

ICARDA

Annual Report for 1986

EXECUTIVE SUMMARY



INTERNATIONAL CENTER FOR AGRICULTURAL
RESEARCH IN THE DRY AREAS

Box 5466, Aleppo, Syria.

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Foreword

In the vast areas of West Asia and North Africa, the summers are dry, and rain falls only in the colder months. To grow crops in winter is always hazardous, especially in a region that is largely subject to continental extremes. Killing frosts and periods of drought occur, both generally and locally, with unpredictable severity. One of ICARDA's principal goals is to develop varieties that will survive such events and assure farmers of consistent harvests from year to year.

When we reported on our work for the winter of 1984/85, we explained that the severe frosts and prolonged drought of that season had given us the opportunity to identify tolerant cultivars, the others having failed to mature. By contrast, at most of our sites, the winter of 1985/86 was unusually mild, and the harvests were bountiful. It was not a year to reveal stress-tolerance, but it was a year when we were able to produce great amounts of seed from the many cultivars that were being tested for desirable characteristics. These stocks of seed will be of benefit, not only for ICARDA's own future research, but will enable us to provide breeding material in larger quantities to our partners in national institutions throughout the region.

As ICARDA completes its first decade, we look to an exciting future. Our achievements in breeding stress-tolerant varieties and in developing cereal-livestock systems need to be complemented by a greater emphasis on soil and water management and also, given the fragile nature of much of the terrain in this region, on the development of an integrated strategy for the conservation and enhancement of the natural environment. It is in these four areas that ICARDA will seek to be recognized as a centre-of-excellence and, while the regional emphasis will be sustained, we shall also work for the betterment of dryland farming throughout the world.

A handwritten signature in black ink, appearing to read 'M. Nour'.

Mohamed A. Nour
Director General

*If you did not see last year's report
and do not already know ICARDA.....*

The International Center for Agricultural Research in the Dry Areas (ICARDA) was established in 1977. Based at Aleppo, Syria, it is one of thirteen centers supported by the Consultative Group on International Agricultural Research (CGIAR).

The CGIAR seeks to increase agricultural production but, at the same time, to improve social and economic conditions for people living in developing countries; hence it supports the kind of research that will help small farmers, even those with inadequate resources, to achieve better harvests. In setting up ICARDA, the CGIAR was addressing the problems of developing countries in West Asia and North Africa. In fact, ICARDA focuses its efforts on areas having a dry summer and where precipitation in winter ranges from 200 to 600 mm.

In terms of crops, the CGIAR has given to ICARDA a world responsibility for the improvement of barley, lentils and faba beans, and a regional responsibility for the improvement of wheat, chickpeas and pasture and forage crops; it has also supported an important ICARDA program on farming systems.

Much of ICARDA's research is carried out at its headquarters at Tel Hadya, 30 km southwest of Aleppo, on a farm of 948 hectares. ICARDA also manages other sites where it tests material under a variety of agro-ecological conditions: at Jindiress, Breda, Boueda and Lattakia in Syria, and at Terbol and Kfardane in Lebanon. However, the full scope of ICARDA's activities can be appreciated only when account is taken of the cooperative research carried out with many countries of the region. Particularly important activities are under way at various locations in Syria and Jordan, at Quetta in Pakistan, in Morocco and Tunisia, and with Egypt, Ethiopia and the Sudan in the Nile Valley.

The results of the research are transferred through ICARDA's cooperation with national and regional research institutions and with Ministries of Agriculture, and through the technical assistance and training that ICARDA provides. These efforts are reinforced by seminars, by publications (research reports, training materials and manuals for the application of techniques), and by specialized information services operating in close association with ICARDA's senior scientists.

ICARDA aims not merely to complement the work of national research programs, but also to strengthen national research capacities. Progressively, much of the work now carried out at the Center will be handed over to scientists at country level.

CONTENTS

| | |
|--|----|
| Foreword | 1 |
| If you did not see last year's report | 3 |
| Farming-Systems Research | 7 |
| Cereals Research | 8 |
| Food-Legume Research | 9 |
| Pasture, Forage and Livestock Research | 11 |
| Genetic Resources | 12 |
| Computer | 12 |
| Training | 13 |
| Scientific and Technical Information | 13 |
| Financial Resources | 14 |
| Special Projects | 15 |
| Permanent Headquarters | 16 |

International Center for Agricultural Research in the Dry Areas

Annual Report for 1986

EXECUTIVE SUMMARY

The International Center for Agricultural Research in the Dry Areas (ICARDA) employs several means to fulfill its responsibilities for research and training:

- it carries out research and conducts training programs using its own staff and facilities; it also welcomes guest researchers at these facilities.
- it provides seeds and technologies, and collaborates with national institutions in West Asia and North Africa to plan and carry out research in their facilities and on farmers' fields, as well as to conduct training courses appropriate to national needs.
- it works with advanced institutions in Europe and North America to apply highly developed research methods to some of the problems of the ICARDA region.
- it cooperates with other Centers in the CGIAR system on matters of common interest, especially with the Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT, Mexico) on wheat, and with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT, Hyderabad, India) on chickpeas.

In 1986, these structures were consolidated and several new initiatives were launched.

Within ICARDA itself, although recruitment continued to be a problem, some vacancies were filled, and the present staff situation is shown in Table 1. There was also a major increase in the number of trainees, 57% more than in 1985.

This year 446 shipments of seeds were sent out, the recipients being in 68 different countries; about 40% of shipments went to recipients in the ICARDA region. Staff travelled extensively in the region to maintain existing projects of cooperation and to develop new ones. Formal agreements were signed with the Governments of Algeria, Iraq and Morocco .

Table 1. Staff of ICARDA at various locations in 1986

| | | International professional | Regional professional | Other staff |
|-----------|--------------------|-------------------------------|--------------------------|----------------|
| Syria: | Aleppo - Tel Hadya | 48 | 30 | 527 |
| | Damascus | — | — | 7 |
| | Lattakia | 1 | — | 4 |
| Ethiopia: | Addis Ababa | 1 | — | — |
| Egypt: | Cairo | 1 | — | 6 |
| Italy: | Perugia | — | — | 1 |
| | Viterbo | — | — | 2 |
| Jordan: | Amman | — | — | 1 |
| Lebanon: | Beirut | — | — | 7 |
| | Terbol | — | — | 29 |
| Mexico: | CIMMYT | 1 | — | — |
| Morocco: | Rabat | 2 | — | — |
| Pakistan: | Quetta | 4 | — | — |
| Tunisia: | Tunis | 2 | — | 4 |

In Rabat, the Institut National de Recherche Agronomique has provided space for two ICARDA scientists who will cooperate with the national program in Morocco and with neighbouring countries. A staff member was posted to Addis Ababa to work with the Ethiopian Institute of Agricultural Research on highland pulses. The first formal coordination meeting was held with ICARDA's research partners in Turkey. Workshops and training courses were organized in Egypt, Jordan, Morocco, Pakistan, Sudan, Syria, Tunisia and Turkey.

The collaboration with ICARDA's host country, Syria, remained especially close. The Annual Coordination Meeting, held at Aleppo in early October, was the fifth in the series and was graced by the presence of His Excellency, the Minister of Agriculture and Agrarian Reform. Such meetings involve the research directors of all the Ministry's research stations in the country.

There are now some forty cooperative research projects with advanced institutions in Europe and North America. A new formal agreement was signed with the French organizations (CIRAD, INRA and ORSTOM) that are mainly responsible for research related to agriculture and food production in the developing countries: French scientists are working with ICARDA scientists in new projects of collaboration with research institutions in Algeria. Discussions were initiated with the

Soviet Union, which seconded a scientist to Aleppo to study the prospects for future collaboration.

Collaboration within the CGIAR system, and the initiatives of ICARDA's farming-systems scientists, led to an inter-Center workshop on agro-ecological characterization, classification and mapping at FAO in April. Several Centers face a common problem: "good" varieties are not necessarily good in all environments. Specially adapted varieties must be developed for harsh climates and adverse soil conditions. Breeders must specify the range of agro-ecological conditions for which a particular variety is best suited, and maps are needed to show the zones in which the different conditions prevail. To produce a useful zoning system would require a large effort, and the workshop was a first move by the Centers to determine the way in which this might be done.

Farming-Systems Research

The Farming Systems Program seeks to understand how the variability associated with environmental and socio-economic factors dictates current farming practices, and to learn how farmers might stabilize and increase production through better resource management; special attention is given to water-use efficiency.

Soil deficiencies are widespread, particularly in nitrogen and phosphorus. However, even in the most harsh environments, research shows that water-use efficiency can be much improved and farmers can increase profits by applying fertilizer to barley (an important sheep feed). This year there was a mean increase in net revenue of 587 Syrian pounds/ha when 20 kg N/ha and 60 kg P₂O₅/ha were applied in on-farm trials across the country. Seventy percent of the farmers who saw the trials said that they intend to start using fertilizer and, after only two seasons of collaboration in this work, the Ministry of Agriculture and Agrarian Reform is now providing agricultural credit in low-rainfall areas. This work is being extended to similar areas in other countries.

A regional network was set up to calibrate soil tests with crop responses (cereals and legumes), but it is clear that the economic optimum for fertilizer use depends on crop rotation, weed control, soil fertility, previous fertilizer history and rainfall. Methods are being developed to take account of these factors when recommendations are offered to farmers.

Fallowing of land is common in the very areas where sheep feed is often in short supply. ICARDA has now analyzed a four-year series of

trials to test the feasibility of replacing fallow with forage legumes such as vetch and lathyrus. The water-use efficiency of a forage/barley rotation is substantially greater than that of a fallow/barley rotation, and forage production is economically attractive, although the absolute profitability depends on the way in which the forage is used. Phosphate applications substantially increase the profitability of all rotations tested.

Alternative farming systems, or adjustments in existing systems, must be evaluated for a range of environmental and socio-economic situations. "Whole Farm" models were constructed to evaluate how improved technologies, new cropping systems, and crop and livestock marketing strategies might impact on farm productivity, and we also started to develop a model to simulate barley growth and thus to predict how it may respond to variations in climate, soil, fertilizer and genotype. We are also evaluating similar existing models for wheat.

The impact of new technologies on rural welfare must be evaluated in its widest sense. When agricultural labor is available, it contributes to farmers' incomes, particularly in drier areas, but it can also constrain the adoption of certain technologies. A new project was started in several countries to assess how technological change affects the supply of agricultural labor.

Cereals Research

In the years since it was established, ICARDA has developed a systematic breeding strategy to help meet the needs of farmers who grow barley, durum wheat and bread wheat during the winter months of an essentially Mediterranean climate. In so doing, we have paid attention to many adverse factors, including drought, cold, heat and salt, as well as to diseases and insects. The process begins by identifying parental material that shows tolerance to one or more of these conditions and, to find such material, we are increasingly turning to landraces and to wild relatives with which wide crosses may be induced.

Crosses are defined in an attempt to breed cultivars that will perform consistently and well in particular environments. After crossing, these lines are followed through a few generations in the actual environments for which the crops are intended and, during this time, superior plants are selected. Yield tests are carried out at several locations, and the seed is distributed to national centers who evaluate it for local use. The process culminates in the release of new varieties. In 1986, Syria released two new varieties of bread wheat and one of barley; Algeria released two durum wheats. Several other lines are under consideration

for release in these countries, and in Cyprus, Lebanon, Jordan, Tunisia and Turkey.

iCARDA makes a great effort to transfer this breeding strategy to national centers, and 1986 saw a major emphasis put on training, including an important course on barley conducted in cooperation with Montana State University of the United States. We look towards the strengthening of a number of national breeding programs who, following proven methods, will be able to generate advanced cultivars for their own use and for use in neighboring countries with similar agro-ecological conditions; such cooperation has been underway for some years in Tunisia and, in 1986, similar efforts were started with Algeria, Morocco, Sudan and Turkey.

In 1986, it was demonstrated that performance in barley is correlated with certain physiological and morphological characteristics, and this correlation has the potential to aid breeders in selecting useful germplasm. Of 5 000 lines of durum wheat planted at Hegla, 50 km north-west of Aleppo, some 250 showed tolerance to salt. A few cold-tolerant and disease-resistant lines of durum and bread wheat gave yields of over 5 000 kg/ha at high-elevation sites in Turkey and Pakistan. Desirable genes from *Triticum turgidum* var. *dicoccoides* (more grain protein, yellow-rust resistance, cold tolerance) were transferred into 36 durum and 24 bread wheat lines by interspecific hybridization.

ICARDA, in association with many partners, regularly screens cereal germplasm for resistance to eight major diseases. Germplasm pools have now been set up for four of these: yellow rust, *Septoria tritici*, common bunt in wheat, and scald in barley. Breeders throughout the region may draw on these pools for parental material.

Although the emphasis of the Cereals Program is on breeding, agronomic research is not neglected. For example, in areas where rainfall averages 200 mm, it was shown that barley yields are better assured by deep sowing (7-10 cm), close row spacing (10 cm) and early planting.

Food-Legume Research

Starting in 1985, ICARDA was required to take a fresh look at its food-legume work in relation to global priorities for agricultural development. Faba beans, lentils and kabuli chickpeas are of minor significance in global statistics for agricultural production and trade, or for contributions to the nutrition of mass populations. Should ICARDA have been reducing its efforts on these crops ?

In crop rotations with cereals, it is already widely accepted that legumes help to maintain soil fertility. But, for farmers to practise rotations, they must be assured of an economic return in every year: in the past, largely because of disease, faba beans were an unreliable crop and, with the increasing cost of labor, lentils became of marginal economic benefit. To ensure that farmers will have the economic incentive to maintain rotations conserving soil fertility, and also because legumes provide valuable protein for human and animal consumption, we have continued to put substantial effort into improving the productivity and profitability of the legume year.

ICARDA now sees its food-legume breeding as about to yield significant results, particularly for faba beans. Many sources of disease resistance have been identified. Plants with determinate growth habits and independent vascular supply produce more flowers, set more pods, and are less likely to shed them before maturity; in the last two years, lines have been selected with larger seeds (up to 1.5 g), and yields are consistently greater. The identification of auto-fertile lines promises to permit the stabilization of such qualities in commercial hybrids.

Two new lentil varieties were released in Tunisia and one in Algeria. The mechanical-harvesting system, reported last year, was further developed, and five countries sent trainees to Tel Hadya to learn about this technology. A laboratory technique was developed to screen lines for resistance to the parasitic weed orobanche (broomrape).

For winter sowing, Syria and Tunisia each released two varieties of kabuli chickpeas which have the necessary qualities of cold-tolerance and resistance to ascochyta blight. For spring sowing, lines have been developed that are resistant to ascochyta and reasonably tolerant of heat and drought; they mature early and give large yields.

Funding has been assured for the next five years of food-legume breeding. By then, ICARDA expects to have put in place, for each of the three crops, a set of varieties that will be adapted to the main agro-ecological situations in the region. We shall seek to transfer our breeding strategies to national institutions (indeed, a major training effort on faba-bean breeding was carried out in 1986) and to continue to provide parental stock. Thus, it should be possible to give farmers a long-term assurance that they can earn profit by retaining a legume year in their crop rotations.

Pasture, Forage and Livestock Research

The objectives of this program are to increase livestock production through the use of pasture and forages in rotation with cereals, through the improvement of native pastures, and through the more effective use of crop by-products. Legumes are emphasized because of their ability to fix atmospheric nitrogen and thus to enhance soil fertility whenever and wherever they are grown.

Rhizobium nodulation of native and introduced medics was studied in detail. Although many of them nodulate freely with commercial inoculants, two of the most important, *Medicago rigidula* and *Medicago noeana*, have special requirements. Inocula for these species were isolated, and will be used on new plantings in the future. Of interest also was that some rhizobia, which are effective in Australia, fail in West Asia, even when used on the same medic cultivars.

After 25 genotypes of common vetch (*Vicia sativa*) had been tested for three years at a number of different sites in Syria, it was shown that several of them are widely adapted. As well as being productive, they are tolerant of root-knot and cyst nematodes, crobanche (broomrape), other common diseases, and frost. Work also continued with another vetch, *Vicia narbonensis*, which is believed to be better adapted to dry areas. Both vetches were found to be palatable to sheep.

The work on straw quality was extended from barley to wheat. It was found that straw in West Asia, unlike in Europe, has considerable nutritional value, a result which confirms the practice of local farmers. Methods, based on morphological attributes, have been developed for rapidly assessing the quality of straw. These will assist plant breeders to select high-yielding lines with good straw quality, this characteristic being important if the new varieties are to be accepted by farmers.

One of the questions most often asked by farmers about pastures and forage crops is what effect they will have on a subsequent cereal crop. In cooperation with Syrian researchers, we have made progress in finding the answers. On farmers' fields, wheat yields after medic are indeed better than those after water-melons, the rotation crop traditionally used by local farmers, but this advantage is lost if weeds are allowed to grow in the wheat. Hence, as with nitrogen fertilizer, the benefits of medic can be fully realized only if the subsequent wheat crop is sprayed.

Two major sheep-grazing experiments were started. In one, the productivity of native pastures is studied as a function of stocking rate and phosphate application. In the other, the productivity of medic pasture in rotation with cereals is compared with wheat in rotation with lentils, water-melons, and fallow. The results of both experiments will be subject to economic analysis. The opportunity is also being taken to study the survival of pasture plants with special reference to seed dormancy.

Genetic Resources

ICARDA maintains a genebank for its principal crops. Missions in Pakistan, Syria and Turkey provided 2 353 new accessions, and 3 035 were obtained from other genebanks; altogether the collection now has 72 101 accessions. Items are systematically rejuvenated and multiplied, and about 40% are now stored in a controlled environment (2°C and 20% relative humidity). The material is also evaluated and, in 1986, morphological and agronomic descriptors were assigned to 5 128 entries of durum wheat, 858 of *Triticum turgidum* var. *dicoccoides*, 22 populations of wild chickpeas and 111 wild lentils. To assist in identifications, a herbarium was started for wild relatives.

The Seed Health Laboratory continues to monitor all incoming and outgoing shipments to prevent the spread of dangerous pests and diseases. Research was carried out on seed treatment with new chemicals, and to detect *Xanthomonas translucens* on wheat and barley seeds. The survey for viruses on cereals and food legumes in Lebanon, Morocco, Syria and Tunisia was extended to Egypt and Sudan.

Computer

ICARDA's in-house computer not only handles the work of the Center, but also many of the needs of Syria's national agricultural research program. Commercially-available software is used where appropriate, but ICARDA has also developed packages that respond directly to its needs and that can be maintained locally. CRISP is such a package for experiment design and statistical analysis; ICADET for database management; and MAS for management and accounting. CRISP and ICADET are now also used at some other CGIAR centers that have VAX computers and at a few institutions of higher learning in the region.

Training

The training function permeates all programs of ICARDA and is seen as an essential component of our efforts to reinforce national research capabilities and to transfer improved technologies. This year, four long-term and five short-term courses were given at Tel Hadya, and six others in countries of the region. By year-end, we will have enrolled some 350 participants in group or individual training programs.

As in research, ICARDA seeks to strengthen the training capacities of national institutions. Agreements for cooperation have been signed with two universities in Syria and one in Sudan, and are in advanced stages of negotiation with another Sudanese university and with two universities in Egypt. The first of a series of fellowships, partly financed by the UNDP, were awarded to scientists who will participate in the planning and conduct of training programs at ICARDA so that they can carry the experience back to their own countries.

ICARDA also launched a new graduate research program which, in collaboration with universities and agricultural research institutions, provides opportunities to candidates for M.Sc. and Ph.D. degrees to carry out their field research in our facilities. This program is partly supported by the Ford Foundation, and we seek to ensure that half of its participants will be women.

Scientific and Technical Information

Several new staff positions were approved at the beginning of the year (librarian, Arabic-language information officer, information specialists on particular crops) but, at the time of writing, only one of these has been filled. Also the publication program was slowed in the first months of the year by the learning process involved in a changeover to direct typesetting on ICARDA's computer. However, for the first time, the annual report was entirely produced on ICARDA's facilities (computer typesetting, offset printing), and the backlog of other publications has been largely cleared.

A retrospective survey of ICARDA publications was carried out, so that these could be included in a comprehensive preservation project organized by the CGIAR; they were also reported to FAO's international information system, AGRIS. Specialized print-outs from AGRIS were obtained to alert ICARDA's scientists to new relevant publications, and

AGRIS was also employed as a tool for indexing some of our collections of technical reports, reprints and photocopies. The publication of the newsletters; FABIS (faba beans), LENS (lentils) and RACHIS (cereals), was maintained.

Financial Resources

In 1986, ICARDA operated on funds totalling almost 19½ million United States dollars, about half a million dollars less than in 1985. A summary account is presented in Table 2, and the sources of the funds are shown in Table 3.

Table 2. Estimates of ICARDA expenditures for 1986 (thousand USD)

| | |
|------------------------------------|--------------|
| Research | |
| Farming Systems | 2 007 |
| Cereals | 2 281 |
| Food Legumes | 2 121 |
| Forage and Livestock | 1 731 |
| Research Support | |
| Genetic Resources | 693 |
| Farm Operations | 1 849 |
| Computer | 470 |
| Training | 661 |
| Information | 927 |
| Cooperation with National Programs | 532 |
| Trustees and Administration | 2 541 |
| General Operations | 2 477 |
| Capital and Working Capital | <u>1 130</u> |
| | 19 420 |

Table 3. Projected sources of funds for ICARDA's core programs and capital requirements (thousand USD)

| | | | |
|-------------------|---------|--------------------|--------------|
| Arab Fund | 343 * | Italy | 1 051 * |
| Australia | 443 | Netherlands | 455 |
| Austria | 175 | Norway | 417 |
| Canada | 719 | OPEC | 125 * |
| China | 50 | Spain | 100 |
| Denmark | 181 | Sweden | 482 |
| Ford Foundation | 150 | UNDP ² | 300 * |
| France | 168 * | United Kingdom | 774 |
| Germany (BRD) | 1 807 * | USAID ³ | 5 600 |
| IBRD (World Bank) | 4 485 | Earned Income | 1 317 |
| IDRC ¹ | 278 * | | <hr/> 19 420 |

* Part or all of these amounts were provided for specified activities

1 International Development Research Centre, Canada

2 United Nations Development Programme

3 United States Agency for International Development

As 1986 ends, ICARDA expresses its appreciation to the donors, whose collective generosity can be indicated, in one sense, by the 135 million USD that is the sum of their contributions over the past ten years; however, no quantitative indicator could ever be set on the moral support and guidance that they have provided to the Center, nor on the devotion they have demonstrated in their efforts to improve the lives of poor farmers and malnourished people.

Special Projects

In addition to the regular operations financed out of its core budget, ICARDA received 2 581 000 USD from various donors as contributions to the cost of some fifteen special projects. Only the larger ones can be mentioned here.

Egypt, Ethiopia and Sudan are the participants in the Nile Valley Project (NVP), which is financed by the International Fund for Agricultural Development (IFAD); and this year for the first time by Italy (200 000 USD). It seeks to improve the production of faba beans and,

increasingly, trials are managed by the farmers themselves. Improved varieties and technologies are applied on demonstration fields and in selected villages where large-scale production schemes have been launched. The project completed its seventh year and, for the first time, the annual coordination meeting was held in Ethiopia. The methodologies of the NVP were also successfully applied in the first season of an OPEC-funded project to enhance wheat production in Sudan.

For six years, partly supported by special-project funds, ICARDA scientists have been based in Tunis and have assisted the national research programs on cereals and food legumes. The effort is now seen to have achieved its objectives and will be scaled down, although the younger farming-systems component will continue. A computer installed in 1986 will permit the processing of a wealth of agro-economic data collected over three crop seasons.

The first year of the seed-production project, financed by the Netherlands and the Federal Republic of Germany, concentrated on training seed technologists from the region.

The US Agency for International Development, with Colorado State University as its contractor, supports a major project based at the Arid Zone Research Institute (AZRI) in Quetta, Pakistan. The work focuses on high-elevation areas in northern Baluchistan but also has components at lowland desert sites in the Indus valley. Research is carried out in collaboration with Pakistani scientists from both national and provincial institutions, and involves rangeland and livestock management, agronomy and germplasm selection. There is a large training component involving ICARDA's own facilities and several US universities.

Permanent Headquarters

The first phase of the building program at Tel Hadya is nearing completion. Laboratories No. 1 and No. 2 were completed in September and October 1986. The Training and Communication Building will be completed around April 1987. The total cost of the building complex has been about 11 million USD, and we acknowledge the major contributions from the OPEC Fund for International Development and the International Fund for Agricultural Development (IFAD).

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