

# Libya and ICARDA

Ties that Bind



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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No. 18

**Scientific Collaboration Activities and Partnership between  
the Libyan Arab People's Socialist Jamahiriya's Agricultural  
Research Center (ARC) and the International Center for  
Agricultural Research in the Dry Areas (ICARDA)**



International Center for Agricultural  
Research in the Dry Areas  
(ICARDA)



Libyan Arab People's Socialist Jamahiriya  
Agricultural Research Center  
(ARC)

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**Cover:** ARC-Libya/ICARDA collaborative work is aimed at saving  
endangered species and preserving the rangelands through better  
management.

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## Introduction

Located in North Africa, on the southern coast of the Mediterranean Sea, Libya is a fairly large country, covering 1.760.000 km<sup>2</sup>. However, only 2.25 million hectares, or 1.2% of its total area, is useful agricultural land. It is one of the driest countries in the Central and West Asia and North Africa (CWANA) region, ICARDA's regional mandate area. The rains are often short-duration heavy showers, varying in amounts and distribution between years, particularly during the crucial spring months that determine the performance of the rainfed, cereal and legume crops. There are wide diversities of climates, plants and systems of crop production.

The coastal areas are wetter, with rainfall reaching 400 mm annually around Tripoli, which gradually decreases southwards. The higher elevation areas in the eastern Jabal Akhdar region can receive as much as 600 mm in some areas, partly in the form of snow, which favors fruit tree production and preserves vast woody slope areas.

Rainfed cropping and rangelands predominate Libya's agricultural landscape, in spite of recent expansion of irrigation in the south and the man-made great river that has made possible agriculture in the central and coastal regions. The main crops grown in the rainfed farming systems of the country are barley, durum and bread wheat, faba bean, peas, chickpeas, lentils, forage legumes, oats and berseem.

Heat, drought and salinity, and insect pests and diseases, take their toll on all crops and reduce yields considerably.

## ARC-Libya/ICARDA Partnership

Established in 1972, Libya's Agricultural Research Center (ARC) is mandated to carry out research on field crops, rangelands, and fruit trees, and identify solutions and strategies to the problems that constrain agricultural production. In addition, the Center is responsible for building capacities of agriculturalists, and establishing partnerships with national and international agricultural research institutions.

The ARC-Libya/ICARDA partnership started in the 1980s and was mainly within the context of the support to countries in the Maghreb Region. Mutual collaboration between Libya, Tunisia, Algeria and Morocco was backed by ICARDA with technical expertise of its researchers, and facilitating donor support, and regional and international partnerships, aimed at development of improved technologies, germplasm and knowledge. This was done within the framework of ICARDA's North Africa Regional Program.

Over the years, Libya has received large numbers of germplasm accessions, breeding lines and varieties of wheat, barley, faba bean, lentil and chickpea that have proved useful in its breeding programs, as they were identified under a wide range of



*Supported by ICARDA, intra-Maghreb collaboration has resulted in complementarity among the countries and cooperative trials across the region.*

environmental stresses across North Africa. Conversely, Libya enabled the testing of germplasm from the other three countries under its harsh climatic conditions. Regional collaboration backed by ICARDA extended to various fields of human resource development for agricultural research. A large number of ARC-Libya researchers were trained in Morocco in conducting rapid rural appraisal research undertaken before the implementation of projects, and training in developing advanced animal nutrition technologies was carried out in Tunisia. Several other examples can be cited in the field of agronomy, food technology, crop production systems, water harvesting, information management, and statistical data analysis techniques.

ICARDA sponsored several cereal and food legume traveling workshops to enable the mutual testing and evaluation of germplasm. These workshops also provided on-the-job training opportunities for the technical staff working on genetic improvement of important crops in Libya.

Collaboration between Libya and ICARDA was strengthened with the signing of an agreement in 1992, and by the Annual Regional Coordination and Research Planning Meetings for the Maghreb region. Two of these meetings were held in Tripoli, in 1994 and 2002. The main areas of collaboration included germplasm improvement of cereals and food legumes, capacity building, and implementation of regional projects.



*Farmers in Libya participate in all phases of technology development and transfer. Here, rural men and women discuss the annual program of work for field demonstrations of improved production techniques, field crop species to be used, and proposed specific herbicides for cereals and legumes.*

## **Germplasm Resources Development**

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### **Cereal improvement**

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The collaboration between ARC-Libya and ICARDA in cereal improvement has been strong and diversified. It has widened the genetic basis of the major small-grain crops, mainly durum and bread wheat, and barley. The national program was aided in its tasks of introducing diverse germplasm materials and testing them under local climatic conditions and abiotic and biotic stresses, and also under supplementary or full irrigation conditions. These steps were followed by selection and on-farm testing of most promising cultivars and by the annual review of the research results during ARC-Libya/ICARDA planning and coordination meetings. These efforts resulted in the introduction in Libya of over 8500 lines and varieties that constitute a valuable asset for ARC-Libya. Out of these genetic resources, 45% were barley, 35% durum and 25% bread wheat lines. Some collections were received from ICARDA through other Maghreb countries.

ICARDA also provided ARC-Libya with a wide variety of improved germplasm from the various cycles of its breeding program, mainly segregating populations, starting from the F<sub>2</sub> generation, semi-fixed observation lines and nurseries, and finished material in the form of replicated variety trials.

Exchange of germplasm with ICARDA and its testing came at the right time as Libya was engaged in ambitious agricultural development projects. The primary research objective of ARC in the initial years was wheat improvement. It resulted in the introduction of a large number of cultivars. The best yielders among them are still occupying large production areas across the country.

Before ICARDA was established, most of the germplasm was introduced from the Maize and Wheat Improvement Center (CIMMYT) located in Mexico. When, in 1977, ICARDA initiated its research on bread wheat, in collaboration with CIMMYT, ARC-Libya



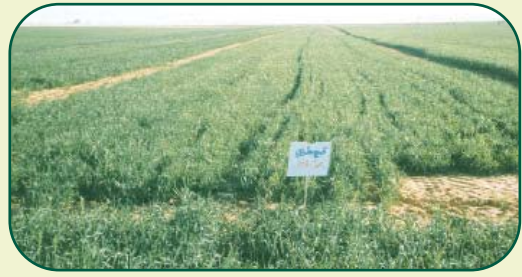
*Working with a farmer to identify best-adapted cultivars to the newly introduced alley-cropping practice.*

benefited from the resulting better-targeted work for the drier areas, which contributed significantly to the national program efforts in:

- Getting a wealth of adapted germplasm that resulted in the identification of superior cultivars for the various production regions.
- Testing of nationally produced germplasm at ICARDA and in the other parts of the Maghreb region for various abiotic and biotic stresses and identifying materials resistant to important diseases such as rusts, and pests such as Hessian fly.
- Determining the quality characteristics of the cultivars produced and their adequacy for local use.
- Making a large number of crosses using local landraces.
- Providing special breeding stocks to combat stresses, such as heat, drought, diseases and insect pests.



Since durum wheat is important for local consumption, the collaborative activities included introduction of required durum types to widen the genetic base of Libya's germplasm pool, developing highly adapted and improved cultivars under local durum production conditions, incorporation of Libya's land types and cultivars in



***Libya imports most of its bread wheat to meet its domestic demand. Varieties such as Bohouth 208 will help to reduce imports.***

ICARDA's crossing program, participation of the national team in the activities of the West Asia and North Africa Dryland Durum Improvement Network (WANADDIN), and quality analysis of the varieties produced for local consumer preference. Through WANADDIN, Libyan scientists participated in international scientific meetings and traveling workshops in the WANA region.

The ARC-Libya/ ICARDA barley improvement collaboration has also been a success. The national program received from ICARDA the six-row, two-row, and hulless type barley material, as required for



***Bohouth 105, a high-yielding durum developed jointly by ARC-Libya and ICARDA.***

improving yield adaptability and resistance of developed cultivars. Thousands of lines received from ICARDA were jointly tested for adaptation, resistance to powdery mildew, net blotch, scald and BYDV, and insect pests such as aphids and barley Gall Midge. Libya also participated in setting up the special Maghreb nurseries and trials. They were developed jointly with

ICARDA barley improvement project and designed to better serve the Maghreb region through the intensive use of special crossing programs of the locally adapted types undertaken at ICARDA, followed subsequently by targeted testing in key locations in North Africa. Other activities have been:

- Exploitation of the adaptation traits of the local landraces of the four Maghreb countries for testing under local stresses.
- Participation of Libyan scientists in the participatory barley breeding project activities carried out in collaboration with farmers and ICARDA scientists.
- Setting up an ARC-Libya/ICARDA project for the development of food barley varieties.
- Provision by ICARDA of basic research tools such as threshers, balances, crossing tools, and computers.
- Carrying out field surveys of diseases and insects of economic importance across barley production areas in Libya. Regional and international scientists participated in the surveys.



*Shortage of feeds prompted the farmers to increase area under barley. Among the many cultivars, Rihane 11, widely adopted, has produced high yields across a large spectrum of the environments in Libya.*

The partnership with ICARDA resulted in the production of several high yielding varieties of all the three cereal crops (Table 1).

Table 1: Varieties produced as a result of ARC-Libya/ ICARDA joint efforts, that occupy significant hectareage across Libya

Crop	Cultivar name	Areas of production
Barley	Barjouj, Maknusa, Ariel, Irawen, Wadi Hay, Wadi Kattara, Wadi Kuf, and Wadi Zart. Barjouj; Maknoosa, Ariel, Irawen; Rihane; Wadi Hay; Wadi Zarat; Al Kuf, Gettara (Meimoun)	Southern production projects and farmers in western and eastern regions
Bread Wheat	Bohouth 106; 108; 110; 112; 104; 202; 204; 206; 208; 304;	Southern production projects and farmers
in	306; 308	western regions
Durum Wheat	Zorda; Qara; Marjawi; Ghuodwa, Cimarron-Sari Bursa 7113, Fazan, D-25, Baraka, Zahra 1, Khiar 92, Zahra 5, Zahra 3, Zahra 9, and Zahra 7. Bohouth 101; 103; 105; Bohouth 301; 303; 305; 307	Southern production projects and farmers in western regions

## Food Legumes

Collaborative research on food legumes between ARC-Libya and ICARDA has saved these crops from disappearing from farmers' fields due to abiotic and biotic stresses that were discouraging farmers from growing these crops. It also offered new prospects for legume production through development of tall cultivars of chickpea and lentil adapted to mechanical harvesting, and chickpea cultivars with ascochyta blight resistance and cold tolerance adapted for winter sowing.

### *Faba bean*

The national program developed a strategy of research to meet the following goals:

- Search for genotypes that are economically attractive and can be harvested for both green consumption and for grain at full maturity.
- Incorporation of resistance to rust, blight, wilt and chocolate spot diseases.
- Introduction of large-seeded types in the southern projects that use full irrigation systems of production.

- Use of small-seeded, higher-yielding types, in the drier desert production systems.
- Development and testing of production technologies adapted to different production zones.

## **Peas**

Peas are important in Libya. They provide good returns, are good in crop rotations, and can be consumed either green or dried. The collaborative work with ICARDA enabled Libya to get the needed types to widen the narrow genetic base of these crops. It also led to the identification of a range of cultivars for various growing niches, making this crop an important component of crop production systems in the southern region.

## **Chickpea**

Chickpea is considered to be the most important food legume in Libya. It is a component of most local dishes and is consumed in various forms. Libya meets most of its chickpea requirements through imports. The achievements in chickpea research allowed the extension of its cultivation far beyond the traditional zones and into the desert production systems. The impact of the collaborative activities can be summarized as follows:

- Increase the economic profitability of chickpea growing through the use of winter chickpea technology, based on the use of winter types, early sowing, ascochyta blight resistance, and mechanical harvesting.
- Widening of the genetic basis of the crop.



***High-yielding chickpea cultivars provide excellent returns. They now occupy large area even under pivot-irrigation across the Libyan desert.***

- Launch of large-scale production under pivot-irrigation systems because of the demand for large quantities of seed of the adapted varieties.
- Tackling such second-generation problems as inefficient nitrogen fixation, and the reliance on nitrogen fertilizer for good yields.

Table 2: Food legume varieties resulting from joint ARC-Libya/ICARDA collaboration.

Crop	Cultivar lines
Chickpea	ILC 484, ILC 482, ILC 3279, ILC 195, FLIP 84-93C, FLIP 84-79C, FLIP 90-179C,
Lentils	FLIP 95-27L, Safsaf2, 78S86002
Faba bean	Reina Blanca, FLIP 83-24 FB, FLIP 84-118 FB, FLIP 82-9 FB, FLIP 84-48 FB, S8002-11-1-1, S83118-12-2-1, B87-148
Peas	Latakia, Earlydun, MG-100446, MG-101197, MG102469, Syrian selection 1690

### *Lentils*

ICARDA has the world mandate for lentil improvement. Therefore, ARC-Libya has heavily relied on ICARDA for its improvement work on lentils. Indeed, most of Libya's lentil varieties have been developed from ICARDA germplasm. These include both small- and large-seeded types, as well as tall lentils suitable for mechanical harvesting.

## **Feed legumes, feed crops, and rangelands**

Vetches, lathyrus, and oats were also the focus of collaborative research between the two institutions as they were the dominant forage crops most preferred by farmers for growing in mixtures or in pure stands. Oat/vetch mixtures are the most widely grown, for they have the highest productivity and can be grazed at the green stage or left for hay making.

## ***Oats research***

The ARC-Libya/ICARDA collaboration on oats research has achieved the following

- Introduction and testing of Maghreb germplasm resources.
- Establishment of a Maghreb Oats Improvement Network (REMAV) with Libyan membership.
- Screening of oats introduced from all oat-growing regions worldwide and their use in breeding to produce adapted genotypes, tolerant to drought, heat and crown rust.
- Supporting farmers and training them to meet their oat seed needs.

## ***Vetch research***

The high nutritive-value of the feed resulting from mixed cultivation of vetch with small-grain species, particularly oats, has been recognized by farmers. Libya used to rely on imports to cover its needs for vetch, and consequently, due to seed scarcity in the market, vetch area decreased drastically. A research program was initiated in collaboration with ICARDA, with the objective of developing vetch cultivars suitable for growing in mixture or in pure stands. The Maghreb oats network is also supporting this program.



*The valuable forage, cactus (Opuntia spp.), is being planted over large areas across Libya. It protects the soil from erosion, tolerates drought, and provides nutritious feed for sheep and goats. It is suited to many parts of the degraded rangelands. Exchange of farmers/scientists visits between Maghreb countries helped Libya to acquire this forage.*

# **Collaborative development projects**

## **The Mashreq/Maghreb project:**

This project aimed at the development and dissemination of integrated crops and livestock production technologies among communities in the semi-arid areas of West Asia and North Africa. It was financed by International Fund for Agricultural Development (IFAD) and Arab Fund for Economic and Social Development (AFESD). Libya was a member of the project and its farmers benefited from it.

This seven-year project, operated in two phases, proved so successful that it has become a model for several institutions. Studies on communities' grazing rights and other policy issues were components that provided a better understanding of factors causing overgrazing, and identification of measures to reverse the trend, and ensuring better sustainability of herding practices within the rangelands.

The initial phase of the project allowed for the identification of technical and socioeconomic constraints to the productivity of crops and livestock in Libya. Over 150 surveys within the target communities showed that rainfed agriculture improved significantly following adoption of the project-recommended integrated crops and livestock production packages.

During the second phase, work focused on the communities of Gadhama in the western mountainous areas and Wade Hay, in the dry Jeffara plain. The project identified alternative feed resources, charac-



*Preserving the rangelands and preventing their degradation is a task that will receive increased attention in the ARC-Libya/ICARDA future collaboration.*

terized the production systems, and applied verified technologies at community level, taking into account prevailing policies and recognized property rights in the target areas. Adoption of recommended packages and their impact on farmers' income were assessed through extended surveys carried out in collaboration with farmers. Technologies produced that deserve special mention include the production of feed-blocks using agricultural by-products and farm wastes, and cactus and atriplex planting on rangelands.

## **Water harvesting project**

Libya was an active member of this project that sought to study modern and indigenous methods of runoff water harvesting, and its subsequent use in supplementary irrigation of crops. Carried out in the rainfed areas, the project focused on:

- Surveying indigenous methods of water harvesting.
- Evaluation of methods of collecting runoff water and assessing its potential use in several rainfed areas of Libya.
- Studying the effect of surface runoff harvesting on productivity of small grains, forages, shrubs, and fruit trees.
- Organizing field days to popularize best methods and sensitize farmers to adopt water-harvesting techniques to increase agricultural production.

## **Supplementary irrigation of rainfed cereals**

Initiated in 1991, the project aimed at stabilizing the productivity of rainfed cereals through supplementary irrigation by:

- Determining crop water requirements depending on season, phenological development of crops, site specificities and soil fertility level.
- Determining minimum levels of irrigation that maximize production and thus maximize water-use efficiency.
- Assessing high economic returns using supplemental irrigation with the prevailing farming systems.
- Determining the best management practices, including the nitrogen fertilizer dose and irrigation level combinations that give better yield and maximize farmer income.



## Capacity building

Over 229 Libyan scientists, and technicians were trained during the period 1978-2003, and they became ICARDA research collaborators after completing their training. Group and individual training opportunities were provided to ARC staff according to their needs. For technical staff, training was mostly practical, enabling them to implement research experiments, whereas it was both applied and in-depth training for researchers. The training covered a wide range of activities: from practical field work (plot machinery use, land preparation and field layout), to theoretical and practical research work in breeding methodologies, biometrical methods, application of DNA molecular marker techniques in crop improvement, plant protection, and seed production.

Table 3: Training opportunities provided to Libyan researchers by ICARDA, 1978-2003.

Courses at Headquarters		Other courses			Total
Long-term	Short-term	Individual	In-country	Regional, sub-regional	
24	92	29	28	56	229

## Future collaboration

In the light of the impressive results of the collaboration with ICARDA over the last decades, ARC-Libya and ICARDA will seek to further strengthen ties and sharpen the focus of the joint future activities. Key areas of collaboration will include:

### Human resource development

Expansion in research and development requires continuous training of scientists. The new researchers would need familiarization with the advanced technologies, establishment of collaboration with scientists at

ICARDA and elsewhere, and opportunities for enhancing their career goals through higher degree training.

## **Genetic resources conservation**

Recurrent droughts over the past decades, coupled with overgrazing due to increased animal population, are seriously threatening the plant genetic resources of the country. There is an urgent need to develop plant types better adapted to cope with abiotic stresses and threats from insect pests and diseases. Germplasm collection, characterization, conservation and use to develop a new generation of cultivars, is crucial for achieving sustainable production in the future. In view of the long experience of ICARDA in genetic resources management and conservation in the CWANA region, ARC-Libya and ICARDA would further strengthen the collaboration in this area.

## **Rangeland management**

Similar to the country's genetic resources, the rangelands in Libya are severely degraded and threatened by desertification. The rehabilitation of rangelands requires a great deal of research to develop appropriate management strategies for their future sustainability for the benefit of herders. The progress obtained by the model project has to be out-scaled, which requires further strengthening and coordination of efforts. Through ICARDA, alternative management strategies that were successful across CWANA and elsewhere need to be tested in Libya, and their adaptability to local conditions assessed.



***ARC-Libya/ ICARDA collaborative work is aimed at saving endangered species and preserving the rangelands through better management.***

## **Conservation and use of water resources**

Like other Maghreb countries, Libya faces severe depletion of its aquifers. Already, Jeffara plain aquifers are in a state of depletion and salinization. New and improved procedures of irrigation and water use are needed for reducing pressure on aquifers recharge and sustainability. ARC-Libya wishes to start a project with ICARDA in this area.

## **Seed production**

Libya is calling upon FAO to launch a vast seed production program, and in view of the experience of ICARDA with development of innovative seed production systems in CWANA, its strategic involvement in the implementation of this program will be very useful.

## **Biotechnology**

Application of biotechnology in crop improvement is crucial for enhancing efficiency in the development of new, improved crop varieties. There is a need to set up a well-equipped biotechnology laboratory with suitably qualified and trained staff to make good use of it. It will be necessary to develop a comprehensive project to support Libya in this field.

## **Project development for eastern Libya**

Benghazi region and the neighboring Jabal Akhdar region in eastern Libya receive the highest amounts of rainfall. However, specific development projects for this region have been few, and most adaptive research has relied on experience gained elsewhere. It is quite urgent to fully tap the potential productivity of this region. Collaboration with ICARDA and ARC/Libya would seek to enhance the scientific competence and expertise in eastern Libya and to catalyse the crop improvement and management research in this region.

# Ties that Bind

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