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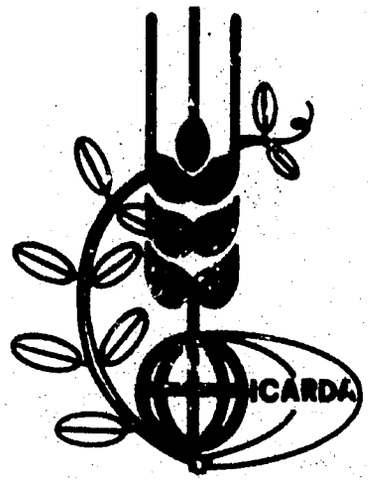
THE INTERNATIONAL CENTER FOR AGRICULTURAL RESEARCH IN THE DRY AREAS




# Report On Research Progress And Developments At ICARDA 1977-78

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September 1978

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# INTRODUCTION

ICARDA's objectives, as restated in the 1979-80 Program of Work and Budget, fall into five major points. In pursuit of these objectives the activities of the center continue to be focussed upon the improvement of rainfed agricultural systems within the widely differing agro-ecological areas of the region of West Asia and North Africa, where the annual precipitation varies between 200 and 600 mm and is concentrated in the winter months.

This region is a net food importer unparalleled in magnitude, on a per capita basis, by any other region of the world. Intra-regional trade in food commodities is barely visible and is less than 7% of the annual inflow of food imports. Its inhabitants, who number over 250 million, thus increasingly depend upon imported basic foods for their survival and, amidst rapid population growth and rising costs, food shortage has become a perennial feature of life; often seriously aggravated by the vagaries of the weather, coupled with the inadequacies of social and economic infra-structures. Yet the potential for agricultural development is enormous and the realisation of this potential will enable the region to regain its food producing role, once truely described as "The Granary of the World".

ICARDA steadily continues to pursue its objectives, designed to assist the region in the achievement of this potential, against a background of increasing uncertainty and insecurity. Both the Lebanon and Iran are in an evident state of flux and the current situation of continuing tension in Western Asia as a whole holds little promise for speedy normalisation. Under this present situation ICARDA stands out more than ever as an important instrument of development, geared to increasing the quality and availability of food and thereby to improving the economic and social wellbeing of the food deficit countries of Western Asia and North Africa.

Over the past 12 months ICARDA's development and research has continued to gather momentum.

Despite continuing civil disturbances in the Lebanon, the Head Office in Beirut has been built into a fully viable and operational unit with the recent arrival of the newly appointed Deputy Director General, and Financial Officer and Controller. Limited research activities also continue in the Beka'a valley .

Development on the 1000 hectare site at Tel Hadia, near Aleppo in Syria, is well underway both in terms of research activities as well as physical facilities. The only matter still remaining unsolved being the payment of compensation to the displaced farmers of the site by the Government. However ICARDA has been given firm assurances that this procedure will be completed in advance of the 1978 winter growing season, so that work can continue untroubled by difficulties arising from this problem.

Progress on the high plateau component of ICARDA's work, centred on Tabriz in northern Iran, however has almost been brought to a halt by the widespread civil unrest throughout the country. Although this has prevented the process of site acquisition, which is difficult at the best of times, from progressing far in the past six months, research in this important sub-region has been initiated on temporary facilities made available at a nearby Research Institute. There is also considerable potential for undertaking investigations in this agro-ecological zone in nearby Turkey, which may be utilised if this present situation persists.

In addition to these activities, centred on the two principal research stations in Syria and Iran and the Head Office, together with some research facilities in the Lebanon, ICARDA has expanded its activities during the past year into a number of other countries in order to better fulfill its obligations to West Asia and North Africa as a whole.

An agreement was reached with the Arab Republic of Egypt in March 1978 providing for cooperative support on the improvement of food crops, in particular broadbeans, in this the largest country of the Arab World with its advanced and almost exclusively irrigated agriculture. A consultant has recently been retained to coordinate this project.

A cooperative research program has also been initiated in Jordan, with the Ministry of Agriculture and the University of Amman's Faculty of Agriculture. This project primarily involves wheat improvement and a senior research scientist has been appointed to head operations in the country.

Furthermore ICARDA has entered into meaningful dialogues with the Sudan, Tunisia and the other countries of the Maghreb in order to initiate, as soon as possible, cooperative activities in these important southern and western parts of the region. At the same time discussions are underway with Saudi Arabia to clarify the involvement of ICARDA in improvement activities in the Arabian Peninsular.

# I - DEVELOPMENTS

## LEBANON

The agreement between ICARDA and the Republic of the Lebanon provides for the establishment and operation of an administrative Head Office in Beirut and for the undertaking of field research activities on a minor scale at the discretion of the Board of Trustees.

### The Head Office

The administrative Head Office was established in Beirut in September 1977 in modest rented accommodation, which also served as an ICARDA guesthouse. In the year since then the number of staff working in it has increased considerably with the appointment of a Deputy Director General and a Financial Officer and Treasurer, both of whom are based in Beirut and in the next few months, with the Purchasing component of ICARDA's administration being centralised in Beirut, the Head Office staff will be further increased by the arrival, from Aleppo, of the Supplies Manager.

This expansion of senior staff in Beirut, together with the necessary support staff and office equipment has put considerable pressure on the space available, and the guesthouse facility had to be closed down in mid-1978 to allow sufficient office space. Despite this, it is anticipated that an even larger floor area will be required within the next year, and thought is already being given to obtaining suitable accommodation.

### Field Research Facilities

Under an agreement concluded in March 1978 with the Agricultural Research Institute of the Lebanon (A.R.I.), ICARDA leased the research stations at Terbol and Kfardane in the Beka'a valley from the A.R.I.

at a nominal rent. These two stations are subsidiary to the Institute's main station at Tel Amara, where ICARDA has maintained a research presence since its establishment in early 1977. Under this agreement therefore ICARDA has transferred its research activities from Tel Amara to Terbol in 1978. There is no plan at present to develop research facilities at Kfardane, which it is envisaged will be used for bulking new cereal varieties for distribution to the national programs of the region.

The Terbol station, which comprises about 100 hectares of land with about 40 hectares suitable for cropping and research plots, is largely unfenced and has suffered from considerable vandalism during the events of 1975-76. There are two derelict building complexes on the site, and despite considerable damage, all the buildings have been inspected and found to be structurally sound. In accordance with ICARDA's policy restoration work is being kept to the minimum necessary to support the activities envisaged. One of these buildings has been converted into a lock-up store to hold supplies and equipment; another shed is currently being reroofed to provide protection to implements and field staff; a simple barbed-wire fence is being erected to protect the cropping area from livestock and to provide a measure of security to the site; and deep wells, sunken in the past, are being re-connected to give an adequate water supply for irrigation. Further rehabilitation work will be carried out as it becomes necessary.

At present it is intended to use the Terbol site for research in support of crop improvement programs in progress at Aleppo. It may prove possible to carry out dry season cropping under irrigation as an aid to speeding up plant breeding research, and the different environment of the site will enable additional complementary screening work on adaptability, amongst other characters, to be undertaken. All the work will be organised from Aleppo and, as far as is possible, farm equipment from Aleppo will be used in the field operations. The first plantings are expected to be made in October/November 1978.

## SYRIA

On January 1st 1977, when ICARDA became an operational entity in its own right, there were a total of 51 staff members, including research associates and assistants, secretaries, technicians, and drivers together with the 12 international scientific and administrative staff. A measure of the way in which the organisation has grown in the 18 months since then can been seen in the present staff complement which numbers 180. All but 20 of these personnel are located in Syria, as a result of the relative speed with which the acquisition of the Aleppo site took place. At present, because the Syrian station is the only one at which large scale research can be carried out, most operations, apart from the Head Office administrative functions, are centred at Aleppo. When the Tabriz site becomes available much of the expertise and structure built up at Aleppo can be transferred directly to Iran and thus cut the lag time for the development of this second major component of ICARDA's operations.

## Administrative and Support Developments

### Financial and Accounting System

From the beginning a high priority was given to the development of an efficient and effective system of accounting. ICARDA's accounting procedures are based on the accepted principles for International Agricultural Research Centers (1975) and have been implemented by several different financial consultants obtained over the course of the year through IDRC. The last of these consultants has just completed his consultancy, arranged to overlap with the Permanent Financial Officer and Treasurer who took up his appointment in July 1978, and who is stationed at the Head Office in Beirut, where the accounts, which have up until now been based in Aleppo, will be centralised in the near future. Together with a station financial officer and his support staff at Aleppo, and in the future a similar officer in Tabriz the basic structure of the financial and accounting system is now complete.

## Personnel

During the course of the past 18 months separate policy documents covering the three staff categories (International, Regional and Local) have been drawn up and, with the exception of that concerning local staff which is currently under review, have been ratified by the Board of Trustees. Since April 1977 a Personnel Officer has been part of the ICARDA administrative team.

ICARDA has provided accidental death and dismemberment insurance to all employees since January 1977. Shortly after this a life insurance plan was added and in late 1977 a comprehensive policy including health, accidental death and dismemberment, life and medical insurance was introduced for all contract employees.

## Supplies and Purchasing

Since early 1977 a Supplies Manager, assisted by an experienced consultant from the Crown Agents(London) who arrived in mid-year, has been evolving a comprehensive and effective purchasing and supplies operation. A central supply depot has been established and a competent staff built up to deal with both international and local purchases and the receiving, inventorying and dispensation of equipment, supplies and materials.

## Buildings and Grounds

All the buildings used as offices, laboratories and stores in Aleppo are rented. Two main office buildings are now fully equipped and functional and biochemistry, soil and pathology laboratories as well as a print shop have been constructed and are being equipped at present. A new service building to house repair and maintenance activities is under construction at the Tel Hadia site and should be useable by early 1979.

## Transportation Services

Due to the very rapid growth of personnel and operations the maintenance of adequate transport has been difficult. However a fleet of pick-ups and passenger cars have been acquired to supplement the

original vehicles made available to ICARDA by the Ford Foundation, and a motor pool has been developed. This, and all vehicle maintenance and repair is organised by a Transportation Officer. Facilities for repair and maintenance have been developed both at the Tel Hadia site and at the Aleppo Office, and following the completion of the physical facilities all this work will be conducted at Tel Hadia.

## Housing

It is ICARDA's policy to furnish staff houses to all international staff and to assist regional staff as much as possible with their housing requirements. A logistics officer was appointed in early 1977 to undertake this work, and since then adequate housing has been found for all the staff concerned, although rents are rather high due to the 40% tax levied on landlords if their houses are rented by foreigners.

Facilities for trainees have been provided until now in hotel accommodation or rented apartments. For the immediate future arrangements are being made to obtain a block of rented apartments for conversion into a hostel, while permanent facilities are being constructed on the Tel Hadia site.

## The International School

Syria has, in the past, not favoured English speaking schools and in order to attract the high calibre of international staff required, it has been necessary to establish a private English language school in Aleppo. After considerable effort the requisit permission was obtained and the school opened with one student in October 1977. At present there are 18 students enrolled in the school and by the 1978-79 school year there are expected to be about 35 students. Two expatriate teachers assisted by three part-time local teachers have been recruited to run this facility. At present ICARDA is subsidizing the school, but as the number of non-ICARDA family students increases the school should become self-supporting.

## Library Services

A library has been set up at Aleppo, based on a compilation of books, bulletins, journals and other documents that came to ICARDA through the ALAD program of the Ford Foundation. A large number of new books have been acquired and over 150 journals are now being received regularly. With the help of consultants from IDRC a development plan for the whole organisation, together with operational procedures for the Aleppo library in particular, is being developed.

## Site Development

Due to various delays ICARDA only took possession of the Tel Hadia site on October 6th, 1977. Temporary roads were installed to give access to the research plots, and the land was prepared to permit the timely planting of the whole 120 hectares of research cropping for the 1977-78 season.

During this season the 100 hectares of land earmarked for development into permanent research plots was laid out with a network of roads, which were designed to enable all land drainage to be accomplished by their ditches. These permanent roads are currently being surfaced with crushed rock extracted from reshaping operations in the two quarries on the site. Temporary field roads will be located within this network on an annual basis as dictated by the cropping to facilitate sowing, harvesting, observation making and other in-crop operations. Other permanent roads will be laid out over the remainder of the site during the winter of 1978, however the peripheral road will not be constructed until the fencing is complete. In turn this fencing will not be erected until the outstanding matters of compensation to the farmers of Tel Hadia are finalised, in order to prevent undue tension.

Water is plentiful on the southern half of the site; there being 21 operational wells in this area when the site came into ICARDA's possession. All but six of these have been capped and it is planned to use four wells for irrigation and two for domestic water supply when the site is fully operational. Irrigation will be achieved primarily by an overhead sprinkler system connected with underground PVC feeder pipes from a reservoir located in one of the hill-side quarries. Water will be pumped into this reservoir from the wells and sufficient head will thus be provided to operate the whole system. Direct feed from the wells, by-passing the reservoir will also be possible by this system.

The current building program has been concentrated on the two buildings acquired with the site, which have been modernised and electrified and have had plumbing installed, It has become obvious that ICARDA will have to supply its own power for the present and immediate future and thus two generators are being acquired to fulfill these needs until 1980. The two quarries located on the south face of the central hill have been cleared, straightened, and enlarged slightly in order to accommodate the farm headquarters. This will be comprised of two prefabricated metal buildings, one of which will be initially used for office facilities and seed storage to enable some firm program activities to be based on-site as soon as possible. The other building will serve as a maintenance workshop, and it is envisaged that both buildings should be completed by the spring of 1979.

In addition to this, six new plastic houses have been erected for experimental purposes and will be equipped with heat and irrigation in time for the fall plantings. The equipment comprising the weather station has arrived and will be erected in the near future so-that meteorological observations can be made throughout the coming season.

It is aimed to conclude the site development work by the end of the summer of 1979 and thus enable the research site to be fully operational. Within the overall site plan an area has been set aside for building development, which is at present in the hands of the architects and will, it is hoped commence in 1979-80.

## IRAN

The machinery for taking over the site, at Gharahbaba near Tabriz, from its existing owners has been set up by the Iranian Government and a sum of money put aside for its purchase by the Agricultural Development Bank. However due to the escalation of civil disturbances throughout the country the processes involved in site acquisition have being deliberately curtailed for the present in order to reduce the tension that could be created by precipitate action at this stage. Much of ICARDA's activities over the past year have thus concentrated on assisting these processes unobtrusively and where possible, and establishing and developing a base of contacts and cooperation with various government departments, the five national research institutions, the universities of Tehran and Azerbaijan, appropriate foreign embassies and other relevant scientific centers, such as FAO and CENTO.

### Facilities

ICARDA has established office/guesthouse facilities in both Tehran and Tabriz to enable it to coordinate its activities. In addition, due to the slow progress being made in the acquisition of the site at Gharahbaba, the Imperial Government of Iran has made available to ICARDA 15 hectares of land at the nearby Soils Research Institute at Tekmehdash. This, together with certain other facilities at the institute, which include the use of administrative and equipment buildings, has enabled preliminary observation trials of both cereals (fall plantings) and legumes (spring plantings) to be grown during the 1977-78 cropping season.

Additional equipment and supplies are being made available to enable expanded fall plantings of cereals and food and forage legumes to be made in October of this year.

## Personnel

During the year a highly skilled consultant was appointed to oversee developments at the Gharahbaba site (and until the site becomes available, the operations at Tekhmedash) and assisted by a Deputy Station Director, who will take up his appointment in November, together with several Research Associates and Technicians appointed on a local basic, he will form the core of the technical personnel in Iran. The overall operations in Iran are coordinated by an Executive Project Director and his support staff, mainly residant in Tehran.

## Extra-Site Activities

An extensive collection of forage legume germplasm (over 900 entries) was made by an ICARDA/Australian team throughout the high plateau region during the summer of 1978. Further tours of this region were also made during the season by teams from the food legume and cereals programs in order to build up background material on the production situation and the major constraints to production in the region.

The build up of facilities, personnel and activities in Iran is moving ahead slowly due to the fact that the selected research site is still unavailable. This build-up is designed to provide a solid base to future crop and farming systems work in the high plateau regions and ensure that when ICARDA actually gains possession of the site relevant research work can move ahead with all possible speed.

## THE INTEGRATED FARMING SYSTEMS PROGRAM

The major objective of Farm Systems work at ICARDA is to evolve appropriate agricultural strategies designed to benefit the majority of the rural population in the winter rainfall region of Western Asia and North Africa by making more effective use of the soil, water and other resources available to agriculture in the region. Such strategies, which may not differ radically from those already practiced, must be able to provide the poorer sections of the community with a substantial proportion of their food and cash needs on a sustained basis, without being over exploitive of physical, biological and human resources.

In order to develop systems and technologies that are truely appropriate to the situation of farmers in the region, and that do not accentuate the income inequalities, displacement of labour and dependence on external inputs existing within the farming community as a whole, the program activities are based on a continuing study of the existing farm systems and on an understanding of the needs and aspirations of the farmers in the region.

During the past year discussions with ICARDA staff, personnel from other international and national research efforts, agricultural planners, and farmers and their families have led to a clarification of the overall program philosophy in terms of the development of a number of interrelated work areas within the overall program structure as originally conceived. These, work areas run across this fairly rigid structure so that the Environmental, Resource Management and Socio-Economic components are not necessarily clearly identifyable and are embodied as interrelated parts of the overall systems approach.

## Environmental Systems

A summary and preliminary analysis of climatic data from key stations throughout the ICARDA region has just been concluded and is yielding valuable information on the seasonality and reliability of rainfall, the timing of the start and finish of the growing season and the severity of drought periods and their occurance within the season.

At the same time an extensive collection of existing information on the climate, geology, hydrology, soils and vegetation of the low elevation littoral has been initiated. The annual rainfall, which is concentrated between the months of October and April, and the generally low winter temperatures, which become of greater importance with increasing continentality, have been found to be the major climatic features of importance in this sub-region. A network of agro-climatological stations is being set up in Syria to determine the extent and importance of these effects and to provide basic data on the climate near the ground, the soil moisture storage and moisture availability, and crop phenology.

The accumulation, storage, availability and subsequent utilisation of soil moisture is of major influence to the flexibility of cropping systems and is thus one of the main research foci of the Farming Systems Program. Soil moisture data collected during the past 10 years, by the Meteorological Department of the Syrian Ministry of Agriculture are being summarised and will be combined with measurements made by the Farm Systems staff at the five villages which form the basis of the studies of existing farm systems in Syria (see below) to give a more complete appraisal of the moisture status of soils in Syria.

These activities are being undertaken together with studies on Socio-Economics and Resource Management and are considered to be one part of the overall initial characterisation of the region and its farming community, geared to the future evolution of improved farming strategies.

## Resource Management

In order to develop effective strategies for the optimisation of resources at the farm level it is essential to first achieve a good working knowledge of the existing farming systems and the factors which impinge upon them. In recognition of this, the main emphasis of the Farm Systems work in this first year has been geared to an evaluation of the

existing systems of farming practiced in the region. This evaluation has been conducted at two levels, involving: the collection and analysis of information on the physical, political, economic and social factors influencing agriculture in the national and rural economics, which at this stage has been confined to studies in Syria and Jordan; and detailed studies of farming systems at the village level, limited at present to the Aleppo Province of Syria. It is realized that an expansion of both these activities to cover the whole ICARDA region is essential in the medium and long term, however the aim of the studies is to achieve a thorough understanding of the farming system and its place in the rural economy and with the limited resources available at present the current work must be location specific in order to be effective. It is intended to verify the basic principles established, through the use of the methodologies developed at Aleppo, at other sites throughout the region at the earliest possible time and to thereby overcome these problems of site specificity.

Country Level Studies

These studies, which include the survey work on existing natural resource data outlined under Environmental Systems and investigations into the socio-economic framework, are helping to clarify the production situations in the two countries and identify the factors which influence this production.

For example in Syria there are about 5.5m hectares of cultivated land of which perhaps 13% is irrigated. The main rainfed field crops are wheat, barley, lentils and chickpeas and important tree crops include olives, grapes, apricots, apples and figs. Sheep production dominates the livestock industry, and production systems vary from extensive grazing in the steppe areas to intensive feed lots in or near the towns. A multitude of factors influence this production pattern, and important amongst these at the country level are: the effects of governmental policy and agricultural planning, with its declared intention of modernising agriculture through intensification and mechanisation and its aim of increasing overall productivity through emphasis on the relatively high potential irrigated conditions; and the impact of land redistribution resulting from the various land reforms of the past 20 years. Investigations have established the major mechanisms for

the implementation of policy, and the effects of such policy and land reform on the production situation at the farmers' level are being analysed.

It is felt that these factors require considerable emphasis as their interaction with improved technologies and the spread and usefulness of these technologies are important considerations in developing technologies that can and will be used by the farming community as a whole and the small farmers in particular.

Village Level Studies

The Aleppo Province of Syria possesses a range of agroclimates and soil types which are very representative of the conditions of the low elevation littoral environments of the region; the annual rainfall varies between 200 and 600 mm and there is a great variation in soil types. The farming systems range from those in which field and tree crops predominate to those that are primarily based on rangeland sheep production.

Out of some 45 villages visited within this province, six, representing different agroecological zones, were selected for further detailed studies on the basis of population, resources and resource use. Within these villages a 25% sample of households was used for a detailed study of activities and economic circumstances throughout the year. Although the routine recording of farming activities, household income and expenditure, and the study of climate, soil, crop and livestock interactions in these situations was not started until October 1977 and will therefore not be completed until October 1979 a number of preliminary findings are worth mentioning at this stage:-

- Over the majority of the study area soil depth has the greatest influence on moisture holding capacity and storage and thus upon the flexibility of cropping. Where rainfall is between 200 and 300 mm per annum the amount of moisture stored in soils of reasonable depth (80cm) during the fallow part of a cereal/fallow rotation is small, and even in rainfall zones of 300 mm or above shallow soils (20-40cm depth) are unable to store moisture during this fallow period.

- Rotations are well established in areas where the rainfall is between 250 and 400 mm. Wherever soil depth is sufficient (greater than 80 cm) two or three course rotations of summer crops /cereals

or lentils and summer crops/cereals/lentils or vetch are common. Established rotations are less evident where rainfall exceeds 450 mm,where trees (principally olives) are important, and in areas with less than 250 mm of rainfall,where one crop may follow a similar crop, especially if the first fails due to drought.

- In most areas a pattern of cultivation, designed to control weeds and prepare heavy, strong and sometimes shallow soils for broadcast sowing, has evolved. Individual plots are frequently long and narrow and are cultivated up and down slopes. The tractor, discplough and the duck-foot or disc cultivator are the main items of equipment used and animal drawn ploughs are often employed for weeding between tree and summer crops. Few seed drills are used where the plots are small and individually owned. In Hassake Province, in the north east of the country, however,seed drills, large disc ploughs and disc cultivators are common items of machinery on the large private holdings and state owned land. Combine harvesters are used throughout the area for cereal crops, but hand harvesting of cereals is still common where the straw is required for animal feed. Almost all grain legume crops are hand harvested. Farmers usually hire cultivation and harvesting machinery from local owners and deferred payment is common. However families with cash available can usually secure timely operations of a better quality than those who are only able to pay after the harvest. Fertilisers and herbicides are used to a certain extent in the higher rainfall and irrigated areas but more information is still required on timing and rates of usage.

- Crop yields vary greatly between seasons, with total annual rainfall and its distribution, and with soil depth and type. Existing improved varieties perform better than the local ones under good growing conditions, but tend to show a much poorer performance when the conditions are unfavourable. Cereal yields in the Aleppo Province vary from 150 kg/ha to 300 kg/ha; barley yielding considerably better than wheat in areas receiving less than 300 mm of rainfall per annum. As regards food legume crops, lentil yields have been found to range from 884 to 1722 kg/ha and chickpeas from 500 to 1700 kg/ha in the 1977-78 season.

- Livestock systems appear to have changed considerably over the past 20 years as the availability and quality of rangeland plants has declined, and the introduction of mechanisation has extended the boundaries of cultivation into former rangelands. The use of weeds and crop

residues in livestock nutrition is important in many areas and recent years have seen an increasing dependence on supplementary feeding.

In addition to this fundamental survey work, appreciable work on Weed Control and Entomology has been carried out within the overall sphere of Resource Management both at the ICARDA site at Tel Hadia, and in surveys and trials at other locations

## Weed Control

Preliminary survey work in Syria has indicated the dominant and potentially hazardous broadleaf weed species to be of the genera Vicia, Vaccaria, Cephalaria and Lathyrus, while grass weeds that may become problems include species of the genera Lolium, Avena and Phalaris

Results of 16 trials spread over 12 locations, designed to give quantitative information on yield losses in cereals through weed competition, and analyse the effects of timing of herbicide application on the control of broadleaved weeds, indicate that total weed control can increase yields by about 20%. Early control of broadleaved weeds is very important and the greatest responses to control were observed in breadwheat crops and in general in crops under higher rainfall, higher soil fertility and continuous cropping conditions.

Weeding studies also conducted during the season have shown that, in wheat crops, yield increases with earliness and intensiveness of weeding; late weeding, whilst giving the greatest quantity of useful fodder resulted in the lowest yields. In lentil and chickpea crops however, owing to generally low weed infestations in the experimental plots, yield differences between time and intensity of weeding were not significant.

Investigations into the effect of crop height on weed populations has clearly shown that taller breadwheat varieties are able to compete considerably more effectively than shorter types. This advantage was less marked in durum varieties

Work on Orobanche control during the 1977/78 season has mainly involved the screening of broadbean and lentil lines for resistance to this important parasitic weed. Of the 768 broadbean lines tested, 36 have been found to show a reasonable level of resistance, but tests on

lentils have only established one line with any degree of resistance. The use of chemicals, the effect of soil fertility, and the role of dormancy and periodicity in Orobanche have also been investigated. With the extension of the ICARDA/IDRC project into 1979, work will continue, in conjunction with the American University of Beirut, into the use of synthetic germination stimulants for Orobanche control.

Over 55 commercial herbicides were tested during the season at Tel Hadia; particular emphasis being placed on pre-emergence applications and compounds for the control of grass-weeds. Varieties of cereals and legumes were also screened for their tolerance to these chemicals, and by further experimentation in the future, it is hoped to evolve recommendations for the effective and economic use of some of these chemicals, under the very distinct conditions of dryland farming.

Entomology

Regular observations of insect infestations on cereal and pulse crops were made throughout the region, mainly at the Tel Hadia site but also at locations in the Lattakia area. Visual ratings of degree of infestation were made and leaf weevils (Sitona spp.), seed weevils (Apion spp.) and leaf midges (Contarinia spp.) were found to be important in lentils, while leaf miners (Liriomyza spp.) caused considerable damage in chickpea lines. These observations will be developed into more precise surveys of the crop growing areas in Syria in the coming season, to provide detailed information on the main insect pests, their life cycles, population changes, movements and predators, and the actual crop damage caused.

The on-site program for the 1977-78 season included the screening of cereal varieties for resistance to wheat stem sawfly, from which 37 out of the 317 lines tested showed promise and will be further evaluated in the coming season; investigations on the effects of planting date, plant population and leaflet size on the infestation of lentil by leaf weevils, which have so far proved inconclusive; and the screening of lentil and broadbean lines for resistance to bruchid infestations in store, which will be repeated in the coming season due to severe depletion of the bruchid population by Pyemote mites.

## Socio-Economic Studies

Considerable data have been gathered during the course of the detailed village survey program on household needs, family income, kinship relations and inheritance, and various other social and economic factors that effect the farming families and hence their attitude to risk and their cropping pattern. Although such studies are, of necessity, rather long term, two important points have become clear:

The combined effect of rural population increase in recent years, the redistribution of land and the subdivision of holdings through inheritance and fragmentation between different land classes has resulted in small family land holdings and low land per person ratios (the mean range across the village samples being 0.68 to 3.05 hectares/household member).

The proportion of household income derived from different agricultural or non-agricultural activities varies widely within and between villages. In high rainfall areas cropping is usually of major importance, and livestock production becomes more important in areas of medium and low rainfall. However in all agricultural zones members of families with low land/person ratios frequently need to resort to agricultural labouring or urban employment in order to subsist.

The conclusion of the first phase studies in October 1979 will enable considerably more information on these important social and economic factors to be put in its true perspective.

## Special Projects

In addition to activities within the overall structure of the Farming Systems Program, outlined above, the program staff are working very closely with the other individual crop improvement efforts at ICARDA and have undertaken several specific study projects to assist in the planning of future experimental work.

The considerable interest at ICARDA, and expressed by legume researchers throughout the region, on the mechanisation of lentil harvesting prompted a study on the role of lentils in the national and

rural economy and of lentil production processes. Preliminary results indicate that within many of the existing production systems in Syria there appears to be little justification for the introduction of mechanised harvesting. However further studies are being conducted in order to establish under what circumstances the mechanisation of harvesting may be justified.

A collection of information on the production of grain legumes in a number of countries of the region is being made jointly with the Food Legume Program, and an analysis of broadbean production in Syria and Jordan is also being undertaken.

An evaluation of the extension contribution made by the Farmer's Field Verification Trials, organised jointly by the Cereal Program and the Syrian Ministry of Agriculture has also been made and is being used in the planning of further trials for the coming season.

## Future Developments

Plans for the 1978-79 cropping season include a continuation of the basic survey studies on an expanded base to include other important rainfed areas in Syria, together with a considerable expansion of on-site research activities especially in the fields of soil water/nitrogen management studies and investigations into cropping systems and crop/livestock management. This on-site work will be complemented by studies conducted at the farm level designed to evolve a range of alternative improved systems appropriate to the range of agroclimatic conditions and to the different economic and social situations of farming families. In particular it is considered important to address the needs of the poorer section of the farming community, hitherto rather neglected, and as such more importance must be attached to studies of the socio-economic and institutional framework, which plays such a significant role in the decision making process of this group.

The research program is thus being developed in close contact with the real farm situation and it is intended to carry out basic work on the structure of components of systems at the main research sites while at the same time emphasising on-farm studies and trials as the only way to truely evolve, test and prove systems designed to make better use of all the resources available to the farming community.

## THE CEREAL IMPROVEMENT PROGRAM

The policy of the Cereal Improvement Program is to assist national research institutions in the region in increasing wheat and barley production by way of the development and introduction of improved and stable varieties with a higher yield potential and better resistance to the pests and pathogens, together with improved management practices for their cultivation. This objective is primarily achieved by the provision of the necessary elements of new technology, research procedures and field training to cooperating national programs.

In the region, which extends from Morocco to Pakistan, evapotranspiration exceeds rainfall for 4-9 months of the year, and the rainfall is commonly erratic. In the lower precipitation zones (below 350 mm) unpredictable rainfall together with the poor moisture holding capacity of the soils present serious obstacles to stablizing and increasing cereal production. Other variables like altitude, soil characteristics and temperature also influence productivity. Although not widespread, the danger of frost damage can not be ignored and higher than optimum temperatures during flowering and ripening can also cause significant yield losses. As yield is the integrated result of all the influences acting upon the crop since germination, an understanding of the different stresses that the plant may experience during its life cycle is necessary to the development of suitable genotypes and production technologies. This aspect is emphasized in the program in order to improve the compatibility of wheat and barley germplasm to the prevailing crop growing environments in the region.

The priorities of wheat and barley research in the Mediterranean and West Asia include the improvement of: crop yield potential and stability under both adequate and low moisture conditions; disease resistance; and grain quality. However there is considerable agroclimatic diversity within the region and thus drought and frost tolerance, winter hardiness, earliness, and lodging, disease and insect resistance all figure amongst the factors requiring special attention.

## Work and Progress

On November 5, 1977, land on the ICARDA site near Aleppo became available for planting. By December 14th, around 100 hectares were sown to barley, durum, bread wheat and triticale yield trials, observation nurseries, national, regional and international nurseries, crossing blocks, disease and insect resistance screening nurseries, segregating populations, germplasm evaluation nurseries and small seed increase blocks. A number of trials were also planted to study agronomic practices such as sowing date, seed rate, fertilizer application and row spacing, under both rainfed conditions (precipitation during the growing season averages about 350 mm) and with one supplementary irrigation, in order to obtain preliminary information on the agronomic practices for cereal improvement work at Tel Hadia. Several weed control experiments were initiated in an attempt to understand the weed flora in the cereal fields and to develop weed control measures.

A collection of 2,350 lines comprising bread wheat, durum wheat, barley and triticale was planted by hand in a poorely prepared, sloping plot of land at an elevation of 1800 meters above sea level at the Tekmadesh Soil Research Station, Tabriz, Iran in September 1977. Soon after planting the land was covered by snow and the small seedlings were not seen until April when the snow melted. At this time the plot was infested with weeds; the plants exhibited both macro and micronutrient deficiency; and later in June-July the plants experienced moisture and high temperature stresses. In late July and again in early August, the lines were critically examined for survival under these growing conditions which are typical of large wheat and barley growing areas in the highlands of Afghanistan, Iran, Turkey, the upper reaches of the Himalayan Belt, and possibly also other adjoining areas. It is significant to note that a few bread wheat and durum lines exhibited

clear superiority over the remaining germplasm and some of the triticale lines also appeared promising. These lines will be further evaluated during the 1978-79 season. It is also of interest to note that the better lines came from winter and semi-winter as well as from spring habit germplasm. During crop surveys in northern Iran, it was found that winter habit land races occupy major areas; furthermore the use of weed control and chemical fertilizers is limited and bunt infection in wheat plots may be as high as 50 percent. All these observations are being taken into consideration in the selection of materials from different collections, breeding lines and crossing blocks for 1978 plantings at Tabriz. Simple agronomic trials are also planned using a few wheat and barley varieties under the prevailing environment of Tekmadesh.

In collaboration with the National Lebanese Cereal Improvement Program, wheat and barley yield trials, observation nurseries, crossing blocks and segregating populations were planted on the experimental plots of the Agricultural Research Institute, Tel Amara, Lebanon. Tel Amara represents a higher rainfall zone (about 550 mm), a deeper soil and a cooler and relatively longer cropping season than the Aleppo site and so yields valuable information on crop adaptability.

## Breeding

### Barley

Barley is considered to be the second most important crop in the region because of its adaptation to a wide range of conditions, including problem soils, poor fertility, low rainfall and short growing seasons; conditions under which other cereal crops are not successful. Both spring & winter types are cultivated in the region, and in some areas, the crop is grown under partial irrigation. Under these conditions lodging and disease resistance become important considerations of a crop improvement program. Barley is frequently consumed as a human food in the Mediterranean region, West Asia, Afghanistan, India, Nepal, China, Korea, Ethiopia, Kenya, Japan, the Andean region of South America, and Eastern and Northern Europe. However, its use as animal feed and

for malting purposes is becoming increasingly important in the region, and it also finds use as forage for hay making or grazing. In Aleppo, ICARDA's research work concentrates on spring barley and on lines arising from winter/spring crosses while work on winter habit barley will be undertaken at Tabriz.

In the past year eleven hundred promising lines/varieties have been evaluated in 50 Preliminary or Advanced Yield Trials at Aleppo under rainfed conditions (350 mm). Both Arabic Abied and Beecher were included as local and improved control varieties; Beecher being well known as a high yielding and well adapted line in the region. Beecher outyielded Arabic Abied by 13 percent in the Tel Hadia trials and by 20 percent in "on-farm" trials. The following new promising lines have performed better than both and have outyielded Beecher significantly in on-site trials.

| Line | % Yield increase over Beecher |
|---|---|
| 1. Promesa x Arrivat CMB-72A-9-6L | 51 |
| 2. CI 7117-9 x Arrivat x Local D8 (S-3418-0AP) | 22 |
| 3. 11258/L 2171-74 | 31 |
| 4. 251-13-CI 1382-Giza 117 | 32 |

In the low rainfall areas of Syria (less than 200 mm), the varieties WI 2197 and Roho have proved to be the highest yielding.

Observation nurseries, comprising 5,079 new lines, were screened for a number of traits which included high yield potential; desirable agronomic characters for low, medium and high rainfall areas, or partial irrigation; shorter and longer duration of growing period; grain appearance;and greater disease resistance and straw strength.

Selected lines will now be tested for yield in Tel Hadia and Terbol. In the future selected lines from both locations will be included in the regional nurseries for wide scale testing and possible use by national programs. The development of naked kernel (Hull-less) barley lines with good plant characteristics and high yields is receiving special attention in this work.

Because the barley breeding efforts of the region are limited, special attention is being given throughout the work to the establishment of guiding principles for new crosses adapted to meet the diverse needs of the areas in which barley is grown. A total of 1000 crosses were made during the season, and although greater emphasis continues to be placed on the development of germplasm for the low rainfall and more marginal areas, some crosses have also been made to suit the relatively higher rainfall and partially irrigated production zones. The segregating families will then be grown for single plant selection, the most promising families being selected for distribution to the national programs to ensure that the most suitable plants are selected in the different production environments.

Durum

Durum wheat is of major importance in the Mediterranean and West Asia region, occupying about 11.5 million hectares of land annually. Unimproved local varieties still predominate and are used locally for the production of bread, couscous and burghul. About 15% of the durum production is used for the preparation of pasta products, which form a considerable part of the important export market.

About 800 durum crosses were made during the 1977-78 season; many of them utilising the most promising material identified in the 1976-77 regional nurseries. Approximately 150 of these crosses utilised different sources of resistance to yellow rust, stem rust, and leaf rust with the aim of developing new combined sources of resistance to these important wheat pathogens.

3,500 segregating durum generations were grown at Aleppo for selection. Unfortunately the lack of rust development prevented selection for resistance, but as most of the nurseries were under considerable moisture stress, the year provided a good opportunity for selecting

plants resistant to drought. Plants were selected only if they appeared to give good grain fill under the limited moisture conditions. However, once this basic criterion had been met an attempt was made to select plants covering a wide range of maturities and plant types in order to develop germplasm suitable for the diverse production conditions of the region. The majority of the segregating families were selected in earlier generations under relatively good moisture conditions in Lebanon, Egypt, and/or Kenya. It is thus hoped that further selection this year at Aleppo will help identify widely adapted material.

Four durum nurseries from CIMMYT were grown and a number of promising lines were identified for this region. Durum lines identified at Njoro in 1977 as having excellent stem rust and yellow rust resistance were screened at Aleppo and some appeared to have good yield potentials. Some lines were selected, from both the durum yield trials grown at Aleppo and the special disease screening nursery for bunt (Tilletia caries), as having complete resistance to this disease.

Results obtained from these trials clearly indicate that a number of new durum lines with yield potentials well above the best currently available varieties are being identified. For example, the line Gta's' - Fg's' outyielded the controls (Jori and Haurani) by 30% and was 20% higher in kernel weight. In another trial the line F. 9-3 exceeded Jori and Haurani by 30% in yield and 26% in kernel weight.

It is generally considered that earliness is desirable for low rainfall areas. However, some of the highest yielding lines in the durum yield trials and nurseries this year were relatively late in maturity. Apparently these lines were able to "hang on" and fill well despite the low moisture conditions.

Grain quality selection has been limited due to the lack of laboratory facilities. All segregating populations, nurseries, and yield trials are routinely screened for grain color, size, and appearance, and all promising durum lines in the regional nurseries were screened for protein content in Cyprus. The results indicate that these lines represent a fairly wide range of protein contents, including some high protein lines which are also relatively high yielding.

## Bread Wheat

During the 1977-78 cropping season a total of 41 Preliminary and Advanced yield trials were planted at Tel Hadia. Each trial of 25 varieties included a local improved control (Florence Aurore) and a regional control (Mexipak). Twenty four trials were conducted under rainfed conditions (350mm of rainfall with 60 kg each of P205 and N/ha) and seventeen trials were provided with one supplementary irrigation at the grain filling stage and top dressed with an additional 60 kg N per hectare in the spring. In the rainfed trials 246 entries outyielded the regional control Mexipak and 226 lines performed better than the local improved control variety Florence Aurore. With one supplementary irrigation and an additional 60 kg N/ha, 215 entries outyielded Mexipak while 346 lines performed better than Florence Aurore. The average yields of the top three lines in the rainfed trials were 35 and 44 percent higher than those of Mexipak and Florence Aurore respectively. In the case of the yield trials with supplementary irrigation, the average yields of the top three entries were 33 and 56 percent greater than those of Mexipak and Florence Aurore. A summary of yields obtained is presented below.

| Lines/Varieties | Average Yield (kg/ha) | | | |
|---|---|---|---|---|
| | Rainfed | | One Supplementary Irrigation | |
| | Preliminary (19) | Advanced (5) | Preliminary (13) | Advanced (4) |
| Mexipak | 1084 | 947 | 2498 | 1479 |
| Florence Aurore | 971 | 931 | 1740 | 1651 |
| 3 top yielding lines | 1388 | 1364 | 3105 | 2202 |

These results indicate that there are strong possibilities for increasing wheat yields under both low and adequate moisture regimes using suitable varieties and improved management practices.

About 7000 observation lines were screened for different agronomic traits, disease resistance and kernel characteristics. Special efforts were made to select lines which exhibited tolerance to the soil moisture stress and high atmospheric temperatures that prevailed throughout the grain filling stage (May & June). Around 700 bread wheat crosses were made in order to combine increased yield potential with stability under different stress situations. Local cultivars and improved control varieties currently grown in the region were used extensively as one of the parents.

## Triticale

Preliminary studies are underway to determine to the potential productivity and usefulness of triticale in the region . The basic triticale materials received from various sources (mostly CIMMYT) were grown for selection and testing. A number of triticale lines were included in the 1976-77 regional nurseries and the results have been very encouraging. For example, one triticale line (Inia-Arm's') had the highest average yield across the region in the Fifth Rainfed Wheat Yield Trial which included the best new breadwheat and durum lines. In general, triticale has shown better resistance than wheat to Septoria, bunt, loose smut, and powdery mildew, thus giving it an advantage over wheat in some parts of the region. Triticale has also shown a higher adaptation ability to acid soils than wheat, which may be of importance in areas such as Ethiopia and the uplands of north India. Among the cereals, triticale has a relatively high percentage of the limiting amino-acid, lysine, which bodes well for its use as either a food or a feed crop. In general, considering the small amount of work which has been carried out on triticale in this region, results obtained thus far warrant a continued and perhaps expanded evaluation and improvement of triticale by ICARDA.

Some of the most promising lines were selected from a large family of segregating populations grown in Aleppo. One of the main problems discovered in triticale seems to be shrivelled seed due to abnormal endosperm formation. A special nursery, consisting of 50 lines selected for good seed type at CIMMYT, was grown at Aleppo. Although still inferior to wheat, some of these lines showed a definite improvement in terms of reduced seed shrivelling as compared to the control varieties. Two of these lines also appeared to have good yield potential

under the conditions of this region. The International Triticale Screening Nursery, the International Triticale Yield Nursery, and the Triticale Crossing Block were also grown at Aleppo and a number of promising lines identified.

In the Aleppo yield trials, one of the triticale lines (Rahum) outyielded high yielding lines of durum by 20%. Eight preliminary triticale yield trials were grown under low moisture conditions. Most of the material in these trials looked poor, but a number of lines stood out as having good drought resistance.

## Pathology

All observation nurseries and segregating populations grown at Aleppo and Tel Amara were subjected to artificial rust inoculations. However, no effective screening for rust resistance was possible due to poor disease development. Promising lines from these nurseries have thus been planted at Njoro in Kenya to screen for resistance. All wheat and barley entries in the yield trials were screened for resistance to bunt (Tilletia foetida) a disease commonly prevalent in many countries. Bunt resistant lines have been identified and will be included in the crossing block. Disease screening nurseries were planted at Aleppo, Lattakia and Tel Amara, and several sources of powdery mildew resistance have been identified in barley.

Disease prevalence surveys were organized in co-operation with Syrian and Iranian institutions and were carried out in Syria and the northern regions of Iran. Only very light infections of yellow rust and Septoria were recorded in northern Syria. Bunt was found to be the most important single disease in the northern winter wheat growing areas of Iran; 10-20 percent yield reductions being expected and head infections as high as 80 percent being recorded. Powdery mildew, downy mildew, leaf, yellow and stem rust, loose smut, ear cocke and yellow slime disease were also observed, but none of them appeared to cause significant yield loss. In the case of barley, covered smut and stripe disease were the most prevalent diseases. Infections of loose smut, the three rusts and leaf-spot were recorded together in some fields.

Resistance sources are being identified from entries in the regional nurseries, which are thus being screened against a wide range of virulences within specific pathogens. Different identified resistance sources are pyramided into agronomically superior genotypes. Greater emphasis is being placed on accumulating minor genes, which have little resistance effects by themselves, but will give additive effects for a long-lasting and, hopefully, non-specific resistance. Lines with superior resistance to different specific diseases are also being crossed in order to develop germplasm with multiple disease resistance. It is realized that different approaches, including new systems of managing resistance genes are necessary to minimize future disease losses.

ICARDA co-operates closely with CIMMYT's Middle East, and Mediterranean regional cereal disease surveillance program. The Regional Disease Trap Nursery (RDTN) and the Regional Disease and Insect Screening Nursery (RDISN) are jointly prepared and distributed in countries from India in the east, to Morocco in the west and in East Africa, in order to collect information suitable for the development of recommendations having some predictive values concerning epidemic diseases. The RDISN provides valuable information on sources of resistance which can be used to develop new resistant varieties.

## Agronomy

The agronomic experiments conducted at Aleppo during the 1977/78 season involved two varieties each of barley, durum and breadwheat sown at three different dates, three different rates and three row spacings. These trials were conducted under rainfed conditions (350 mm rainfall and 60 kg each of $P_2O_5$ and N per ha) and with one supplementary irrigation (+ 100 mm). Increasing the seed rate from 70 to 130 kg/ha resulted in yield increase of 25% under rainfed conditions, but with supplementary irrigation the effect of seed rate was not significant. The effect of advancing the sowing date was however significant in both rainfed and partially irrigated trials. Sowing on November 13th resulted in yield increases of 52% over December 27th sowing under rainfed conditions and of 60% when the crop

received supplementary irrigation. In both cases the lower yields of later sown crops resulted from a reduced number of grains per tiller. When planted on January 22nd, the durum and breadwheats failed to yield while barley yields were reduced to half the level of the November plantings. Varying the row spacings between 16 and 32 cm had no significant effect on grain yield although a tendency for lower yields to result from increased spacings was noted.

An observation trial on the effect of nitrogen fertilisation indicated that grain yields of barley can be increased significantly even with moderate doses of nitrogen.

Response of Two Barley Varieties to N. Fertilisation

| N (Kg/ha) | % increase in average yield |
|---|---|
| 0 | - |
| 20 | 49 |
| 40 | 75 |
| 60 | 100 |

Investigations have further shown that the mean yield of four varieties of wheat can be doubled by the application of one supplementary irrigation (+ 100 mm) at the flowering stage.

These experiments have served to provide much basic information concerning cultural practices for cereal crops under the conditions of the Aleppo region and at the same time have indicated the considerable potential for yield increases that can be achieved by the use of additional inputs and improved management.

## Grain Quality

The testing of grain quality characters has been limited due to the present lack of facilities. Arrangements, however, were made with the Agricultural Research Institute in Cyprus, to screen the entries in the regional yield trials and preliminary observation nurseries for protein content and quality by the DBC method. Bread-

wheat lines were also screened for baking quality by the Pelshenke test. Some lines of the three crops possessed very high protein content and some of the bread wheat lines seem to possess good quality. The range of protein contents obtained for each different crop species are as follows:

| | Protein Content Range | Control Variety | Protein content |
|---|---|---|---|
| Barley | 9.8-17.1% | Beecher | 11-[illegible]% |
| Breadwheat | 10.2-18.5% | Mexipak | 12.6-14.4% |
| Durum | 9.8-19.3% | Stork's' | 10.2-12.3% |

Lines exhibiting high protein contents will be further checked and used in the crossing program. The Pelshenke time for breadwheat lines ranged from 29 to 188 minutes, while Mexipak as a control ranged from 35-42 minutes. Some of the lines with higher protein content, and Pelshenke value were also among the highest yielders. Results indicate that entries in the Regional Nurseries have considerable genetic variability for grain quality characters along with other desirable agronomic traits.

At present visual grain quality characteristics are among the main criteria used for selecting segregating populations and nurseries. White or yellow grained barleys and white or amber grained breadwheats are selected as there is a preference for these colours in the region. For durum wheat, lines with amber colour and vitreousness are selected. The improvement of the food and feed quality aspect of research will be accelerated when grain quality analysis facilities become available at ICARDA.

## Entomology and Weed Control

An experiment was conducted at Aleppo to screen for lines of barley, triticale, durum and breadwheat resistant to the wheat stem sawfly. A survey was also carried out to determine the importance of this insect in the different cereal growing areas in Syria, and its movements.

A number of experiments were conducted to study various weed control chemicals and their impact under both irrigated and rainfed conditions together with the response of different genotypes to various treatments. A large number of lines of barley, durum, and bread-wheat were screened for their tolerance to these chemicals.

## Collaborative Projects with National Programs

### Agreements with National Programs

An agreement between the Government of the Hashemite Kingdom of Jordan, (represented by the Ministry of Agriculture and the Faculty of Agriculture at the Univeristy of Jordan), ICARDA and the Ford Foundation, aimed at the development and implementation of a co-operative winter cereal research and demonstration production program in Jordan, has recently been signed. ICARDA and the Ford Foundation will provide the technical and financial assistance needed for the implementation of the project which will concentrate its efforts on crop improvements; agronomic practices; varietal verification and demonstration trials; verifications on farmer's fields; and training. It is hoped that the project will provide a good link between the research program and the national production program. An experienced agronomist has been appointed as the Project Officer in Jordan.

A collaborative cereal improvement project has been organised between ICARDA and the Agricultural Research Institute in Cyprus (ARI), where the 200-400 mm of annual precipitation and mild winters are growing conditions characteristic of considerable areas in the ICARDA region. A working program has been arranged with Cyprus whereby the ARI will grow additional breeding material and conduct mutually agreed upon agronomic experiments to complement the main research work at Aleppo and Tabriz.

### Regional Nurseries

During 1977/78, a total of 866 sets of regional nurseries were shipped to 54 countries, mainly in the Mediterranean, West and South East Asia and East Africa. The regional nurseries are a cooperative testing system involving the national programs of the region, ICARDA and CIMMYT. Through these nurseries, the best breadwheat, durum,

barley and triticale germplasm available in the region is made available to the national programs for evaluation over a wide range of environments. The data obtained from different locations are provided to the national programs and form a source of supplementary information in the selection and further use of the better lines. These nurseries also foster contact and co-operation among scientists of the region, and between ICARDA and national programs. In conjunction with this effort, during the year ICARDA staff members visited several countries to exchange ideas concerning cereal improvement and production and to obtain first-hand information regarding production constraints.

## Training

The training effort concentrates on the improvement and production of wheat and barley. The cereal training course is designed to provide basic background information and necessary field-oriented research skills to wheat and barley research workers in the national programs. Six trainees from Syria and Egypt took part in a four-month program in 1978, and several research workers from Pakistan, Jordan, Lebanon and North Yemen participated in short-term training. For 1979, the training program will be expanded to include 18 trainees from many countries in the region. In addition to this, ICARDA provided short-term fellowships to three scientists from Iran, Turkey and Lebanon, to attend international scientific conferences in 1978.

A series of lectures and manuals covering topics such as insect pest management, experimental design and statistics, agronomy, cereal pathology and breeding techniques is being prepared and will be provided to future trainees to complement field training.

## Field Verification Trials

ICARDA and the Syrian Agricultural Research Department jointly conducted trials in the northern cereal growing provinces of Syria in the 1977/78 season. The primary objective of these trials was to test the yielding ability, stability and disease resistance of most promising lines of breadwheat, durum wheat and barley in large plots on

farmers fields. The trials were conducted in the three zones classified as A, B and C which represent areas with precipitation greater than 350 mm., between 350-250 mm., and below 250 mm. respectively.

These trials demonstrated that cereal production in Syria can be improved best by use of new improved varieties, together with appropriate management practices and that the potential for improving cereal production is high under both low and adequate moisture regimes.

The barley variety Beecher outyielded local varieties at all locations and WI 2197 was the best yielder in the 250 mm rainfall zone. All the durum varieties in the trial yielded about 50 percent higher than the average yield of farmers' varieties &D. Dwarf S15 x Cr s and Cr's' - T. dic. V. Vernum were the highest yielding varieties in zone A and B. In zone A, of the breadwheat varieties, Lerma varieties, Lerma Rojo $64^2$-Son 64 x CC/Ska, Choti Lerma-Inia s and Dougga 74 out-yielded Mexipak by 10-11 percent. Arvand, the highest yielding breadwheat line in zone B, out-yielded Mexipak by 10%.

Results of the field verification trials were jointly discussed by ICARDA officials and Syrian scientists. As a result, Syrian officials have decided to use several varieties for further large scale demonstrations on farmers fields, in the coming year.

## THE FOOD LEGUME IMPROVEMENT PROGRAM

The Food Legume Program seeks to encourage, support and complement research efforts on lentils, broadbeans and chickpeas at the national level through the collection, maintenance, development and distribution of germplasm, elite lines, early generation segregating populations and other genetic material throughout the region. In pursuit of this objective, activities undertaken during the 1977/78 cropping season have included: studies on microbiology, pathology, agronomy and physiology in support of the basic plant breeding work carried out on lentils, chickpeas and broadbeans; a six month group training course on food legume research and production for 18 participants from 10 of the countries of West Asia and North Africa; and a six day international workshop focussing on the common problems of food legume production and improvement within the region. In addition several research projects have been carried out together with personnel from the Farming Systems Program. These have involved investigations on important insect pests; studies on weed control methods and screening for resistance to Orobanche in broadbeans and lentils; and surveys of production practices and uses of food legumes in general in north-western Iran and broadbeans in particular in Syria. These program activities are set within the framework of achieving a better cooperation and understanding between relevant research efforts throughout the world and thereby facilitating the free exchange of research results and materials.

# Lentils

## Breeding

During the season a variety of new accessions were added to the lentil germplasm collection, notably from IARI, India (78 entries), Pantnagar University, India (851 entries), Ethiopia (97 entries), Nepal (10 entries) and Punjab Agricultural University, India (857 entries). The collection, which now stands at 4,350 accessions, was grown in the field at Aleppo and data were recorded on a number of characteristics and will be included in a germplasm catalogue to be produced in the near future. Several entries were identified for further testing and for inclusion in next year's crossing block.

Parents for crossing were planted in a greenhouse in Lebanon. They included such characteristics as high yield potential, wide adaptation, tall and erect growth habit, early maturity, resistance to downy mildew, high number of seeds/pod, high number of pods/peduncle, cold tolerance, high total biological yield and high harvest index. Several accessions of the wild species, Lens orientalis, were also included. Unfortunately, root diseases were very severe (it had not been possible to sterilize the soil before planting) and thus, much of the material was lost. It is planned to repeat this crossing block next year, with a few modifications.

In a study of crossing techniques on lentils in the field at Aleppo, the highest success rate (15%) was recorded with emasculation in the morning followed by immediate pollination. This is not considered high enough for the method to be of use as a technique in the regular crossing blocks, and so the use of greenhouses for most of the hybridization work will have to continue.

Bulk populations and progeny rows of lentils (F2-F6 generations), were planted at Tel Hadia. Early generations were advanced following a simple mass-selection procedure, while a large number of single plants were selected in later generations for preliminary yield evaluation in the 1978/79 season. 160 selections are being advanced in the summer nursery at Shawbak, Jordan for replicated yield testing next season.

Two entries in the advanced yield trial at Tel Hadia (74 TA 260 and 74 TA 265) significantly out-yielded the two local check varieties by nearly 30%. These and other promising lines from both Aleppo and Lebanon will be included in next year's international yield trials and also in advanced yield trials to be conducted in cooperation with the national programs in about ten locations in Syria, Jordan and Lebanon.

Agronomy

In an attempt to gain a better understanding of the growth and performance of different lentil cultivars in the Aleppo environment, a series of trials was conducted to study a range of agronomic variables. Dry-seeding in the last week of November (the earliest planting) gave the highest yields, while a delay of only one month resulted in a 36% reduction. It is worth mentioning in this context that farmers in the area frequently sow the crop in December and early January, after they have sown the cereals. At the earlier planting dates, increasing the seeding rate from 80 to 160 kg/ha increased yield considerably, while at later plantings there appeared to be no yield advantage beyond a seeding rate of 120 kg/ha. Farmers in the area are broadcasting up to 200 kg/ha of seed and this may, therefore, represent as much as 20% of the final yield. The development of agronomic practices and cultivars which would allow farmers to use lower seeding rates is considered to be an important objective in this respect and genetic differences, the basis of any improvement efforts, have been recorded in both of these characters. Likewise seeding at a depth greater than 5 cms significantly delayed germination. The use of a seed-drill to prevent this might also be expected to reduce the high seed-rate requirement and enable farmers to sow the crop earlier. This will be studied in greater detail next season.

Farmers may delay planting lentils in order to allow the first rain to germinate the weeds before cultivation and sowing. Alternative weed control measures are thus required both to reduce competition by weeds and to allow earlier sowing. In addition to the work of the farming systems program on weed control, a study of crop-weed competition indicated that the period 60-90 days after planting was critical and that weeding during this period increased yields by nearly 20% over the unweeded control.

Farmers in the area frequently use both phosphate and even nitrogen fertilizers on lentils although very little research has been done to determine optimum rates, timing and methods of application. In a study on the response of lentils to nitrogen and phosphate fertilization, with and without inoculation with Rhizobium bacteria, yield increases of around 40% over the unfertilized control were obtained following the application of 50 kg/ha of phosphate. No further increases in yield resulted from the application of nitrogen. However, in the absence of phosphate, a starter dressing of nitrogen (20kg/ha) increased the yield over the control by nearly 20%. No responses to inoculation were observed and the residual effects of these treatments on the performance of wheat will be investigated next season.

The root nodule development of 32 lentil cultivars was studied and significant differences in nodule numbers (from about 20 to nearly 60 nodules per plant) were found. In a survey of nodulation in Syria, Lebanon and Jordan, widespread nodule damage was observed, apparently caused by the larvae of the Sitona Weevil. Cultivaral differences (ranging from about 26% to 84% of nodules damaged), were observed and work on this will thus be followed up next season.

During the survey trips nodules were collected from lentil, broadbean and chickpea plants and a number of strains have been isolated from these for testing next year.

A major problem in the improvement of lentils on an international level is the very specific adaptability of the crop. In order to develop cultivars having wider adaptability it is necessary to identify and qualify the effects of the key environmental factors which influence this character. One such factor is photoperiod sensitivity. A preliminary study of 36 lentil genotypes has shown that all were sensitive to day-length and behaved as long-day plants. Different day-length responses were observed, however, with some genotypes showing an essentially qualitative requirement and others having varying degrees of quantitativity in their requirements.

Much of the lentil work this year was of necessity somewhat location-specific but most of the studies have broader implications for lentil research and production elsewhere. In addition to the breeding nurseries it is planned to organize an international series of agronomic trials on lentils, broadbeans and chickpeas, next year with the

aim of building up a base of information on responses to a uniform set of agronomic variables across a range of environments. This information will be valuable in the future design of trials to determine optimum agronomic practices for particular locations.

Investigations into weed control in legume crops mainly involved the testing of 38 herbicides, almost exclusively soil acting. These chemicals were tested as normal pre-emergence applications and most were also applied post-emergence in an attempt to identify useful in-crop herbicides. Although lentils appear to have less herbicide tolerance than the other legume crops, several chemicals, including such broadspectrum herbicides as Methabenzthiazuron, Terbutryne, Chlorbromuron, Metribuzin and Prometryne, and grass weed killers such as EPTC, Pronamide, Trifluralin, Benfluralin and Metolachlor proved promising for use as both pre-planting and post-planting, pre-emergence applications. For post-emergence use however, only the grass and wild oat killers Diclofop-methyl, 1-flamprop-iropropyl and Benzoylprop-ethyl showed sufficient selectivity.

Labour constraints during the harvest may limit production in many lentil producing areas. The development of cultivars having a tall, erect growth habit and with resistance to lodging and shattering is thus an important objective of the breeding work. Besides its advantages for mechanical harvesting, such a plant ideotype is also considered to be valuable for increasing yields in situations where mechanization is not important and would allow easier hand harvesting. Several methods of mechanical lentil harvesting were compared with conventional hand harvesting on large plots raised under varied agronomic practices, including a standard farmers' method of broadcasting and ploughing using animal power. Direct combine harvesting (using a Hege plot combine) give the least harvest loss of grain; however, almost 80% of the straw was lost, which poses a problem because straw is a valuable animal feed (this year farmers in the area realized a greater return per hectare from lentil straw than from its seed). Combining was not possible on the plots sown by the farmers' methods. Self-propelled mowers, a side-mounted mower and hand mowers all did a good job of cutting, even on the crop raised by the farmers' method, and left the plants in windrows for subsequent collection and threshing. The whole operation, although more time-consuming than direct combining, saved considerable labour when compared with hand harvesting and almost 90% of the straw was recovered.

## Broadbeans

### Breeding

The broadbean germplasm collection is less developed than that of the other two crops and now stands at about 1300 entries. During the season 32 accessions were added from the U.K. and Ecuador and 3 accessions were received from the Chinese Academy of Agricultural Science. Since approximately two-thirds of the world broadbean production is in China, it is hoped that this small beginning will develop into further, more substantial exchanges of germplasm and to cooperation in other areas of broadbean research.

One reason for the limited avalability of broadbean germplasm is the reluctance of national programs to keep large collections owing to the expense and difficulty involved in maintaining purity in this species, with its high level of natural outcrossing. To overcome this problem, the ICARDA germplasm is now being maintained in two separate collections: the basic collection in which each accession is maintained as a separate unselected open population; and the working collection comprising pure lines derived by single plant selection from the basic collection, under strict conditions of selfing. In the 1977/78 season approximately 6,000 plants in the working collection were individually bagged to maintain purity. One advantage of the selfing method is that a selection pressure is applied in favour of auto-fertility (the ability to set seed in the absence of tripping by insect pollinators) which is considered to be an important component in yield stability. A large number of plant characters were scored in the working collection and data on these will be included in the forthcoming germplasm catalogue. A number of lines were also identified for inclusion in the hybridization program planned for the 1978/79 season.

Breeding work to date has concentrated mainly on the improvement and stabilization of dry-seed yield. However, as parents are identified from the screening nurseries so other characters, in particular disease, Orobanche and aphid resistance, drought and cold tolerance and high protein content will be considered in the future.

The breeding program is following several different approaches in the improvement of this crop. In the 1977/78 season two new

freely intercrossing populations were started at Tel Hadia in addition to the four established in Egypt in 1977. These populations are being formed by growing broadbeans in cages and introducing honey bees during flowering to inter-cross the plants. It is intended, after three generations of random-intercrossing, to advance the populations by a system of simple recurrent selection. Several new populations will be initiated next year.

F1 to F3 segregating bulk populations were grown at Tel Hadia during the season and nursery lines, also selected in 1977, were grown in Lebanon and at Aleppo. A large number of single plants were selected in the 1977/78 season in open pollinated populations as well as from plants bagged at flowering to ensure selfing in the same populations. These two methods will be compared with a modified bulk population breeding method next year.

Trials to study the degree of out-crossing by honeybees in cages and the effect of row-spacing and distance between isolation-plots on out-crossing, were conducted at Tel Hadia in 1977/78. Because the marker gene used in these trials controls hilum-colour, the results will not be known until the end of the next generation. However, results from trials in the 1976/77 season at Muslimieh near Aleppo indicated an average level of 33% out-crossing between rows, and nearly 70% out-crossing between plants within rows.

Broadbeans are normally grown under higher rainfall conditions than the other pulse crops (generally over 400 mm annually) or with irrigation. In the 1977/78 season, the precipitation fell during a short period of time and essentially ended over one month earlier than expected. For various reasons irrigation was not applied to the crop in Aleppo until later than the optimum time and many of the plants suffered from moisture stress. Several lines, particularly certain early maturing ones, looked extremely good under these conditions. A number of selections were made for testing next year under rainfed conditions with the aim of developing cultivars having the ability to tolerate or escape drought.

Of a total of 170 genotypes evaluated in several yield trials at Aleppo in the 1977/78 season, 43 out-yielded the best local controls. Similar promising results are expected from the yield trials in Lebanon and at the Tekmedash station near Tabriz although the final results

have not yet been obtained from these two stations. The best entries will be evaluated next year in the international yield trials. An advanced yield trial will be also grown in cooperation with the national programs at about six locations in Syria, Lebanon and Jordan.

Pathology

Diseases are one of the major factors limiting the production of broadbeans. Chocolate spot (Botrytis fabae), rust (Uromyces fabae) Ascochyta blight (Ascochyta fabae), leaf spot (Alternaria sp.), root rot/wilt (a complex of pathogens including Fusarium spp. Rhizoctonia spp. and Sclerotinia spp.) powdery mildew (Erysiphe polygoni and Leveillula taurica) and several virus diseases all cause serious damage.

Screening for diseases was carried out on rented land on the Mediterranean coast of northern Syria, near Lattakia, where environmental conditions are much more conductive to disease development than these of the Aleppo area; in 1977 for instance many farmers in the area were forced to plough in their crops as a result of severe epiphytotics of chocolate spot, Ascochyta blight, leaf spot and rust. Over 500 entries from the broadbean working collection were planted in November to screen for resistance to chocolate spot and Ascochyta blight. A further 377 entries were planted in January to screen for rust resistance. In addition, progenies of plants selected from the germplasm, several bulk populations, two broadbean yield trials and a nursery of rust resistant lines from the University of Manitoba, were planted for disease screening and evaluation.

Diseases in general were less severe than in previous seasons and it proved impossible to screen for resistance to chocolate spot. Despite this, differential reactions to Ascochyta blight and rust were observed and many plants were selected for further evaluation. About 20 of the most promising lines, showing resistance to Ascochyta, are being distributed to cooperators in the national programs of the region for multi-location evaluation in the coming season.

Although the bulk of the work at the Lattakia site was on broad beans, small lentil and chickpea nurseries were also grown. Neither crop performed very well, being severely attached by root diseases. However, several lines showed a very vigorous growth and high yield potential and a number of chickpea lines with resistance to Ascochyta rabiei were observed.

## Agronomy

As with lentils, broadbeans were found to be sensitive to the date of planting in Aleppo, early planting dates resulting in high yields. European commercial varieties were especially sensitive to planting date and failed to set seed when planted later than early February.

Both large and small seeded local varieties responded positively to applications of phosphorus and nitrogen. The small seeded variety was responsive, giving a 54% increase in yield over the unfertilized control following an application of 120 kg N and 50 kg P205/ha. The optimum fertilizer rate for the large seeded variety was 60 kg N and 50 kg P205/ha, and this resulted in a 29% increase in yield over the control.

The nodulation survey indicated that broadbeans were well nodulated on farmers fields in Syria, Lebanon and Jordan. In a few localized areas on the Mediterranean coast poor nodulation was observed and this may have been due to high levels of disease and insect attack on the crop or to localized high salinity levels.

A comparative growth analysis of two cultivars each of broad beans, lentils and chickpeas and one of dry peas and Vicia narbonensis (a weedy species closely related to the broadbeans) showed that with winter planting, under both rainfed and irrigated conditions at Aleppo, broadbeans were very significantly higher yielding than any of the other species. Under spring planting, however, the broadbeans failed to produce any mature pods, and chickpeas produced the highest yields.

The weed control studies have shown that good broadspectrum weed control can be achieved through the pre-emergence use of Methabenzthiazuron, Terbutryne or Chlorbromuron, particularly the former. EPTC, Pronamide, Trifluralin, Benfluralin and Triallate pre-planting and Metolachlor pre-emergence gave good control of grass weeds, although activity against different species varied with the chemical. EPTC was in general tolerated better by the crop than the other chemicals. With regard to post-emergence application the only safe broadleaf killer was Bentazone, while Difenzoquat, Benzoylprop-ethyl, 1-flamprop-isopropyl and Diclofop-methyl were effective in controlling wild oats. The results of the pre-emergence applications should

however be treated with caution as they were obtained from rainfed experiments, whereas broadbeans are generally grown under irrigated conditions and these soil acting chemicals may have different levels of activity under such high moisture conditions.

## Chickpeas

### Breeding

Chickpeas are commonly divided into two major groups; kabuli types, which have large, rounded or brain-shaped, light beige coloured seeds; and desi types which generally have smaller and more angular seeds ranging incolour from almost white to yellow, brown, green or black. Because kabuli types predominate throughout most of the West Asia and North Africa, an understanding has been reached between ICARDA and ICRISAT, whereby ICARDA will work almost entirely on these types while ICRISAT will focus mainly on the desi cultivars.

The world germplasm collection of chickpeas, as developed and maintained at ICRISAT, will be duplicated at ICARDA, and a working collection of kabuli types is at present being developed here. During the 1977/78 season over 1,400 kabuli germplasm lines were grown at Aleppo and evaluated for a few selected characters.

Early and advanced segregating populations were grown during the year at Tel Hadia and both single plant and bulk selections made. Poor growth unfortunately did not allow any selection or bulking in F5 and F7 generations and this material is being advanced on the basis of seed characters alone.

Conventional chickpea plants do not necessarily have the ideal growth habit and higher yields might be achieved by altering the plant architecture. The development of comparatively tall and erect cultivars is receiving considerable attention on the basis that such types might produce higher yields under high plant populations and may also be more amenable to mechanical harvesting. During the year 23 F2 populations and 160 F3 and F4 individuals were selected along these lines for further evaluation. In a plant population trial of 4 genotypes, a tall type from USSR (NEC 138) gave a 60% increase in yield when

the population was raised from 167,000 to 500,000 plants/ha. The local cultivar in the same trial showed very little variation in yield over the same range of populations.

## Pathology

The main reason why farmers do not grow chickpeas in the winter is probably the increased risk of attack by Ascochyta blight; a several epiphytotic of this disease can completely destroy the crop. The spring planted crop is also liable to attack and Ascochyta blight is considered to be the most destructive disease of chickpeas in the region.

Although it can be controlled by fungicides, and indeed it may be economical to use them on the winter-planted crop, the most desirable method of Ascochyta control is through the development of resistant cultivars. In a search for sources of resistance, over 1,200 kabuli germplasm lines were grown during the winter season. Twenty-nine lines showed a high degree of resistance and seven lines failed to show any disease symptoms at all. These lines will be further tested next year to confirm their resistance. An additional eight resistant lines were observed in the International Chickpea Ascochyta Blight Nursery (ICABN) from ICRISAT although these were all desi types. Several of the kabuli germplasm lines grown in the winter were almost totally destroyed; however, many lines showed a remarkable degree of recovery once the season became favourable for crop growth and unfavourable for disease spread.

Lines found to be resistant to Ascochyta blight in Aleppo may not necessarily be resistant to all races of the pathogen. It is thus intended to distribute a nursery of the most promising lines to cooperators next year, as part of the international nursery program, to test the resistance over a large number of locations.

## Agronomy

Trials conducted in previous seasons have indicated that significant yield increases might be possible from winter planting providing Ascochyta blight disease can be controlled. The practice of winter

planting would also allow the crop to be grown in areas currently considered too dry for production. Results of trials in the 1977/78 season have substantially confirmed these earlier findings.

There were no visible signs of any damage due to cold weather on 1200 kabuli germplasm lines grown during the winter season at Aleppo. Unfortunately, it was not possible to plant the germplasm under the more severe conditions of the high plateau in Iran, but it is planned to screen about 4,000 lines at Tabriz next season.

Thirty-six entries in an advanced yield trial, grown during the winter, with fungicidal protection against blight but with no irrigation produced an average grain yield of 1640 kg/ha as compared with an average of 1025 kg/ha for the same 36 entries planted in spring and under irrigation.

In another trial 64 entries were planted in winter, early spring and at the normal spring planting date and all plantings were unirrigated. The mean yield of the winter planted lines exceeded that of the early spring planted crop by 57% and the spring crop by almost 100%. Generally there was a differential response of cultivars to winter and spring plantings but a few lines performed well in both; NEC 293, for example, ranked first and third in the winter and spring planted advanced yield trials respectively. This suggests the possibility of developing cultivars suitable for both winter and spring planting.

In a trial to study the effects of planting date, row spacing and plant population on two chickpea cultivars the highest yield (1871 kgs/ha) was achieved with the local cultivar sown at the earliest planting date, the closest row spacing (30 cms) and the highest population. (275,000 plants/ha.). In another trial involving eight cultivars, NEC 1656 give the highest yield of 2147 kg/ha at the earliest (November) planting date, whereas with spring plantings the local cultivar performed best and possessed considerable stability when compared with the other entries in the trial.

Experience in the 1976/77 season on a private farm near Tel Hadia had indicated that chickpeas might nodulate poorly in the area. Farmers do not normally consider the rainfall to be sufficient for the production of chickpeas and few, if any, are grown in the vicinity, resulting

in low levels of natural Rhizobia in the soil. Several trials were conducted on the site in 1977/78 to study various aspects of the chickpea/ Rhizobium symbiosis. In one trial the effects of eight Rhizobium strains, from different parts of the world, were studied on two cultivars ( a local kabuli and an introduced desi),. The uninoculated control plants produced an average of less than one nodule per plant and two of the eight strains were little better, resulting in an average of less than three nodules per plant. The two cultivars responded differently to the various strains with the greatest weight of nodule tissue being produced in the kabuli cultivar with the Rhizobium strain 3889, followed by the strain IC-26 and in the desi cultivar with strain Ca-7. Yield increases of the order of 20% over the respective uninoculated controls were recorded in both the kabuli and desi cultivars with the best strains, and in general the yield figures closely reflected the pattern of nodule development under the different treatments.

In another experiment the interactions between five Rhizobium strains and four chickpea cultivars were studied. In general the local cultivar produced more nodules and nodule tissue than the other cultivars, and seemed to benefit most from added Rhizobium; a yield increase of nearly 35% was recorded following inoculation with the best strain (3827). This same strain, obtained from Australia, was also used to screen 151 chickpea genotypes for nodulating ability. In the uninoculated treatment only about 40% of the cultivars produced any nodules at all and of these all except one produced an average of less than one nodule per plant. In the inoculated treatment large cultivaral differences were observed (ranging from 19.2 nodules, and 413 mg. of dried nodule tissue per plant to 1.7 nodules and 1.8 mg., of dried nodule tissue per plant). These differences will be investigated further next year to see whether it is feasible to consider breeding for improved levels of nitrogen fixation.

Results of the weed control work indicate that for pre-emergence applications, with the exception of triallate, selectivity may be obtained with the same chemicals found to be effective in lentils and broadbeans. In addition Alachlor also seemed to perform well. Of the post-emergence chemicals, only Difenzoquat and Diclofop-methyl appear selective enough

to be used. Because the 1978 season was so dry after chickpea sowing these results should be looked upon with some reservation and further trials must be conducted in future seasons to confirm or refute them.

## International Program

Nurseries of elite germplasm for screening, yield trials and sets of F3 bulk populations of lentils, broadbeans and chickpeas were distributed to national programs for the 1977/78 season. A total of 120 nurseries were sent to 17 countries and a comprehensive report on the results of these international trials will be ready for distribution to all cooperators by the end of this year.

## THE FORAGE IMPROVEMENT PROGRAM

The Forage Program was initiated in early 1977, and since then activities have centred upon the development of successful forage legumes designed to be used in conjuction with cereal rotations as ley pastures for livestock both in the low elevation littoral with its distinctive Mediterranean climate and in the high elevation plateau environments with extremes of winter cold and summer heat. The primary purpose of these crops is to improve soil fertility by supplementing nitrogen and organic matter and at the same time to provide high quality forage for sheep, and possibly also cattle, as part of an integrated crop/livestock system.

Initially the main thrust of the program is concerned with the collection, identification and selection of annual legumes such as medics (Medicago spp.), vetches (Vicia spp.), Trifolium spp., Pisum spp. and Lathyrus spp. for the lower elevations; and cold tolerant legumes such as sainfoin (Onobrychis spp.), lucerne (M. sativa) and other winter hardy species such as V. villosa etc... for the high plateau areas. Cereals, such as barley, triticale and oats are also receiving some attention.

### Germplasm

In order to capitalise on the wide diversity of forage plants and the inherent genetic variability existing within the region and in the world as a whole, the acquisition of a large working collection of forage germplasm forms a very vital base to the current program activities. Requests have been made for germplasm from the national programs and plant collection centers in the region as well as from institutions in Australia, Europe and North America, and collection missions have been undertaken in Jordan, Syria and parts of Iraq, Iran and Turkey. In this way 5,702 entries, predominantly of forage legumes, have been acquired (Table). The data concerning this material have been collated and will be used, together with preliminary evaluations of the accessions

made at Aleppo over the past two seasons and Tabriz in the coming season, as a basis for selections in the future.

## Screening and Evaluation

### Annual Forage Legumes

#### Medicago species

Approximately 1,661 entries from 33 species of medics were grown in nursery rows at the Tel Hadia site primarily in order to assess their adaptabilty. Preliminary observations indicate a marked lack of cold tolerance in most of the entries, including those cultivars from Australia In general the cold winter temperatures followed by the sudden onset of spring heat appear to have prevented prolific growth and to have limited dry matter production. However a total number of 81 row selections were made from 7 species and 591 single plant selections from 8 species.

In the Beka'a valley (Lebanon) where winter temperatures are more severe, 1,332 entries were also sown, mainly to investigate cold tolerance. Here row and single plant selections were made from 5 species. Emphasis in future will thus be placed on developing potential cultivars from the 9 species that have proved promising in these observation trials, while the other species will be discarded or given very low priority in future testing programs due to their very poor performance.

For 300 entries sufficient seeds were available, as a result of multiplication in the preceeding season, to enable the establishment of microswards ($5m^2$ plots) in which it was planned to estimate dry matter and seed production as well as regeneration. However, due to the lack of cold tolerance establishment was poor and mass selection was made from the surviving plants in only 39 plots.

#### Vicia, Lathyrus and Pisum species

A total of 968 nursery rows of these three genera were established. Growth was prolific in many entries and both single row and single plant selections were made from a fairly large number of species on the basis of plant establishment and vigour, flowering date and desirable morphological characters. Depending upon the availability of seed, the single row selections will be promoted to microsward trials for studies of dry matter and seed yield and other characters in future seasons.

### Trifolium species

Ninety-three entries of T. resupinatum and 27 entries of T. alexandrinum were also planted in nursery rows at Tel Hadia. Establishment was poor in both these species, especially in the case of T. alexandrinum where only a few plants from one line survived the winter. About 112 single plant selections were made from these rows for further evaluation.

### Other Legume species

A small number of entries of fenugreek (Trigonella foenum-graecum) and Lupinus species were also evaluated, but the growth and vigour of these legumes were extremely disappointing and it has been decided to discontinue screening of these two genera for the Aleppo-type environment.

## Perennial Forage Legumes

### Medicago sativa

A total of 540 entries of lucerne have been established in nursery rows and small plots on the Tel Hadia site. These will be evaluated for cold tolerance and desirable forage characteristics next season under rainfed conditions. A modest screening program for this forage is also planned at Tabriz during the coming season.

### Onobrychis species

In addition to the lucerne plots, 40 entries of sainfoin have also been planted at Aleppo and will be evaluated in 1979, and some screening is planned in Tabriz.

## Forage Cereals

### Barley

Two hundred and fifty-three lines, selected from a 2000 line world

barley collection in 1977, together with additional entries from other national programs were planted in small plots ($7m^2$) at Tel Hadia Dry matter yield and other forage characteristics were studied and selections made for replicated yield trials in the 1978/79 season.

Lines suitable for conservation (hay or silage) and grazing have also been selected from this crop as well as from triticale and will be evaluated in replicated trials in the coming season.

## Triticale

Approximately 540 entries of triticale were screened, and a total of 252 single plant and row selections were made from segregating material and newly acquired germplasm during the season. Dry matter yields were also obtained from a number of lines. However, valid comparisons with barley based on this character can only be made from trials in which the seed rate of triticale is increased to compensate for the lower tillering ability of this crop. Such compensated trials are planned for next season.

Barley/vetch and triticale/vetch mixtures are also currently being considered for utilisation as conserved feeds during the hot and dry summer months when there is an acute shortage of forage. A number of entries of these mixtures have thus been planted on an exploratory basis to study competition and dry matter production and to identify compatible lines.

## Oats

Forty-one nursery rows of this crop were planted in the 1977/78 season and selections were made on the basis of dry matter production (visual estimate), leafiness, and tillering and flowering characters. These lines will be further evaluated in mixtures with Vicia, Lathyrus and Pisum species.

## Adaptation Studies

Simple exploratory trials designed to investigate the adaptability of 8 medic cultivars developed in Australia were planted at 12 sites, representing the major ecological zones in Syria. Preliminary observations indicate that there appeared to be no differences in stand, vigour and growth between inoculated varieties. Further research should be carried out on the effect of phosphate fertilisation on dry matter production, as increasing applications appeared to increase dry matter yield. In addition further evaluation is necessary on the cultivars Jemalong, Snail, Harbingar and Cyprus in the higher rainfall areas of north eastern and north western Syria and in the warmer zone in the southwest of the country.

## Germplasm Acquisition (Forage)

| Species | No. of entries acquired | source |
|---|---|---|
| Medic (annual medicago) | 1686 | South Australia<br>ICARDA 1977 collection, D.D.R.<br>ALAD, N.Africa, miscellaneous. |
| Medicago sativa | 570 | USA, Canada, Hungary, Yugoslavia, Turkey, D.D.R., Syria. |
| Trifolium spp. | 461 | USA, Turkey, ICARDA 1977 collection. |
| Onobrychis spp. | 592 | USA, Canada, Turkey. |
| Astralagus, spp. | 106 | USA, Canada, ICARDA 1977 collc. |
| Coronilla spp. | 20 | Canada, USA, ICARDA 1977 collc. |
| Vicia spp. | 707 | Turkey, Yugoslavia, Hungary<br>D.D.R., ICARDA 1977 collection. |
| Pisum spp. | 87 | Canada, Turkey, Yugoslavia,<br>Hungary, D.D.R. |
| Lathyrus spp. | 275 | USA, Turkey, ICARDA 1977<br>collection, D.D.R. |
| Lupinus spp. | 28 | Egypt, Hungary, ICARDA collection. |
| Trigonella spp. | 41 | Egypt, ICARDA collection. |
| Barley | 264 | World collection. |
| Triticale | 840 | CIMMYT, Hungary. |
| Avena | 38 | Turkey, Hungary. |
| Dactylis spp.<br>Lolium spp.<br>Festuca spp.<br>Setaria spp.<br>Phalaris spp. | 56 | Turkey, ICARDA 1977 collection. |

| | |
|---|---|
| Total forage legume entries | 4505 |
| Total grasses(including barley triticale Avena) | 1198 |
| Total | 5702 |

## THE TRAINING AND COMMUNICATIONS PROGRAM

The Training and Communication Program is designed to assist in the process of exchange of information, knowledge, skills and technology related to the food crops and farming system research efforts of ICARDA. To achieve this end, assistance has been given to the research programs in the organisation and development of a series of training courses, conferences and seminars, educational materials, and public information services. This effort is conducted in such a way that, while it provides the necessary support to ICARDA's research program, it also addresses the needs of national research institutions throughout the region for technical information and manpower development and training.

It has been observed, through country-visits and continuous contacts between ICARDA's scientists and the national programs, that there is an urgent need for manpower training at all levels in the areas of food legume research and development; forage improvement and production; and system design and analysis regarding farming pattern, and resource allocations. In cereal improvement (specifically wheat and barley) the training needs are of a special nature since work on these crops is considerably more advanced than the legume, forage, and farming system efforts.

The differential needs, as related to variations in country-level research and manpower availability, are an important consideration when planning training courses for the region. For example, Syria has a great potential for increasing the production of legumes, cereals, and forages, yet the severe shortage of trained manpower is acutely felt by government planners and officials. Here the need for training and manpower development is rather great and general at all levels. In Egypt on the other hand, training opportunities have to be tailored to meet very specific situations and specialized needs. Other countries

in the region fall somewhere between these two positions. In an effort to identify the specific needs of individual countries for training and information, ICARDA scientists have started a series of country visits involving discussions with officials in the research programs concerning the training priorities essential for the national improvement of wheat, barley, lentils, chickpeas, broadbeans, forages, and farming systems during the next three years. Data collected from these visits will be shared with concerned international organizations and agencies in order to co-ordinate resource allocation for training purposes in areas of mutual interest.

## Program Activities

A number of activities were undertaken during the first year of ICARDA's operation.

### Food Legume Training Course

This first course was launched on February 1, 1978, bringing together more than 18 participants from ten countries to work on technical and practical aspects of food legume research and development. Coming from Syria, Lebanon, Jordan, Iran, Libya, Egypt, Sudan, Algeria, Turkey and India, the participants spent six months working on issues essential to the improvement of chickpea, lentil, and broadbean production in these countries.

The course which was completed by the end of July, provided the participants with the opportunity of working on the development of improved cultivars and production practices for the low and medium elevation Mediterranean environments. The bulk of the course was conducted at Aleppo, with fields trips to research stations and several agricultural zones in Syria. One important feature of the course was the development of simple, practical, and relevant educational manuals focussing on the major concerns of genetics, entomolgy, agronomy, and pathology of food legumes. The teaching process embodied in the course enabled the participants to evaluate these manuals critically in order to modify them for use at the national research and training level

IDRC, USAID, and the Ford Foundation sponsored participants attending this course from Algeria, Egypt and India, respectively.

## Cereal Training

A special four-month course, focussing on the improvement of wheat and barley, was also organized for six participants. Two came from Egypt under the sponsorship of the Ford Foundation, and the remaining four from the Syrian national research program in an effort to strengthen the wheat and barley research work being conducted in several research stations in the country.

In addition two seminars were held at the beginning of the planting season for about 17 Syrian technicians assigned by their government to work on the field verification trials. These seminars were found to be useful and efforts will be made to sponsor similar functions for related personnel throughout the next cropping season, with the aim of keeping decision makers, planners and field personnel up-to-date with research projects and progress in all areas of ICARDA's activities.

## Other Training Activities

Special efforts were made to provide training opportunities in forages and weed control for field research workers from the Syrian national program. Six technicians (two in weed control & four in forages) spent the cropping season working with ICARDA researchers. This was helpful in providing them with the opportunity to learn about the research program, acquire the requisit skills, and to plan joint field research projects for next cropping season. Similar arrangements are being discussed with officials from the national programs of other countries in the region.

ICARDA scientists have contacted the Food Crop Production and Protection Division of FAO in order to co-ordinate future training programs and to ensure a better utilization of the resources available for this purpose. Accordingly, a training course in food legumes and forages may be conducted jointly in 1979 and 1980. Similar arrangements are being contemplated for national level training in selected countries in the region.

## The Production of Educational and Training Material

The training effort has been strongly associated with the production of educational material and audio-visual aids. The generation of technical information has been geared to support the center's effort to reach national research personnel, policy makers, and concerned international agencies.

Seven technical manuals have been produced for use in food legume research and development training work. These manuals are:

| | |
|---|---|
| No 1- | Introduction to Food Legumes |
| No 2- | Introduction to Breeding |
| No 3- | Introduction to Genetics |
| No 4- | Insect Pests on Food Legumes |
| No 5- | Agronomy |
| No 6- | Diseases of Food Legumes |
| No 7- | Statistics |

These are written in a practical, simple, and illustrated style and are designed specifically for use in applied research and training. A similar series of manuals is currently being prepared to support the cereal training efforts.

## The Production of General Information

ICARDA has arranged with several periodicals and magazines for the inclusion of various articles concerning the center in an attempt to reach a wide audience with agricultural development interests. This effort is being expanded to build on the four or five articles published to date.

An ICARDA News Service entitled "News from ICARDA" has been initiated. The first of the Newsletters in this service, which provides information on activities of interest at the center, has already been published. The second is at present on the press. It is planned to produce this publication quarterly in English, Arabic and French, and possibly also Farsi as the program expands

## The Production of Special and Technical Information

The proceedings of the Fourth Regional Cereal Workshop, focussing on Barley and held in Amman in 1977, were published in two volumes. These present up-to-date technical information on the production and improvement of barley throughout the world, and are being distributed widely through ICARDA and CIMMYT.

Also published early in the year was the first in a series of reports of the Regional and International Cereal Nurseries. This summarises and analyses the information received from the nurseries distributed during the 1976/77 cropping season . The second report, covering the 1977/78 nurseries is under preparation at present.

A comprehensive report on the results of the field verification trials undertaken in Syria during the season is due to be published in the near future. This report, in English and Arabic is directed towards researchers and planners in the countries of the region, and it aims to assist in the mounting of similar projects, designed to speed up the process of transferring improved cereal technologies to the farmers' fields, in these countries.

Detailed technical reports, presenting information on trials, results and the future research plans of each of the ICARDA programs are currently being prepared. These will be distributed to scientists and researchers concerned with food crops improvement throughout the world, and are designed to stimulate increased cooperation and reduce duplication within the global research efforts, as a whole.

## Workshop Activities

A six-day International workshop on the improvement and development of food legumes, attended by participants from 20 countries and 5 international agricultural institutions was held in cooperation with the University of Aleppo in May 1978. This gathering served as an excellent forum for the exchange of valuable experience and information on the present state and future potential for food legume production and improvement between scientists concerned with these aspects throughout the Near East and North Africa. In addition concrete recommendations for future research priorities in the improvement of the major food legume crops of the region were derived from small

problem orientated discussion groups, which were a major feature of the workshop's structure.

A publication arising from this workshop is currently under preparation with the assistance of IDRC. This document will set out the present state and future potential for food legume improvement and production in Western Asia and North Africa and will include the technical papers presented and recommendations derived, together with further details of the salient factors affecting food legume improvement work.

The workshop and this resultant publication are the first steps towards achieving a common understanding of the problems of production and the potential for the improvement of these crops in the region. It is hoped that they will provide a firm foundation for all future development efforts.