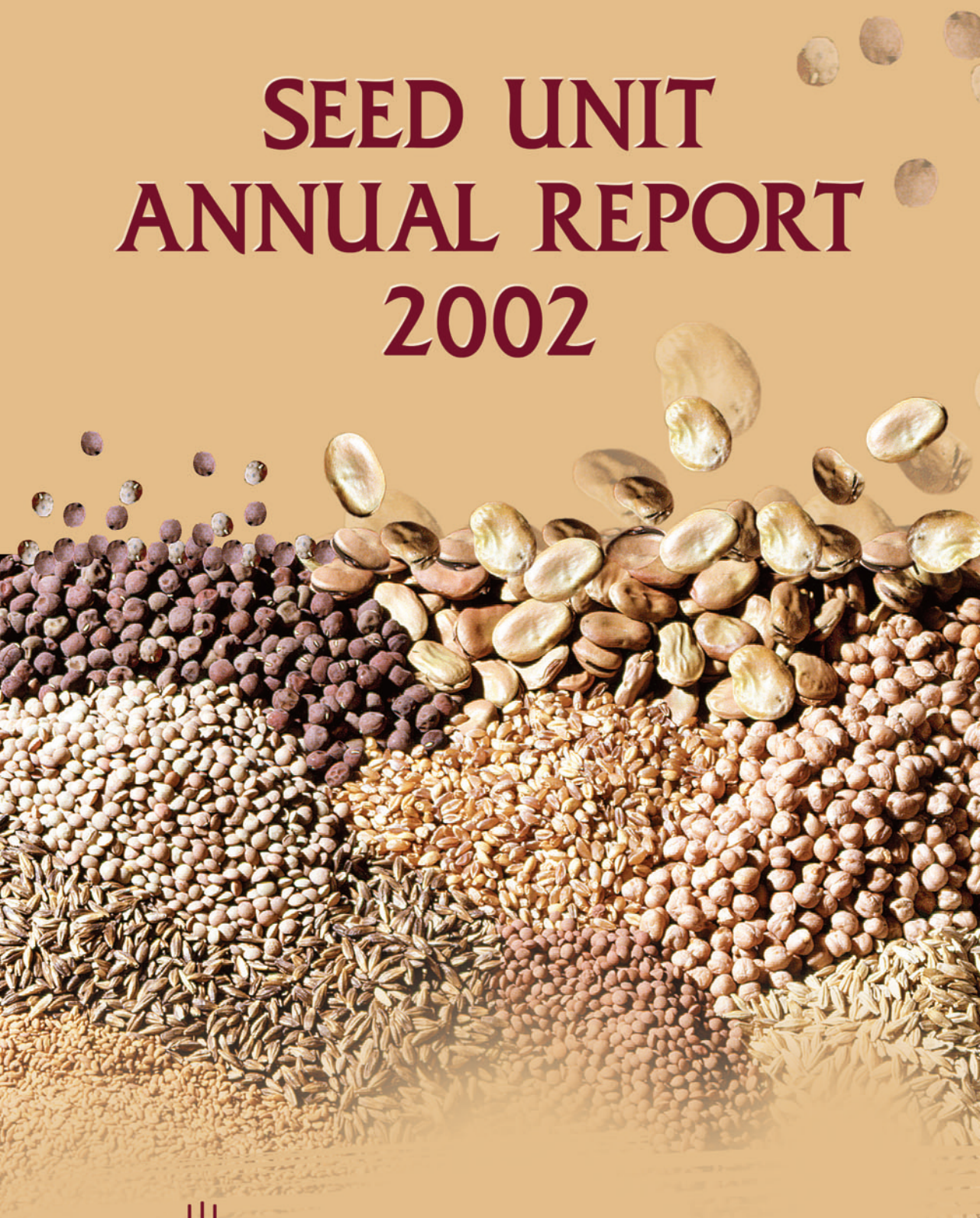
SEED UNIT ANNUAL REPORT 2002



International Center for Agricultural Research in the Dry Areas

About ICARDA and the CGIAR

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

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

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

The CGIAR 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 receives support from many country and institutional members worldwide. Since its foundation in 1971, it has brought together many of the world's leading scientists and agricultural researchers in a unique South–North partnership to reduce poverty and hunger.

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

The World Bank, the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), and the International Fund for Agricultural Development (IFAD) are cosponsors of the CGIAR. The World Bank provides the CGIAR System with a Secretariat in Washington, DC. A Science Council, with its Secretariat at FAO in Rome, assists the System in the development of its research program.

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The primary objective of this report is to communicate the research results speedily to fellow scientists, particularly those within the Central and West Asia and North Africa (CWANA) region, with whom ICARDA has close collaboration.Therefore, the report was not subjected to rigorous editing. A CD-ROM version of this report is also available and can be requested, free of charge, from the Head, Seed Unit, ICARDA.

Printed at ICARDA

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Contents

1. INTRODUCTION

Almost all countries in the Central and West Asia and North Africa (CWANA) region have invested significant resources in strengthening their agricultural research programs and national seed supply systems with a view to develop an agricultural sector that contributes to the national economy and improves the status of food security. In recent years, the liberalization of the seed sector led to the emergence of the private sector in some countries. However, national seed programs in CWANA are still dominated by the public sector and face serious constraints. Well-functioning seed programs are operating only for few major food and industrial crops. The development of the seed sector varies across the region, with the seed industry characterized by different regulatory requirements, standards and procedures which are barriers for regional integration.

The primary objective of the Seed Unit of ICARDA is to strengthen national seed systems in Central and West Asia and North Africa (CWANA) region to build sustainable seed supply systems. Given that much of the Unit's activities are currently undertaken within the framework of special projects, this approach provides funding only for those countries that these projects serve, while limited resources are allocated for work in other countries of the region. During 2002, two new projects were funded for seed activities in Afghanistan, one by the United States Agency for International Development (USAID) and the other by the Canadian International Development Research Centre (IDRC).

The progress of the Unit's activities during 2002 is reported in 8 sections as follows: WANA Regional Seed Network (Section 2), Harmonization Initiative on Seed Regulations (Section 3), Review of Seed Programs (Section 4), Seed Security (Section 5), Research (Section 6), Human Resources Development (Section 7) and Seed Production and Distribution (Section 8). Section 9 and 10 present Seed Unit Staff, External Consultants and List of Publications.
– A.J.G. van Gastel

2. WANA REGIONAL SEED NETWORK

The Seed Unit is operating a Regional Seed Network aimed at integrating the national seed systems in member countries and promoting regional trade through harmonization of policy, regulatory, technical and institutional issues. The Network is a window of opportunity for long-term collaboration and partnership with national seed programs and agricultural development organizations in the

region. To date, the Network has 19 member countries from the region and is linked to 11 regional/international organizations dealing with agricultural research and development. The Secretariat continued to coordinate the activities and provided technical backstopping for implementation of the Network activities.

In 2002, one of the major Network activities was the organization of the Steering Committee meeting and a regional workshop on Harmonization of Seed Regulations for Central and West Asia Sub Region (see Section 3). Moreover, the Network revised and published several publications and launched the Seed Unit website as the information clearing house.

Steering Committee Meeting

The Ninth Steering Committee (SC) meeting of the WANA Seed Network (WSN) was held in November 2002 in Karaj, Iran. The SC committee members from Cyprus, Lebanon, Morocco, Syria, Turkey and the Secretariat attended the meeting with exception of Egypt. The Secretariat presented a comprehensive status report on Network activities.

Members of the SC also attended the First Iran/ICARDA National Seed Workshop held in Karaj, Iran and made presentations on wide-ranging issues from policy and regulatory reforms to technical issues in seed program development in their respective countries. The workshop provided an opportunity for SC members to interact and share their experiences with colleagues from NARS in Iran, other regional and international organizations.

Highlights of Network Activities

The WSN activities were presented within the context of the decisions of the WANA Seed Council during its Third Council meeting held in 1999. Most of the Network activities are aimed at collecting, assembling and summarizing existing information in member countries with a view to developing a model policy and/or regulatory framework across the WANA region. The progress report is presented below.

Regulations for Variety Release and Registration (Ethiopia)
The purpose is to develop a model for variety evaluation, registration and release procedures to commercialize varieties in member countries. A document prepared based on the Ethiopian experience was circulated during the SC meeting in 2000. The Secretariat prepared a comprehensive questionnaire to collect information

from member countries. The lead country will use the questionnaire to collect information or develop a model regulation from its experience.

Database on Publications (Lebanon)
A database of key technical publications related to policy/regulatory issues, technical publications, project documents and mission reports in member countries was compiled by the Country Representative (CR) of Lebanon. The activity will continue through contacts with member countries and updating the available information with a possibility of obtaining copies for the central library. The available information will also be put on the Internet.

Proficiency Seed Testing (Morocco)
The round of proficiency tests carried out by the Network showed no major significant differences in test results among seed testing laboratories of member countries. As the next step, some seed testing laboratories will be selected to participate in the International Seed Testing Network (ISTA) Proficiency Testing to assess the status of the laboratories in the region.

The WANA Seed Network (WSN) will collaborate with ISTA in developing seed testing protocols for important crop species of CWANA that are not covered by ISTA Rules and include them in International Rules for Seed Testing. Moreover, common areas of interest will be explored and joint workshops arranged to strengthen the collaboration between WSN and ISTA. WSN member countries can also make use of ISTA experts for training courses and/or workshops by covering participation costs only.

Seed Certification Schemes (Turkey)
A draft document for regional seed certification scheme is now available both in Arabic and English and some countries have expressed a willingness to participate if a regional scheme could be launched. Most member countries, however, neither gave their consent to participate nor did they submit comments on the scheme. The document will be re-circulated to all member countries again in order to seek: (a) whether each member country agrees to participate in the regional seed certification scheme, and (b) solicit comments on the draft text. Based on the response from members, it was suggested to hold a meeting to discuss further action to develop the framework of the regional scheme.

Reference on Identification of Seeds (Cyprus)
Responses were received from eight countries (Cyprus, Lebanon, Morocco, Oman, Pakistan, Sudan, Syria and Tunisia) where over 100 publications on seed identification have been compiled both for cultivated and weed species. The information will be made available on the internet.

WANA Network Publications

During 2002 the revision of three major publications of the WANA Seed Network have been completed. Moreover, the regular newsletter was published both in Arabic and English.

WANA Seed Directory (Egypt)
The WANA Seed Directory provides a list of policy making institutions (e.g., Ministry of Agriculture, National Seed Council), agricultural research organizations (gene banks, research centers), seed production and marketing enterprises (public or private seed companies, seed import-export companies, seed dealers), seed regulatory offices (variety release committee, quality control and certification, seed trade, quarantine), national seed trade associations and managers and specialists in the seed sector. In 2002, the directory has been revised and put on the ICARDA website. The directory will be updated regularly to reflect changes in the national seed sector of member countries.

WANA Catalogue of Crop Varieties (Morocco)
The catalogue provides lists of released and commercialized crop varieties of major crops in member countries, of which a significant proportion is from materials supplied by International Agricultural Research Centers (IARCs) through international nursery programs. In 2002, the WANA Catalogue of Crop Varieties was revised and published on the ICARDA website. The catalogue will be updated regularly to reflect changes in the list of varieties in member countries.

WANA Catalogue of Field and Seed Standards (Syria)
The catalogue of field and seed standards for cereals, legumes, cotton, sugar beet and selected vegetable crops was published in 1998. The revised catalogue incorporates standards for oilseed crops and forage crops and was printed in 2002. The catalogue is useful reference for developing field and seed standards for harmonization initiatives undertaken by the WANA Seed Network.

Network Newsletter (Secretariat)
Since the SC meeting in March 2001, two issues of Seed Info were published both in Arabic and English. Both versions of the newsletter are now available on the internet.

Table 2.1. WANA Seed Network Publications

Diekmann, M. 1993. Equipment and supplies list: Seed health testing. WSN 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. WSN Publication No. 2/93.

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

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

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

Gregg, B., S.A. Wanis, A.J.G. van Gastel and Z. Bishaw. 1994. Marketing seed. WSN 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. WSN Publication No. 7/94.

WANA Secretariat. 1995. WANA catalogue of field and seed standards. WSN Publication No. 8/95.

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

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

Tourkmani, M. 1995. WANA referee test - Lentils. WSN 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. WSN Publication No. 12/96.

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

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

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

Tourkmani, M. 1997. WANA referee test - Alfalfa. WSN Publication No. 16/97.

WANA Secretariat. 1998. WANA seed directory. WSN Publication No. 17/98.

WANA Secretariat. 1998. WANA catalogue of varieties. WSN Publication No. 18/98.

WANA Secretariat. 1999. WANA catalogue of field and seed standards. WSN Publication No. 19/99.

WANA Secretariat. 1999. WANA catalogue of crop species. WSN Publication No. 20/99.

Mohamed Tourkmani. 1999. WANA Referee Test - Clover. WSN Publication No. 21/99. 13 pp

Tourkmani, M. 2001. WANA Referee Test - Maize. WSN Publication No. 22/01. 10 pp

WANA Secretariat. 2001. WANA Catalogue of Weed Species. WSN Publication No. 23/01

Tourkmani, M. and Z. Bishaw. 2002. WANA Catalogue of Varieties. WSN Publication No. 24/02 (Third edition)‡

Madarati, A. and Z. Bishaw. 2002. WANA Catalogue of Field and Seed Standards. WSN Publication No. 25/02‡

Lotfi, F. and Z. Bishaw. 2002. WANA Seed Directory. WSN Publication No. 26/02 (Third edition) ‡

‡ Available as electronic publication (http://www.icarda.cgiar.org)

Moreover, ISTA invited WSN to contribute regular news items to its quarterly ISTA News Bulletin.

A recent update of the Seed Info mailing list showed that the newsletter is distributed in over 110 countries and territories and the list includes agricultural research centers and organizations, public/private seed companies, national seed trade associations, regional and international seed organizations and prominent seed scientists around the world.

Focus on Seed Programs (Secretariat)
The Focus on Seed Programs series is a complementary edition of the Seed Info Newsletter. So far, 17 'Focus on Seed Programs' were published including one on Iran which was published in early 2003. Seven countries (Cyprus, Egypt, Ethiopia, Lebanon, Oman, Syria, Turkey and Yemen) updated their previous editions to take account of recent changes that have taken place in the national seed programs. The reports on Algeria, Iran, Jordan and Pakistan are relatively recent.

Electronic Publishing: The use of modern technology for publishing and delivering information is becoming popular, faster and cheaper. It is envisaged that all WANA Seed Network publications (old, revised or new) be electronically published on the internet and made available to the larger audience. In 2003, efforts will be made to complete this process. All information collected and published by WSN is available free to all organizations in member and non-member countries.
- Z. Bishaw

3. HARMONIZATION INITIATIVES ON SEED REGULATIONS

From the mid-1980s, there has been a strong desire for economic liberalization to stimulate global economic growth and development. These policy shifts brought many changes in the seed industry which included: (a) policy and regulatory reforms to create an enabling environment for other actors to enter the seed markets; (b) reduced government involvement in seed production to allow the participation of the private sector; (c) globalization of the seed industry where seed was considered as a strategic commercial commodity for international trade; and (d) harmonization initiatives to create regional markets to attract external investments in the seed sector.

At present, the general trend is for political and socio-economic integration at sub- or supra-regional levels for freer movement of goods and services. Within this

wider context of integration, harmonization of policies and regulations for freer movement of varieties and seeds across the region would help to bring benefits to all stakeholders involved in international agricultural research and development. Therefore, harmonization and integration is high on the agenda of many governments as a means of stimulating agricultural development and economic growth.

Harmonization of seed policies and regulations among the countries of the CWANA region could help in establishing a common regional market to attract private investment and create a competitive, efficient and sustainable seed industry. The potential areas for such harmonization are: (a) Variety regulations (variety release and registration procedures); (b) Seed regulations (certification procedures and standards); (c) Seed trade regulations (seed import/export procedures); (d) Phytosanitary regulations (quarantine pests); (e) plant variety protection (intellectual property rights); and (f) Regional seed policy initiative.

A Regional Workshop on Review of National Seed Programs and Seed Regulations was organized from 2-3 November 2002 in Karaj, Iran. The Workshop was organized by the Seed Unit of ICARDA in collaboration with the Iran/ICARDA Agricultural Research Project and the Seed and Plant Improvement Institute (SPII) of the Ministry of Jihad-e-Agriculture. It is a first in a series of regional consultation meetings to achieve tangible results by bringing together stakeholders of the national seed industry of the respective countries to initiate dialogue. The objectives of the workshop were to: (a) review the status of national seed industry with particular reference to policy, regulatory and institutional arrangements; (b) discuss opportunities and options for harmonization and prioritize feasible policy and regulatory reforms at national and regional levels; (c) endorse a harmonization initiative and seek support from policy makers in respective countries; (d) develop national action plans and projects for implementing policy and regulatory reforms; (e) discuss and agree on national commitments in implementing the harmonization initiatives; (f) develop strategies for harmonization of policies and regulations at regional level; and (g) present recommendation for possible action by policy makers for seed sector development.

The participants of the seed workshop were drawn from relevant institutions dealing with agricultural research, crop improvement, seed sector development as well as policy and decision makers from the Ministry of Agricultures in Afghanistan, Azerbaijan, Iran, Iraq, Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, Turkmenistan, Turkey and Uzbekistan. Apart from NARS from CWANA, a number of international organizations in the seed sector development (ICARDA, ISTA, UPOV) participated in the meeting. A total of 39 participants attended the

meeting comprising 20 from NARS of Iran, 12 from other CWANA countries and seven from international organizations.

Recommendations

The following recommendations have been compiled from discussions made at the meeting by senior research and seed production staff from 11 countries (Afghanistan, Azerbaijan, Iran, Iraq, Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, Turkmenistan, Turkey and Uzbekistan), and representatives from FAO, ICARDA, ISTA and UPOV:

General

- The Ministries of Agriculture should create a policy, legal, economic and financial environment conducive to private sector development in order to attract national and international private sector involvement in the seed industry. The policy will consider options for harmonization at regional and international levels.
- Administrative procedures should be streamlined to minimize restrictions and hindrances to seed industry development. An adequate Variety Testing, Evaluation and Release system, which support quick and efficient release of new varieties, should be developed and implemented. Variety testing should not be rigid and should serve the development of the agricultural sector in general and the seed sector in particular.
- Regional variety evaluation should be encouraged to identify varieties adapted to different zones across the region.
- Seed quality control should be separated from seed production activities to enable independent verification of quality. Extension services and/or agricultural development services should carry out extensive seed-related educational programs to create farmers' awareness of improved seeds.
- Cross-border seed movement should be encouraged by adapting harmonized procedures to enable companies/enterprises to market seed across the region.
- Policies, laws, rules and regulations should be harmonized along with technical procedures and standards such as variety testing, seed standards, labeling, certification, import and export procedures to promote regional seed trade.

Harmonization Initiatives

At In-country Level

- As a first step towards harmonization, the following should be reviewed and documented by the participants of the workshop, in consultation with relevant

authorities/ministries: National seed policies; seed laws and regulations; procedures for variety testing, evaluation, release and registration and seed certification; seed import and export regulations; and quarantine regulations.
- ICARDA and FAO should prepare and make available detailed guidelines and table of contents for these national reviews by 1 January 2003.
- The draft review of policies and regulations should be completed within one year following the receipt of the guidelines. All documents of the review process will be prepared in national language and English.
- To discuss and approve the national review on varieties and seeds, a national consultative workshop of all stakeholders should be organized.
- This national review process should be implemented and supported by the respective national governments. ICARDA, FAO and other interested organizations will provide technical backstopping as required.

At Regional Level
- A regional technical working document on harmonization of policies and regulations for varieties and seeds should be prepared in collaboration with national resource persons based on the national reviews.
- To discuss and approve the technical working document on harmonization of policy and regulations, a consultative regional workshop should be organized.
- The technical (working) document should be submitted to respective governments for official approval and endorsements.
- To enable the harmonization process ICARDA and FAO should pursue opportunities for donor funding.
- The national programs in collaboration with ICARDA and FAO should prepare project proposals to support national seed program development.

- Z. Bishaw and A.J.G. van Gastel

4. REVIEW OF AND SUPPORT TO SEED PROGRAMS

Iran

The Iran seed industry is at crossroads. Since the 1990s, Iran made major reorganization of the agricultural sector to better coordinate and define a national agricultural policy and strategy. In a national plan to achieve food self-sufficiency the government gave high priority to agricultural development by creating an enabling policy environment, granting managerial autonomy and allocation of resources. The government is emphasizing on development of strategies that will guarantee the availability of adapted varieties and quality seed to farmers through

sustainable seed supply systems that involve the participation of government, private sector, farmer groups or non-governmental organizations. Currently, the national seed industry is dominated by the public sector and participation of the private sector is limited. The performance of the seed sector has not reached the desired level due to policy, regulatory, institutional and technical constraints.

The First Iran/ICARDA National Seed Workshop was organized from 28-31 October 2002 in Karaj, Iran. The Workshop was organized by the Seed Unit of ICARDA in collaboration with the Iran/ICARDA Agricultural Research Project and the Seed and Plant Improvement Institute (SPII) of the Ministry of Jihad-e-Agriculture.

The Workshop was aimed at bringing together national stakeholders of the Iranian seed industry and international experts to discuss options for the improvement and development of the sector. The objectives of the workshop were to: (a) Review the status of national seed sector with particular reference to policy, regulatory, institutional and technical issues; (b) Discuss the role of public and private sector, farmer groups/associations, NGOs in seed sector development; (c) Discuss recent trends in regional and global seed sector development in view of drawing lessons for improvement of the national seed sector; (d) Discuss policy and regulatory reforms required to address constraints hindering the development of the seed sector; and (e) Present key recommendation for possible action by policy makers.

The participants of the seed workshop were drawn from relevant institutions dealing with agricultural research, crop improvement, seed production and seed quality control as well as policy and decision makers from the Ministry of Jihad-e-Agriculture. Apart from national participants, a number of international organizations in seed sector development (ICARDA, ISTA, OECD, UPOV, CIHEAM, University of Aberdeen) and senior managers with broad knowledge in national seed program development from members of the WANA Seed Network (Cyprus, Egypt, Lebanon, Morocco, Syria and Turkey) participated in the meeting. A total of 41 participants attended the meeting i.e. 26 from various institutions of the Iranian national program, six from other WANA countries and nine from international organizations.

Recommendations

Based on presentations and working group sessions, the meeting prepared recommendations for the improvement of the national seed program in Iran. The recommendations included key policy and regulatory reforms required to diversify the seed sector by providing legal support for the participation of the private sector.

Moreover, recommendation on technical and institutional aspects focused on key issues to address existing constraints in the seed sector.

The following recommendations for the development of the seed industry in Iran were made:

National Seed Policy, Seed Law and Regulations

- The national seed policy should define the duties and responsibilities of the formal (public sector, private sector) and informal sector (NGOs, cooperatives, farmers' groups) in variety development, seed production, quality assurance, seed marketing and distribution. The national seed policy should encourage the development of the private sector as well as alternative seed delivery systems.
- The Ministry of Jihad-e-Agriculture should create a legal, economic and financial environment conducive to private sector development in order to attract national and international private sector participation in the seed industry. The policy should consider options for harmonization at regional and international levels.
- A comprehensive seed law and regulation should be enacted and implemented.
- The Government should consider the implementation of Plant Variety Protection to encourage investment in plant breeding.
- A National Seed Board should be established to advise, guide and monitor development of the seed industry. The Board should be composed of all stakeholders. The Board should regularly review the seed policy, seed laws and regulations and suggest appropriate changes to the Government.

Privatization

- The liberalization and/or privatization of the seed sector should be carried out gradually without disrupting the continuity of seed supply to farmers. The government should remain involved in non-profitable crops and should continue to support seed supply for less favorable areas (e.g. rainfed areas) where private sector is less interested. However, it is important that such government programs do not hinder private sector development through unfair competition. A long-term stable policy is therefore required indicating the roles of the private and the public sectors. Similarly, appropriate legislation (laws and regulations) and procedures are required.
- There should be an Investment Promotion Law, which identifies seed as a priority area for investment for which the government makes incentives available. The current benefits for the agricultural sector should be maintained.
- The price of Certified Seed for the different crops should be determined in consultation with all stakeholders.

- Government should encourage the emergence of small to medium size private enterprises/companies/seed growers groups to enhance seed production and reduce prices.
- Administrative procedures should be streamlined to minimize restrictions and hindrances that hamper the seed industry and related activities.

Variety Testing, Evaluation and Release

- An adequate Variety Testing, Evaluation and Release system, which support quick and efficient release of new varieties, should be developed and maintained. The newly proposed Variety Registration and Seed Certification Institute (VRSCI) should play the leading role in this function.
- Both DUS and VCU tests should be carried out for the registration of varieties of major crops as determined by the National Seed Board. However, options should be left open for the registration of varieties that have been developed for less favorable areas, using different breeding approaches appropriate to small-scale farmers.
- The Variety Registration and Seed Certification Institute should carry out DUS testing. Any variety subject to official certification should be described and a summary description sheet made available to certification authority (VRSCI). VCU testing is either carried out by the respective breeding institution/private organization under the supervision of the VRSCI or by the VRSCI itself. In the former case, the VRSCI would carry out a final evaluation.Variety testing should not be rigid and should serve the development of the agricultural sector in general and the seed sector in particular. A national variety release committee should be established. The release committee should comprise representatives of all stakeholders (e.g. from research, extension, seed industry, farmers associations). The national release committee should review the results of DUS and VCU tests and approve varieties for registration and release. The Registration and Seed Certification Institute should be the Secretariat of the Committee.

Seed Quality Assurance and Certification

- Seed quality assurance and certification should be separated from seed production activities.
- The certification of all agricultural and horticultural crops should be carried out by the VRSCI or under its supervision.
- At present different seed classes are used for different crops, which creates confusion. Seed certification classes should be standardized in harmony with international terminology.
- The certification program should include and implement market control of seed offered for sale by public and private companies to ensure that farmers receive quality seed.

- Some tasks (e.g. 'accreditation' for field inspection, sampling, analyses, post-control) of the certification process may be carried out in partnership with, or delegated to, the private sector, but under the supervision of the VRSCI who will have the ultimate responsibility.
- As a member of ISTA, Iran should take immediate action to set up an ISTA accredited laboratory in the country. This would involve: (a) an application for accreditation, and (b) setting up a quality assurance program following the ISTA accreditation standards and by laws. The laboratory should be encouraged to adopt new seed testing methods, such as vigor tests that are appropriate for the crops and environments of the country.
- The referee testing system among the regional laboratories should be strengthened and coordinated by the main ISTA-accredited central laboratory. This will ensure uniformity in the quality of seed produced in different regions of the country.
- External quality control should give more attention to control of the process/procedures. The task of the quality control agency should be to support and advise, and not only to regulate seed quality assurance and certification.
- Iran is a member of OECD Sugar Beet Seed Scheme. It is recommended that this collaboration should be extended to include other crops having potential for seed export (e.g. maize, alfalfa, clover, chickpea, rape seed) to facilitate international trade in these crops.
- Internal quality assurance (IQA) operations should be encouraged/supported when private enterprises emerge.

Seed Production

- Variety maintenance and Breeder Seed production of public varieties should be carried out by a special unit within each plant breeding institute.
- It should be the task of the breeding institutions to produce the Pre-basic and Basic seed. The later generation (Certified Seed) of public varieties should be produced (on contract with farmers) by the Agricultural Support Company, which also markets the seed to farmers. Private companies would make their own arrangements.
- Any party (ies) interested in multiplying and marketing public bred varieties that are not protected should have equal access to these materials. Breeder Seed of public bred varieties could be made available to the private sector for the production of Basic and Certified Seed.
- Pre-release multiplications should be initiated to ensure that seed is available for sale when a variety is released.
- Even if the seed industry is privatized, the Government should remain involved in the production of seed of non-profitable crops and provide seed for less favorable areas. Care should be taken to avoid unfair competition.

- For marginal areas, such as some of the rainfed areas, community/village based seed multiplication, using adapted and improved varieties should be encouraged.
- Appropriate technology should be introduced for cotton seed production, including the use of delinted seed, to reduce seed rates and save costs.
- Emphasis should be given to selection from local materials of forage crops to develop new varieties, with acceptable quality, of alfalfa, clover and sainfoin. Formal seed production of these crops should be organized.
- Since the number of varieties of maize, sorghum and cotton is rather limited, efforts should be made to increase the availability of more varieties to minimize the risk of crop failure.
- In the vegetable seed sector, emphasis should be given to indigenous vegetable crops in terms of variety development and seed production since there is a large gap between the seed required and the seed provided.

Credit

- It is recommended that farmers and seed entrepreneurs be given low-cost credit in forms that ensure repayment and stimulate the use of high quality seed.

Extension/Promotion

- The national extension service should carry out extensive educational programs to create farmers' awareness of improved seed. Companies/enterprises would carry out promotion of their own specific products.
- Government should also develop markets for extra farm produce: export, processing, canning, freezing, industrial use, etc.

Seed Growers/Trade Associations

- Seed growers associations and at a later stage, a National Seed Industry Association, should be established to ensure that all stakeholders are involved in the national seed development efforts.

Regional Seed Trade and Cooperation

- Cross-border seed movement should be encouraged by adapting procedures that enable companies/enterprises to market seed in several countries.
- Regional variety evaluation should be encouraged to identify varieties that are adaptable across several countries.
- To promote regional seed trade, policies, laws, rules and regulations should be harmonized along with technical procedures and standards such as variety testing, seed standards, labeling, certification, import and export.

Fruit Trees

- The health status of fruit species should be investigated to prevent possible spread of diseases.

- Measures should be adopted to minimize the spread of plant diseases by, for example, prevention of the import of infected planting material, application of strict quarantine regulations, implementation of eradication programs and identification of pathogen free areas.
- A certification scheme (including legislation) that produces healthy propagating material should be initiated.
- A rigorous educational promotion, including extension programs that create awareness of the importance of healthy propagating material should be implemented.

Training and Human Resource Development
- Professional and technical staff of the seed sector should be given opportunities to participate in international workshops, conferences and training courses.

– A.J.G. van Gastel and Z. Bishaw

Turkey

GAP Project on Improving Sustainable Seed Production Systems for Food Legume and Cereal Crop Varieties

The diffusion of new varieties amongst small farmers is a key constraint to raising farm productivity and household income, maintaining food security and helping to alleviate poverty in developing countries. Seed delivery is often a weak link between variety development and adoption by farmers particularly for the self-pollinating crops including the ICARDA mandate crops such as wheat, barley, lentil and chickpea. The ICARDA Seed Unit is collaborating with the Regional Directorate Administration of the Southeastern Anatolia Project (GAP) in Turkey in identifying alternative institutional arrangements that could overcome this familiar bottleneck in the southeastern Anatolia region.

After two years of project implementation, the main challenges of obtaining sufficient early-generation seed of selected varieties from research institutions, and putting appropriate seed delivery systems into practical operation still remained. The activities for 2001/02 season were planned with a view to address these specific constraints. For example, a workshop on establishment of a Seed Unit at Dicle University and cooperation with Harran University was meant to focus on the issues of variety development production of and early-generation seed, while the staff and farmers' training visits were to help in developing better seed delivery mechanisms.

As in 2001, the Unit organized a visit for 9 farmers and technical staff from the Southeastern Anatolia Region during 2002 to examine seed multiplication fields

and other experimental plots on the ICARDA farm and to hold discussions with other farmers working with the Syrian General Organization for Seed Multiplication (GOSM).

It is the effectiveness of the linkages between research in variety development, on-farm demonstrations and seed delivery systems that hold the key to the success of this project especially in terms of the impact that will be created at the farm level of the smallholders. Much of this will depend not only on technical efficiency but also on favorable policy environment, effective relationships with relevant public and private sector institutions, and favorable rules and regulations.
– S. Kugbei

Central Asia and the Caucasus

During the sixth ICARDA-CAC Regional Coordination Meeting (September 2002, Dushambe, Tajikistan), a working group on Germplasm Enhancement discussed issues relating to seed. Considering the seed policy constraints highlighted by each country during the meeting, it was agreed that a workshop would be organized on seed program re-structuring for key technical staff and policy makers across the region to find practical and lasting solutions to these bottlenecks.
– S. Kugbei

5. SEED SECURITY

Both natural- and manmade disasters can have devastating effects on agricultural systems and the environment. There is an increasing trend in such disasters (e.g., war or civil strife) worldwide and emergency assistance to regions affected by such stresses. Among natural disasters, drought is a threat in many dry areas of the world including some countries of the WANA region. During such disasters, farmers may be forced to deplete their meager seed stocks, resulting in the loss of well-adapted farmers' varieties, which could lead to erosion of valuable genetic diversity that is the building block for rehabilitation and restoration of agricultural systems.

'Seed security' is an important component of food security but relatively little information is available either on local practices or national strategies for emergency seed supply. A concerted effort is required to rehabilitate agriculture to a sustainable level to assist farmers affected by disasters. Such undertaking needs a partnership among the farmer communities, national governments, NGOs and international community. Two new special projects have been initiated during 2002.

USAID Seed Project for Afghanistan

Agricultural production capacity and food security in Afghanistan were greatly damaged by more than a decade of civil strife and several years of continuous drought. Rebuilding agriculture is, therefore, crucial if conditions in Afghanistan are to return to pre-war status and then progress beyond that level. To this end, ICARDA convened a *Stakeholders Meeting on Restoring Food Security and Rebuilding the Agricultural Sector of Afghanistan*, 20–21 January 2002 in Tashkent, Uzbekistan, which was attended by 74 participants representing 34 organizations, including international agricultural research centers and agencies, international NGOs, United States universities, the U.S. private sector, and donor development agencies, together with Afghan agricultural experts. The meeting, which was partly supported by USAID, recommended the establishment of a CGIAR - Future Harvest Consortium to implement a plan of short- and longterm interventions. ICARDA was asked to lead the Consortium.

Program Objectives

1. In the immediate future, multiply and deliver quality seed of adapted varieties through effective delivery systems to reach farmers in time, and to build, with Afghan partners, an effective regulatory system that enforces standards and promotes the use of high quality seed and varieties.
2. In the longer term, provide technical assistance in the development of sustainable agricultural production systems in Afghanistan. Working Groups at the Stakeholders Meeting considered four major components: (1) Seed Systems and Crop Improvement, (2) Soil and Water Management, (3) Livestock, Feed and Rangelands, and (4) Horticulture, together with cross-cutting considerations of agricultural diversification, employment and gender issues, and institutional strengthening and human resource development.

Implementation of the Consortium began soon after a first meeting in Tashkent, and several activities have been undertaken including a code-of-conduct workshop in Kabul, seed procurement and distribution to farmers in Afghanistan, training of Afghan technical staff, supply of seed testing laboratories and processing equipment, rehabilitation of agricultural research stations, a steering committee meeting, and needs assessments to guide future interventions.

Program of Work

Seed Systems

To re-establish their productive capacity in the short-term and to stabilize food production and rural livelihoods in the long-term, farmers will need quality seed of appropriate varieties and other inputs. This involves:

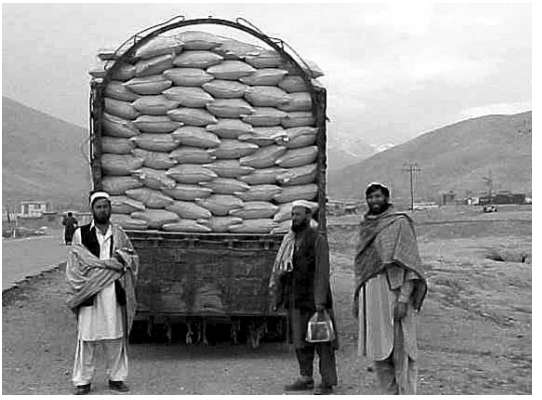
1. In the short term, expanding the production and effective delivery of quality seed to farmers to ensure sufficient quantities for sowing, and
2. Over the longer term, enhancing the capacity for increased seed production through a multi-year program to develop viable, self-sustaining seed supply systems.

Short-term measures: Lack of seed is the most immediate problem facing Afghan farmers, as a result of the prolonged drought and disruption of input supplies. Consequently, a detailed plan for seed relief activities was developed in 2002, which included:

- Procurement of seed and distribution to provide for immediate deficits for spring sowing in 2002.
- Production of seed within Afghanistan during the spring season for planting in the fall season of 2002
- Foundation seed production at ICARDA HQ of varieties adapted to Afghanistan and shipment to Afghanistan for fall planting in 2002.

Long-term measures: A series of other activities aimed at the restoration of the research capacity and the seed system were planned. These included:

- Providing a series of international nurseries for testing and evaluation in Afghanistan in the fall season of 2002.
- Repatriation of genetic resources, including rehabilitation of a gene bank.
- Rehabilitation of research stations, including the provision of farm machinery and meteorological stations.
- Initiating a variety evaluation and testing, using a participatory approach, whereby farmers are directly involved in the evaluation of genetic material.
- Initiating a farmer-based seed production and distribution system, which makes use of communities (community-based seed production). These will be developed into village seed enterprises.



- Assisting the government in implementing an effective regulatory system that enforces standards and promotes the use of high quality seed and varieties
- Human resources development: Short-term training, workshops, on-farm demonstrations and field days for farmers.
- Needs assessments to assess options for longer-term sustainable agricultural development.

Progress

Seed Provision for Planting in 2002

- For the 2002 spring planting season, approximately 3500 MT of high quality wheat seed was procured from Pakistan and distributed to Afghan farmers (Table 5.1) through a network of NGOs, in close coordination with the Afghan Interim Administration (AIA).

Table 5.1. Spring Wheat Seed Distribution, 2002

No	Name of Organization	Quantity (MT)	Province of Distribution
1	FAO	330	Badakhshan, Baghlan, Samangan, Takhar, Bamyan, Ghazni, Parwan, Wardak and Urozgan
2	Focus	210	Badakhshan
3	GRSP	222	Ghazni
4	IMC	1215	Ghazni, Kapisa, Parwan, and Wardak
5	MC	400	Urozgan (Gezab, Khas Urozgan, and Kejran)
6	MAOL	200	Ghorband (Surkh Parsa, Sheikh Ali, Seya Gerd and Shinwari)
7	Solidarity	750	Wardak
8	ACTED	170	Takhar (Khowaja Ghar District)
	Total	**3497**	

- This seed relief has contributed to an increase in agricultural production; 40,000 beneficiaries have been reached, and at least 15,000 MT of extra wheat grain was produced. Also, a much more longer-term effect is expected. Farmers were provided with quality seed for planting and by saving seed for the next planting season a much longer and broader benefit of the spring distribution is expected.
- For the fall season of 2002, a total of 4,583 MT of wheat seed (produced within the country) was made available to farmers in Afghanistan. For irrigated areas, the total amount was 4185 MT, while rainfed areas received 398 MT. IFDC distributed fertilizer through a voucher system.

- Besides wheat, seed of rice, barley, chickpea, lentil, berseem clover, alfalfa, flax, sesame and mung bean have been purchased and distributed.
- For establishment of horticulture nurseries, planting material of almond, pistachio, apricot, walnut and peach have been procured and nurseries have been planted at some locations.
- 53 MT of foundation seed has been shipped from ICARDA to Afghanistan for on-station testing, large-scale evaluation and pre-release multiplication in the fall season. This includes seed of bread wheat, durum wheat, barley, lentil, chickpea and vetch.

Restoration of the Research Capacity and the Seed System

- The Consortium has rehabilitated some agricultural research stations (Baghlan, Kabul, Kunduz, Nangarhar, and Takhar), which have potential for seed production. Farm equipment has been provided for on-station research and seed production, and meteorological stations. A total of 100 ha of land have been planted in these stations. Horticultural nurseries have been planted in Darul Aman, Taloqan, Kunduz and Jalalabad.
- A variety maintenance program has been initiated in Baghlan, Darul Aman, Kunduz, and Taloqan to maintain varietal purity and to initiate the seed multiplication cycle of existing varieties.
- Several international nurseries have been sent to Afghanistan for testing (trials)for yield, drought and cold tolerance, and disease resistance to re-establish the variety evaluation system. These comprise bread and durum wheat, barley, chickpea, lentil, faba bean and forage legumes. The international nursery program will identify adapted germplasm for Afghanistan's varied agro-ecological zones.
- In the process of repatriating genetic resources back to Afghanistan, seed samples of 41 barley land races and 250 kg seed of several cereal and legume landraces have been sent back to the country.
- A total of 260 MT of seed has been distributed to 821 farmers in 7 provinces to initiate a farmer-based seed multiplication system. This is the first step in the establishment of private village seed enterprises aimed at bringing seed self-sufficiency. Farmers will be assisted and trained in seed production practices, including marketing (training courses planned for 2003). These farmers' seed multiplication fields expected to provide approximately 5000 MT seed of adapted varieties.
- Six mobile seed cleaning machines, specifically designed for use at the farmer level, have reached Kabul. These units will be setup in Baghlan, Kabul, Kunduz, Nangarhar and Takhar to support the community based seed activities. Five more cleaning machines will be manufactured.

- CIP has provided a total of 22 tons quality potato seed of adapted varieties from Pakistan and India, which have been introduced to Afghan farmers for further multiplication.
- A workshop to develop "Guiding Principles for Production of Seed and Planting Material and Seed Import to Afghanistan" took place in Kabul, 21-23 May 2002. It was the first national meeting on seeds and brought together more than 80 participants from national and international institutions. Guiding principles for seed production and distribution were formulated.
- A draft National Seed Policy and Seed Law has been submitted to the Government and the documents will be translated into the national language by the Consortium. Both the National Seed Policy and the Seed Law take into account specific conditions in Afghanistan, but also consider the need for its integration with developments that are taking place in the seed industry around the world.
- The Consortium has purchased appropriate seed testing and seed health testing equipment and is rehabilitating the required buildings to assist the government in carrying out its regulatory function.

Human Resources Development

- The first in-country training course on seed production was organized in Kabul in July 2002 for 70 participants focusing on varietal identification, seed multiplication and seed health to improve the seed quality aspects.
- Several training activities have taken place in potato seed multiplication and Afghan staff has participated in sunn pest training in Iran. On-the-job training is a permanent feature in the locations where research stations are supported.
- Senior Afghan staff attended a Regional Review of Seed System and Regulations in Iran to acquaint himself with trends in seed industry development.
- Training activities are planned for seed quality assurance (to ensure staff will be able to manage the seed testing stations), research station management and operating meteorological equipment/stations.

Needs Assessments (NA)

- Four Needs Assessments were conducted: i.e., (1) Seed Systems and Crop Improvement, (2) Soil and Water Management, (3) Livestock, Feed and Rangelands, and (4) Horticulture. These assessments derived information from secondary sources, meetings and discussions with staff of relevant organizations and farmers, as well as nationwide sample surveys.
- For the livestock, feed and range needs assessment 183 rural communities in five provinces were interviewed. A total of 390 households in 98 villages were randomly selected and interviewed for the seed and crop improvement needs

assessment, while the soil and water needs assessment surveys were conducted in six provinces. A total of 129 soil samples were also collected during the survey and dispatched to Cornell University, USA for analysis.

- The horticulture needs assessment was co-led by IPGRI and University of California (Davis). A workshop was held on status of horticulture in Kabul, Afghanistan in July 2002. In cooperation with IPGRI, the plant genetic resource assessment on pistachio and almonds was conducted. Seventy-six almond samples of available genetic diversity have been collected in three provinces of the northern region. In addition, eight samples of pistachio from the natural forests of Afghanistan have been collected from Herat and Kunduz.

- NA teams included members from the Afghan MOAL, Future Harvest Centers (CIMMYT, CIP, IPGRI, IWMI), the Private Sector, and US Universities (Cornell, Hartford, Purdue, Texas A&M, and University of California (Davis)) and other national and international organizations. ILRI and ICRISAT and other US Universities have also participated in recent FHCRAA workshops.
- The Wrap-up meetings of needs assessments in seeds and crop improvement, soil and water were convened by ICARDA at its Headquarters in Aleppo, Syria, to discuss findings and results of these assessments and develop project ideas for the future. The Seed Needs Assessment Meeting was attended by 43 participants representing 23 different organizations, including the Ministry of Agriculture and Livestock (MOAL)-Afghanistan, CGIAR Centers, US institutions, Afghan NGOs, FAO, the private sector, international agencies and donors (USAID and DFID). Key outputs of the meeting included outlines of research and development priorities and project ideas in the form of concept notes, which may form the basis for full project proposals for those cases in which donors express interest. All needs assessments will be validated into final reports, which will be made available on the web. The concept notes will serve as indicators to the future and will also be available on the web for subsequent e-mail interaction. - ***A.J.G. van Gastel, N. Wassimi, S. Kugbei and A. Niane***

<u>Spring Wheat Seed Distribution in Afghanistan - LESSONS LEARNT</u>

As indicated by partner NGOs and confirmed by ICARDA monitoring missions, a significant propotion of the seed distributed in the spring of 2002 was not planted

and a major proportion was stored for the fall planting. In Table 5.2 estimates are provided with regard to the amount of seed (in MT) planted and stored. This ranged from no planting (ACTED in Takhar) to almost planting all seed delivered (AKDN in Badakhshan). It has been assessed that 1170 Mt was not planted; this represented 37 % of the amount that was under the control of ICARDA-led Consortium.

Table 5.2. Summary of the Results of the Spring Wheat Distribution

Organi-zation	Province	Amount Supplied (MT)	Amount Planted (MT)	Amount Stored (MT)	Amount Planted (%)	Bene-ficiaries
Focus	Badakhshan	210	210	0	100	4,200
GRSP	Ghazni, Urozgan,	222	154	70	69	3,080
IMC	Ghazni, Kapisa, Parwan, Wardak	1,215	840	375	69	16,800
MC	Urozgan	400	220	180	55	4,400
MOAL	Parwan	200	50	150	25	1,000
ACTED	Takhar	170	0	170	0	0
Solidarity	Ghazni, Wardak	750	525	225	70	10,500
Total ICARDA		**3,167**	**1,999**	**1,170**	**63**	**39,980**
FAO		330				
Overall Total		**3,497**				

The main reasons that the seed was not planted – as reported by the NGOs – were: (a) late arrival of the seed, (b) spring planting is not common in the area (Chak district in Wardak), and (c) drought (many areas). Limited snowfall during the winter and a cessation of rains after April 15 contributed to the fact that some NGOs decided not to plant.

Based on information from NGOs and ICARDA monitoring missions, yields have been generally low due to limited availability of water for irrigation. In many cases, kareses had dried up and were not able to provide water for irrigation. Our estimate is that the spring seed distribution campaign provided seed to almost 40,000 beneficiaries. It resulted in approximately 15,000 MT of additional wheat production, i.e. 4,200 MT in Badakhshan, 3,800 MT in Ghazni, 2,200 MT both in Uruzgan and Wardak, 1,500 MT in Parwan and 1,000 MT in Kapisa.

Lessons Learnt

1. The provision of seed to the interior of a country, which is devastated by war and drought, is a great challenge. Roads, communication facilities and the security situation were all poor and the earthquake, which hit Afghanistan in April 2002, exacerbated the situation. Also, when the program was approved, time was very short and the planting windows would be closing very quickly. However, such conditions are expected when dealing with an emergency operation.
2. Some argue that the need for seed should have been better assessed before embarking on large emergency seed operations. The fact, that all the seed for fall season distribution was produced/procured within the country - from other varieties than the ones that were distributed in the spring – gives credibility to this opinion. However, this is not a valid argument, since immediate action was required and assessing the situation would have taken too much time and we would have missed the season completely; none of the seed would have reached in time.
3. However, no matter what, the program has reached farmers, which otherwise would have had no access to seed. The system worked, and was much appreciated by farmers. Quoting a farmer in Wardak province "Being able to get seed now, and pay for it with wheat grain after we harvest our crops is a wonderful idea," and "If I had not received this seed, I would not have sown any crop this season. We ate everything we had." remarked another farmer.
4. Procuring large quantities of seed from outside Afghanistan was constrained by time. The availability of the seed from the Punjab Seed Corporation was delayed by 14 days and transportation to Kabul was again delayed by a few days. This all in spite of the contractual agreements, stating clearly all delivery conditions, signed with the PSC and WFP. Every day of the delay, makes the planting window further close.
5. The dispatch of seed from Kabul (between 29 March 2002 and 12 April 2002) took only 14 days due to existence of a vibrant trucking private sector and the commitment of project staff and was only constrained by the time of arrival of trucks from Pakistan.
6. The fact that only 63% of seed was planted is a poor achievement and can be mainly attributed to the interest and commitment of (some of) the partner NGOs. Limited snowfall during the winter season and a cessation of rains after April 15 contributed to the fact that some NGOs decided not to distribute seed. Admittedly, if the program was to succeed, NGOs had to make a concerted effort to get the seed to farmers and have it planted. For these operations they were paid a very reasonable management fee.

7. IDRC has calculated that it is more than twice as efficient to produce wheat with the program's seed and fertilizer package than importing food wheat aid. Food aid is valued at 500 $/MT, while the cost of the program's wheat is approximately 230 $/MT.
8. Complaints – by partner NGOs – that seed arrived late are genuine for certain areas. But, for the higher altitude areas it is not a valid argument. For instance, in the districts of Ajristan (Urozgan), Hazara Jat (Malistan) and Jaghuri (Ghazni), the winter is long and cold and April to mid-May is planting time for spring wheat.
9. In spite of good intentions when selecting NGOs, the emergency nature of the operation, did not make it possible to sufficiently assess whether NGOs meet the criteria listed above. Based on performance during the spring season, NGO partners have been selected for participation in the fall seed distribution operation of the Consortium.

10. Complaints concerning the adaptability of the varieties used in the spring wheat distribution program are invalid. Inqlab-91 and MH-97 have been tested in Afghanistan by FAO crop improvement component (1997-2000). They were selected for early maturity, their ability to tolerate drought and low water requirements.
11. Certain NGOs complained that the seed was poor in germination capacity. However, tests carried out on samples, provided by the concerned, indicated that germination – except for one sample – was high; average germination percentage of Inqlab-91 and MH-97 were 93% and 89 %, respectively. However, it is imperative to state that seed germination may easily decline if seed is not stored under proper conditions. Keeping the seed dry and cool are most important, but weevils will also very easily infest seeds in storage. It is very important to work with NGOs that have experience with seed. Otherwise, a crash-training program of NGO staff must accompany the program.
12. Monitoring and evaluation have been the weakest part of the spring wheat seed distribution program and yield and extra production data are only estimates. This can certainly not be only attributed to the poor security situation in the country. It is mainly due to the fact that the priorities of staff on the ground was 'delivering the goods and preparing for the fall seed distribution operation'.

Conclusion

- Emergency operations are always risky and full of pitfalls. Work plans have to be prepared in very short period, which does not allow the details to be worked at the start of the program.
- After the approval of the program, the ICARDA-led Consortium moved swiftly and procured a significant quantity of wheat seed from Pakistan for spring planting in war torn, drought stricken, Afghanistan.
- The operation was not helped by the fact that many areas experienced another drought, but areas where farmers had access to irrigation water gave satisfactory yields. Many farmers and some NGOs decided – often incorrectly - that the planting window had closed and stored the seed for fall planting. The program could have been more successful if NGOs had really given a first priority to the planting of the seeds by their cooperating farmers.
- It is safe to state that the spring wheat seed distribution program has contributed to an increase in agricultural production, although the impact could have been larger. Not only almost 40,000 beneficiaries have been reached, but also - at least - 15,000 MT of extra wheat grain was produced.
- A much longer-term effect is also expected. Farmers were provided with quality seed for planting and by saving seed for the next planting seasons - a one-time operation like the current one - will continue to have benefits in the future.
- Monitoring and evaluation was the weakest part of the program. For the fall distribution program, ICARDA has formulated a Monitoring and Evaluation plan, which will be put in place. ***– A.J.G. van Gastel, N. Wassimi and S. Kugbei***

IDRC Project (Strengthening Seed Systems for Food Security in Afghanistan)

This project is an outcome of a concept note that was submitted by ICARDA to IDRC in October 2001 soliciting funds to assist food security efforts in Afghanistan. A full project was later developed by ICARDA in consultation with IDRC and other key partners including institutions and professionals in Afghanistan. The project benefited from a long process of development, and was approved for funding in September 2002. It comprised two components: (i) Diagnosis of Seed and Related Needs and (ii) Analysis of Crop Population Structures, and will focus on the rainfed areas in northern Afghanistan.

The main activity undertaken during 2002 was a pre-implementation planning meeting in Kabul during December to identify key research issues and study sites, form a research team, agree on research methodology and finalize the workplans. The following were highlights of discussions that took place at the meeting:

- The project will not cover the ICARDA mandate crops only, but will include other crops that are important for genetic diversity in Afghanistan.
- The coordinating role of the Ministry of Agriculture was regarded crucial, since there seemed to be a lot of isolated activities by different aid organizations in the country.
- Continuous monitoring and evaluation were essential components of the work plan.
- The workplans focused on key issues, main activities including specification of study sites or areas, methods, timeliness and definition of responsibilities.
- The following were identified as key criteria for the selection of study sites: combination of irrigated and rainfed conditions, security, road infrastructure, partner availability with on-going activities for sustainability of programs, willingness of communities to participate and appropriate ethnic/religious/tribal mix in village communities. On this basis, two provinces and two NGOs were selected for the seed component of the project.

A research team was also formed at the meeting, which was given the task to identify and train a field team in seed system diagnostic tools including sample surveys, focus group discussions and informal semi-structured interviews with key informants. It was emphasized that some female enumerators must participate in the household sample surveys and in the focus group interviews involving female groups. It was agreed that the research team of the seed component meet in Kabul during early March 2003 to discuss and finalize the methodology and make arrangements for the fieldwork. **- *S. Kugbei***

6. RESEARCH

This section brings together all aspects of the Unit's work that have a significant research dimension, and therefore covers a wide range of subjects or disciplines particularly those of seed science and technology, policy and economics, and development. They include research carried out by the Unit's staff and consultants, and postgraduate research projects supervised by staff of the Unit.

Seed Needs Assessment Survey in Afghanistan

As part of the USAID-funded seed project, the Seed Unit formulated a needs assessment survey in Afghanistan with the objective to obtain primary information on variety choices, the supply and use of crop seed by farmers, and how these could be improved to enhance farm productivity.
Enumerators of the Afghan Survey Unit (ASU) collected the field data. A total of 390 households were randomly selected and interviewed using formal questionnaires. Since it was not possible to survey all districts in each province, three

representative districts in each of six provinces in the six agricultural regions (Northeast, North, Central, Southwest, West and East) were selected. As food security was the primary focus, the survey covered seven major food crops: irrigated wheat, rainfed wheat, barley, potato, maize, rice and chickpea.

The data from the three districts per province per region were only indicative of crop improvement and seed needs in the survey areas. They were not representative of situations in the country as a whole.

Questionnaire design and data requirement: The questionnaire was divided into two main parts to collect data on (i) household features, and (ii) crop-specific issues relating to land, varieties, seed, and other inputs and farming practices, depending on the crop for which a particular household was interviewed.

The households were purposely selected for specific crops, since the survey was primarily concerned with seed issues related to specific crops. The questionnaire was designed to obtain detailed quantitative and qualitative information on the following:

- Farm household food insecurity and other constraints to productive agriculture.
- The extent to which farmers use local/improved varieties, their understanding of varieties and their need for good seed.
- Farmers' seed management practices (*e.g.*, quality/purity issues, post-harvest processing, seed-saving, etc.).
- Farmers' channels for seed acquisition/exchange and utilization.

Enumerator training and pre-testing: A training program on seed system survey methods was organized for the enumerators, that involved a thorough review of all questions, and modification of both the household and crop questionnaires. Particular attention was given to common and thorough understanding of questions by all enumerators, uniform interview approaches, relevance/sensitivity of questions in Afghan communities, and proper recording of answers. Modified questionnaires were pre-tested in Afghan farming communities and the questionnaires revised accordingly. The final questionnaires were translated into Farsi.

Sample selection and household interviews: A total of 390 households in 98 villages of 18 districts were interviewed (Table 6.1). Regardless of their location, villages in each district were selected on the basis of agro-ecological/economic conditions that were typical in that region.

Data analysis: ASU analyzed all data with technical backstopping from ICARDA Seed Unit.

Table 6.1. Household Sampling by Villages, Districts, Provinces and Agricultural Regions

Region	Province	District	Number of Villages	Number of Households Interviewed
North-East	Baghlan	Baghlan-e-Markazi	6	25
		Pulikhumri	8	30
		Dahnaeghori	4	21
North	Balkh	Balkh	8	25
		Chamtal	4	27
		Sholgara	6	26
Central	Ghazni	Khwaja Omri	4	21
		Qarabagh	7	18
		Andar	8	17
South-West	Helmand	Nahre Seraj	3	18
		Nad Ali	8	20
		Nawa Barakzai	3	18
West	Herat	Gozarah	5	28
		Pashton Zarghon	7	21
		Kushk	3	22
East	Nangarhar	Shinwar	3	13
		Kama	8	21
		Khogyani	3	19
Total			**98**	**390**

Results and Discussion

The results of this study reflect situations that existed in the areas surveyed, which were small in relation to the entire country. Any interpretation of these results in a regional or national context should take this limitation into account. The following discussions relate to broader issues that arose from the key results obtained.

Socio-economic features of households

In almost all cases, the main source of food for a majority of households was own production on the farm, followed by purchase in the local market. Contribution by food aid to overall food security was not shown as particularly significant, probably due to less coverage by World Food Programme (WFP) in these areas.

Food needs which farmers expected to meet from the 2002 harvest varied widely, from 37% fulfillment in Ghazni to 71% in Nangarhar, with an overall national average of 59%, which indicated a significant projected shortfall in food supply from farm sources. On average, farmers thought that their farm production could provide up to 86% of household food needs in normal years without drought.

Besides making the highest contribution to food security, on-farm production was also the most important source of family income, thus indicating the important role agriculture plays in the rural economy. Household income was derived from the sale of surplus crop and livestock products above subsistence needs. Employment outside the farm was also an important source of income, particularly in severely drought-affected provinces such as Ghazni.

The survey results showed a generally high household indebtedness. With its severe drought, Ghazni had the highest average household debt, which was equivalent to US$1,158, with 86% of its households indebted in one form or another. A significant proportion of this debt may have been used to dig wells for drinking water and irrigation.

Variety needs

This survey showed that use of new varieties by farmers was low, although this varied slightly by crop. The limited use of new wheat varieties by farmers (zero in most cases) was striking, given that 15 new varieties were released between 1996 and 2001, in addition to several introductions from abroad.

Up to 55% of the irrigated-wheat-growing households interviewed did not use any improved varieties at all, although the farmers mentioned many improved wheat varieties they were aware of. The limited use of new varieties for the other crops was not surprising, since far fewer new varieties of these crops existed.

The results showed a clear desire by farmers to have varieties with high yield, but such yield levels must be stable, and hence the desire for adapted and stress-tolerant varieties. The varieties should also meet food (taste and flavor) requirements. New varieties must have these attributes in order to be widely accepted.

Suitability for food preparation was ranked high for all crops except barley, since it is mainly used for livestock feed.

Household seed needs and land use

The farmers obtained seed from different sources including their own farms, other farmers, and local markets. With minor differences among crops, 50% of all households saved seed on their own farms, 32% purchased from local markets,

23% from other farmers, and 5% got seed from other sources such as aid agencies. The farmers were able to fulfill a high proportion (87%) of their total seed needs from these sources for the 2002-sowing season. On the contrary, up to 60% of potato-growing households purchased their seed from the market.

While few households grew only one crop (which was largely wheat), a majority of households grew wheat and a second crop, depending on the agricultural region. Fewer households grew a third or fourth crop, and no households grew more than 4 of the main crops.

Despite the high fulfillment rate of seed needs, farmers' satisfaction with the quality of seed from these different sources revealed a somewhat different story. The proportions of households that used seed from given sources and are happy with its quality were 40% for own farm saving, 18% from local markets, 13% from other farmers, and 3% from other sources.

There was high satisfaction with the quality of seed farmers kept for themselves, since as expected, farmers took greater care of the seed they reserved for their own use the next sowing season. In contrast, seed from the market, which was normally ordinary grain, was of lower quality for the purpose of sowing.

The critical factor in household seed needs was quality and not the amount of material that was available within the community from different sources. To satisfy their seed needs, farmers obtained as much planting material as possible, although this could not meet the quality level they would normally have preferred. The focus should have therefore been on seed systems that produced high quality planting material for distribution within the community at prices that farmers clearly perceived as worth a premium.

For each crop, there was wide variation in area cultivated per household. The results showed that, although most households cultivated small areas, there were a few households with relatively large areas.

Most households grew crops on their own land. In addition, they are engaged in sharecropping as a way of getting access to more than their own land. The proportion of crop harvest the sharecropper gave the landowner varied widely, depending on arrangements regarding the relative contributions and use of inputs, particularly, water, fertilizer and labor. Renting is another form of acquiring land, but this is not very widely used.

As regards farm output, the wheat harvested was used almost exclusively for home consumption, which meant that farmers had to grow other commercial

crops such as barley, potato and pulses in order to meet their financial needs. Apart from wheat, all other major crops seemed to have a significant cash dimension. Barley was used to feed livestock and for sale to other livestock owners, including nomads. Barley could become an important cash crop as the livestock industry develops, with a consequent increase in demand for feed. Potato was a profitable cash crop, although its bulkiness increased transport costs, particularly in Afghanistan, which has poor road infrastructure in rural areas. A small proportion of the harvest from all crops was kept as seed for sowing the next season's crop.

National seed requirements

The survey data on seed rate and household seed needs of farmers was used to estimate the gap in national seed requirement that would have come from external sources (Table 6.2). The total deficit of about 27,000 tons compared well with the combined targets of different agencies that intended to supply Afghan farmers with seed during 2002.

Hypothetical calculations of cereal seed needs by Dennis et al. (2002) of 101,000 tons highly over-estimated the quantity of rainfed wheat seed that farmers required from outside their communities, since these calculations assumed a drastic decline in seed stocks due to drought. The results of this survey revealed that even households in the drought-affected province of Ghazni had access to seed of rainfed wheat which could meet up to 78% of their sowing needs. These must have come from within the Afghan communities.

It could be concluded from these results that there was sufficient planting material of adapted varieties in Afghanistan during 2002 and there was no need for import of large quantities from other countries. What Afghan farmers needed was a wider choice of varieties and an assurance of high seed quality.

Needs for other inputs

The survey examined the use of other agricultural inputs: fertilizers, hired labor, animal power, agricultural machinery and pesticides. The fact that almost all interviewed households needed fertilizer underscored the importance of irrigation in crop production. Farmers stated that they used fertilizer for all major crops except rainfed wheat and pulses (in this case, chickpea). Hired labor was most important in rice because of the labor-intensive practice of transplanting.

Many households owned animals and these were readily available for crop production and transport, although difficulties arose during periods of drought when the number of animals declined. As for fertilizer, mechanical services for land

Table 6.2. Estimate of National Seed Needs of Major Crops in 2002

Crop/Region[1]	2002 Cultivated area estimate[2] (1000 ha)	Seed rate[3] (kg/ha)	Total requirement (1000 ton)	Need gap[4] (%)	Need gap (1000 ton)
Irrigated wheat					
Northeast	190	151	28.6	7.2	2.1
North	268	151	40.4	7.2	2.9
Central	78	151	11.7	7.2	0.8
Southwest	365	151	55.0	7.2	4.0
West	181	151	27.2	7.2	2.0
East	116	151	17.5	7.2	1.3
Sub total	**1199**		**180.4**		**13.0**
Rainfed wheat					
Northeast	229	91	20.8	13.9	2.9
North	245	91	22.3	13.9	3.1
Central	8	91	0.7	13.9	0.1
Southwest	82	91	7.5	13.9	1.0
West	203	91	18.5	13.9	2.6
East	42	91	3.8	13.9	0.5
Sub total	**809**		**73.6**		**10.2**
All wheat total			**254.0**		**23.2**
Barley	**148**	**133**	**19.7**	**6.1**	**1.2**
Maize	**134**	**74**	**9.8**	**10.4**	**1.0**
Rice	**143**	**130**	**18.5**	**9.4**	**1.7**
All crop total	**2432**		**302.0**		**27.2**

1 The FAO/WFP report refers to 8 agricultural regions instead of 6, as in this survey. For the purpose of this analysis, area estimates of the south and south-central regions, respectively, in the FAO/WFP report have been added to those of the southwest and eastern regions.

2 Mean of cultivated areas 1998-2001 (FAO/WFP Crop and Food Supply Assessment Mission to Afghanistan – Special Alert, Number 315, 8 June 2001).

3 Mean seed rate from household survey

4 Mean percentage deficit in household seed needs according to survey results

preparation seemed to be widely available in the areas surveyed, and many farmers could afford and use them. There were probably many tractor owners who charged competitive prices that the farmers could afford.

Pesticides were moderately available but seem rather expensive, with few households using them, although many needed them. On average, 67% of the households indicated that their fields had some infestation with pests and diseases. The farmers estimated an average level of infestation as 17% of the cultivated area, resulting in an expected yield loss of 12%.

Constraints to agricultural production
Results showed that, except for Nangarhar province, where the effects of drought seemed moderately severe, almost all households considered drought as the key constraint to crop production. The incidence of drought was therefore widespread, although the severity varied by location. Drought and the need for irrigation water were closely related, since Afghan crop production depends heavily on irrigation; hence the similarity in household ranking of both constraints.

Although farmers seemed to have access to sufficient quantities of planting material, they were concerned about poor quality of seed, which was a constraint to crop productivity. Similarly, although fertilizer was widely available, households could not meet up to 50% of their average needs because this input was rather expensive. Access to pesticides was also constrained by high price when this was compared with the loss in yield farmers expected, and was also more difficult than seed to overcome.

Households may not have perceived access to land as an important constraint, because most had their own land and could also acquire more through sharecropping arrangements.

In the survey, the farmers' understanding of credit was the loan they obtained from their relatives and other farmers in the community. Because of the close kinship and welfare nature of rural communities, the farmers seemed to have repeated easy access to these sources of loans regardless of their continuing state of indebtedness.

Because the households sampled in this survey probably sold produce to the merchants directly at the farm gate, the farmers did not consider marketing a constraint. However, marketing would be a serious bottleneck for highly productive agricultural systems that generate significant output that must be transported to urban consumers or processing industries.

Conclusions

This survey has shown that given appropriate support, Afghan farmers could produce much of the country's food requirements. Of particular importance is improving farmers' access to irrigation water (the country's agriculture depends largely on irrigation), quality seed of good varieties, and fertilizer.

There seemed an increasing scope for Afghan farmers to adopt new varieties, although those they had were predominantly of local origin. The objective of making available new varieties should have been to increase the choices farmers had, and not solely to replace existing varieties, since local varieties could have superior attributes.

Crop improvement efforts should be intensified to develop more water efficient or drought tolerant rainfed wheat varieties, considering the large areas cultivated and the continuing threats of drought and shortage of irrigation water.

Since wheat was used mainly for domestic consumption, households diversified into other crops such as potato, barley and maize for sale in local markets. Therefore, having more productive varieties of these crops would support more viable rural economies.

In seeds, the focus should have been on quality enhancement and not on quantity, since households met a high proportion of their seed needs from sources within their communities including own production and other farmers. Alternative seed systems should, therefore, be developed within these communities to produce high quality seed and make it available to local farmers. Most farmers were aware of the quality attributes they desired in crop varieties.

Optimal use of other production inputs such as fertilizer and pesticides was restricted by high prices of these inputs, with a high proportion of household debt being used each year to finance input costs. Since most farmers had their own land in addition to sharecropped land, access to water resources seemed to be more important than access to land itself. Households ranked access to irrigation water as the most important constraint to crop production.

The perception and interpretation of constraints by households in this survey reflected their scale of operation, which was relatively small and in most cases subsistence. Once the scale of operation or productivity levels increase, other aspects such as credit and marketing, which were of low priority in the households, would become more important **– *S. Kugbei***

Study on Wheat and Barley Seed Supply Systems

The studies on wheat and barley seed supply system in Ethiopia and Syria were carried out to get a better understanding of the functioning of formal and informal seed systems at the farmer's levels. Formal surveys were conducted during the 1997/98 and 1998/89 crop seasons which coincided with the main wheat and barley planting periods in both countries. Subsequent laboratory tests and field experiments were conducted in the following years. The analysis of survey questionnaires is combined with assessment of seed quality in the laboratory and subsequent field experiments.

Objectives of the Study: The main objectives of the study were to: (a) understand the functioning of the wheat and barley seed supply system with particular reference to the informal sector; (b) characterize farmer's perception, criteria and adoption of modern varieties and associated technologies to assist breeders to focus on farmers' preferences; (c) identify farmer's seed sources and indigenous knowledge of on-farm seed management practices to formulate responsive seed delivery systems; (d) investigate the quality of seed planted by farmers by comparing seed obtained from different sources and understand the quality constraints to recommend options for improving them at farm level; (e) characterize the wheat and barley diversity at the farm level using morphological and agronomic traits; and (f) identify technological and socio-economic factors affecting adoption of modern varieties and associated technologies. The findings on seed sources, farmers' perceptions and on-farm seed management are reported here.

Sampling Procedures and Data Collection: A multistage purposive stratified sampling procedure was followed from higher to lower administrative levels, with farmers being the sampling units. A total of 304 wheat farmers in Ethiopia and 206 wheat farmers and 200 barley farmers in Syria were interviewed in three to four major wheat and barley production comprising of 6 to 9 districts and covering 59-81 villages across the selected regions.

Structured and open-ended questionnaires were administered to selected farmers during the formal surveys. A team of four enumerators and two supervisors conducted the survey. A two-day training course was organized for the enumerators and the supervisors, which included discussion of the survey objectives, detailed question-by-question review of the survey instrument, instructional sessions on interviewing techniques and practice interviews with farmers.

Each farmer was interviewed about the wheat or barley varieties grown and the perception about these varieties, source and information on agronomic practices,

seed sources used for planting, perception of seed quality and seed management practices for production of both crops. After the interview about 1 kg of wheat or barley seed sample was collected from each farmer from the seed lot planted or intended for planting for analysis in the laboratory. The samples were tested for physical, physiological and health quality based on ISTA rules. A selected number of samples were identified and planted for each crop in designed field experiments with authentic or certified seed samples as controls to study the diversity of varieties collected.

*Study Areas***:** In Ethiopia, four major wheat production zones i.e. Arssi, West Shoa, North Shoa and East Gojam were selected based on the informal assessment and secondary data from the Central Statistics Authority. The two regional states together accounted for over 83% of wheat area and production in the country. Apart from being representative of the major wheat growing areas, these administrative zones also provided contrasting situations in terms of agro-ecological diversity, exposure to and use of modern agricultural technology, and institutional factors such as proximity to research centers, agricultural input providers or output markets.

Similarly, in Syria three major wheat and barley production provinces namely Aleppo, Raqqa and Hassakeh in northeastern part of the country were selected based on the secondary data from the Central Bureau of Statistics. The three provinces altogether accounted for nearly 65% of wheat and 78% of barley area and production in the country (1994 statistics).

Results and Discussion

Farmer's seed sources and management

Farmer's seed sources:. The decision by farmers to change varieties already adopted is termed variety replacement, whereas the decision to obtain fresh seed stocks of the same variety is termed seed renewal (Bishaw and Kugbei, 1997). In both cases the decision to replace seed may be due to perceived reduction in productivity arising probably from genetic change and/or deterioration in quality through continuous use of the same variety or seed.

In general farmers have four major sources of seed for planting: (a) own saved seed from the previous years' harvest; (b) seed obtained from other farmers (relatives, neighbors); (c) seed purchased through local trading (local markets or grain traders); and (d) seed purchased from the formal sector. There is interplay of many technical and socio-economic factors when seed is obtained from a particu-

lar source including anticipated benefits and household food security; availability of reliable information on source, quantity and quality of the product; proximity and timely availability; and price and risks associated with it. Small-scale farmers grow as many diverse crops as possible which are dictated by their domestic circumstances including the provision of household food security. The alternatives to source seed for mix of crops grown on the farm is challenging and complex decision-making process, not just lack of seed for planting a particular crop. For example some studies confirmed that farmers are not short of seed even in case of extreme and recurrent disasters (Rhorbrach, 1997), although the extent of disruption varies with crops, seed sources, farming systems and farmers seed management practices (Sperling, 1998).

Seed acquisition is not a simple one step decision associated with lack of seed on-farm, but it is a dynamic process reflecting farmers response to specific problems associated with farming. While farm saved seed is the most common source, there are many reasons for off-farm demand for seed including: (a) last minute change in cropping pattern due to delay in onset of rainfall; (b) need for replanting because of poor crop establishment or failure; (c) introducing new/existing crops on the farm as part of diversification and profit maximization plan; (d) introducing new/better variety of the crop already grown on the farm; (e) changing seed because of perceived weaknesses in existing seed stock such as declining yield or product quality; (f) seed shortage where not enough quantity is available on hand to plant a crop; (g) emergency situation because of manmade and/or natural disasters; and (g) out of choice/necessity because sourcing seed off-farm is more convenient/essential. For example, in some countries subsidized price could be the main reason for artificially high demand from the formal sector rather than the actual demand for certified seed.

Farmers' initial seed source for crop varieties: Here it is important to distinguish between two aspects: (a) the initial seed source for all wheat or barley varieties currently grown by farmers; and (b) farmers seed source for wheat or barley planting during the survey year. In Ethiopia, the formal sector accounted for about 42% of the initial source of seed of modern wheat varieties grown by farmers i.e. through Regional Agricultural Bureau (39%), Ethiopian Seed Enterprise (1.8%) or agricultural research (1.2%). Some of the bread varieties (HAR series) were released few years prior to the survey year and were at the initial stage of diffusion where the formal sector appeared to be the main source of seed. The Regional Agricultural Bureau became a major supplier of seed to farmers as part of the agricultural extension package through its demonstration and popularization program. The agricultural research played a very minor role in dissemination of

modern varieties despite its long-term involvement in on-farm demonstration of technology to farmers.

Likewise the informal farmer-to-farmer seed exchange was the major initial source of wheat seed particularly for the relatively 'older' modern varieties and farmers' varieties. The informal sector was an initial source of modern wheat varieties for 57.8% of the farmers, through neighbors/other farmers (35.5%), relatives (6.9%) or local trading (15.4%). Similar results have been observed for wheat in central Ethiopia (Beyene *et al.* 1998) and northwestern highlands of Ethiopia (Hailye *et al.* 1998).

During the survey year in 1997/98 cropping season, the majority of farmers used seed from the informal sector for planting their wheat crop (Table 6.3). About 79% of the respondents used retained seed, whereas the remaining sourced their seed off-farm from neighbors (9.4%) and traders (3.4%). The formal sector accounted for only 8.2%, typical for self-pollinated crops such as wheat where retained seed is a major source for planting. Tetlay *et al.* (1991) reported that in Pakistan, the most common source of wheat seed was retained seed (55-62%), followed by seed from other farmers (21-27%). Similar results were also found for wheat in Ethiopia (Bishaw *et al.* 1994) and USA (Stanelle *et al.* 1988).

Almost all Syrian farmers were growing a wide range of modern varieties and thus expected to be more familiar with seed from the formal sector. Unlike barley, the main initial seed source of wheat varieties was the formal sector where it altogether accounted for nearly 60% (n=272) where ACB, GOSM and Cooperatives accounted for 50.4, 6.6 and 2.6%, respectively. Moreover, the local level informal seed acquisition through relatives (0.7%), neighbors (10.3%), other farmers (16.5%) or local grain traders (12.9%) combined also played a significant role in diffusion of modern varieties. Tetlay *et al.* (1991) found that in Pakistan up to two third of farmers acquired seed of modern wheat varieties through informal sources such as neighbors or other farmers. Similar results were also reported from Ghana where other farmers were the major initial sources of seed for modern maize varieties (Tripp, 1997).

Table 6.3. Farmers Initial Seed Source

Initial seed source for new varieties			Seed source during survey year		
Seed source	**No of farmers**	**% response**	**Seed source**	**No of farmers**	**% response**
Ethiopia-wheat (n=436/438)					
Formal sector (RAB, ESE, research)	183	42	Formal sector	36	8.2
State farms	1	0.2	Neighbors/ other farmers	41	9.4
Relatives	30	6.9	Traders/local markets	15	3.4
Neighbors/other farmers	155	35.5	Own saved seed	346	79
Traders/local markets	67	15.4			
Total	**436**	**100**	**Total**	**438**	**100**
Syria-wheat (n=272/273)					
Formal sector (ACB, GOSM, Coops)	162	59.6	Formal sector	65	23.8
Relatives	2	0.7	Neighbors/other farmers	34	12.5
Neighbors/other farmers	73	26.8	Traders/local markets	12	4.4
Traders/local markets	35	12.9	Own saved seed	162	59.3
Total	**272**	**100**	**Total**	**273**	**100**
Syria-barley (n=200)					
Formal sector	27	13.5	Formal sector	-	-
Relatives	65	32.5	Neighbors/farmers	22	11
Neighbors/other farmers	71	35.5	Traders/local markets	13	6.5
Traders/local markets	37	18.5	Own saved seed	165	82.5
Total	**200**	**100**	**Total**	**200**	**100**

During the 1998/99 cropping season, almost two thirds of farmers (59.3%; n=273) in Syria obtained seed on-farm for planting their wheat crop. Moreover, 24% of farmers sourced seed from the formal sector through ACB (13.2%), cooperatives (6.2%) or GOSM (4.4%) whereas 4.4% got their seed through local traders. van Gastel and Bishaw (1994) found similar results, which showed that over fifty percent of wheat farmers used own seed and 25.4% sourced from neighbors and 18.6% from the formal sector. Hasan (1995) also found that in Jordan the majority of wheat farmers also used on-farm saved seed (58.3%) compared to seed from external sources such as certified seed (34.1%).

As expected, the majority of farmers growing barley initially sourced their seed stock used informally from relatives (32.5%; n=200), other farmers (22.5%), neighbors (13%) or local grain traders/markets (18.5%). However, a minority (13.5%) purchased their initial barley seed from ACB or GOSM confirming the involvement of the formal sector in production and distribution of seed of local barley landraces. However, during 1997/98 cropping season no farmers was encountered who purchased barley seed from the formal sector in the survey area and the seed was entirely obtained from the informal sources.

Farmers perception of certified seed

In Ethiopia, most wheat farmers had previously experienced acquiring seed from the formal sector at one point in time, but only 36 respondents (8.2%; n=438) purchased seed from the formal sector in 1997/98 crop season (Table 6.4). Sourcing seed from the formal sector appeared to be a strategy for acquiring new varieties (varietal replacement) or for the renewal of old seed (seed replacement) on the farm. There was also a general belief that certified seed gave better yield, although no distinction was made whether this was from varietal characteristics or simply due to better quality seed. Ensermu *et al.* (1998) cited the use of certified would increase wheat seed yield by 0.2 to 0.5 t/ha, although this estimate is difficult to verify.

Table 6.4. Farmers Perception of Certified Seed of Wheat in Ethiopia and Syria

Farmers' perception	Ethiopia-wheat (n=36)		Syria-wheat (n=65)	
	Farmers	%	Farmers	%
Replace old variety	10	27.7	10	15.6
Replace old seed	9	26.0	16	24.4
Better seed quality	11	30.5	38	57.8
Better grain yield	32	88.9	14	22.2
Cheap price	-	-	1	2.2
No own seed	1	2.7	3	4.4
Others (credits)	1	2.7	7	11.1

In Syria, farmers had a very high perception for the seed from the formal sector and valued the quality of certified seed. Most of them appreciated the seed quality (57.8%) and perceived that it also give high yield (22.2%) compared to on-farm saved seed. The other main incentives for farmers buying certified seed was to replace an old variety or buy fresh seed as indicated by 15.6 and 24.4% of farmers, respectively. Hasan (1995) reported that wheat farmers in Jordan buy certified

seed because of positive perception of seed quality (cleaned, treated) or expected high yield.

The seed replacement rate for wheat was high where 66.7% of farmers (n=65) who purchased certified seed in 1998 claimed purchasing certified seed every year from the formal sector. The remaining 33.3% though did not buy seed every year the majority claimed purchasing certified seed at an interval of three years. Price of seed and the quality of own saved were the main reasons for not buying certified seed regularly from the formal sector. Mazid *et al.* (1998) stated that wheat farmers in irrigated areas were more dependent on seed from the formal sector than those in rainfed areas.

The majority of farmers who purchased from the formal sector indicated that certified was always available, properly cleaned, properly treated and were satisfied with the quality. van Gastel and Bishaw (1994) found that 18% of farmers purchased seed from the formal sector and were all satisfied with the quality. However, only 35.6% of farmers were satisfied with the price of certified seed. Radwan (1997) indicated that although seed is distributed at cost or at nominal profit for some crops as per the government policy, farmers still consider the price of seed too high.

In Syria, the relatively high use of certified seed can be explained by five possible factors: (a) sustained government policy and effort in promoting use of certified seed; (b) low price of certified seed which is provided at production cost, although farmers still consider the formal sector seed as expensive; (c) adequate seed production and distribution facilities and rural infrastructure guaranteeing easy access; (d) farmers' perception of certified seed in terms of quality and increased yield; (e) adequate grain marketing procedure where the whole production can be delivered to government depots at premium prices; and (f) less need for on-farm storage where seed could easily be purchased later in the season as a matter of choice or convenience.

Farmer's perception of own saved (retained) seed

On-farm seed production and retention for planting is the most economic approach provided that new varieties with superior agronomic and quality attributes are not on the market and there is no biophysical constraints that are detrimental to seed quality on the farm. In case of wheat, there is little evidence to suggest a decline in yield through continuous use of seed of the same variety if farmers follow sound crop production procedures. As a result, for most cereal crops including wheat, own saved seed is the major source for planting both in developed (Stanelle *et al*. 1988) and developing (Hasan, 1995; van Gastel and Bishaw, 1994; Bishaw *et al*. 1994; Yonas, 1999) countries.

Farmers' perception about own saved (retained) seed is presented in Table 6.5. Wheat farmers in Ethiopia considered the quality of on-farm seed as equal or better than seed from elsewhere (43.3%; n=263) and did not see any justification for changing the seed unless to acquire new variety on the market (6.5%). Some farmers did not want to change their variety at all because of its good quality attributes for local food preparation (3.8%). The timely availability of seed and the costs incurred were also considered as useful alternative sources. On the other hand seed shortage (39.2%), high price or lack of cash/credit remain the major reasons for not sourcing seed from the formal sector. There was also lack of confidence on the quality of seed from the formal sector (7.2%) and lack of varietal adaptation (4.6%) which further discouraged farmers from using modern varieties and buying certified seed. Almost all farmers (92.7%) who obtained seed on-farm were satisfied with the quality of their retained seed.

Table 6.5. Farmers' Perception of Own Saved (Retained) Seed of Wheat and Barley

Why farmers use own saved seed			Why farmers not buy certified seed		
Perception	**Farmers**	**%**	**Perception**	**Farmers**	**%**
Ethiopia-wheat (n=263)					
Seed available on time	6	2.3	Variety not adaptable	12	4.6
No extra seed cost	7	2.7	Poor seed quality	15	5.7
Seed quality is good/better	114	43.3	Certified seed is expensive	98	37.3
Certified seed not available	103	39.2	No cash/credit	69	26.3
Prefer local variety (food, etc)	10	3.8	Lack of awareness	2	0.8
No new/better variety	17	6.5	Fresh certified seed	17	6.5
Others	6	2.3	Others	15	5.7
Syria-wheat (n=127)					
Seed quality is good	77	60.6	Certified seed is expensive	59	46.5
Seed available on time	14	11.0	Certified seed not available	21	16.5
No extra seed cost	7	5.5	Poor seed quality	6	4.4
Certified seed not available	12	9.4	No cash/credit	19	14.9
Difficult procedures	7	5.5	Lack of awareness	2	1.6
No better variety	3	2.4	Own seed is good	13	10.2
Others	10	7.9	Others	7	5.5
Syria-barley (n=165)					
Seed available on time	45	27.3	Certified seed is expensive	117	71.3
Good seed quality	90	54.6	Lack of credit/cash	32	19.2
No extra seed cost	10	6.1	No new variety	5	3.0
Small seed quantity	3	1.8	Lack of awareness	3	1.8
No improved variety	6	3.6	Poor seed quality	5	3.0
Others	10	6.1	Seed not available	2	1.2

Almost 60.6% of Syrian wheat farmers (n=127) believed that own saved seed produced on the farm was of good or better quality. A significant number of farmers used retained seed because they considered certified seed costly, not available on the market, difficult and long bureaucratic procedures to obtain or see no merit in purchasing it if the variety is not adapted to their condition. Conversely, however, the price of seed remained the single most important factor for farmers not purchasing certified seed (46.5%). Lack of credit or cash, poor seed quality and lack of awareness altogether accounted for the remaining percentage of farmers not buying certified seed. The two most critical factors for sourcing seed on-farm are the perception of seed quality and price of certified seed. The overall perception of farmers about seed retained on-farm was very high.

About 165 barley farmers (82.5%; n=200) used own saved and 144 (87.3%; n=165) were satisfied with the quality of own saved seed. Over 50% of farmers considered the quality of own saved seed as better or equal to seed from other seed sources including the formal sector. Moreover, timely seed availability (27.3%), cost of seed (6.1%), lack of improved variety/certified seed (3.6%) and smaller seed quantity (1.8%) were some of the reasons for sourcing seed on the farm. The most overriding issue for farmers not buying seed from the formal sector was seed price (71.3%), shortage of cash (15.2%) and lack of credit (4.2%). Although not clearly indicated, the complete absence of modern barley varieties contributed to farmers not sourcing seed from the formal sector. In Ethiopia, lack of alternative seed sources (56.5%), adaptation of local varieties (40.7%) and good quality of own seed (2.1%) were the main reasons for the majority of barley farmers retaining seed on the farm (Yonas, 1999).

Seed retention/replacement

Seed retention refers to a continuous uninterrupted use of the same seed lot for planting once a farmer purchased fresh seed of the modern variety or local landrace from outside sources i.e. formal or informal sources. It is one of the most common seed acquisition strategies and enables farmers to maintain any inter- and intra-crop diversity that exists on their farms. The number of years seed is retained on farm varies from crop to crop and depends on the availability from external sources and farmers' decision to change seed, which in some cases goes beyond 20 years. The majority of farmers acquired their seed during the last five years, showing a higher seed replacement rate for wheat seed in Ethiopia. About 29.9% of farmers acquired seed from external sources during the 1997/98 cropping season whereas 43.8% kept seed for one year, 21.7% for two years and 19.7 % for three years (Table 6.6). Seed of local landraces or obsolete varieties were kept on the farm for longer periods compared to modern varieties. In 1994,

Bishaw *et al.* (1994) found that 21% of wheat farmers saved their seed for 6-10 years and 14% saved seed for 11-15 years.

In Syria, the rate of wheat seed replacement, both from formal and informal sources appeared to be high. During the survey year, the majority of farmers sourced seed off-farm, with highest proportion from the formal sector and followed by seed from relatives, neighbors or other farmers. In general almost all farmers replaced their wheat seed stock within the last five years. In 1998, out of a total of 206 farmers who planted wheat, 40.7% obtained fresh certified seed or changed their seed informally, 34.8% retained seed for one year, 13.6% for two years, 8.1% for three years and 1.5% for four years. Such seed replacement rate was considered very high in comparison with normal standards in the formal sector of four to five year for self pollinated crops. van Gastel and Bishaw (1994) found frequent seed renewal rates among wheat seed farmers in Syria where nearly 80% replace seed within the period of three years. Cromwell *et al.* (1993) cited that over 75 and 40% of farmers growing soybean and beans, respectively replace their seed more frequently within less than five years. Such high rate of varietal replacement is quite useful provided new varieties are released frequently and available on the market particularly for wheat varieties where longevity against rust diseases is quite short-lived.

Contrary to common knowledge and despite the fact that all farmers were growing local landraces, there was moderately high turnover of barley seed. About two-third of the farmers replaced their seed during the last five years and the figure reached 85% when the previous 10 years were considered. There are three possible scenarios for such high turnover of seed of local barley varieties i.e. (i) availability of seed from the formal sector, (ii) government grain price, and (iii) frequent droughts. First, prior to 1991 the formal sector provided seed of local landrace at a relatively cheaper price thus encouraging farmers to buy cleaned and treated seed of local landraces from the formal sector. Second, the government grain price for barley prompted farmers to sell their produce and buy seed or feed on the market at a reduced price. Third, frequent droughts and crop failures particularly in marginal areas forced farmers to seek seed from outside the farm. However, when a different grain price was introduced, wheat and barley farmers opted to use their own barley seed leading to a significant drop of seed purchase from the formal sector except in drought years. Tutwiler *et al.* (1997) indicated that barley farmers tend to sell all their barley grain at high prices to the government and buy cheap grain on the market to feed their animals. This had an influence on farmers who frequently change or purchase seed from outside sources.

Despite frequent droughts and crop failures in marginal environments where barley is the principal crop, about a quarter of farmers retained barley seed on the farm for over 10 years. Mpande and Mushita (1996) indicated that in Zimbabwe, for example, sorghum and pearl millet farmers kept enough seed for two cropping seasons as security against droughts, although the quantity varies depending on the harvest. This phenomenon might explain the survival of two barley local landraces with better adaptation to the extremely harsh and stressful barley growing environments across Syria. This is a testimony to the intrinsically dynamic nature of the informal sector and its resilience to environmental stresses to meet farmers' seed needs at the local level. For example, 29.8% of farmers who used own saved barley seed in Ethiopia retained the same seed lot for over nine years (from 2-30 years) claiming as valuable legacy inherited from their ancestors (Yonas, 1999). Similarly, Cromwell *et al*. (1993) quoted data from Nepal where farmers typically replaced wheat seed every seven years, open pollinated maize every ten years and rice seed every twenty years.

Table 6.6. Number of Years Wheat and Barley Seed Retained on the Farm by Farmers

	Ethiopia-wheat		Syria-wheat		Syria-barley	
Years	**Counts**	**%**	**Counts**	**%**	**Counts**	**%**
0	91	20.8	111	40.7	35	17.5
1	133	30.4	95	34.8	23	11.5
2	66	15.1	37	13.6	21	10.5
3	60	13.7	22	8.1	13	6.5
4	14	3.2	3	1.1	15	7.5
5	19	4.3	2	0.7	20	10.0
6 to 9	20	4.6	3*	1.1	19	9.5
10	35**	8.0	-	-	24	12.0
11 to 19	-	-	-	-	19	9.5
≥ 20	-	-	-	-	11	5.5
Total	438	100	273	100	200	100

NB: * more than 5 years; ** equal or more than 10 years

Farmers' seed management

Do farmers perceive any difference and make distinction between grain they use for consumption or seed for planting? Is there any concern of seed quality problems among farmers? If so how do they manage their seed differently from grain?

Understanding these issues lead us to design alternative strategies in delivering seed of better quality to farmers or try to improve on farm seed production techniques to improve quality constraints at local level.

On-farm seed management practices are often the reflection of farmer's perception and the value they attach to seed planted to raise the next year's crop. Farmers' positive perception of seed influences them to practice different seed management approaches to maintain the quality of their wheat seed through selection, cleaning, treatment, storage or direct/indirect assessment of seed quality. The responsibility to manage and execute these operations on the farm was shared between men and women, who have a distinctive role to play. These values and expectations of seed quality are given in Table 6.7. In Ethiopia 92% of farmers (n=304) recognize the difference between grain and seed and some of them attributed these differences to purity (60.1%), freedom from weeds (18.1%), intact seed with good germination (18.4%), big kernel size (11.5%), no disease or insect damage (10.2%) and no admixture with seed of other varieties of the same crop (3.3%).

Table 6.7. Farmers' Perception of Seed Quality and On-farm Seed Management

Farmers' Perception	Ethiopia Wheat (n=304) %	Syria Wheat (n=206) %	Syria Barley (n=200) %
Recognize differences	92.0	97.6	98.5
Purity (cleanliness from dirt, etc)	60.2	53.2	17.0
Free from weeds/other crops	18.1	30.5	1.0
Good quality (intact, germination)	18.4	6	2.0
Big kernel size	11.5	12.9	9.5
No disease/insect damage	10.2	8.5	-
No mixture with other varieties	3.3	-	-
Seed Management			
Seed selection	67.1	53.9	45.5
Seed cleaning	82.8	90.3	91.0
Seed treatment	3.5	90.3	6.5
Separate storage	64.8	64.1	76.0
Check germination*	33.9	4.4	3.0

NB: * Mostly indirect assessment

Similarly, from 206 wheat growers in Syria, 97.6% observed the difference between grain and seed and attributed these differences to cleanliness (53.2%), seed treatment (17.9%), free from weeds (30.5%), freedom from diseases (8.5%), good germination (6%) and seed size (12.9%). A majority of farmers practised seed cleaning (90.3%), chemical treatment (89.3%), stored seed separately (64.1%), selected seed (53.9%) and checked germination (4.4%).

About 98.5% (n=200) of barley growers distinguished the difference between grain and seed. Apparently, 17% attributed the difference to purity, 9.5% to kernel size, 2.5% for treatment, 2% to quality and 1% for freedom form weeds. As a result, most farmers cleaned their seed (91%), stored seed separate from grain (76%) and practiced seed selection (45.5%). Few farmers treated their seed (6.5%) and checked germination of barley seed before planting (3%).

Farmer's plant/seed selection: Seed selection is part of on-farm seed management practice (Walker and Tripp, 1997). Farmers practise empirical selection of plants or seeds through critical observation using crop performance criteria although these do not involve specific physical measurements. Plant or seed selection could take place at least in three stages during crop production cycle: selection of plants or ears in the field of standing crops before or at harvest; selection of ears/grains on threshing floors; and selection of grains from threshed grain in a store at planting time. The decision to use a particular lot for planting is a combination of processes requiring continuous observation and evaluation rather than an isolated one-time decision. Farmers monitor the crop during the entire growth period in the field, at harvesting or threshing time, or later during storage. Combining the situation of standing crops in the field and the grain quality at harvesting time and in storage can help in differentiating between the seed that can be used for planting and the grain that can be used for other domestic purposes. Such elaborate approach for plant or seed selection could still persist in traditional farming systems where outside influence is minimal. However, the practice is becoming less relevant for small grain cereal crops where commercial agriculture predominates as farmers become increasingly dependent on seed from outside sources such as the formal sector.

In Ethiopia, two-third of farmers (67.1%; n=304) practice a combination of different selection methods, stages, criteria and responsibilities to discriminate between grain used for consumption or planting on their farm (Table 6.8). However, most of the selection practices are intuitive or indirect. For example, of those farmers who practiced selection, few selected plants (3.4%; n=204), ears (2.5%) and most of them selected grains (82.4%). Women contribute significantly to the seed selection process whereby they make decisions alone (4.9%) or jointly with men

(31.4%). The decision from which field or part of field to use the seed (16.2%) could be made at planting time or later in the season. They decided on which field or part of field that could be harvested and further evaluated the produce in terms of other criteria to differentiate between grain used for planting, feed or market. Wheat farmers in Ethiopia believed that a crop from fresh land is of good seed quality because of better soil fertility or plant nutrition and freedom from weed contamination. Moreover, fields identified for seed received adequate agronomic management such as better land preparation, application of fertilizers, proper weed control, etc. Most farmers selected grain (82.4%) and usually after harvest on threshing floors (12.3%), during storage (57.9%) or right before planting time (7.8%). The selection criteria reflected farmers knowledge and easily observable characters such as more grain yield, grain size (not shriveled or small seeds), grain color (not mixed with other colors highly related to marketability), less damage from pests and food quality i.e. where the role of women in selection is reflected strongly. Farmers kept seed from fields free from pests, non-lodging crops, sound seed free from frost, rain or storage insect damage, etc. but not necessarily evaluated pest resistance, lodging tolerance of a particular variety and made selection on these criteria. Similar selection practices have been reported for

Table 6.8. Farmer's Plant/Seed Selection of Wheat and Barley

	Ethiopia Wheat		Syria Wheat		Syria Barley	
	Farmers	**%**	**Farmers**	**%**	**Farmers**	**%**
Select for seed	204	67.1	111	53.9	99	49.5
Method of selection[1]						
Whole or part of field	33	16.2	96	86.5	79	79.8
Select plants	7	3.4	2	1.8	8	8.1
Select ears	5	2.5	8	7.2	1	1
Select grain	168	82.4	14	12.6	23	23.2
Others	-	-	2	1.8	-	-
Time of selection[1]						
At planting	16	7.8	6	5.4	5	5.1
Standing crops	59	28.9	7	6.3	19	19.5
At threshing/harvesting	25	12.3	96	86.5	75	75.8
After harvesting/storage	118	57.9	1	4.5	-	-
Responsibility for selection[1]						
Men	130	63.7	109	98.2	95	96
Women	10	4.9	-	-	-	-
Both	64	31.4	2	1.8	4	4

NB: [1] Percent of farmers based on those who practice selection

wheat (Beyene *et al*. 1998; Ensermu *et al*. 1998) and maize (Gemeda *et al.* 1998) in Ethiopia and for rice in Philippines (Fujisaka *et al.* 1993).

Almost over one-half of wheat farmers (53.9%; n=206) and barley farmers (49.5%; n=200) claimed practicing plant or seed selection in Syria. The majority of wheat farmers decided what seed to use based on selection of a field or section of a field of the standing crops (86.5%; n=111) and usually made selection before (6.3%) or at harvesting (86.5%) time. Similarly, most barley farmers selected fields (79.8%; n=99) and prior (19.5%) or at harvesting (23.2%) time. Mpande and Mushita (1996) reported similar results for sorghum and pearl millet where seed selection was mostly carried out in the field and at threshing point which provided an opportunity for farmers to evaluate the crop for agronomic characteristics such as less lodging, less shattering, less damage from pests, etc.

For wheat farmers the most important selection criteria were freedom of the standing crops from contaminating weed plants (72.1%; n=111), ear size (34.2%), grain size and absence of disease (or tolerance to disease) whereas other factors remained to be of less importance. About 68.7% (n=99) of barley farmers considered grain size as the most important factor to determine whether to use the grain for seed or other purposes. Grain color (42.4%) or grain yield (41.4%) at harvest or ear size (22.2%) of the standing crop were considered important selection criteria in deciding the seed used for planting barley crop. The freedom from weeds came as an important second criterion (55.5%), since most farmers had serious problems from weed infestation in barley growing areas of the country. By doing so farmers may be indirectly selecting for plants that has some inherent resistance to weeds as new evidence suggests varietal differences in crops such as wheat for suppressing weeds (Rizvi *et al.* 2002). Mpande and Mushita (1996) reported that grain yield, grain color, grain size, early maturity, drought tolerance and a combination of them as the criteria used by farmers in seed selection.

Selection for most of these characteristics was rather indirect for making decision which grain harvest from which field should be kept for seed than individual ear selection, as is the case with maize, sorghum or pear millet reported elsewhere where individual plant heads or ears are selected and kept for seed (Mpande and Mushita, 1996; Walker and Tripp, 1997). For example the absence of infection rather than the level of pest resistance of the plant or crop was considered a selection criteria. This did not preclude that some farmers were using these criteria in selection. Walker and Tripp (1997) reported few seed selection in the field for maize and cowpea in Ghana (<4%) compared to sorghum and cowpea in Zambia where up to 18-25% of farmers selected seed on the farm.

During the field survey a handful of farmers in Ethiopia were encountered who practiced methodological approach in plant or seed selection. These farmers selected plants that appeared to be different in the standing crops out of curiosity usually at maturity using whole or part of the plant as selection criteria which included cluster of vigorous plants/tillers, plant height, ear size, grain size, etc., where selected plants were collected, threshed and stored separately. During the next cropping season the seeds were planted separately and critically observed throughout the entire plant growth period for any agronomic advantages including yield. If the farmer was convinced of any benefits the seed was multiplied and used on a larger scale. Ensermu *et al.* (1998) also reported an interesting observation where a farmer collected a left over seed from his neighbors' field and started multiplying the seed of the modern variety for own use. If farmers apply such meticulous selection pressure on the variety adopted, the structure of the variety may change significantly overtime. Therefore, this could raise the fundamental question of whether seed replacement of existing variety is of any practical relevance to farmers.

The plant and/or seed selection practiced in wheat and barley in Ethiopia and Syria could be summarized as follows: (i) No methodological approaches were observed in plant selection both in wheat and barley crops; (ii) Farmers' seed selection for planting was anecdotal and not systematic and largely influenced by field observation at harvesting or grain after harvesting or at planting; (iii) The intensification and commercialization of agriculture both in wheat and barley production might have led to loss of traditional practice of crop/seed selection; (iv) The high rate of seed renewal and varietal turnover resulting from availability of better adapted varieties relieved farmers from the pressure to look for improvement in existing varieties; (vi) No significant variation in plant and/or seed selection between wheat and barley growers, although barley farmers still used mostly local landraces; and (viii) the role of women in decision making process of plant/seed selection appeared to be high in more traditional farming (Ethiopia) than in mechanized or commercial farming (Syria).

Seed cleaning and handling: In broader terms, seed processing is an elaborate post harvest operations and may include seed drying (removing excess moisture), cleaning (removing impurities), grading (improving uniformity), treatment (protection against pests), packaging and storage. On-farm seed management may include simple winnowing of seed after threshing (Mpande and Mushita, 1996) or detailed techniques to maintain seed quality (Mugedza and Musa, 1996) or an elaborate traditional seed treatment technique to protect the seed against storage pests (Monyo *et al*. 2000). In general, it is an effort to ensure that the seed used for planting is well established in the field and raise good crop resulting to better

harvest. Apart from seed lots obtained from the formal sector, seed cleaning and treatment was a very common seed management practice both for wheat and barley seed sourced locally from neighbors, other farmers, traders or seed retained on the farm (Table 6.9).

Table 6.9. On-farm Seed Cleaning and Treatment (for seed obtained informally from other farmers, markets or retained)

Seed cleaning and treatment			Purpose of seed cleaning		
	Farmers	%		Farmers	%
Ethiopia-wheat (n=304)					
Not clean seed	36	11.8	Improve quality/remove inert matter	129	42.4
Purchased cleaned seed	1	0.3	Remove weeds/other crops	174	57.2
Seed cleaning	252	82.9	Remove small/broken/dead seed	34	11.2
Hand winnowing	195	64.1	Reduce seed rate	5	1.6
Hand sieving	53	17.4	Remove insect damaged/diseased seed	12	3.9
Machine cleaning	4	1.3			
Seed treatment	10	3.3			
Syria-wheat (n=206)					
Purchased cleaned seed	13	6.3	Remove inert matter	61	29.6
Seed cleaning	148	71.8	Remove weed seeds	67	32.5
Hand sieving	125	60.7	Remove other crop seeds (e.g. barley)	31	15.0
Machine cleaning	23	11.2	Remove small seeds/good size	24	11.7
Seed treatment			Remove broken seeds	54	26.2
Purchased treated seed	5	2.4	Facilitate easy planting	4	1.9
Treated seed	156	75.7			
Syria-barley (n=200)					
Not clean seed	12	6.0	Remove inert matter	146	73.0
Purchased clean seed	6	3.0	Remove weeds/other crops	74	37.0
Seed cleaning	182	91.0	Remove small/shriveled seeds	20	10.0
Hand cleaning	174	87.0	Remove broken seeds	21	10.5
Machine cleaning	8	4.0	Remove insect infested seeds	8	4.0
Seed treatment	13	6.5	Facilitate easy planting	29	14.5

Wheat farmers in Ethiopia cleaned their wheat seed right after threshing of the crop using locally made wooden implements or at a later stage at planting with home made tools. Winnowing at threshing time was a two-stage process: (i) threshed grain was separated from the rough straw; and (ii) the grain was further purified from fine straw, inert materials, shriveled or broken seeds. This was the most common practice in traditional wheat farming systems except when the crop is harvested by combine. In both cases complete removal of inert matter or

contaminants is not possible. Therefore, 64.1% and 17.4% of farmers, respectively cleaned their seed by hand-winnowing and hand-sieving at planting time using hand made tools to increase purity, reduce weed contamination or remove insect damaged grains, etc. In Ethiopia, nearly 90% of barley growers who retained seed on the farm or purchased seed from neighbours cleaned their seed using locally manufactured hand tools (Yonas, 1999). However, such cleaning tools were ineffective in removing the impurities and weeds to a desired level of seed quality. Men were mostly responsible for winnowing after threshing and women mainly carried out cleaning of the seed at planting time.

In Syria, almost all wheat growers in the survey reported that they used cleaned and treated seed either from the formal sector or through on-farm seed management (Table 6.9). Forty-five farmers (21.8%) used cleaned and treated certified seed sourced from the formal sector. The remaining 161 farmers (78.2%) sourced seed from other farmers, traders or used their own seed where most of the seed was cleaned and/or treated by farmers themselves. Moreover, about 91% of farmers (n=200) cleaned their barley seed before planting. Manual cleaning using a wire mesh sieve is the most commonly practiced method both for wheat (77.6%; n=161) and barley (87%; n=200) farmers whereas fewer farmers used locally manufactured mobile cleaners. Stanelle *et al.* (1984) found that 83% of farmers cleaned their wheat seed, but commercial cleaners accounted for 63%.

In almost all cases, the main purpose of on-farm wheat and barley seed cleaning was to improve the physical quality of the seed by removing inert matter, weeds and other crop seeds, shriveled/broken seeds or diseased/insect damaged seed using mostly traditional methods. But the traditional seed cleaning methods and equipment were not efficient in removing weeds and inert matter from the seed lots.

Chemical seed treatment: Chemical seed treatment is becoming one of the cheapest and most economic to control and limit the spread of seed-borne diseases. In Ethiopia, on-farm chemical seed treatment was negligible (3.3%) as shown in Table 6.9. Moreover, as a general policy, the formal sector distributed treated seed

only to the state farms not to the peasant sector to avoid risk of chemical hazards. Some reports, however, suggested the use of chemical seed treatment against seed-borne diseases of wheat as an alternative solution of disease control (Hulluka *et al.* 1991; Bishaw, 1987).

The striking difference between wheat and barley seed management was the extent of chemical treatment used by farmers in Syria (Table 6.9). Surprisingly, few farmers practiced chemical seed treatment for barley (6.5%; n=200) as compared to wheat seed. The availability of chemicals had induced wheat growers to use chemical seed treatment probably influenced by the practices of the formal sector. On-farm chemical seed treatment was widely practiced whereby almost all farmers treated their seed before planting (75.7%) except those who purchased treated seed (24.3%). In Jordan on-farm wheat seed cleaning (64%) and wide spread use of seed treatment chemicals (61.7%) has been reported for seed sourced from other farmers or retained on the farm (Hasan, 1995). However, Stanelle *et al.* (1984) reported that seed treatment was practiced by 36% of the wheat farmers, but more targeted towards areas with high rainfall and humidity where disease problems is anticipated which is not necessarily the case in Jordan and Syria.

The main constraints in seed treatment were found to be the formulation of chemicals; the method and rates of application; handling procedures including safety measures; and lack of sufficient knowledge about the chemicals used. Adequate extension program for seed treatment would be beneficial for the farmers in increasing the efficacy, targeting the organisms, reducing the cost and pollution of the environment.

Seed storage and management: The grain storage structures, management practices, and the role of gender is presented in Table 6.10. In Ethiopia, information on storage for grains in general and for seed in particular is very scanty (Tsega, 1994). Moreover, the influences of traditional grain storage structures on pest infestation and loss of seed quality is limited. It is observed that 261 farmers (85.9%; n=304) had some experience with pest problems, in which weevils and rodents were reported as two most important storage pests. About 45.1, 9.9 and 30.9%, reported weevils, rodents or both as threats to grain and seed storage, respectively. In general, pest infestation not only reduces the grain weight, but also destroys seed viability.

Table 6.10. On-farm Wheat and Barley Seed Storage and Management in Ethiopia and Syria

Seed storage	Ethiopia Wheat Farmers	%	Syria Wheat Farmers	%	Syria Barley Farmers	%
Store seed separate	197	64.8	132	64.1	152	76.0
Storage structures/facilities						
Polypropylene sacks	16	8.1	52	39.4	-	-
Jute sacks	26	13.2	75	56.8	143	94.1
Gotera, etc.	130	66	5*	3.8	9**	5.9
Barrel	25	12.6				
Pest control measures						
No pest problem/control	25	12.7	48	36.4	44	28.9
Sun drying	40	20.3	15	11.4	27	17.8
Cleaning	45	22.8	42	31.8	57	37.5
Change /dispose seed	-	-	15	11.4	13	8.6
Chemical (dusting, spraying/fumigation)	68	34.7	60	45.4	2	4.2
Others (traditional, etc)	19	9.6	-	-	9	5.9
Responsibility						
Men	89	45.2	111	84.1	134	88.2
Women	26	13.2	6	4.5	9	5.9
Both	82	41.6	15	11.4	9	5.9

NB: * Both (polyproplene and jute bags); ** Others (bulk storage, etc)

Most farmers stored seed separately (64.8%; n=304) from grain, and use both traditional and modern approaches in pest control before or after infestation. Several types of locally made traditional storage structures used for grain storage were observed. *Gotera* is the most common and popular grain storage structure, both for those who stored seed and grain together (77.5%) or separate (66%) and usually kept in the backyard outside the house. In contrast, smaller capacity structures such as *debegnt*, *gota* and *gushgush* are mainly made of wooden materials/mud and could be kept inside the house for storing smaller quantity of seed. However, these structures are neither insect nor rodent proof and considerable damage is observed when grain is sampled from farmers. Previous studies found *gotera* as the most popular storage structure and weevils as most prevalent storage pests of

small cereal grains in Ethiopia (Bishaw *et al.* 1994; Yonas, 1999). Tsega (1994) also found that 34 and 13.2% of farmers used *gotera* or *gota* for seed storage, respectively.

Cleaning infested seed, sun drying or changing the seed or storage facilities are common traditional storage management practices. However, use of chemicals such as contact insecticides appears to be popular (35-40%), although availability, use of actual recommended rates and application methods remained problematic. Wider use of chemicals for seed storage pests was reported for wheat (Yonas, 1999) and for maize (Gemeda *et al.* 2001). Generally, disinfection of traditional structures was difficult to achieve and infestation might have started from grain stored from the previous seasons. It appeared that the role of both men and women was equally distributed and shared the responsibility of managing seed storage.

During wheat and barley seed surveys in Aleppo, Raqqa and Hassakeh governorates, 63.6% of wheat farmers reported experiencing storage pest problems slightly less than barley growers (74%) which could be attributed to less wheat grain storage on-farm, where farmers dispose almost all their produce directly to government due to favorable prices. Moreover, in the case of wheat frequent change of seed by sourcing from external sources particularly the formal sector, resulted in less practice for on-farm seed storage and less pest problems. From those wheat farmers who had storage pest problems, 61.8%, 39.7% and 5.3% of farmers (n=131) reported that weevils, khapara beetle and rodents were serious storage pests, respectively. In the case of barley, 83.1%, 14.2% and 10.1% of farmers (n=148) reported that khapara beetle, weevils and rodents were serious pests, respectively. Earlier reports indicated that all three pests were confirmed as serious grain storage problems. A survey of grain and seed storage facilities in northwestern Syria found that khapara beetle as the most widespread and destructive storage pest (Niane, 1991).

It was found that 64.1% (n=206) of wheat farmers and 76% (n=200) of barley farmers store seed separate from grain whereas the remaining store seed and grain together. Walker and Tripp (1997) found that farmers in Zambia tended to separate their sorghum, bean and groundnut seed than farmers in Ghana who were less predisposed to such practice for their maize and cowpea seed. Almost all wheat and barley storage on the farm was handled in polypropylene or jute sacks or both, whether the seed was stored with grain or separated, which accounted for more than 94% of the respondents. Jute or polypropylene sacks were also reported to be the most common seed storage materials in Ghana and Zambia for maize,

cowpea and groundnut seed (Walker and Tripp, 1997). Traditional storage structures were much quoted elsewhere such as baskets, clay pots, glass jars or tins (Mpande and Mushita, 1996; Walker and Tripp, 1997) were not common and are not in use because they are irrelevant for cereal crops such as wheat and barley where large quantities of seed are required.

Wheat and barley farmers in Syria used a combination of both traditional (sun drying, cleaning or changing infested seed) and modern (insecticide sprays, fumigation) storage pest control measures to manage storage pests on the farm. However, traditional storage pest control methods were becoming less popular through time and there was an increasing trend to use chemical pesticides. In case of wheat, there was wide spread use of chemical control for storage pests where it became increasingly popular. Both contact insecticides and fumigants were available on the market for use by farmers. About 21.2 and 24.2 % of wheat farmers (n=132) storing seed separate used contact insecticides (dusting/spraying) or fumigation for pest control, respectively. These two chemical control methods constituted 13.5 and 23% for farmers (n=74) who did not store seed separate in the same order. Walker and Tripp (1997) found that cereal and legume farmers in Ghana and Zambia used a combination of traditional and modern storage pest control methods. They reported that farmers in Ghana were inclined to use more seed protectants more on cowpea (77.5%) than on maize (48%) compared to farmers in Zambia who did apply less so and no chemical at all for crops such as sorghum, although insects found to be the main causes for seed damage on the farm.

Modern storage pest control measures were used less on barley compared to wheat. Yonas (1999) also reported traditional practices such as heat treatment, drying seed in the sun, winnowing to remove live insects, changing the storage structures or disposing infested seed as well as use of chemicals (contact insecticides and fumigation) as most common strategies for control of grain storage pests for barley crop in Ethiopia.

In traditional subsistence agriculture, farmers use a wide range of locally available natural seed treatment techniques to control storage pests (Mugedza, 1996; Monyo *et al*. 2000). The use of contact insecticides and fumigants is becoming available if farmers had access to the chemical and affords the costs of application. However, the type, rate and method and equipment for application raised fundamental questions of efficacy and safety. In general, the inappropriate use of chemicals has led to the development of pesticide resistance worldwide. For example, in Syria, the strains of kahpra beetle collected from different grain storage structures had shown different levels of pesticide resistance (Niane, 1991).

Conclusions

Farmers had two main sources of seed for planting wheat and barley crop i.e. from formal and/or informal sources. The informal sector remained the major initial source of modern wheat varieties and supplier of seed for planting in any particular cropping season. The traditional farmer-to-farmer seed exchange mechanisms played a key role in lateral diffusion of modern varieties as well as the source of information for associated agricultural technologies.

Farmers have a positive perception of seed both from formal and informal sources and generally satisfied with the quality of seed obtained across different sources. For example farmers acquire seed from the formal sector because of likely perception of seed quality in terms of physical purity, chemical treatment, anticipated incremental yield or as part of strategy for acquisition of new varieties rather than regular purchase of fresh seed stocks. Moreover, the majority of farmers were satisfied with the quality of own saved seed and seed obtained from other farmers.

The plant and/or seed selection practiced by wheat and barley farmers in Ethiopia and Syria indicates no methodological approaches, but anecdotal and not systematic and largely influenced by field observations at harvesting or grain after harvesting or at planting. There was no significant variation in plant and/or seed selection between wheat and barley growers, although barley farmers still used mostly local landraces.

The majority of farmers clean their seed obtained informally using traditional equipment and methods. In almost all cases, the main purpose of on-farm wheat and barley seed cleaning was to improve the physical quality of the seed by removing inert matter, weeds and other crop seeds, shriveled/broken seeds or diseased/insect damaged seed using mostly traditional methods. But the traditional seed cleaning methods and equipment were not efficient in removing weeds and inert matter from the seed lots.

The use of fungicide seed treatment and pesticides for storage pest control is wide spread among wheat farmers in Syria and less so among barley farmers in Syria and wheat farmers in Ethiopia. However, the formulation of chemicals, the method and rates of application, handling procedures including safety measures, and lack of sufficient knowledge about the chemicals remained a concern where adequate extension program need to be introduced to better increase the efficacy and avoid risks associated with use of pesticides.

From the wheat and barley results it can be concluded that the seed from the informal sector had exhibited high quality that could be comparable to that of the formal sector. However, seed health quality appeared to be low for barley as compared to wheat in Syria which may have been associated with the wide spread use of chemical treatment. ***– Z. Bishaw***

Impact of Mechanical Damage on Germination, Emergence and Yield Components of Durum Wheat

Germination capacity determines the planting value of seed. Standard germination is a major seed quality attribute and a main component in seed certification systems. A study was conducted to investigate the effects of reduced germination capacity on yield and yield components due to different levels of mechanical damage during harvesting.

Materials & methods

Two durum wheat cultivars (Cham 1 and Acsad-65) were used and the experiment was planted in two replicates at two locations (Tel Hadya and Breda) with different mean annual precipitation (307 and 260 mm and 198 and 230 mm in the respective seasons) for two years. Entries had different germination percentages due to mechanical damage incurred during threshing of the seed. Plots of six-rows (row space: 25 cm; row length: 1m) were planted with 25seeds in each row. The trial was replicated three times in a randomized block design. The planting was done using a 'Heage-190' precision plot seeder. Three weeks after germination, the number of seedlings that emerged was counted. At full maturity, the number of tillers that produced spikes, the weight of the biomass, and the grain yield were recorded using the four middle rows of each plot. Analysis of variance was carried using the Genstat, statistical package.

Results

Significant differences in laboratory germination percentage (LG) and field emergence (FE) were recorded for both varieties, at all sites in the two seasons (Table 6.14 and 6.15). Sgnificant differences in the number of productive tillers per individual plants (PTP) were observed for both varieties in both seasons in Tel Hadya. At Breda, PTP was only significant in the 1998/99 season and not in the subsequent season.

As expected, differences in yield were observed between the two locations and years. No significant differences in grain yield (GYD) and biomass (BYD) were observed in Cham-1. However, for Acsad-65, significant differences in grain yield and biomass were observed in the 1999/00 season at Breda only.

Table 6.14. Effect of Mechanical Damage on Laboratory Germination and Field Emergence of Seed and the Subsequent Effects on Main Yield Components of Cham-1 in Two Locations over Two Seasons

Drum speed	1998/99								
	Germination		Tel Hadya			Breda			
	LG	FE	PTP	GYD	BYD	FE	PTP	GYD	BYD
Hand	96.8	84.3	2.9	1.4	6.2	68.9	1.6	0.3	2.2
800	89.4	66.7	3.3	1.4	6.0	71.4	1.7	0.4	2.2
1200	85.0	59.8	3.6	1.3	5.8	60.7	1.8	0.4	2.1
1400	78.3	57.1	3.6	1.2	5.7	54.7	1.9	0.4	2.0
Se ±	0.856	2.35	0.2	0.1	0.2	3.53	0.07	0.04	0.1
LSD (0.05)	2.509	6.9	0.5	0.2	0.3	10.43	0.1	0.1	0.1
%CV	2.9	10.5	16.7	14.7	12.2	16.6	11.5	32.4	17.4
Significance	<.001	<.001	0.042	0.082	0.537	0.012	0.03	0.509	0.77
	1999/00								
Hand	96.4	93.4	3.0	4.8	13.4	76.3	2.1	2.4	7.2
800	89.2	85.2	2.9	5.2	13.7	66.8	2.2	2.2	6.4
1200	82.0	80.7	3.3	4.8	13.2	66.8	2.2	2.2	6.4
1400	77.0	72.8	3.5	4.9	13.4	59.3	2.2	2.0	5.8
Se ±	1.273	1.446	0.1	0.2	0.4	2.8	0.1	0.2	0.4
LSD (0.05)	3.733	4.24	0.4	0.7	1.2	8.2	0.4	0.5	1.1
%CV	4.4	5.2	12.9	14.1	9.2	12.5	18.2	18.4	17.8
Significance	<.001	<.001	0.017	0.584	0.901	0.003	0.981	0.380	0.099

LG = Laboratory Germination, FE = Field Emergence, PTP = Productive Tillers per plant, GYD = Grain Yield, BYD = Biomass Yield

Discussion

The percentage of pure life seed (PLS) for seed lots threshed with 1400 revolutions per minute is 78% for Cham-1 and 59% for Acsad-65 compared to 96% for the hand threshed seed lots. The minimum certification standard of PLS for durum wheat in most WANA countries is 72%. It can be concluded that using drum speeds of 1400 for threshing durum wheat would result in rejection of seed lots of Acsad-65. Cham 1 seemed to be more resistant and wouldl still meet the

Table 6.15. Effect of Mechanical Impact on Laboratory Germination and Field Emergence of Seed and Subsequent Effects on Main Yield Components of Acsad-65 in Two Locations over Two Seasons

	1998/99								
Drum speed	**Germination**		**Tel Hadya**			**Breda**			
	LG	**FE**	**PTP**	**GYD**	**BYD**	**FE**	**PTP**	**GYD**	**BYD**
Hand	96.1	75.9	3.0	1.4	5.4	65.9	1.9	0.4	2.2
800	83.0	63.9	3.3	1.3	5.1	64.8	1.8	0.4	2.1
1200	72.9	56.7	3.6	1.3	5.1	55.4	1.8	0.4	2.0
1400	59.3	47.7	4.3	1.2	5.0	51.9	2.0	0.4	2.1
Se ±	1.61	3	0.2	0.1	0.2	3.03	0.1	0.0	0.1
LSD (0.05)	4.74	8.81	0.5	0.3	0.7	8.89	0.2	0.1	0.3
%CV	6.2	14.8	14.2	19.6	13.5	15.3	13.4	24.7	14.1
Significance	<.001	<.001	<.001	0.572	0.582	0.007	0.300	0.585	0.625
	1999/00								
Hand	95.4	88.3	2.8	5.3	12.4	69.7	2.4	2.6	7.1
800	83.0	81.2	2.7	4.7	11.3	64	2.5	2.3	6.6
1200	72.1	70.8	3.3	4.9	12.3	58.3	2.5	2.2	6.1
1400	59.3	59.1	3.8	4.8	11.6	46.2	2.8	2.0	5.7
Se ±	1.391	1.44	0.1	0.2	0.4	3.01	0.1	0.1	0.3
LSD (0.05)	4.081	4.23	0.3	0.6	1.2	8.84	0.3	0.4	0.9
%CV	5.4	5.8	10.5	12.4	10.4	15.2	12.2	18.6	14.7
Significance	<.001	<.001	<.001	0.283	0.173	<.001	0.083	0.038	0.022

LG = Laboratory Germination, FE = Field Emergence, PTP = Productive Tillers per plant, GYD = Grain Yield, BYD = Biomass Yield

certification standards. The study suggests that drum speed setting is critical when threshing durum wheat.

The seed rate used was 100 seeds per m^2 instead of the 300 seeds recommended for rainfed wheat. This difference in seed rate generated significant differences in productive tillers and resulted generally in non-significant differences in grain yield and biomass. The results are in line with the fact that cereal crops have a high capacity to compensate because of their tillering capabilities. This study has shown that compensation takes place even under sub-optimum conditions of

drought (Breda 1998/99) and/or poor rainfall distribution at Tel Hadya 1998/99. During this season, a major part of the rainfall occurred before the crucial growing and grain filling period.

The results clearly suggest that discarding a cereal seed lot based on low germination capacity (50-90%) may not be scientifically or economically justified.

The results suggest that seed certification standards adopted in WANA for cereal crops are much higher than necessary. Percentage germination of 96% did not generate significantly higher grain or biomass yields than the lots of 47% germination. ***– A.A. Niane***

Seed Longevity Study on *Salsola vermiculata*

Salsola vermiculata is a highly palatable and adaptable rangeland plant. The major problem is poor storability of seed possibly due to genetic and/or physiological factors related to temperature and/or moisture. This study investigates means to promote seed longevity.

Materials & methods

Freshly harvested *Salsola* seed has been used to investigate storability. The material was subdivided into threshed and non-threshed pods. Each part of the threshed and non-threshed pods was again subdivided into two portions. One was dried for 10 days during which the percentage of moisture content dropped from 10.7 to 5.7% for the winged pods and from 7.9 to 5.1% for the de-winged pods.

Each of the dried and non-dried portions were subdivided into two parts from which one was packed in vacuum-sealed aluminum packets while the other was kept in paper bags. Finally, each sample was stored at either –21°C, 4°C or ambient conditions (room temperature).

Samples will be tested for germination capability, each month for up to 24 months starting January 2002.

The summary of the trial set up is: 2 (pods with and without wings) × 2 (high and low moisture) × 2 (aluminum and paper bags) × 3 (moisture regimes) × 2 (replicates) × 24 months.

The results for the first year are illustrated in three graphs.

Preliminary results

- Germination of threshed pods was significantly higher and faster than germination in non-threshed (winged) pods.
- Germination of seed, stored in paper bags under room temperature, steadily declined to zero within the first six months of storage.
- Dried seeds and seeds packed in vacuum maintain had best germination capacity.

Preliminary conclusion

- De-winging increased germination in terms of speed and percentage.
- Vacuum storage maintained germination, regardless of storage temperature.
- The performance of dried seeds in both packaging and temperature regimes was better than that of non-dried seeds.
- Cleaning to remove immature seeds may have been necessary in reducing the high heterogeneity in the test results. ***– A.A. Niane***

Fig. 6.1. Decline of % germination in Salsola seed with wings stored at room temperature and two different levels of moisture content and packaging material

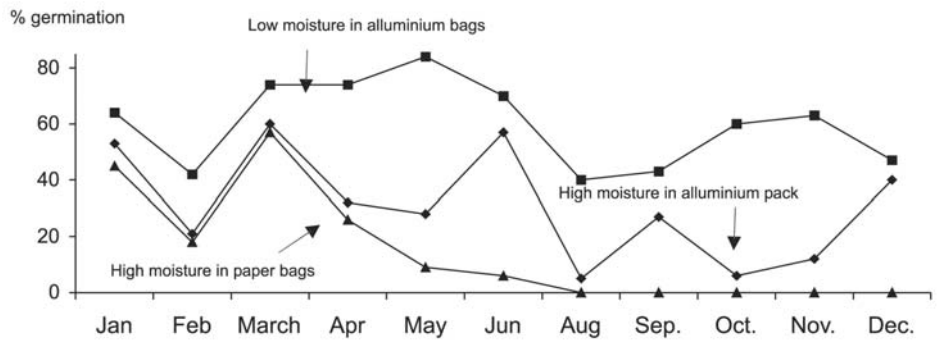


Fig 6.2. Decline of % germination in Salsola seed without wings stored at room temperature at two different levels of moisture content and packaging material

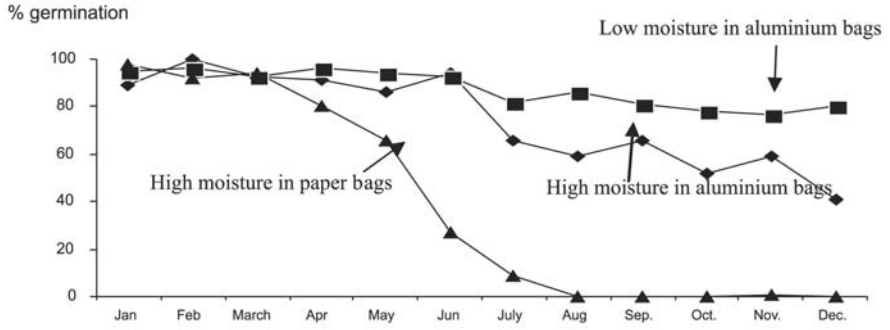
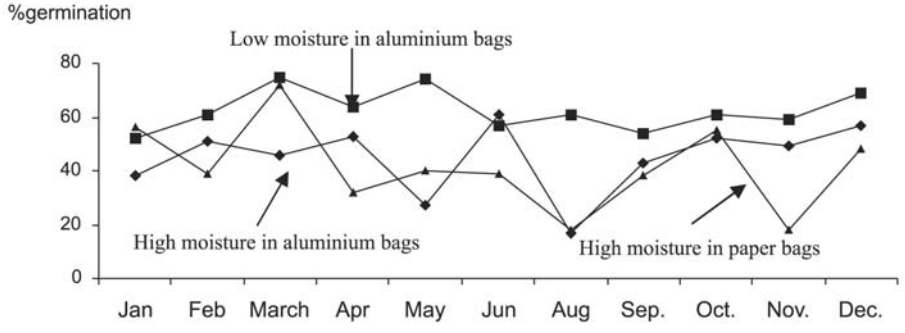


Fig 6.3. Decline of % germination in Salsola seed with wings stored at 4°C and two different levels of moisture content and packaging material



7. HUMAN RESOURCES DEVELOPMENT FOR THE SEED SECTOR

The purpose of the Unit's training program is to strengthen the capacity of national seed organizations in the region by providing training in different aspects of seed science and technology. The target groups are managers, professionals and technicians of both public and private seed sectors (as well as seed growers, development workers and farmers in the CWANA region).

During 2002, the training needs of NARS have been assessed during national and regional coordination meetings. Based on the needs identified, appropriate training programs were developed. A summary of training activities is presented in Table 7.1. A total of nine courses have been conducted, which were attended by 145 participants from seven countries.

Table 7.1. Seed Unit training activities in 2002

Type of course		Course title	Target country	No. of participants
In-country	Group	Quality Assurance	Sudan	12
		Forage Seed Production	Sudan	10
		Seed Certification	Iran	20
		Seed Technology	Afghanistan	71
		Fodder Shrub Seed Quality	Syria	2
Headquarters	Group	Training tour for pilot farmers	Turkey	15
Tel Hadya	Individual	Variety Management	Iran	3
			Iraq	2
			Syria	6
			Palestine	1
		Seed Economics	Syria	1
		Seed Vigor	Iraq	2
Total				145

In-Country Courses

The **Quality Assurance in Seed Testing** course was aimed at exposing staff members from the Seed Administration in Sudan to new trends in field inspection, seed testing and certification. The course was requested by the Seed

Administration (SA) and the program was designed in the light of new trends in quality control. The course covered the importance of and rationale behind the shift from product to process control and highlighted the major conceptual and practical differences between the two systems. Participants acquired skills to establish and run the new quality assurance system in seed testing. Participants from public and private agencies, and from the Faculty of Agriculture of the Gezira University, attended the course.

The **Forage Seed Production** course, also requested by the Seed Administration (SA) in Sudan, aimed at increasing forage production through improving the technical capabilities of staff to produce and supply high quality forage seed. The course program not only covered cultivar selection, adaptation and merits, but seed-production-specific crop management practices, post-harvest management, quality assurance techniques and associated socio-economic issues were discussed and complemented by hands-on practical sessions. Forage production managers, forage agronomists, and seed specialists from public agencies, private seed companies, and teaching institutions participated in the course.

The Iran **Seed Certification** course was organized at the request of the Seed and Plant Improvement Institute (SPII), as part of its preparation for a possible separation of seed production from certification. The main objective of the course was to upgrade the skills of seed certification staff, and provide them with skills to deliver professional and independent certification services. The course program discussed components and functions of seed programs. Lectures and practical sessions covered seed quality attributes in field crops, and field and laboratory evaluation of quality. Variety maintenance technicians, seed processing managers, field inspection officers, and seed analysts from the different branches of SPII in the different regions of Iran participated in the course.

The **General Seed Technology** course in Afghanistan was part of the action plan of the ICARDA-led Future Harvest Consortium to Rebuild Agriculture in Afghanistan. The objective of the course was to provide participants with skills in seed production, crop inspection and seed testing to properly carry out multiplication, inspection and certification of the seed. The course consisted of lectures and practical sessions. Seventy staff from the Ministry of Agriculture and Livestock (MOAL), NGOs and the Future Harvest Consortium to Rebuild Agriculture in Afghanistan attended the two-weeks course.

The **Seed Quality and Variety Management** course was designed and organized in response to requests from national programs for training in efficient and effective procedures in seed production. The course was a forum for discussion and information exchange for a wide range of participants from seed programs at different levels of development and complexity. The program included presentations, demonstrations, group discussions, and technical visits. The course provided opportunities for regional integration, by initiating technical interaction, business cooperation, and partnership. Twelve participants from four countries attended the course. The participants were involved in a wide range of technical and managerial activities including seed production officers, field inspectors, heads of seed testing stations and marketing departments.

Group Training at ICARDA HQ

A **Farmers' Tour** was organized as part of the 2002 cooperation program with the South Eastern Anatolia Project in Turkey (GAP). The main objective of the tour was empowerment of farmers through sharing the ICARDA experiences in linking farmers' perception with scientific options in germplasm improvement and dissemination. The program (5 days) consisted of demonstrations, discussions and visits to plant breeding and seed production facilities at the ICARDA research station and the General Organization for Seed Multiplication in Syria (GOSM). The nine participants in the tour were private progressive farmers, seed producers, extension officers, state farm managers.

Individual Training at ICARDA HQ

Two participants from the Syrian Steppe Directorate and the FAO Range Rehabilitation Project in Syria were trained in **Fodder Shrub Seed Processing and Storage.** The course program was mainly practical-oriented. It consisted of seed collection trips, seed cleaning, and laboratory testing.

The Head of the Cereal Seed Production Department of General Organization for Seed Multiplication (GOSM) in Syria was trained in **Economics of Seed Production**. The objective was to acquaint the participant with the principles of cost-benefit analysis in seed production and distribution. The program consisted of assignments and discussions on economics of seed production, including calculation of costs and margins.

Two participants from the Seed Viability Section of the Iraqi Central Seed Testing Station in Baghdad visited the Seed Unit to be trained in **Seed Vigor Techniques and Applications.** The program covered the principles, procedures and applications of a wide range of vigor testing methods for different crop species.

International Teaching

Participation in International Seed Course: The Seed Unit has been a regular contributor to the course on Seed Production and Seed Technology organized for three months by the International Agricultural Center (IAC), Wageningen, the Netherlands. The course provides participants with the broader knowledge and skills to effectively manage national seed programs in their respective countries. During 2002, the Head of the Seed Unit participated in the course for one week as resource person providing lectures on seed enterprise development and business planning and management. Participants come from developing countries of Africa, Asia and South America.

Participation in Regional Forage Course: Utilizing indigenous forage species, to replace the 'water hungry' exotic forages such as Rhodes grass and Alfalfa, is a major strategy of the Range/Forage component of the ICARDA-Arabian Peninsula Regional Program (APRP). A major constraint for the full utilization of these species is availability of good quality seeds. To develop the necessary human resources a regional training course (APRP countries) was organized in UAE to provide theoretical and practical background on (a) Seed multiplication of perennial grasses, (b) processing and cleaning of grass seeds, and (c) Quality aspects of seeds. The Head of the Seed Unit participated in the course as resource person.

8. PRODUCTION AND DISTRIBUTION OF SEED

Improved varieties are major outputs of agricultural research, but quality seed is the only means for transferring this output from research institutions to farmers. The aim of the seed production activities of the Seed Unit is to produce and maintain limited stocks of high quality seed of ICARDA related varieties, as well as of promising lines, that may be released in the future in one of the national programs.

The Unit has established a range of facilities for the provision of such seed-related services.

Seed Production

In 2001/02 crop season, 107.3 metric tons (MT) of seed were produced from 308 varieties of five crop species. Of this quantity, 0.7 MT were Breeder Seed, 3.1 MT Pre-basic Seed, 20.9 MT Basic Seed, 5.7 MT Certified Seed and 77.0 MT Quality Seed (Table 8.1).

Seed Processing

A one ton/hour seed processing line managed by the Seed Unit was used to clean and treat the seed produced in the center by different Programs and Units. The total amount of seed cleaned in the 2001/02 season was 531.8 MT. The quantity produced for commodity programs was as follows: 392.0 MT for Station Operations, 98.8 MT for the Seed Unit, 37.2 MT for the Germplasm Program and 3.8 MT for the Natural Resources Management Program (Table 8.3).

The seed-cleaning laboratory equipped with a wide range of small machines provides cleaning services for ICARDA's commodity programs. During 2002, a total of 13,432 samples have been cleaned of which 4703 were from the Genetic Resources Unit, 8701 from the Germplasm Program and 27 samples from the Seed Unit.

Quality Control

The seed testing services of the seed quality control laboratory are summarized in Table 8.4. In 2002, a total of 2601 tests on samples of different crop species were carried out for research and for monitoring quality of seed produced at ICARDA.

Seed Storage

The Seed Unit manages the medium term seed store of ICARDA in which 113,291 samples and 134 tons of seed and breeding material from commodity programs were stored (Table 8.6). In addition to book keeping, monitoring and controlling storage pests such as rodents and beetles were carried out throughout the year.

Seed Distribution

From the total seed production, 92 metric tons were distributed, i.e. 65.6 MT (71%) to national programs in the region for further multiplication, 7.1 MT (7.7%) for research, 16.9 MT (18.4%) participatory research activities and 2.4 MT (2.6%) were used for further multiplication by Seed Unit at ICARDA (Table 8.2).

Seed Production and Storage Database SEEDMAN

CBSU and the Seed Unit have developed a second version of the Seed Production and Storage Database (SeedMan). The new version is more user friendly and provides more data entry, retrieval and query options. The seed production, processing and distribution tables in this report have been generated from this version of SeedMan. ***– A.Niane and N. Azrak***

Table 8.1. Quantity (in kgs) of Seed Harvested per Multiplication Category in 2002

Crop	No. of	Categories					
	Cultivars	Breeder	Pre-basic	Basic	Certified	Quality	Total
Wheat	16	278	950	3,343		60,222	**64,793**
Barley	270	318	2150	5,350	5,650	5,000	**18,468**
Chickpea	9	40		5,850		3,530	**9,420**
Lentil	7	38		6,400		2,250	**8,688**
Vetch	6					5,950	**5,950**
Total	**308**	**674**	**3100**	**20,943**	**5650**	**76,952**	**107,319**

Table 8.2. Seed Distribution (in kgs) in 2002

Crops	Seed Distribution				
	NARS	Research	Participatory Research	Multiplication	Total
Barley	9,163	650	4,150	565	**14,528**
Wheat	37,390	332	12,750	675	**51,147**
Chickpea	9,150	385	0.00	420	**9,955**
Vetch	2,000	3,618	0.00	332	**5,950**
Lentil	6,650	100	1,250	400	**8,400**
Total	**65,603**	**7,085**	**16,900**	**2,392**	**91,980**
Percentage	**71.3%**	**7.7%**	**18.4%**	**2.6%**	**100%**

NARS = National Agricultural Research System

Table 8.3. Large-scale Seed Processing (in kgs) in 2002

	Program				
Crops	Germplasm Program (GP)	Natural Resource Management Program (NRMP)	Station Operations (St. Op)	Seed Unit (SU)	Total
Barley	19,140		17,150	18,468	**54,758**
Wheat	3,800	800	11,940	56,233	**72,773**
Chickpea	2,300		167,530	9,420	**179,250**
Vetch		3,000	22,200	5,950	**31,150**
Lentil	11,965		170,900	8,688	**191,553**
Safflower			2,300		**2,300**
Total	**37,205**	**3,800**	**39,2020**	**98,759**	**531,784**

Table 8.4. Small-scale Seed Processing in 2002

Crops	Program			
	Genetic Resources Unit (GRU)	Germplasm Program (GP)	Seed Unit	Total
Barley	138	3,752	0	**3,890**
Wheat	1,965	4,947	24	**6,936**
Lentil	1,600	2	0	**1,602**
Chickpea	1,000	0	3	**1,003**
Total	**4,703**	**8,701**	**27**	**13,432**

Table 8.5. Seed Testing Activities in 2002

Tests	Tests/Programs				
	Seed Unit	NRMP	Germplasm Program	Station Operations	Total
Viability	788	214	38	3	**1043**
Vigor	25				**25**
Physical Purity	114				**114**
Genetic purity	50				**50**
Specific weight	574		788		**1362**
Moisture				7	**7**
Total	**1551**	**214**	**826**	**10**	**2601**

Table 8.6. Seed Storage Services in 2002

Crops	GP		NRMP		SU		St.Op	Total	
	Samples	Lots (t)	Samples	Lots (t)	Samples	Lots (t)	Lots	Samples (t)	Lots (t)
Barley	84,000	5			27	20	5	84,027	30
Faba bean	21,552	2	3	1	2	2		21,557	5
Chickpea	2,000	6			7	9		2,007	15
Lentil	1,348	10	2	2	6	6	16	1,356	34
Bread wheat	550	1			42	1	2	592	4
Medic			100	12				100	12
Durum wheat					17	9	5	17	14
Vetch	3,570	12	5	1		6		3,575	19
Trifolium			60	1				60	1
Total	**113,020**	**36**	**170**	**17**	**101**	**53**	**28**	**11,3291**	**134**

9. SEED UNIT STAFF, CONSULTANTS, STUDENTS

Seed Unit Staff

Tony van Gastel	Head of Seed Unit
Samuel Kugbei	Seed Economist
Zewdie Bishaw	Seed System Specialist
Abdoul Aziz Niane	Seed Production Manager
Naim Azrak	Consultant – Seed Production

External Consultants

For the Seed and Crop Improvement Needs Assessment in Afghanistan

Bill Gregg	Freelance, Seed Industry Development, Starkville, Mississippi, USA (also for *Seed Policy* and *Seed Law* development)
Hans Braun	CIMMYT, Ankara, Turkey
John Dennis	Freeelance, Social Scientist, Ithaca, NY, USA
Sarath Ilangantileke	Potato Specialist, CIP, New Delhi, India
Arturo Martinez	Head, Seed and Genetic Resources Service, FAO, Rome, Italy

MSc Students

Hossam Al-Deen Abedo	University of Aleppo: Barley seed vigor (2000-02)

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van Gastel, A.J.G., B.R. Gregg and E. Asiedu. 2002. Seed Quality Control in Developing Countries. Journal of New Seeds. 4(1/2) 117-130

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van Gastel A.J.G., B.R. Gregg and E. Asiedu. 2002. Seed Quality Control in Developing Countries, 117-130 pp. *In* Seed Policy, Legislation and Law: Widening a Narrow Focus (ed. N.P. Louwaars). Food Products Press, Inc. New York, USA

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Abdulwahab Madarati and Zewdie Bishaw. 2002. WANA Catalogue of Field and Seed Standards. WANA Seed Network Publication No. 25/02

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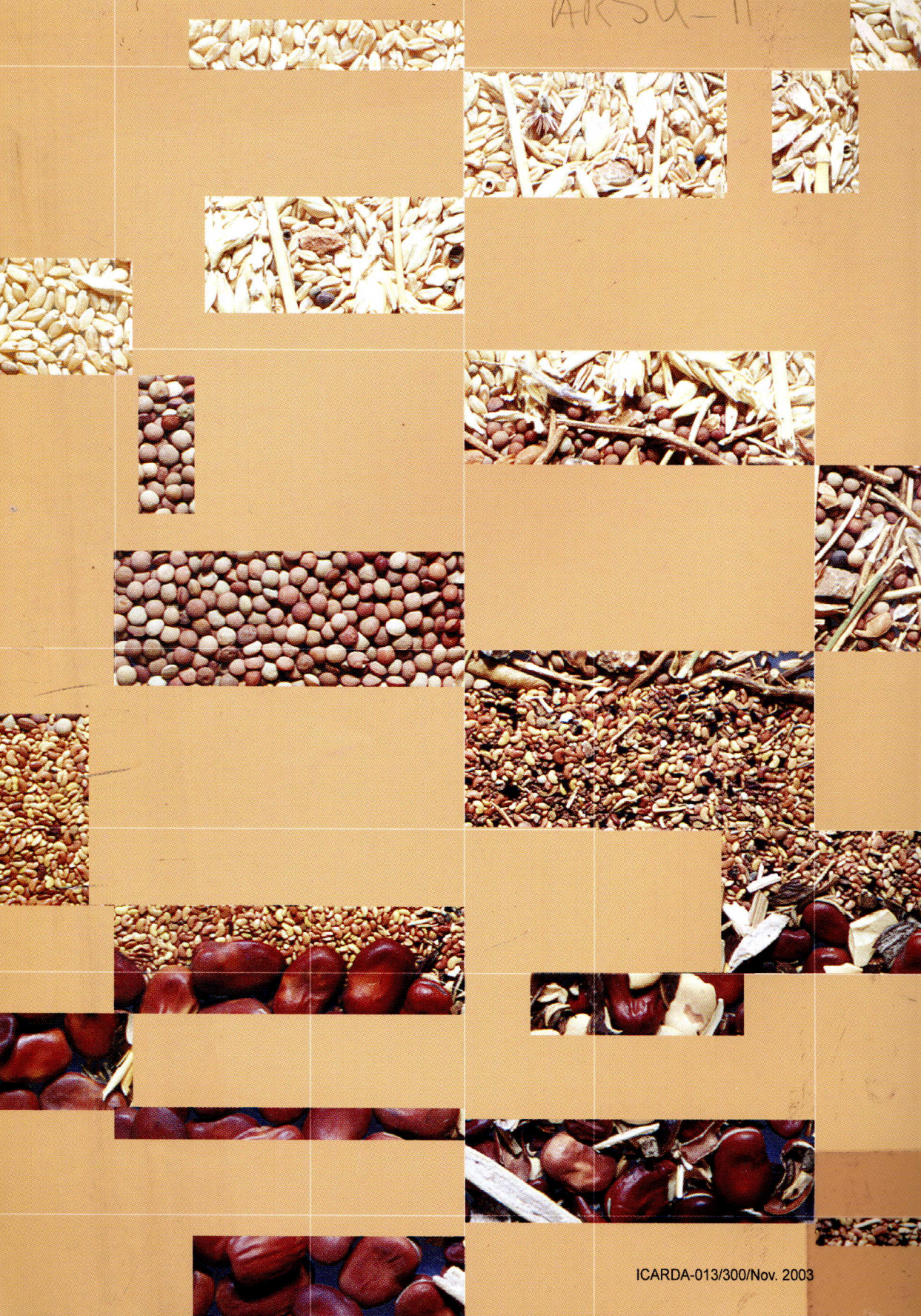

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