agreed upon to facilitate seed import/export within WANA Region.
  - Provision for seed reserve stocks essential in each country to counteract unpredictable shortage of seed at regional level.
  - Establishing an adequate number of research centers in drought-prone areas to assist in dry land farming is currently a concern in many countries of the WANA Region.
  - Emphasizing the use of local landraces essential in farmer-managed seed production and supply systems where improved varieties have not been developed.

4. RESEARCH

Research activities are pursued mainly by MSc studies undertaken in the region under the supervision of Seed Unit staff. An MSc study in economics of seed production was completed, while another on the informal vetch seed sector in Turkey is in progress. This section also reports on long-term studies on storability and germination conducted by the Unit.

4.1 Economics of Wheat Seed Production

A Jordanian student supported by the Seed Unit of ICARDA successfully completed an MSc dissertation on *Economics of Wheat Seed Production in Jordan.* Staff of the University of Jordan and ICARDA jointly supervised this thesis, essential elements of which are summarized below.

4.1.1 Background

Wheat is a major staple food crop in Jordan. Up to 80 per cent of national wheat requirement is imported annually, with the gap between domestic production and consumption widening as the country's population continues to rise. Government therefore subsidizes the production of wheat as a means of encouraging farmers to increase productivity, and in this way help reduce dependence on imports. Other attempts to maximize production from the limited land resource available (arable land constitutes about 4% of total area) include introducing new high yielding varieties and promoting mechanization at farm level.

The Government of Jordan recognizes seed production as a fundamental means of enhancing food production. A Seed Multiplication Project (SMP), established in 1982 through a bilateral agreement between the governments of Jordan and Germany (GTZ), is the main source of certified seed in the country. There are three local implementing partners of SMP: the National Center of Agricultural Research and Technology Transfer (NCARTT) of the Ministry of Agriculture, which undertakes variety maintenance, production of basic seed and quality control; the Jordan Cooperative Organization (JCO), which carries out contract seed multiplication, processing, storage, distribution and marketing; and the University of Jordan (UOJ), which conducts seed technology research and training in a unit established within the Faculty of Agriculture.

At present, small-scale farmers who use traditional varieties and cultural practices dominate wheat seed production nationwide (a fact, also revealed by a survey conducted in 1990 and reported in the Seed Unit Annual Report of 1993). There is little information on national effective demand for improved seed, although it is believed that current certified seed production does not meet actual need. It is against this background that this study has been formulated.

4.1.2 Objectives

- To investigate the efficiency and effectiveness of wheat seed production and distribution in Jordan.
- To identify alternative cost-effective approaches to seed production

4.1.3 Data collection

- Secondary data on efficiency and effectiveness of SMP: NCARTT for data on variety development, as well as information on area, output levels, and costs of producing basic seed; JCO for data on area, output levels, costs, and revenue from production of certified seed; UOJ for information on seed quality and training.

- Primary data on farm-level efficiency and effectiveness: formal questionnaires used in interviewing 100 randomly selected certified seed growers of JCO in order to obtain information on socio-economic characteristics, production and distribution constraints, views on extent of success in current efforts, and ideas on future prospects.

4.1.4 Major findings

(a) Using Ordinary Least Squares estimation for variation in certified seed output from growers, the following linear functional form was established between seed output (dependent variable) and specified explanatory variables:

$$SEED = 28.69AGE + 9.81EDUC + 14.35AGEXP$$

t-values: (2.8) (2.2) (5.9)

$\overline{R^2} = 78\%$

$F_{k-1,n-k} = 113.5$

where:

SEED = Quantity of certified seed produced by grower
AGE = Age of seed grower
EDUC = Educational level of seed grower
AGEXP = Number of years of agricultural experience

Nearly 80 per cent of the variation in seed output can be 'explained' by the variables AGE, EDUC and AGEXP. The explanatory power of these variables is demonstrated by significant values of the test statistics: t, F and corrective coefficient of determination. The specification shows that educational background, age and years of experience in crop production are important factors, which determine the efficiency and effectiveness of seed growers. The thesis presents and discusses these factors as important considerations in selecting growers for seed multiplication.

(b) Contract seed production in Jordan is found to be carried out mainly on a part-time basis by growers who also derive additional income from various types of off-farm ventures.

(c) Many of the growers multiply seed either on their own holdings or in joint ownership for which much of the labor comes from the family household; family size (active members within the household), therefore, seems to be an important factor.

(d) The growers, on the whole, practice crop rotation based on a seed - fallow - seed system. There is little sharecropping or cash renting of farmland, particularly due to the fact that the cost of leasing land is rather high because of the benefits associated with cash crops such as tobacco and onions.

(e) Despite a substantial amount of government subsidy, seed production under the Seed Multiplication Project seems barely profitable as judged from the derived mean Benefit-cost ratio of 1.2. The implications of this in terms of the current government policy of withdrawing subsidy on seed-related inputs are discussed.

(f) In deriving the total cost of production for certified seed, the values of physical inputs such as basic seed, fertilizer and herbicide tend to remain constant because the Ministry of Agriculture fixes the prices of these items. The costs of distribution and marketing, however, appear most variable since these components are not subject to control and depend mainly on the size of production and the distance from the farm to the points of sale.

(g) Total income earned by the growers comprises revenue derived from the sale of not only clean seed, but straw as well, and hence many farmers prefer the wheat variety, Hourani 27, because of its similarity to traditional varieties in terms of high straw yield and palatability.

(h) Judging from a survey of seed growers, constraints faced in contract growing generally include those related to low yields, high input prices, high marketing costs, untimely availability of inputs, admixtures in the seed, and a lack of reliable seed testing that could help improve problems associated with seed quality.

(i) Finally, the study presents an alternative seed production strategy based on contract production in areas of higher potential since this enables the production of cheaper and good quality seed.

4.2 Vetch seed production within the informal sector in Turkey

A staff member from the Central Field Crops Institute is studying at the University of Ankara to investigate the informal vetch seed supply in Central Anatolia. Initial contacts were made with the extension staff to seek assistance in implementing the survey in Polatli and Cubuk counties.

4.2.1 Polatli County

A preliminary interview was made with extension staff to gather general information about the county and the farmers. Different extension methods were used, but the staff observed that demonstration trials were most effective. The demonstrations were conducted in five different villages, and this stimulated demand for vetch seed in the area.

4.2.2 Cubuk County

Based on the survey of seed merchants and interview with extension staff, a short list of villages that produce vetch has been formally selected for the survey. The survey on vetch seed supply will be conducted in March 1997.

4.3 *Monitoring germination of seed during long-term storage*

This section reports on two experiments designed to study the germination capacity of seed stored over a long time in the ICARDA seed store.

4.3.1 Experiment 1: The effects of water and nitrogen on germination capacity

The amount and distribution of rainfall are frequent constraints to crop production activities in dry areas of WANA. It is expected that crops grown under varying stress conditions exhibit differences in seed quality. The objective of these experiments in wheat was to assess the effect of different levels of water and nitrogen available during plant growth on: (i) seed size, (ii) germination, (iii) seed vigor, (iv) field emergence, (v) yielding capacity in the next season, and (vi) storability. Results of the effects on seed size, germination, seed vigor, field emergence, and yielding capacity have been published in previous Annual Reports. This report considers the effects on storability.

4.3.1.1 Methods

To study the influence of different water and nitrogen levels, seed was harvested in two consecutive seasons (1989/90 and 1990/91), from a line source irrigation experiment in which different plots receiving varying amounts of water depending on the distance from the water source. The seed was threshed, cleaned and stored under ambient conditions in the laboratory and germination was assessed at 6-month intervals. The mean conditions in the store during winter and summer periods were 50% - 85%, 45% - 65% (relative humidity), and $3^{o}C - 15^{o}C$, $28^{o}C - 40^{o}C$ (temperature) respectively. Two varieties of wheat (Cham 1 and Cham 4) were studied. The experiments were based on the application of 5 levels of water (W_0 = rainfed; W_1, W_2, W_3, W_4, and W_5 = 20%, 40%, 60%, 80%, and 100% water balances respectively), and 3 levels of nitrogen (N_0, N_1, and N_2 = 0 kg N/ha, 50 kg N/ha, and 100 kg N/ha respectively). All seed samples for both experiments 1 and 2 had an initial moisture content of about 10%.

4.3.1.2 Results

Results of the influence of different levels of water and nitrogen on germination capacity are presented in Tables 3 and 4.

Table 3 Influence of different water levels on germination of wheat seed

Months after harvest	W_0	W_1	W_2	W_3	W_4	W_5	Mean
			Water level				
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
88	80.5	82.3	80.0	83.0	81.5	87.0	82.4
				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
76	93.5	95.0	84.7	84.0	90.3	71.5	86.5
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
88	85.0	85.0	87.5	87.5	84.5	86.5	86
				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
76	92.0	90.0	90.7	91.7	88.3	78.0	88.5

Table 4 Influence of different nitrogen levels on germination of wheat seed

Months after harvest	N_0	N_1		N_2	Mean
			Nitrogen level		
Cham 1					
			1989/90		
6	93.3	95.5		91.7	92.7
52	84.3	87.3		81.8	85.7
88	82.5	80.5		79.5	82.4
			1990/91		
7	94.0	95.7		92.5	93.7
40	77.7	80.2		75.2	77.7
76	91.0	83.7		85.0	86.6
Cham 4					
			1989/90		
6	97.2	95.8		96.0	96.7
52	85.7	87.3		90.3	89.2
88	83.8	85.8		85.5	86.6
			1990/91		
7	94.2	96.0		95.2	95.1
40	89.3	91.4		87.0	89.1
76	93.4	90.8		85.0	89.7

Results of Ordinary Least Squares linear regression of germination as dependent variable and months of storage as independent variable are shown in Table 5 for water and in Table 6 for nitrogen. For simplicity, only the effects of minimum and maximum levels of treatments for both water and nitrogen are considered.

The following linear relationship is used for estimation:

$$G = a - bT + U$$

where G = germination capacity in % (dependent variable)
a = intercept term
b = slope term or coefficient of time
T = time (months after harvest)
U = error term

The test statistics used to assess the levels of significance are t, F and adjusted R^2.

Table 5 Ordinary Least Squares estimation for differing water levels

Dependent variable is germination percentage
10 observations used for estimation from 34 to 88 months after harvest

Harvest year	1989/1990				1990/1991			
Variety	Cham 1		Cham 4		Cham 1		Cham 4	
Water level	W_0	W_5	W_0	W_5	W_0	W_5	W_0	W_5
Regressor: Time (T)								
- Coefficient	-0.1232	-0.0587	-0.1579	-0.1172	-0.0408	-0.1410	-0.0839	-0.1435
- t-Statistic	-2.5347	-1.0972	-3.8254	-1.7276	-1.8442	-0.7508	-2.1374	-1.7274
F-Statistic	6.4248	1.2038	14.633	2.9845	3.4010	-0.5636	4.5687	2.9839
Standard error	2.6496	2.9150	2.2492	3.6963	1.2059	10.2359	2.1402	4.5284
Adjusted R^2	0.3760	0.0221	0.6024	0.1807	0.2106	-0.0510	0.2839	0.1806

Table 6 Ordinary Least Squares estimation for differing nitrogen levels

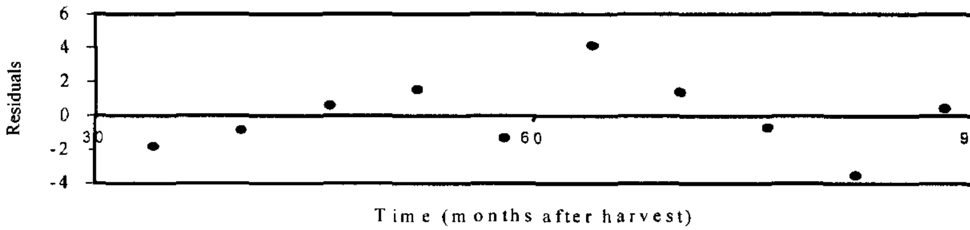
Dependent variable is germination percentage
10 observations used for estimation from 34 to 88 months after harvest

Harvest year	1989/1990				1990/1991			
Variety	Cham 1		Cham 4		Cham 1		Cham 4	
Nitrogen level	N_0	N_2	N_0	N_2	N_0	N_2	N_0	N_2
Regressor: Time (T)								
- Coefficient	-0.1362	-0.2105	-0.1692	-0.1315	-0.017	-0.1359	-0.0167	-0.1431
- t-Statistic	-4.4960	-2.9033	-4.4612	-3.3522	-0.1778	-1.5550	-0.4135	-4.4016
F-statistic	20.2140	8.4291	19.9022	11.2375	0.0316	2.4181	0.1710	19.3744
Standard error	1.6505	3.9514	2.0681	2.1381	5.2015	4.7613	2.1967	1.7721
Adjusted R^2	0.6810	0.4522	0.6774	0.5322	-0.1206	0.1361	-0.1015	0.6712

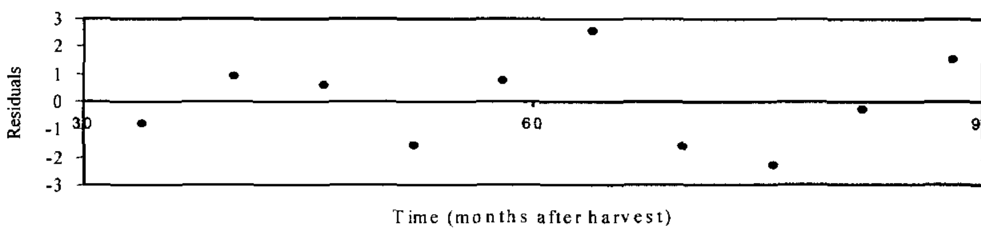
Figure 1 shows plots of residual and fitted/actual values for relationships between germination and time of storage which show the best goodness of fit for water (Cham 4 W_0 1989/90) and for nitrogen (Cham 1 N_0 1989/90). In both cases the residual plots show a random scatter of points about the mean, while the fit plots show a close fit between fitted and actual values of germination capacity. These provide further support to the significant values of the test statistics given in Tables 5 and 6, and that the linear specification is acceptable.

Figure 1 Residual and Fit Plots for varying levels of water and nitrogen

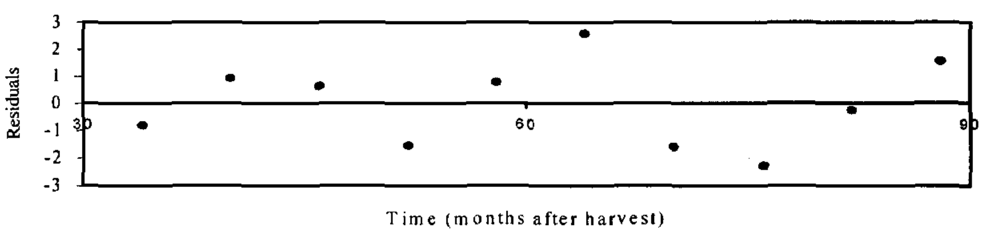
(i) Residual Plot for Varying Levels of Water - Cham 4 W_0 (1989/90)



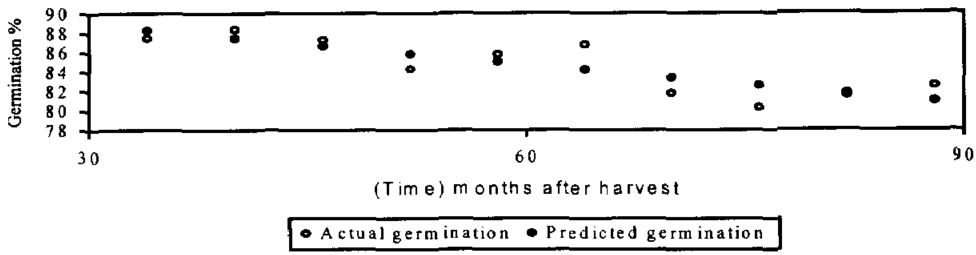
(ii) Residual Plot for Varying Levels of Nitrogen - Cham 1 N_0 (1989/90)



(ii) Residual Plot for Varying Levels of Nitrogen - Cham 1 N_0 (1989/90)



(iv) Fit Plot for Varying Levels of Nitrogen - Cham 1 N_0 (1898/90)



4.3.1.3 Discussion

As expected, the germination capacity of seed kept in storage gradually declines with time regardless of the crop, variety or the levels of water and nitrogen fertilizer applied during the growth of the crop. This result is confirmed in all cases by negative coefficients of the variable, Time (months after harvest). An attempt is made using the results of this study to determine the extent to which the rate of decline in germination can be explained by differences in the levels of water and nitrogen.

Effect of water

Beside Cham 1 (1990/91), the decline in germination with time in all cases is more significant for seed grown under rainfed conditions (W_0) than for seed grown under high water balance (W_5) as judged from the significant levels of t, F and adjusted R^2 test statistics (Table 5). This means that seed grown under W_5 condition tends to decline less in germination during storage compared to seed grown under W_0 condition. A possible explanation for this finding is that high water balance supports the development of more vigorous and mature seed, which tends to last longer in storage.

Levels of significance in the test statistics also indicate that for seed from both years, Cham 1 maintains higher levels of germination during storage than Cham 4. Durum wheat is generally regarded as more susceptible to mechanical damage than bread wheat because of limited protection given to the coleoptile, which negatively affects the germination capacity. However, the results of this study show that for seed of comparable germination capacity, durum wheat (Cham 1) maintains germination better during long-term storage than bread wheat (Cham 4). Damage to the coleoptile in durum wheat may therefore be a crucial factor in post-harvest handling, but not so much during storage.

Effect of nitrogen

The results for seed grown during 1989/90 indicate that the rate of decline in germination is less at N_2 than at N_0 for both Cham 1 and Cham 4. As in the case of water, this is probably associated with the development of more vigorous seed at high nutrient or nitrogen levels. At N_0, both Cham 1 and Cham 4 show more or less the same rate of decline in germination with time. However, at N_2 Cham 4 shows a marginally higher rate of decline in germination, but not significant enough to draw a general conclusion that Cham 1 stores better than Cham 4 under these conditions. On the whole, the results for 1990/91 seem less convincing in explaining the drop in germination with time for seed grown under varying nitrogen levels.

Besides Cham 4 at N_2, the decline in germination with time is not significant in other cases regardless of the level of nitrogen.

4.3.1.4 Conclusion

This study has established a relationship between storability of wheat seed and the levels of water applied during the growth of the crop. A similar clear relationship could not be developed in the case of nitrogen fertilizer. It has also been shown that Cham 1 (a durum wheat variety) maintains germination capacity better in storage than Cham 4 (a bread wheat variety).

4.3.2 Experiment 2: Effect of seed treatment

Seeds from different sources are kept in the ICARDA seed store, and some over a long period of time. This experiment discusses the results of an experiment designed to study the change in viability of seed kept in the store over the period of 8 years for treated and untreated seeds of varieties of wheat, barley and lentil.

4.3.2.1 Methods

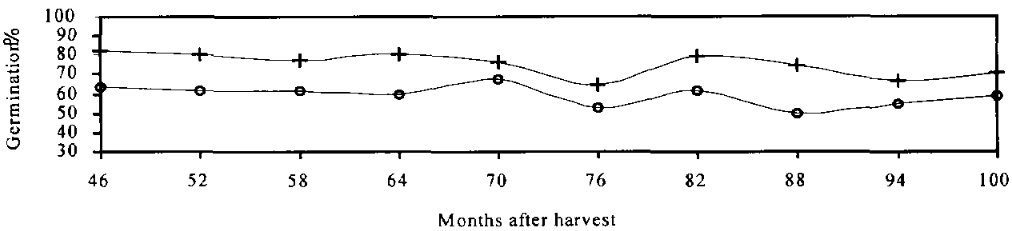
Treated and untreated seed samples of two bread wheat varieties (Cham 4, Seri 82), one durum wheat variety (Cham 3), one 6-rowed barley variety (Rihane 03), two 2-rowed barley varieties (Tadmor, Faiz), and one lentil variety (Idleb 1) were stored in jute bags under ambient conditions in the ICARDA seed store. The wheat and barley varieties were treated with the fungicide, Vitavax 200 (carboxin and thiram), while the lentil variety was treated with the fungicide, Benlate (benomyl) and the insecticide, Actelic (perimiphos methyl). Standard germination was tested on all samples at six-month intervals.

4.3.2.2 Results

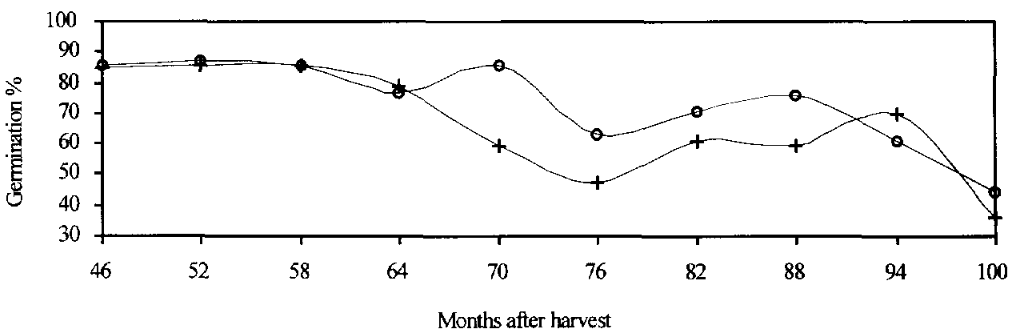
The change of germination over time is illustrated in Figure 2. As in section 4.3.2, the results are tested for goodness of fit using Ordinary Least Squares estimation methods with germination capacity as dependent variable, and time (months of storage) as independent variable. The significance levels of the test statistics (t, F, SE, and adjusted R^2) are shown in Table 7.

Figure 2 (a) – (g) Seed viability during long-term storage

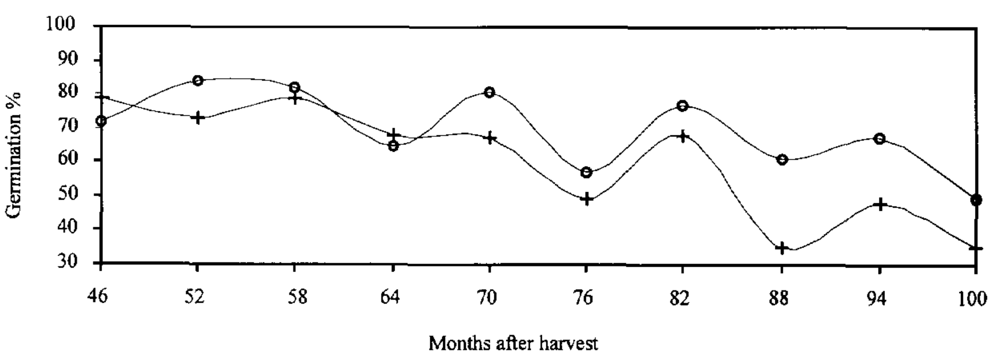
(a) Wheat - Cham 3



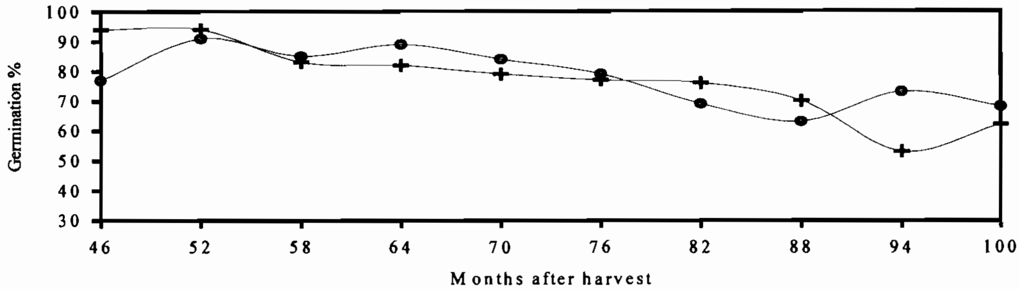
(b) Wheat - Cham 4



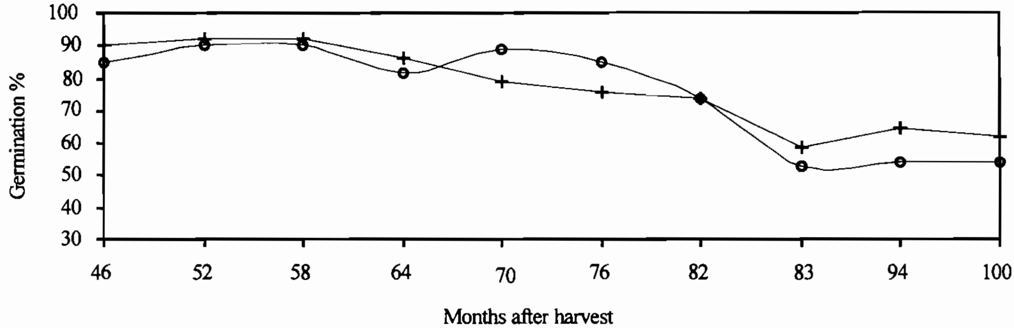
(c) Wheat - Seri 82



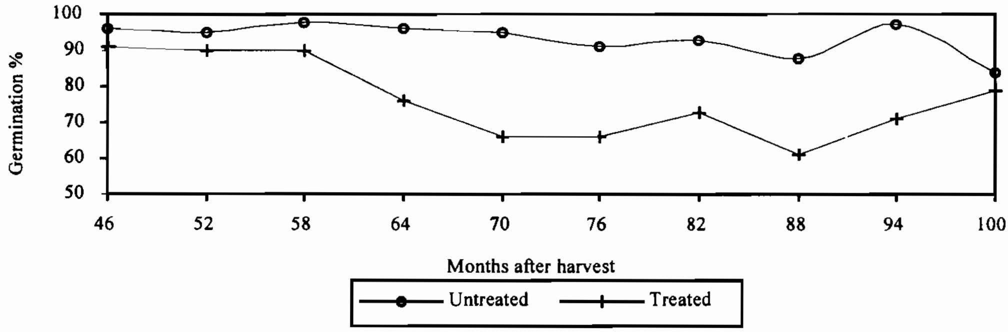
(d) Barley - Tadmor



(e) Barley - Faiz



(f) Barley - Rihane 03



(g) Lentil - Idleb 1

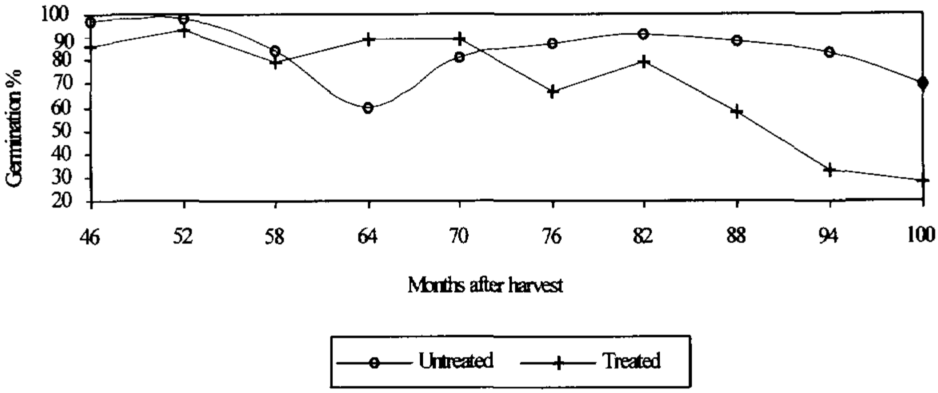


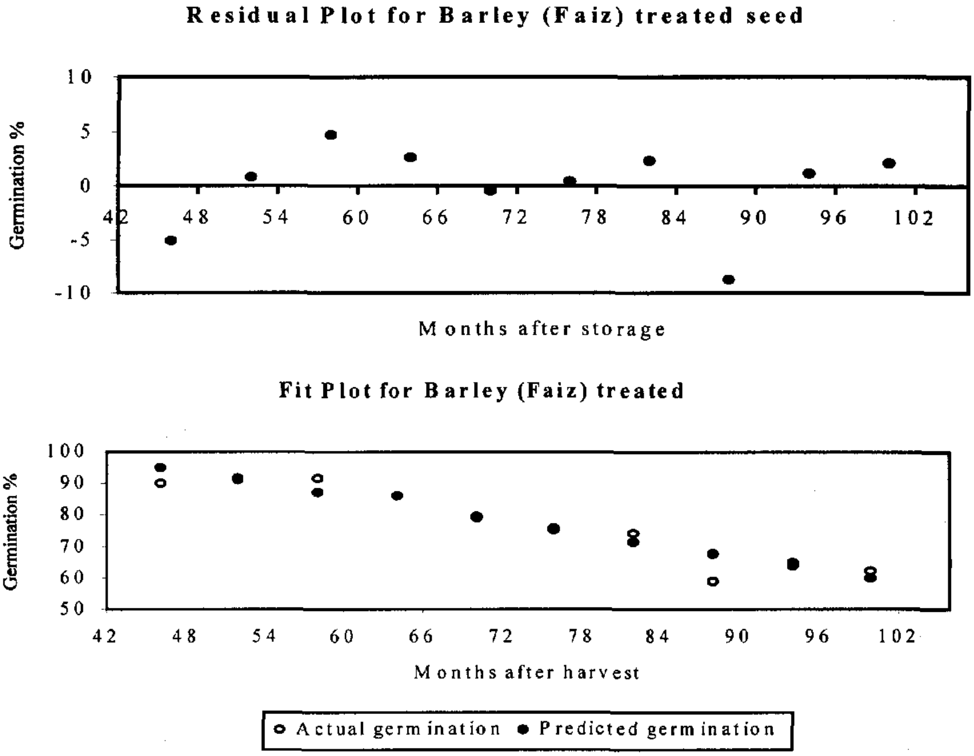
Table 7 Ordinary Least Squares estimation for samples of treated and untreated seed

Dependent variable is germination percentage
10 observations used for estimation from 46 to 100 months after harvest

	Test statistics				
	Coefficient of T	t-value of T	F-value	Standard Error	Adjusted R^2
Untreated Seed					
Wheat - Cham 3	-0.1636	-1.9410	3.7674	4.5944	0.2352
Wheat - Cham 4	-0.6576	-4.4118	19.4636	8.1229	0.6723
Wheat - Seri 82	-0.4232	-2.4579	6.0412	9.3841	0.3590
Barley – Faiz	-0.7515	-4.8058	23.0958	8.5222	0.7156
Barley – Tadmor	-0.3859	-3.1115	9.6812	6.7584	0.4910
Barley - Rihane 03	-0.1586	-2.4275	5.8927	3.5603	0.3522
Lentil - Idleb 1	-0.2404	-1.1287	1.2739	11.6079	0.0295
Treated Seed					
Wheat - Cham 3	-0.2374	-2.8967	8.3909	4.4659	0.4509
Wheat - Cham 4	-0.7616	-3.7109	13.7709	11.1850	0.5866
Wheat - Seri 82	-0.8172	-5.1440	26.4603	8.6575	0.7388
Barley – Faiz	-0.6515	-8.3742	70.1264	4.2400	0.8848
Barley – Tadmor	-0.6667	-7.7904	60.6817	4.6637	0.8690
Barley - Rihane 03	-0.3990	-2.4875	6.1875	8.7414	0.3656
Lentil - Idleb 1	-1.1111	-4.7587	22.6454	12.7247	0.7063

Figure 3 shows plots of residuals and fitted/actual values of the relationships between germination and time of storage for treated seed of barley (variety Faiz), which shows the best goodness of fit. As in section 4.3.2, the residuals again show a random and unsystematic behavior, and the fit plot shows a close fit between fitted and actual values of germination capacity.

Figure 3 Residual and Fit Plots for Barley (Faiz) treated seed



4.3.2.3 Discussion

It can be seen from Figure 2 that for nearly all crops and varieties, the level of germination is kept more or less at the same levels up to 58 months of storage, after which there is a progressive decline. The pattern of decline varies with crop and variety, but also depends on whether the seed is treated or not.

For both treated and untreated seed of wheat, Cham 3 (durum wheat) maintains germination capacity better during storage than Cham 4 and Seri 82 (bread wheat). This result is similar to that in the case of the experiment on storabilty of wheat in section 4.3. In the case of barley, the 6-rowed variety (Rihame 03) stores better than the 2-rowed varieties (Faiz and Tadmor). The reason for this is not clear, although it is possible that differences in the levels of dormancy between the two types of barley may play a part.

In almost all cases, the rate of decline in germination is more significant for treated seed than for the corresponding untreated seed. This effect is evident particularly in the case of the lentil variety, Idleb.

4.3.2.4 Conclusion

As in the case of the study on storability of wheat, this experiment shows that seed of durum wheat maintains germination better during storage that the bread wheat varieties studied. Furthermore, regardless of the crop or variety, treated seed tends to decline more significantly in germination during storage than untreated seed.

5. TRAINING

The Seed Unit has strong links and collaborative activities with the national seed programs in which human resource development is one of the major components. Training remains an important tool for strengthening national seed systems. A wide range of training courses were designed and offered through regional, sub-regional and in-country courses to increase the competence of people working at various decision-making levels; these are summarized in Table 8. The courses are meant to enhance knowledge and expertise amongst technicians and technical managers in national seed programs.

The Seed Unit has also continued exploring new strategies and is shifting emphasis to train-the-trainers approach to make training more effective and sustainable. It is intended to strike a balance between regional and in-country courses. Most up-stream, management and train-the-train courses will be held at regional or sub-regional level whereas technical courses including follow-up courses will be offered at the national level.

5.1 Regional Train-the-Trainers Courses

Past experience clearly showed an increase in training requests from national programs on specialized topics. This large demand can be better met through train-the-trainer courses with an ultimate objective of decentralizing training to the national programs.

The primary step in the train-the-trainers approach is to select subject matter specialists as trainers from national programs for proper training at the initial 'mother' course conducted by the Seed Unit. The trainers are in turn expected to organize follow-up courses on the same subject matter in their respective countries to help disseminate technical and practical knowledge acquired during the main course. It is anticipated to gradually decentralize and encourage NARSs to play a major role in training.

5.1.1 Economics of Seed

In view of privatization efforts by seed programs in WANA there is a growing need for staff to acquire knowledge, skills and techniques in order to analyze and design seed delivery systems which are cost-effective and more sustainable. A □train-the-trainers□ course in economics of seed production was organized in cooperation with the GTZ Seed Project (Egypt) from 29 September to 10 October 1996 in ICARDA, Aleppo, Syria. The objective of the course was to train national staff in appropriate techniques in seed system analysis. The course comprised topics covering four broad areas, which constitute the seed system analysis: (a) technical aspects, (b) institutional, organizational and managerial aspects; (c) financial and commercial aspects, and (d) economic, social and environmental aspects. Lectures have been designed and compiled into a comprehensive guide book (draft) on the economics of seed production for use by field staff, supervisors and managers in the national seed programs, as well as a guide for policy makers. Formal lectures were supplemented by group tasks and presentations on selected country case studies with the aim of stimulating discussions and sharing of experiences during which very useful and innovative ideas were generated.

Fourteen participants from nine countries (Algeria, Egypt, Ethiopia, Jordan, Morocco, Pakistan, Sudan, Syria and Yemen) attended the course. It is expected that some participants will organize in their respective countries follow-up courses during 1997 and 1998.

5.1.1 In-country Train-the-Trainers Courses

The second follow-up course in legume field inspection methodology was conducted from 24 to 28 March 1996 in Egypt. The course was organized at two locations, Sakha and Sids, in cooperation with the Central Administration for Seed Testing and Certification (CASC) and the German Agency for Technical Cooperation (GTZ). Twenty-nine field inspectors and quality control officers from 13 governorates attended the course, which covered legume field inspection methodology, variety maintenance, variety description and important seed-borne diseases. Emphasis was given to the detection and identification of faba bean virus diseases during field inspection and laboratory seed testing. The eight 'trainers', who attended the 1994 national 'train-the-trainer' course, took the lead in coordinating the course, delivering lectures and conducting practicals with minimal assistance from senior staff of CASC, GTZ and ICARDA.

5.2 Regular Courses

Apart from the trainer courses, the Seed Unit continued to organize some regular courses based on the need of national seed programs in the region. The variety description course appeared to be relevant as some WANA countries are considering implementing plant variety protection and breeder's rights. However, success depends on detailed technical know how for descriptions of the crops to be protected.

5.2.1 Morphological Variety Description

The morphological variety description course was organized in April 1996 at ICARDA headquarters in response to strong demand from the national seed programs. The course focused on description of major cereals and legumes and to a lesser extent on pasture and forage crops. The topics covered include breeding methodology, variety maintenance and characteristics for variety identification as well as issues of plant variety protection and breeder's rights. Moreover, experimental designs, data collection, statistical analysis and the use of computers in variety description were also covered. The lectures were augmented by practical sessions in the field, laboratory and data handling on computers.

15 participants attended the course from 14 countries, which are at different stages of variety description activities. They came from Algeria (2), Egypt, Ethiopia, Iraq, Jordan, Lebanon, Libya, Morocco, Oman, Pakistan, Syria, Sudan, Turkey and Yemen.

5.3. In-Country Courses

Sometimes the Seed Unit receives special requests from national programs, which are taken as the basis for organizing in-country courses. Such courses are focused on technical issues and are practical-oriented. In addition, other in-country courses are organized as follow-up to the train-the-trainer courses conducted at ICARDA.

5.3.1 General Seed Technology

In Iran, government policy has encouraged a substantial increase in seed demand for different crop varieties where the need for skilled staff becomes necessary to expand the national seed program. The Seed Unit was requested to organize a seed technology course, the first with the national program of Iran, in close cooperation with Agriculture Research, Education and Extension Organization (AREEO) from 6-14 July 1996 in Merageh, Iran. The course was designed to train participants in general seed technology with particular emphasis on cereal and legume crops covering different aspects of seed program components: variety development, testing, evaluation, release and maintenance; seed production, processing, and storage; seed marketing, promotion and distribution; and seed quality control. Particular emphasis was also given to variety description, seed-borne diseases and seed health testing. Theoretical lectures were supplemented with practical sessions and demonstrations.

The course was attended by 17 participants; eight from the Seed and Plant Improvement Institute and nine from the Dry Land Agriculture Research Institute (DARI). All participants were staff of agricultural research centers (variety development, maintenance and elite seed production) or the seed certification and quality control service.

Table 8 Training courses in 1996

Course type and topic	Date	Location	No. of participants
<u>Regional Train-the-Trainer Course</u> Economics of Seed Production	29 September - 10 October	Aleppo, Syria	14
<u>In-country Train-the-Trainers Course</u> Legume Field Inspection Methodology	24 – 28 March	Sahka & Sids, Egypt	29
<u>Regional Course</u> Morphological Variety Description	15 – 25 April	Aleppo, Syria	15
<u>In-country Course</u> General Seed Production	6 – 14 July	Merageh, Iran	17
<u>Individual Training</u> Seed Testing	15 – 27 June	Aleppo, Syria	1
<u>Training Workshop</u> Referee Seed Testing	21– 25 January	Amman, Jordan	18
<u>Training Seminar</u> Legume Seed Production	5 – 16 May	Aleppo, Syria	15

5.4 Short-term Individual Training

5.4.1 Seed Testing Techniques

From 15 to 27 June 1996 a postgraduate student from the University of Jordan was given a two-week training in seed testing techniques as part of her MSc course work. The training covered testing seed for moisture, purity, germination (including dormancy treatment), and vigor, using samples of wild wheat (*Triticum dicoccoides*) collected from different locations in Jordan. The seed testing rules of the International Seed Testing Association (ISTA) were explained and demonstrated during practical sessions.

5.5 Training workshops and seminars

During 1996 one training seminar, one training workshop and one follow-up seminar in seed technology were organized.

5.5.1 Workshop on Referee Seed Testing

The WANA Seed Network aims at promoting inter-regional seed trade among member countries; and referee seed testing is one of its regular activities which is coordinated by Morocco. In 1994 and 1995, wheat and lentil seed samples were tested by seed testing stations of member countries to monitor the accuracy of results from different laboratories.

The Network Secretariat in cooperation with the University of Jordan and The Seed Certification and Quality Control Department in Morocco organized the Training Workshop on Referee Seed Testing for heads of seed testing stations from 21-26 January 1996 in Amman, Jordan. During the workshop the history, procedures and principles of seed testing and referee testing were discussed. The WANA referee test results were reviewed in an effort to harmonize the procedures. Apart from lectures and practicals on purity and germination, the participants were also introduced to sources of variation in test results. In purity sessions, proper identification of seeds was emphasized, whereas in germination sessions, the focus was on physiology of germination, seed dormancy and seedling abnormalities. The use of tolerance tables in seed testing in general and in referee testing in particular was also discussed in detail.

18 participants representing the seed testing laboratories of 12 member countries who participated in the referee testing attended the workshop namely Algeria, Cyprus, Egypt, Ethiopia, Iraq, Jordan, Lebanon, Oman, Turkey, Tunisia, Syria and Yemen.

5.5.2 Training Seminar on Legume Seed Production

Legumes play an important role in the agriculture of WANA as a source of food and feed, and as a break crop to maintain soil fertility. However, compared to cereals, the legume seed industry is very much constrained by high production costs, lack of mechanization, high disease incidence and limited availability of improved varieties.

A Training Seminar on Legume Seed Production was organized from 5-16 May 1996 at Aleppo, Syria. It was designed to discuss important aspects of legume seed supply relating to variety development, evaluation, release, description and maintenance; seed production, processing, storage; seed marketing and distribution; and quality control. The training seminar focused on the status and constraints at each level from national and regional perspectives. The role of formal and informal seed sectors were discussed by looking into different options for seed programs development and the linkages that are necessary for effective legume seed supply to farmers.

The seminar was participatory and all that attended gave presentations on the status and constraints of legume seed industry in their respective countries. Moreover, group sessions were held to exchange views and share experiences in legume seed production and supply. The group made recommendations, which were intended for wider circulation to national programs in the region.

Fifteen staff from diverse research and seed production organizations attended the training seminar. They were seed program managers, senior seed production officers and agricultural research officers from the national programs of Algeria, Egypt (2), Ethiopia (2), Iran, Jordan, Lebanon, Libya, Morocco (2), Pakistan, Sudan (2) and Syria.

5.5.3 Seminar in Seed Technology

Over the years, the Seed Unit of ICARDA has designed a wide range of training opportunities through international, regional, sub-regional and in-country courses for seed sector staff in the region. Such courses have benefited over 1,000 staff within and beyond the WANA region. A Seminar in Seed Technology was organized for participants of ICARDA seed courses from 1985-1995. After thorough selection, 28 former participants working with public, private and NGOs in the seed sector were invited to attend the seminar to share their experiences. The participants represented 12 countries within the WANA region (Egypt, Ethiopia, Iran, Iraq, Jordan, Libya, Morocco, Pakistan, Sudan, Syria, Turkey and Yemen) and 4 from Sub-Saharan Africa (Kenya, Tanzania, Uganda and Zambia).

The main purpose of the seminar was to bring together former participants of ICARDA seed courses to: (i) assess past achievements through their contribution to the national programs, (2) increase awareness of new developments in the seed sector, and (3) discuss future strategies for seed sector development. The seminar was based on key presentations on formal and informal seed sector. Several topics were addressed on formal and informal approaches in plant genetic conservation, variety development and seed supply issues; and how to operate an integrated, sustainable, efficient and cost-effective seed supply systems. Presentations from public sector, private sector and NGOs generated interesting ideas and vigorous discussions. The discussions resulted in recommendations addressing policy, institutional, technical and regulatory issues within the perspective of developing seed programs. It is expected that the proceedings of the seminar will be published in 1997.

5.6 Training Material Development

5.6.1 Seed Production Manual

A new seed science and technology manual was published based on materials developed for a course organized in 1993 for academic staff in agricultural universities of WANA. The manual replaces the seed production technology manual previously used as a resource book by the Unit.

5.6.2 Audiotutorial on Seed Processing

The Seed Unit in collaboration with the International Livestock Research Institute (ILRI) developed an audiotutorial on seed processing. This has a set of slides and resource book explaining the principles of seed processing.

6. PRODUCTION OF EARLY GENERATION SEED

The Seed Unit is responsible for production of quality seed of promising lines and varieties of ICARDA origin for distribution to NARS for research purpose or national seed programs to initiate seed multiplication of released varieties. The seed production fields as well as the processing and laboratory facilities are also intensively used for practical training of staff from the national seed programs.

6.1. Seed multiplication

The quantity of different seed categories produced in 1996 is indicated in Table 9 and summarized in Table 10 for the period 1988 to 1996. From the total of 31.2 tons of seed produced during 1996, 0.2, 1.1, 13.5 and 16.4 tons are Breeder, Pre-basic, Basic and Quality Seed, respectively. Cereals with 24.5 tons and legumes with 6.7 tons are representing 78.6% and 21.4%, respectively.

Table 9 Quantity of seed harvested (kg) per seed category in 1996

	Crop						
Seed category	Wheat	Barley	Chickpea	Lentil	Medic	Vetch	Total
Breeder	100	30	65	20	20		235
Pre-basic		680		390			1070
Basic	4700	8500	345				13545
Quality	8765	1750	850	3125	1150	745	16385
Total	13565	10960	1260	3535	1170	745	31235

Table 10 Quantity of seed produced (ton) during the period 1988 to 1996

Seed	Year									
Category	1988	1989	1990	1991	1992	1993	1994	1995	1996	Total
Breeder	1.5	0.4	0.3	0.5	0.2	2.5	0.1	0.1	0.2	5.8
Pre-basic		6.1	8.7	6.8	3.7		0.2	0.9	1.1	27.5
Basic			4.3	17	21.6	9.7	6	12.6	13.5	84.7
Certified					17.8	6.8	9.2			33.8
Quality	79	25	7.4	14.5	21.1	15.2	19.7	10.2	16.4	208.5
Total	80.5	31.5	20.7	38.8	64.4	34.2	35.2	23.8	31.2	360.3

6.2 Seed processing

A 1-ton/hour seed processing is used primarily to clean seed produced by the Unit. In addition, the plant is used to clean and treat seed produced by other ICARDA commodity programs. In 1996, a total of 282.6 t of seed was cleaned, comprising 36.4 t for the Seed Unit, 201.2 for ICARDA breeding programs, and 45.0 t as a service to the General Organization for Seed Multiplication (GOSM), Syria. The amount of seed processed since 1988 is given in Table 11.

Table 11 Quantity of seed processed (tons) during the period 1988 to 1996

	Year									
	1988	1989	1990	1991	1992	1993	1994	1995	1996	Total
Seed Unit	80.6	31.5	20.8	42.0	65.7	35.0	29.3	28.2	36.4	369.5
ICARDA programs										
- Cereal	0	1.6	5.8	0.3	1.8	28.8	3.2	11.5	33.0	86
- PFLP	3.1	4.3	1.8	8.9	14.7	5.6	19.0	5.0	6.2	68.6
- Legume	10.5	6.5	16.7	18.1	12.7	42.5	11.0	13.9	30.9	162.8
- FRMP	16.2	20.1	25.5	35.4	33.9	45.1	18.5	13.8	18.9	227.4
- Station op.	21.6	6.4	29.0	47.6	75.7	123.0	116.0	176.1	112.2	707.6
Sub total	132	70.4	99.6	152.3	204.5	280.0	197.0	248.5	237.6	1621.9
GOSM (Syria)	0	0	108.3	218.7	94.7	206.2	40.0	152.1	45.0	865
Total	132	70.4	207.9	371.0	299.2	486.2	237.0	400.6	282.6	2486.9

6.3 Seed distribution

In 1996, a total of 36.9 tons of seed were distributed i.e. 15.5 tons of wheat seed, 17.9 tons of barley seed, 1.6 tons of lentil seed, 1.3 tons of chickpea seed, 0.6 tons of vetch, and 0.06 tons of medic seed (Table 12) for the following purposes: (1) for next year's plantings of the Seed Unit (1.4 tons), (2) to NARS in ICARDA region (1.6 tons), and (3) for research and large-scale testing purposes (33.9 tons). Table 13 shows the amount and destination of seed during the period from 1988 to 1996.

Table 12 Quantity of seed distributed (tons) in 1996

	Crops						
Destination	Wheat	Barley	Lentil	Chickpea	Vetch	Medic	Total
Seed Unit	0.20	0.45	0.30	0.33	0.08	0.01	1.37
NARS	0.25	0.85	0.35	0.13	0	0	1.58
Research	15.00	16.60	0.95	0.80	0.55	0.05	33.95
Total	15.45	17.90	1.60	1.26	0.63	0.06	36.9

Table 13 Quantity of seed distributed (tons) during the period 1988 to 1996

	Year									
Destination	1988	1989	1990	1991	1992	1993	1994	1995	1996	Total
Seed Unit	2.3	1.4	1.1	3.2	2.4	2	1.2	3	1.4	18
Region	23.6	5.8	14.7	9.4	27.8	8.1	4.7	1	1.6	96.7
GOSM[1]	2.6	0.9		0.2	6	4	3.8			17.5
Research	14.3	6.9	7.9	8.5	14.1	21.3	16.6	17.5	35	142.1
ICARDA farm	3.4	4.4	1.1	1.4	0.4	0.4	0.7		0.1	11.9
Farmers	11.1	2.3								13.4
Total	57.3	21.7	24.8	22.7	50.7	35.8	27	21.5	38.1	299.6

[1] GOSM: General Organization for Seed Multiplication, Syria

6.4 Seed Quality Control

The quality of all seed produced, processed and stored is carefully monitored in the seed-testing laboratory before distribution. This is to ensure that the seed distributed is of a good quality. Moreover, seed testing was also carried out for research, variety description work and other purposes. In 1996, 1837 samples were analyzed to monitor the quality of the seed produced, stored and distributed (Table 14). The tests carried out include varietal purity using phenol test (113 samples), physical purity (237 samples), specific weight (246 samples), moisture content (57 samples), germination (1071 samples), and vigor (113 samples).

Table 14 Number of seed samples tested during the period 1988 to 1996

	Year									
Test	1988	1989	1990	1991	1992	1993	1994	1995	1996	Total
Variety purity	304	165	178	117	125	84	302	108	113	1496
Physical purity	158	283	149	28	70	106	166	102	237	1299
Seed weight			802	883	335	54	48		246	2368
Moisture	8	148	178	143	153	26	20	65	57	798
Germination	290	822	531	1069	833	1018	1005	1169	1071	7808
Vigor			21	356	68	1001	261		113	1820
Total	760	1418	1859	2596	1584	2289	1802	1444	1837	15589

6.5 Other services

The seed cleaning laboratory became operative in 1990 and has ever been extensively used since then for a service to ICARDA's commodity programs. In 1996, the Genetic Resources Unit (GRU) cleaned a total of 6930 samples comprising 3292 of *Triticum* spp., 2038 of *Cicer* spp., 1600 of *Lens* spp (Table 15). Fifty-five samples of barley and 62 samples of *Trifolium* were cleaned, for the respective germplasm programs.

Table 15 Number of samples cleaned in the seed processing laboratory in 1996

ICARDA Program	Crops	Samples cleaned
Genetic Resources Unit (GRU)	Triticum spp.	3292
	Cicer spp.	2038
	Lens spp.	1600
Pasture, Forage and Livestock Program (PFLP)	Barley	34
Germplasm Program (GP)	Wheat	62
	Barley	21
Total		7047

7. PUBLICATIONS, STAFF AND CONSULTANTS

7.1 Publications

During the year, the tenth and eleventh issues of *SEED INFO*, the Newsletter of the WANA Seed Network, and *FOCUS on SEED PROGRAMS* of Egypt, Turkey and Yemen has been produced and distributed. Other publications produced are:

Gregg, B., S.A. Wanis, Z. Bishaw and A.J.G. van Gastel. 1996. *Plant variety protection: Decree under national seed law of a country of West Asia and North Africa.* WANA Seed Network Publication No. 12/96.

van Gastel A.J.G., M.A. Pagnotta and E. Porceddu (eds.). 1996. *Seed Science and Technology.* Proceedings of the `Train-the-Trainers' course sponsored by Med-campus Programme (EEC), 24 April to 9 May 1993, Amman, Jordan. ICARDA, Aleppo, Syria, vii + 311pp.

van Gastel, A.J. G., Z. Bishaw, R. Griffiths and J. Hanson. 1996. *Seed Processing. Audiovisual training module*. International Center for Agricultural Research in the Dry Areas, Aleppo, Syria, and International Livestock Research Institute, Addis Ababa, Ethiopia, 16pp.

7.2 Staff

Dr. A.J.G. van Gastel	Head of Seed Unit (resigned March 1996)
Mr. Zewdie Bishaw	Seed Production Specialist (Acting Head from March 1996)
Dr Samuel B. Kugbei	Seed Economist (Joined February 1996)
Mr. Abdoul Aziz Niane	Senior research technician
Mrs Sonia Noaman	Administrative assistant

7.3 Consultants

Mr M. Makkawi	Seed Research, since January 1996
Dr. R. Shachl	Seed Specialist, Austria (Janaury '96).
Mr M. Tourkmani	Cheif, Seed Quality Control, Morocco (January '96)
Ir. H. Koster	Seed Specialist, CPRO, Wageningen, The Netherlands (April '96)
Mr Gugsa Indeshaw	Seed Specialist, Addis Ababa, Ethiopia (fixed-term for 2 years commencing 1996)

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ايكاردا
ص. ب. 5466 حلب ، سورية

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

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