ICARDA

INTERNATIONAL CENTER FOR AGRICULTURAL RESEARCH IN THE DRY AREAS












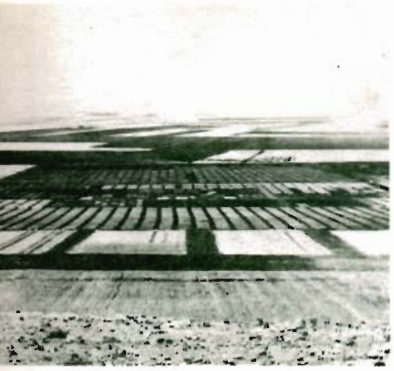

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INTERNATIONAL CENTER FOR AGRICULTURAL

RESEARCH IN THE DRY AREAS

Report on Research Program at ICARDA 1978-79

ICARDA

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PREFACE

The winter cropping season at Aleppo in 1978-79 though remarkable for below-average rainfall was favourable to ICARDA's research and development work and good progress was made in the Center's activities. This report describes in summary form and in non-technical language ICARDA's achievements during the year ending 30th June 1979.

The Center held its first in-house review in early December 1978 when the research proposals which underlie this report were examined in detail before all the senior staff of ICARDA prior to consideration and approval in January 1979 by the Program Committee of the Center's Board of Trustees.

This report explains how the activities so planned were carried out and examines the research results so far to hand. It is of necessity brief. Comprehensive reports on the achievements of each research program accompanied by detailed data will appear separately at a later date.

Harry S. Darling
Director General

LIST OF CONTENTS

INTRODUCTION

No one can accuse ICARDA of lacking ambition. Within its mandate comes responsibility not only for research into a wide range of foodstuffs grown in the lightly watered winter rainfall areas of West Asia and North Africa but also for investigating and improving the agricultural practices of farmers of the Region.

ICARDA is not just attempting to increase and stabilise production of basic cereals (bread-wheat, durum, barley and triticale), legumes (lentils, chickpeas and broadbeans) and forage crops. It is also looking into existing Farming Systems in the region and assessing their capacity for change with the introduction of improved cultivars and techniques. ICARDA's Farming Systems Program thus stands on an equal footing with its Crop Improvement Programs. In some ways because of its novelty , Farming Systems has become an area of special emphasis to ICARDA. All Programs are backed by a Training and Communications Program which helps synthesise research material and put it out to the widest possible audience, from research scientists in the Region, eager for information on their particular crops, to the general public as a whole. An integrated approach to research and application of results is the order of the day.

ICARDA'S PROGRAMS:

- FARMING SYSTEMS
- CEREALS
- FOOD LEGUMES
- FORAGE CROPS
- TRAINING AND COMMUNICATIONS

The range of research undertaken reflects the wide geographical Region serviced by ICARDA. From Pakistan to Morocco, countries within ICARDA's mandate are struggling, and usually failing, to maintain agricultural self-sufficiency. The Region has one of the largest food deficits in the world, and its people are having to make do with less food at a time of rising prices and population. Part of ICARDA's goal is to rectify this situation so that increased agricultural production goes hand in hand with better standards of living, particularly in the rural areas.

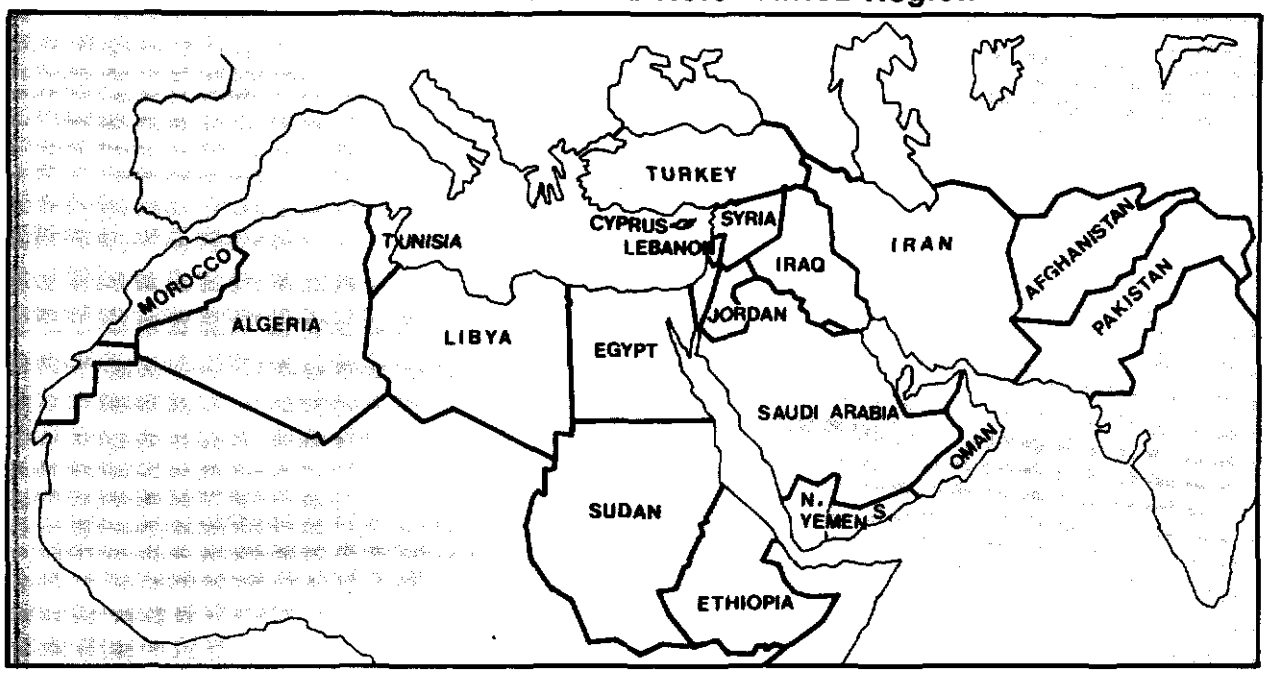
Already in two seasons significant advances have been made. Taking over where the Arid Lands Agricultural Development (ALAD) program left off, a large number of selections and crosses have been made from local and world -wide material. Examples of breeding initiatives at ICARDA are improvements in drought resistance of crops such as wheat and broadbeans previously unsuited to the marginal areas of this rain-scarce region, increases in the winter tolerance of cultivars like chickpeas normally grown in the spring, and development of wider regional adaptability for all plants.

In this work the role of the 964 hectare site at Tel Hadia, near Aleppo, has been crucial. With continuing uncertainty concerning access to a high altitude research station near Tabriz, in Iran, Tel Hadia has become the main centre of ICARDA's research. It is good to report the major developments in site construction at Tel Hadia.

But equally, as a result of problems over Tabriz, other out-station research has become more important to the Center — replicated trials in the Beka'a Valley, Lebanon; disease trials at Lattakia, Syria; investigation into the effects of different agro-climatic zones at a number of sites throughout Syria; off-season screening facilities at Shawbak, Jordan.

Through these links ICARDA is beginning to fulfil its responsibility to the region. Other means of communication between ICARDA and national programs are the Regional Nurseries and the important new initiative which ICARDA has taken in providing training courses for middle level research scientists in the fields covered by the Center. In these ways ICARDA's achievements and influence are growing. More specific details can be found within.

The West Asia and North Africa Region



The Increasing Need

The Surplus of Imports Over Exports of Cereals and Pulses
(in 1000 tons)

	1965/67	1975/77		1965/67	1975/77
Morocco	465	1178	Jordan	166	322
Algeria	472	2003	Lebanon	414	585
Tunisia	261	456	Cyprus	26	239
Libya	199	557	Syria	38	382
Egypt	2100	3624	Iraq	40	921
Sudan	110	63	Turkey	131	−230
Saudi Arabia	491	815	Iran	248	2098
Kuwait	75	241	Afghanistan	129	17
Yemen (AR)	29	276	Pakistan	887	160
Yemen Dem.	115	148	TOTAL	6,396	13,855

Source: FAO

ADMINISTRATION

Despite apparent impracticality, ICARDA's multi-locational approach to activities works well. With continuing troubles in Iran and the delay in ICARDA being able to occupy its long promised high altitude research site near Tabriz, the Center has found itself based essentially in two places, Beirut, Lebanon and Aleppo. Syria.

Beirut is the hub of administrative operations. ICARDA's Director General is based there, along with the Deputy Director General and Financial Controller/Treasurer. Beirut's ease of communication with the rest of the world (both in transportation and telex) still makes it an ideal center of operations, while the city's relative international status tends to remove it from the petty jealousies that might arise if ICARDA's headquarters were based elsewhere.

Aleppo has grown spectacularly as the principal venue for ICARDA's crop improvement and production technology research. Our 964 hectare site at Tel Hadia, 27 kms south of Aleppo just off the Damascus road, is now completely fenced in and the second season's crops have just been harvested. As teething problems with the site disappear, the quality of scientific research improves greatly.

Originally ICARDA had intended Aleppo to be just one out of two main research sites, but the station for high altitude studies near Tabriz in Northern Iran has not yet materialised, though there is still hope it may do so in some form or other.

In the meantime ICARDA has had to approach its high altitude research from a different angle. It hopes shortly to sign a co-operative agreement with the Turkish Government to facilitate high altitude studies into mandated crops. Such an agreement would be in line with others contracted with specific countries which will help develop ICARDA's scientific dialogues with national programmes and enable it to conduct studies in agro-climatic zones other than Aleppo. Already agreements have been signed with Jordan (winter cereals), Cyprus (nurseries), Egypt and Sudan (legumes). Others are in the offing.

Beirut

Coordination of ICARDA's diverse activities has required a strengthening of the central administrative team in line with original plans for the Center.

In August 1978 a Deputy Director General and Financial Controller/Treasurer were appointed. This autumn a Deputy Director for Research and a new Purchasing and Supplies Officer will be joining us while a Station Development Engineer for Aleppo should soon be appointed.

The work of the Directorate in Beirut is concerned primarily with facilitating the smooth working of all parts of ICARDA and resolving policy decisions which cannot be taken elsewhere.

One of ICARDA's tasks (it can hardly be called a problem) has been to find the right balance between its projects. It inherited a program of crop research from ALAD. This has had to be modified slightly to give emphasis to a particular initiative of ICARDA's - the integration of improved crop varieties into existing agricultural practices through the Farming Systems Program.

This year, an In-House Review was held for the first time in December to help senior scientists assess research priorities. After considerable discussion in which, for example, the cereals Program's list of potential projects was reduced from over 80, it was decided to limit research efforts and resources to 12 fields

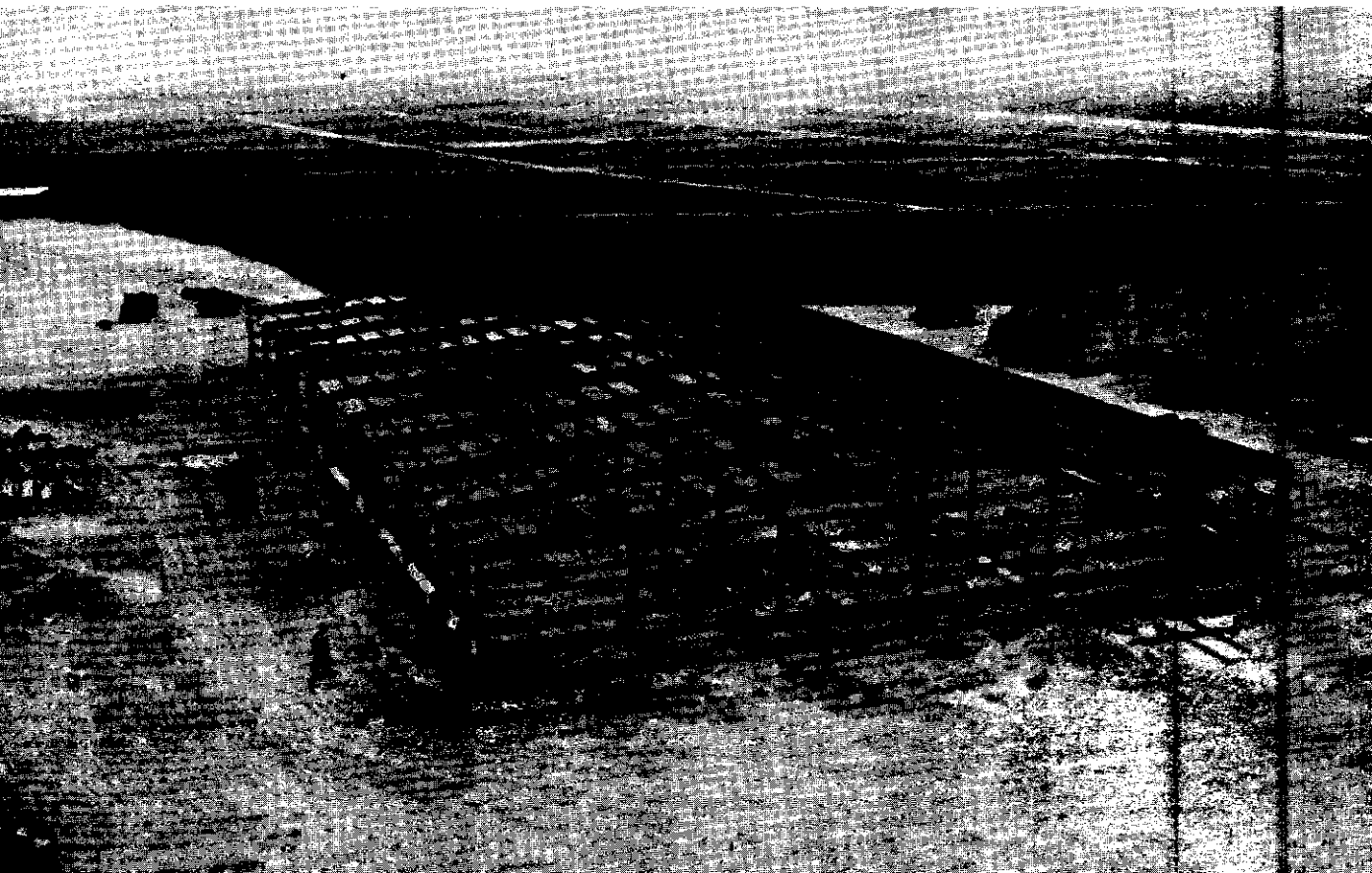
Signing an agreement with the Government of Cyprus

of activity for Cereals, 9 for Legumes, and 6 each for Farming Systems and Forages.

The day to day working of the Beirut office continues to be from modest rented accommodation in the west of the City.

Limited research continues in Lebanon under an agreement signed in March 1978 with the Agricultural Research Institute (ARI). ICARDA rents ARI's Terbol Research Station in the Beka'a Valley for a nominal sum. ICARDA has put funds and effort into restoring the station (which had been badly vandalised during the Civil War) to an effective condition. Fencing has been erected and wells and buildings rehabilitated. As a result ICARDA has an important 50 ha site for slightly higher altitude (1200 meters) and rainfall (550mm) screening than is possible at Aleppo.

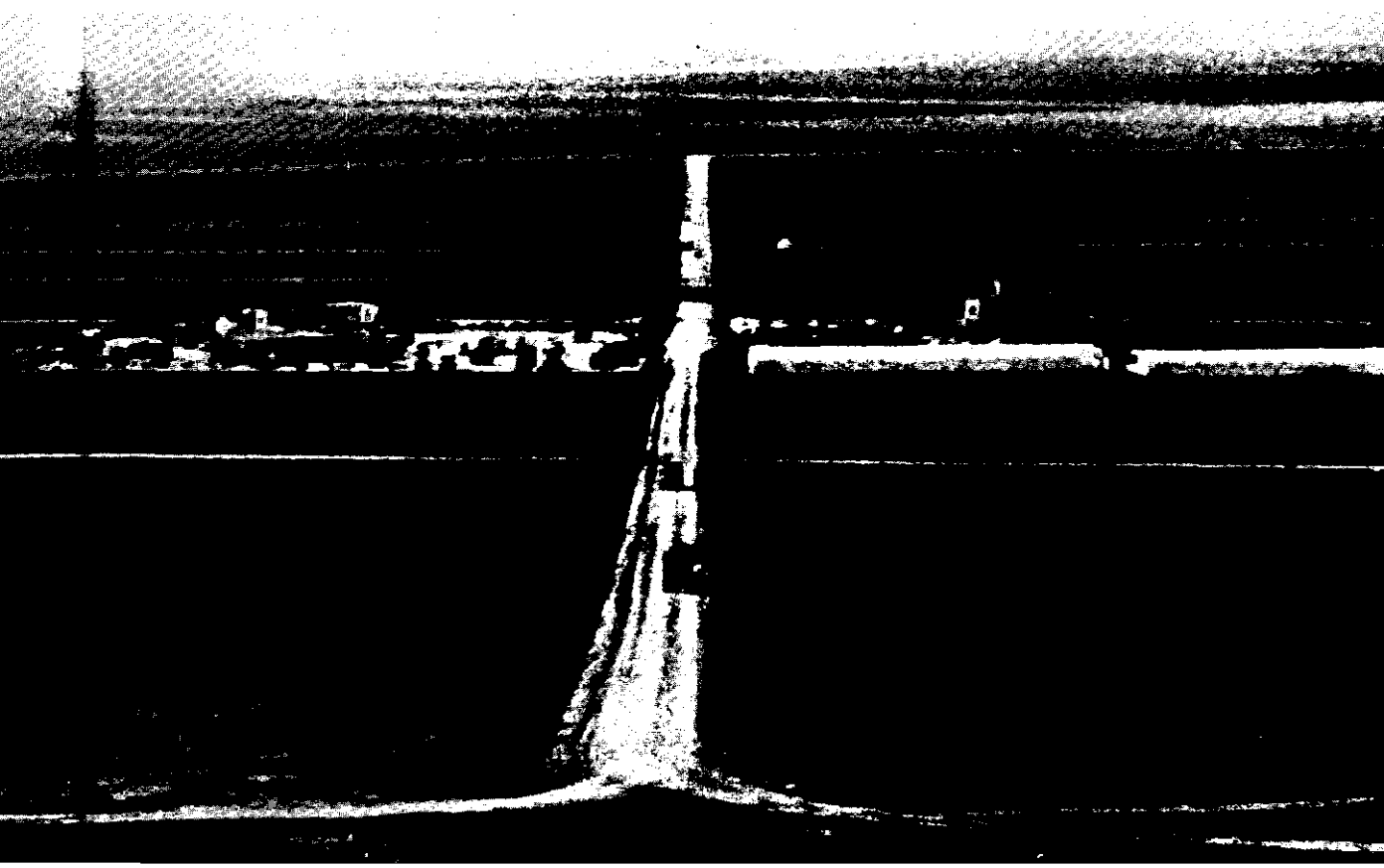
For the time being, Terbol is run as a subsidiary station to Aleppo. Senior research staff travel down from Aleppo to supervise work there. They stay in a small guest house near the site.



It is hoped to expand the Terbol facilities to include a germplasm preservation unit in a building which once served as a model dairy.

Aleppo

Development of the site at Tel Hadia, 27 kms south of Aleppo,has proceeded apace and is one of ICARDA's proudest achievements this year. As recently as October 1977 we were without a permanent site in Aleppo, but on October 6th that year Syrian President Hafez El-Assad gave permission for work to start at Tel Hadia. The following day 14 ploughs were out in the fields and during November 150 hectares were planted. The site comprises 964 hectares in all; 650 ha will eventually be crop land, 300 ha of it with irrigation water available for intensive nursery work. About 315 ha will be for grazing. With the help and generosity of the Syrian government who provided US $5m



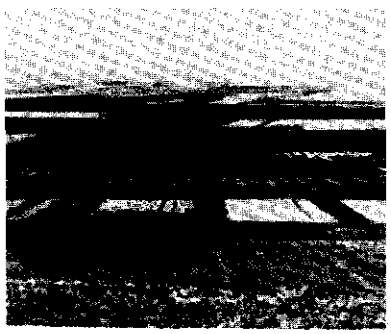
in compensatory payments, almost all problems arising from the dispossession of the farmers who formerly cultivated the land have now been solved.

Work has begun on making an agricultural research station which, with the apparent demise of our Tabriz operation, will serve as ICARDA's principal site. Within five years there will be laboratories, administrative offices, warehouses, maintenance depots, housing and recreational facilities on station. Plans for the US $18m complex have been drawn up by the internationally known Canadian architects Giffels. Tenders are expected to be sent out early in 1980, and building work to begin on site in the autumn of that year.

However, the experience of the past two years leads us to believe that we can do much of our site preparation work ouselves, thereby saving a sizeable portion of that $18m.

The first buildings constructed by ICARDA will be two large prefabricated structures which are being moulded into the scars caused by earlier quarrying on higher ground on the site. One will act as a store and processing area for genetic seed material, the other as a maintenance warehouse, with plumbing, paint, carpentry, metalwork and other facilities. An area of the first building will serve as a temporary laboratory. It is estimated that ICARDA will save around $250,000 buying and erecting the shell of the buildings itself. Work is now underway on grading and tracing the farm site in preparation for the construction of another warehouse.

By autumn next year work should begin on the three main laboratory and office buildings to be followed by short-term residences for trainees and senior scientific staff.



ICARDA'S Tel Hadia site

The emergence of Aleppo as the senior ICARDA research station, owing to lack of development in Iran, means Tel Hadia will now support 40 to 45 senior scientists compared to the 30 to 35 formerly envisaged.

Expansion of senior staff numbers has caused ICARDA to think seriously about the kind of amenities it needs to provide to attract suitably qualified scientists. Good research land and decent medical facilities are pre-requisites. High on its list of priorities is a school for staff children. Since English is not the

usual medium for education in Syria, special permission had to be obtained to open an ICARDA school, known now as the International School of Aleppo. First students were admitted in October 1977. At the end of the 1978-1979 academic year there were nearly fifty pupils in the school studying up to grade 7 of the American System. Arabic is also part of the curriculum. Two full-time teachers have been employed, and three others work part-time.

Another incentive to recruitment of good staff is provision of adequate housing. The appointment of a logistics officer in 1977 has helped ICARDA to rent a fair share of what suitable accommodation there is available in Aleppo. ICARDA also runs a guesthouse with three annexes for temporary visitors and hostel facilities for up to 50 trainees, all of which consist at present of rented accommodation.

In Damascus,ICARDA maintains an office and guesthouse. These serve as useful staging posts for personnel passing through the Syrian capital, where Damascus International Airport is becoming an increasingly important communications centre. They also provide a liaison point for contact with the Syrian Government.

The International School of Aleppo.

Tabriz

Development of the 1200ha Gharahbaba site, near Tabriz, did not take place this year owing to continuing political dissension in Iran. Money for purchase of the site had been put aside by the Agricultural Development Bank, but no actual acquisition of land resulted. For a while ICARDA maintained a presence on 15 hectares made available to it by the Iranian Government at the Soils Research Institute at nearby Tekmehdash. Late last year ICARDA planted 12,000 lines of bread-wheat, durum and barley there for yield trials, but ICARDA staff have not been able to visit the site this year to monitor their progress.

On the whole, it seems unlikely that ICARDA will ever get involved in Iran to the extent it was proposing. However, contacts with the new government have been maintained, and it

may still be possible to have some form of co-operative agreement or subsidiary station in Iran.

Finance

ICARDA's budget has grown steadily from $2.4m in 1977 to $7.8m in 1978, and an estimated $10.1m in 1979. However, expenditure of core and capital funds and sources of funds have not always been exactly as expected.

The cutback in the Tabriz operation has inevitably helped ICARDA save on capital and operating costs in Iran. But all outlays at Aleppo have risen, partly as the result of delays in getting established on site at Tel Hadia. Nevertheless ICARDA's funds have kept up with expenditure, if sometimes with judicious adding into the accounts of surplus revenue from the previous year. However there have been some specific shortfalls in committed funds. Last year ICARDA received $1.2m less than it had been promised. Some of this was the result of understandable difficulties the Iranian Government had in paying its contribution. Some of it was not. This had led to practical steps to cut back on expenditure, such as an almost total ban on staff hiring and on purchase of equipment.

Capital costs have risen quite substantially. While an overall expenditure of $21m on both Aleppo and Tabriz stations was originally estimated, development of Tel Hadia site alone is now expected to cost $16m to $18m over the next four or five years.

A feature of the budget this year has been the rise in funding for special projects. 1979-80 should see the start of the flow of funds from the International Fund for Agricultural Development (IFAD) which has earmarked $1m specifically for a broadbean development project in Egypt and Sudan.

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FARMING SYSTEMS

Introduction

With the completion at the end of 1979 of its initial two-year village study, the Farming Systems Research Program is well and truly established.

A clearer picture has emerged of the workings and inter-relationships of the village level economy in Northern Syria, from the study of physical inputs such as climate and soil, through personal details such as household expenditure and activity, to the effects of central planning policy on local decision making.

The Farming Systems Program will now be able to focus more precisely on its basic research aim, which is to recommend wide ranging agricultural practices which can be used by the farmers of West Asia to maximise their use of (often scarce) resources and so improve their productivity and income.

Certain areas have already emerged as worthy of further study. The need for more precise data on the properties of the soil has led to the initiation of a UNDP funded study into soil moisture and nutrients in the Region. Data from the study will help gain a better understanding of the relationships between climate, soil and cropping practices, and thus of the overall farming system. Cropping patterns and weed control are other areas of specific interest and research. ICARDA's Farming Systems Research Program has been careful not to jump in and

A North Syrian farming family

recommend piecemeal alternative agricultural strategies from the start. An important premise of the Program has been its insistence on having no preconceived notions. It has sought to build up a body of knowledge about existing economic, social, physical and biological processes in Syrian agriculture. It has been particularly keen to examine the inter-relationship between these factors. In its enquiries it has used published data about the Syrian economy, with a view to placing agriculture within the context of the wider political, social and economic developments in the country. It has conducted its own village level surveys of agricultural practices, and it has followed up with questionnaires on specific topics.

This data will allow the Program to suggest components for alternative farming systems which can then be tested in the field. For example, it might recommend and eventually test a different relationship between cropping and livestock. But it may well come to the conclusion that present farming practices evolved over millennia are adequate and efficient. There will be no change for change's sake, in spite of the pressures in that direction.

As envisaged in ICARDA's original mandate, the Farming Systems component in the Center's overall research stretches across all Programs. The idea is to ensure that all recommended crop improvements fit into the overall pattern of agriculture in Syria and the region as whole. The dynamics of change in agriculture is of particular interest to the Farming Systems Program.

Interviewing farmers

Existing Farming Systems

Aleppo Province enjoys a relatively wide range of soil types and agro-climates representative of the varying conditions throughout the lower rainfed areas of the ICARDA region. The study of existing farming systems has made use of this range to gain information on day to day domestic and agricultural practices of Syrian farmers and on factors (such as income and governmental price fixing) which affect their decision making and capacity for change. Data have been collected mainly as a

result of careful observation of farming practices in six villages stretching across four different agro-climatic zones identified in Aleppo Province. In some 50 selected households in the six villages, monthly recordings of all farming operations have since been made. These recordings take in details of all on-farm transactions, such as household income and expenditure, transfer to households of crops and sales of commodities. In addition, information on climate, soil, crop and livestock interaction has been collected.

The Harvest

As might be expected the main types of cropping system and the relative importance of crops in supplying household income and food requirements vary widely across the four different agro-climatic zones. Although the two year study is yet to be completed and tabulated, certain trends and patterns can be discerned:

— In the high rainfall area (450-600mm) wheat is still the main arable crop (both bread-wheat and durum high-yielding varieties are grown). However, olives are, or are becoming, an important source of income to the family farm. Weeds are a major problem, both broad-leaved ones and wild oats. The value of herbicides is known but good control is not practised owing partly to poorly developed spray machinery hire services. Rotational and cultural methods of weed control are not as common as in slightly lower rainfall areas. There has been a dramatic switch to chickpea production in 1979 as result of a relatively high price for the commodity — at least in comparison with its rival for cultivation, the lentil.

— In the medium rainfall area (300-450mm) the predominant farming system is a three-year rotation of cereals, legumes and fallow/summer crops. However in some parts cultivation of summer crops has increased to over half the land area, and a two-year rotation now exists. Throughout the zone farmers have an intimate understanding of the value and productive potential of the differing soil types within their land. Up to five types have been recognised,

though three are generally taken into account and farmed in different ways, the shallower poorer soils with a ducks-foot cultivator, the deeper ones with a disc or mouldboard plough.

Sheep – a main source of protein and milk

— In the low rainfall area (rainfall 200-300mm) cropping systems are simpler as neither legumes nor wheat can be grown reliably. Barley/fallow systems predominate and livestock assume a greater importance in the household economy. In the drier parts of this zone barley is often grazed following a decision in February/March that the crop will not produce a worthwhile grain yield. Households are increasingly in debt. They sell very little. Their barley and feedstuff crops are earmarked for their livestock. Off-farm employment is important.

— A simple range of machinery is in use. It is well adapted to the different soil conditions in the area. Farmers do not suffer from lack of appropriate equipment at a given moment. Seed drills are being used in increasing numbers and tractor mounted sprayers are being made locally. Hand harvesting is still common, particularly with legumes and barley, and this is likely to continue as long as straw prices remain high.

— Observation and measurement of plant establishment, tillering and yield across the zones have shown that soil type can have a greater effect on productivity than total annual rainfall. The most important features of the soil appear to be soil depth and capacity to retain moisture for use during the spring growing period.

— The extent and complexity of the livestock (sheep) industry has prompted a special survey of livestock systems ranging from feed-lots in towns, through village based flocks to animals primarily based in the steppe. Preliminary results show that the proportional contribution of livestock to family income is greater in the drier zones. In high rainfall

areas livestock (often goats) are mainly kept for domestic consumption (milk, cheese etc.). In the drier steppe areas where rangeland has been depleted, the size of a flock is popularly considered to be more important than its productivity. Various supplementary feeding regimes have been introduced, mainly through co-operatives . Some families in the wetter zones grow small areas of vetch, but they tend not to use them for grazing, preferring to leave the crop to mature and to use its seed and dry matter as feed for the following winter.

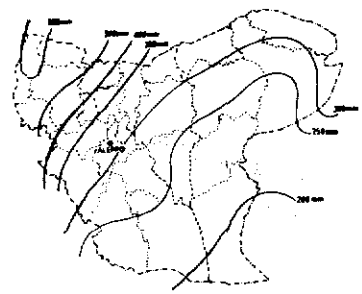
Special Studies

Certain areas of Farming Systems research have emerged as worthy of special study. Further information has been sought on the institutional, economic and physical (particularly climate and soil) background to Syrian agriculture. Cropping systems and weed control have also been important areas of specific research.

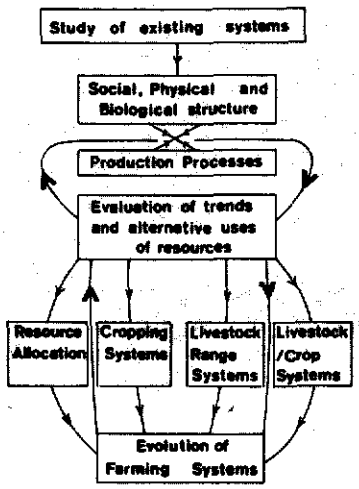
Farming Systems scientists have tried to put Syrian farmers and their farming systems into clearer economic perspective. Using mainly secondary sources they have looked into such things as historical developments in farming, land holdings and redistribution, demography, natural resources, credit, education, crop and livestock patterns and trade.

This information has been complemented by more precise details of climate and soil quality in the country. Soil moisture and nutrient management is to be an important area of study in the future, funded specially by UNDP.

As a start an intensive survey of climatic records at 400 weather stations in West Asia was made by a consultant. This information is now stored on computer tape and available for use by all ICARDA Programs. As part of the detailed village study, soil moisture measurements of cropped and fallow land have been made over a two-year period. Early next year a special ICARDA / UNDP workshop is to be held so as to focus the aims of the soil moisture and nutrient management project from the outset.



Annual rainfall zones in Aleppo province



A framework for the study of Farm Systems

Already a number of 10 ha sites are being established in rainfall zones ranging from 200 to 600 mm rainfall per annum. A simple meteorological station will be set up at each site and intensive moisture studies utilizing neutron probes and soil tensiometers will be conducted under a range of crops and several management treatments. These studies will be accompained by detailed crop growth investigations in order to obtain a proper understanding of the soil moisture/crop moisture use/crop growth/yield interactions.

In addition, in collaboration with the University of New England, Australia, a sophisticated drip irrigation system will be established at Tel Hadia to obtain controlled simulation of different rainfall regimes at one site. This study will involve a detailed examination of the growth, water use and yield of three wheat varieties with four levels of nitrogen application under five "rainfall regimes".

It is hoped that the combination of these studies under naturally varied rainfall at five sites, and artificially simulated rainfall regimes at one site will enable the production of water balance/crop growth/yield models which can be tested in a much wider range of environments.

Inter-related with this research, is a study of the effects of various production inputs on performance of the main crops within ICARDA's mandate.

The first step in what is known as the cropping systems study has been to assess the effects of individual crop husbandry practices within a normal crop production sequence. This year work has begun on wheat and lentils. Farming Systems Program scientists have been determining the consequences of four components (variety, fertilizer, method of planting and weed control) at two levels of the crop production package. Ultimately the results of this experiment will help ICARDA decide the relative importance of individual components and their interaction with one another in the overall crop production package strategy.

Step two has been to begin three long-term rotation experiments at Tel Hadia designed to compare the effects of different sequences and management systems on the

performance of different crops. Data on soil moisture, crop nutrients, agronomy and yield are being accumulated. The rotations are expected to run for seven or eight years before any conclusions are drawn.

Step three is to establish three unit farms of 10 to 12 hectares to look at the integration of different cropping systems with livestock. Only one "farm" has yet been laid down, but already it is providing information on an issue of critical importance to an understanding of ICARDA's potential influence on agriculture in the region — how far a new cropping system (as might be suggested by the Farming Systems Program) can be integrated into existing farming practices.

One major constraint on any cropping system is the prevalence of weeds in the region. A rudimentary survey of important weed species conducted at 20 places in Syria last year showed the dominant broadleaf genera to be *Vicia, Vaccaria, Cephalaris* and *Lathyrus* while prevalent grass weeds include the genera *Lolium, Avena* and *Phalaris*.

Selection of effective and economic methods of weed control is no easy business however. Different chemicals have to be tested in a wide range of conditions and soils. Tolerance of crops to herbicidal treatments must be assessed, while the efficacy and economics of natural methods of weed control must not be neglected.

A weed control project has involved experiments on a 30 hectare block at the Tel Hadia site. This land is divided into six sections of five hectares — three under a three year rotation for short term experiments, one for studies on broomrape (*Orobanche*), the most widespread parasitic plant in the Region, and two for perennial tests on the effects of different farming systems on weed proliferation.

An important area of research is the competitive effect of weeds on cereals. It seems that, with the right seeding rate and variety, barley can be grown economically without other weed control inputs, at least in the marginal rainfall areas.

Studies are underway to discover a low cost, low rate early broadleaf weed killer in cereals. Three formulations based on bromoxynil, MCPA, bromofenoxin and picloram have been found to be particularly effective, easily out-performing the

commonly used 2,4-D. All data indicate the beneficial effect of early application of these formulations, contrary to normal practice in the area.

The search for a similar broad spectrum method of weed control (covering grasses such as wild oats - *Avena sterilis* - and canary grass - *Phalaris*) has failed in its attempt to evolve a pre-emergent herbicide which can be applied with a fertiliser. But post-emergent treatments, based on dichlofopmethyl, are proving more successful.

Studies of the effects of herbicides on legumes have been equally wide ranging. The project has identified a safe chemical for use on pre-emergent broadbeans. Dry peas have shown the opposite tendency to most legumes, responding to post-emergent treatment.

It has proved particularly difficult to evolve a weed control strategy for lentils. They have no competitive power with weeds. Experiments with mechanical weeding brought damage to crops and had to be discontinued. Herbicide application integrated with hand weeding, will have to be the main control mechanism. Further work is needed on varieties tolerant to weed killers. Experiments are also in progress to identify herbicides for winter grown chickpeas. The Orobanche control study has progressed satisfactorily. The main work has been to select for crop resistance to *O. crenata* from 768 lines of broadbeans. With this crop five partially resistant lines, four of them new, have been discovered.

Co-operative Studies

The Farming Systems Research Program also conducts specific field investigations in conjunction with ICARDA's crop improvement projects, and other outside bodies.

For example, last year it embarked on an investigation of the place of legumes in Syrian agriculture. This summer micro-economic studies were begun by conducting one hundred interviews with both lentil and chickpea producers in Syria. Later

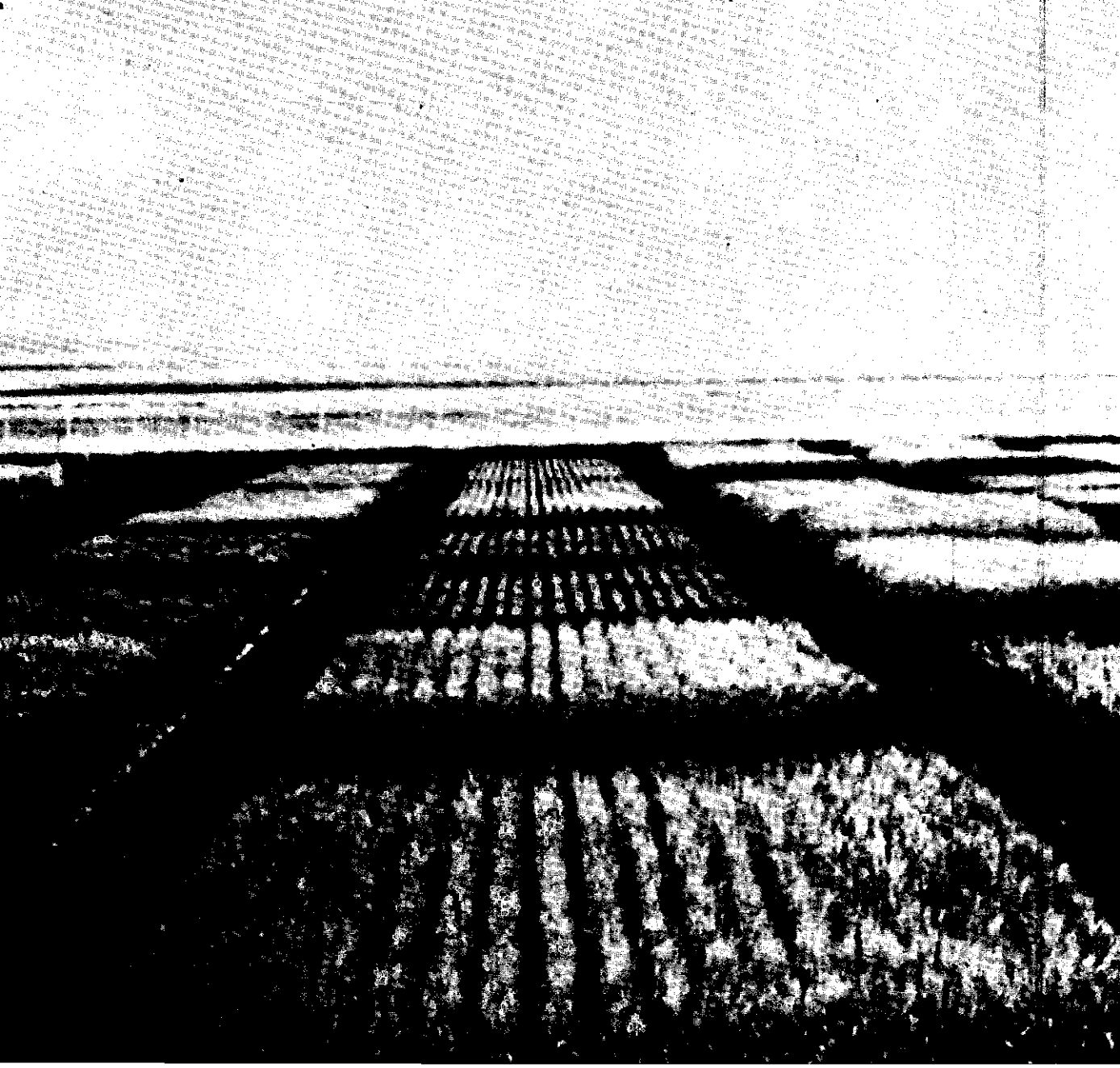
it is hoped to do a similar series of interviews with broadbean cultivators in Egypt or Morocco. Work is also progressing on a wider survey of legume production throughout the region. Assessment of secondary sources in Tunisia, Algeria, Morocco and Iraq so far has underlined the demand for increased mechanization of these crops.

In addition Farming Systems scientists are working with the Syrian Ministry of Agriculture to assess the pattern of livestock feeding in the country. Their data will be used as basic information on farmer's livestock feeding requirements and will help distribution of a $17.5m loan promised by the World Bank to the Syrian Government, part of which will constitute a revolving fund giving credit for feed purchases.

The livestock/income/credit survey is being conducted on the basis of 100 interviews (already completed) with heads of cooperatives to gain an overall picture of livestock management and feeding, including problems of feed availability. These interviews will be followed up with in-depth interviews with randomly selected members of certain cooperatives to gain more precise information.

Finally, the Farming Systems Program has been involved in Farmers' Fields Verification Trials carried out by the Cereal Program in conjunction with the Syrian Ministry of Agriculture. The object has been to determine the yield and disease resistance of promising breadwheat, durum and barley varieties in farmers' fields. In all 45 trials were conducted across different agro-climatic zones in the country. The potential of promising varieties of bread-wheat, durum and barley to provide higher yields was confirmed. In 1977/78 Farming Systems scientists were on hand to assess the trials, particularly to decide how representative were the locations chosen and what the farmers thought of the whole process. This year the scientists have been helping in site selection for further field verification trials.

Farmer's field verification trial



CEREALS

Introduction

The main objective of the Cereal Improvement Program is to assist the national and international effort aimed at increasing and stabilising wheat and barley production. This is carried out through the development and introduction of improved higher yielding varieties together with improved management for their cultivation.

The Program focuses on four cereal crops; barley, durum wheat, breadwheat and triticale. Research efforts in the region have traditionally concentrated on breadwheat. Durum has received little attention in comparison, despite a strong consumer preference for it. ICARDA is hoping to make up for earlier neglect and has already had some success in identifying durum lines suited to moderate to low rainfall areas (less than 400mm). Barley too is something of a cinderella crop. It is widely grown in the drier parts of West Asia and North Africa both for grain and grazing. ICARDA is trying to improve barley's water use efficiency in the dry areas, as well as its yielding ability in the higher rainfall parts of the region. Development of dual-purpose barley for both grain and grazing is also intended. Triticale, the baby of the cereal family, has proved promising in the form of the few varieties included in the Regional Yield Trials, but it is too early to say whether it is well adapted to the region.

Hand harvesting

The main emphasis in the Program to date has been on the development of spring material for rainfed areas (200-600 mm). Hopes that ICARDA would involve itself this season in trials of winter cereals at its projected Tabriz site proved premature. True, 16 hectares of breadwheat, durum and barley (12,000 lines in all) were planted at Tabriz in October. But owing to political disturbances in the area there was little or no chance of harvesting them in July/August.

Genetic material received from other international programs does not normally adapt well to the low rainfall (around 300 mm) and growing conditions characteristic of West Asia and North Africa. Although the annual average rainfall at Tel Hadia is around 320 mm there were only 232 mm in the 1978-79 season. It was therefore possible to select widely for drought resistance and, to a lesser extent, for grain quality and disease resistance. A considerable effort has been made in the development of the germplasm collection, and the wide range of nurseries have proved invaluable in testing material for wide adaptability. The regional network of nurseries, which has been essential to the development and diffusion of the plant material, has also helped the Program keep closely in touch with the national programs, and vice-versa.

Preliminary agronomic trials have been carried out and have helped emphasise the importance of barley in the drier rainfed parts of the region (less than 250 mm).

Important links between the Cereal Program and regional research organisations have been maintained through the Wheat and Barley Training Course which was attended by 19 participants from 14 countries, and international workshops, particularly the Cereals Disease Methodology Workshop which was held in Aleppo in April.

The Program also has special ties with certain countries in the region. It is working on collaborative projects with the governments of Jordan, Syria and Cyprus and hopes to extend this type of co-operation in the future.

Barley

In ICARDA's region barley is second only to wheat, occupying around ten million hectares, with production slightly less than ten million tons of grain annually. Although barley is grown under marginal conditions and in 'problem' soils, it is an important food and feed crop in areas of West Asia and North Africa. However, it has not received the attention it needs and deserves.

This neglect is unfortunate since barley is the most dependable cereal crop under extreme conditions of low fertility and minimal and erratic rainfall.

ICARDA is hoping to establish barley as a reasonable option in any farming system adopted in its region. It aims to breed suitable types for all agro-climatic conditions that might be found, ranging from partial irrigation to high plateau and marginally cultivable land. It intends to concentrate initially on spring genotypes (including naked barley types) in the lower rainfall areas, but it also has projects looking into winter hardy varieties and the development of dual-purpose barley for both grain and grazing. Once improved and higher yielding varieties have been obtained, ICARDA aims to assist national programs with their own research problems and to provide scientific help where possible.

The ICARDA barley germplasm collection is comprised of about 13,000 lines. This year the barley breeding program contained 52 preliminary or advanced yield trials, including two yield trials for naked barley and three for lodging resistance. Observation nurseries of several thousand lines were screened for a number of traits including yield potential, maturity pattern, disease resistance and grain appearance.

Results of 1978/79 yield trials indicate that 15% to 20% of the lines performed significantly better than the checks. This was particularly interesting in view of the low level of rainfall at Tel Hadia this season. Among other major characteristics for which selections were made this year was lodging resistance, a required trait for mechanical harvesting.

Emasculating barley

Efforts are being made to produce varieties which can be grazed continuously in dry years and harvested for grain after grazing in wetter years. Grazing in experimental plots has shown that for some lines one grazing gave yields as high as those for no grazing, and only small reductions in yield resulted from two grazings.

Durum

Durum wheat is one of the most important and popular crops in the ICARDA region and is widely used for making bread and other local foods. Consumer preference has meant that durum tends to fetch a higher market price than ordinary breadwheat.

But although around 11m hectares in West Asia and North Africa are planted to durum, considerable quantities of this cereal have to be imported. However, there are opportunities for reversing — at least partially — the unfavourable balance of trade in durum. About 15% of durum sold in the region is used in the preparation of pasta products for which there is thought to be a promising market. And there always the large potential for crop improvement.

ICARDA is in the vanguard of research on durum improvement in the region. Until now most of the scientific effort to produce higher yielding cereal varieties has been spent on breadwheat, with the result that this crop has actually displaced durum in some of the higher rainfall areas despite consumer preference for durum.

The field is therefore open for breakthroughs in durum productivity and production technology. Many lines have been screened for high yield although the lack of rust development prevented selection for resistance to this disease. However, a high degree of moisture stress did allow considerable scope in selecting for drought tolerance. Plants were selected primarily for adequate grain-fill under moisture stress conditions; once this basic condition had been met selections were made for wide adaptibility.

Over 500 durum lines were tested in preliminary and advanced yield trials. The outstanding line out-yielded the checks by 30%, producing grains which were 20% heavier. Several durum varieties were also tested in international nurseries and in the Farmers' Field Verification Trials in Syria.

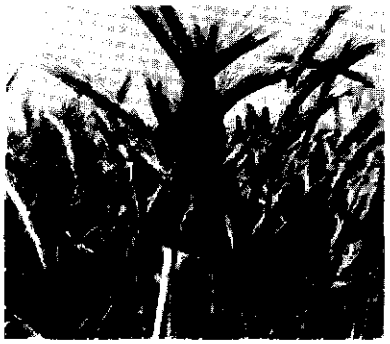
Breadwheat

Despite increasing competition from durum, breadwheat remains the most widespread food crop in West Asia and North Africa. Some 13.5 million hectares, or about a third of the total land area under food crops, are devoted to breadwheat in the region. Ninety per cent of this land receives no irrigation, half of this getting less than 400mm of rain a year.

There is not a great deal of scope for utilising the high yielding varieties which heralded the Green Revolution. These often need irrigation and good fertile soil - inputs which are not readily available in the arid lands of the region. ICARDA therefore has to develop high yielding breadwheat varieties suited to the special conditions of West Asia and North Africa. It hopes to evolve suitable varieties and production technologies appropriate to the lower rainfall areas. It also needs to stabilise the production potential of the higher rainfall zones, and this means concentrating on lines resistant to the many breadwheat diseases prevalent in the area.

Out of the breadwheat germplasm collection of 12,000 varieties, about 3,000 were selected this year for the preliminary observation nurseries. A further 87 yield trials were conducted to screen for high yield and for certain desirable traits such as disease and shattering resistance, drought tolerance and grain quality. Many of the ICARDA entries were found to out-yield local checks. Already a number of advanced lines have been identified that gave 5% to 15% more yield than the best of the varieties currently grown when they were compared under both rainfed and partially irrigated conditions.

Taking field notes on plant height and selection.



Triticale

Triticale

ICARDA's involvement with triticale has been limited to what can be termed feasibility studies on the possibility of introducing this potentially high yielding cereal crop to the unique agro-climatic conditions of the region. In some parts of the world triticale has developed mainly as an animal feed grain, although small amounts are processed for human consumption in the form of cereals and biscuits.

The work to date has consisted of selecting adapted genotypes for lower rainfall conditions. However, a number of lines have exhibited yield potentials similar to breadwheat and durum lines. Already the triticale variety Inia-Armadillo has given the highest mean yield out of 24 different cereal cultivars (13 breadwheat, 9 durum and 2 triticale) over 18 locations in the Sixth Regional Rainfed Wheat Yield Trials. It has also shown better resistance than the wheats to Septoria, bunt, loose smut and powdery mildew.

For the moment, however, the project emphasis has been on building up a germplasm bank. This year the spring and winter-by-spring materials have been expanded considerably. Wide selections have been made from the early generation populations of established triticale programs and some crosses have been made to produce secondary material.

Field trials have been conducted on good lines which have shown both fertility and disease resistance. One of the promising observations made in this season of abnormally low rainfall is that some of the tested lines have a fairly high measure of drought resistance.

Agronomy

Agronomic research started at Tel Hadia in the 1977/78 season through preliminary trials aimed at determining the major agronomic factors limiting cereal production. Such information is essential to the process of achieving higher yields for the winter cereals in the ICARDA region. The trials were conducted under both rainfed and partially irrigated conditions; through

irrigation it was hoped to extend the relevance of the results to the higher rainfall zones. The different factors investigated were sowing date, seed rate, row spacing and level of nitrogen fertilization.

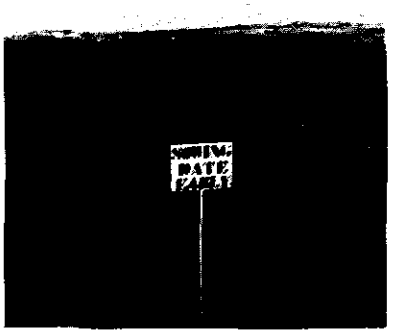
In the dry areas the determination of the optimum seed rate is vital to the establishment of a good stand and therefore to the production of the highest yields. Low rates can mean thin stands which cannot compete with weeds or make full use of nutrients and water ; high rates can result in exhaustion of nutrients and water before a good grain yield is achieved. Results to date have suggested that seed rate is more important under rainfed rather than irrigated conditions.

Sowing date is largely governed by the date of the first rains, but sowing too early may result in excessive weed competition; sowing too late may delay flowering leading to high water stress during the grain filling period. The trials at Tel Hadia supported the view that early sowing gives best yields, especially for the wheats. The trials also indicated that relatively small additions of nitrogen fertilizer could play an important role in the improvement of barley yields.

In addition to experiments at Tel Hadia a series of on-farm trials have been conducted in farmers' fields throughout the different rainfall zones of Syria. The forty-five trials aimed to give an assessment of the yielding ability, stability and disease resistance of promising varieties of breadwheat,durum and barley when grown in farmer's fields using a suggested 'package' of agronomic practices. It is hoped that the results will form the basis for a future increase in cereal yields in Syria.

Pathology

Cereal yields in the region are limited by the prevalence of a number of diseases. The three rusts, Septoria and bunt adversely affect the wheats of the region. The major diseases of barley are



Date of planting trial

powdery mildew, scald, rusts and other foliar diseases.

During the 1978/79 season screening for disease resistance was carried out at Aleppo, Terbol and Lattakia in a 3,000 line disease screening nursery. Breadwheats and durum were screened for disease resistance while the diseases of barley under investigation were powdery mildew and bacterial blight.

At Tel Hadia the germplasm collection of 12,000 durum lines was evaluated for resistance to yellow rust and 14,000 barley lines for resistance to powdery mildew, bacterial blight and other foliar diseases. It was clear that the level of bunt resistance in the available high yielding 'adapted' varieties was not adequate, so some of these were crossed with selected bunt resistant cultivars.

In all around 1,200 crosses were made this season. These were designed to bring together genes for resistance to different specific diseases and to build up a germplasm with multiple disease resistance. The seeds from these crosses have been planted in the off-season nursery at Shawbak in Jordan.

FOOD LEGUMES

Introduction

With the appointment in the last 18 months of lentil and chickpea breeders, the Food legume Improvement Program has taken an important step towards its goal of improving cultivars and production practices of major food legume crops in the region.

Over the past years there have been major advances in the selection of entries from ICARDA's 3,300 strong chickpea germplasm collection which are resistant to *Ascochyta* (a particularly severe blight of the chickpea crop, especially in the winter months), those adapted to cold environments (therefore enabling higher yielding winter plantings) and generally higher yielding varieties.

Faba (broad) bean trials brought significant results in identifying high yielding lines for both dry seed and green vegetable production, and screening for drought tolerance and resistance to *Ascochyta, Botrytis* and *Orobanche*.

With lentils, important trials on crop yield, stability adaptation and resistance to drought have been conducted and promising results obtained in screening a large proportion of the more than 4,000-strong germplasm collection for genotypes better suited to mechanical harvesting.

Agronomic research has helped identify optimal levels for factors such as seeding rate, moisture levels, fertilizer input and date of planting which affect the growth and yield of legumes in the region. This information will help farmers to increase productivity even before superior genotypes become available. In addition, work on crop physiology has led to a better understanding of such factors as plant growth characters, ideotypes and, in the case of lentils, photoperiod reactions.

Microbiological studies have centred on the important matter of symbiotic nitrogen fixation by Rhizobia. Several promising strains of Rhizobia for all three legumes have been identified for further research.

Faba (broad) bean root nodules

Pathology studies in the 1978-79 season were conducted mainly on a one and a half hectare site at Lattakia on the Syrian Mediterranean coast. In addition work has been carried out in Egypt by a pathologist supported by ICARDA who spent a year's sabbatical leave from his own university to work in close collaboration with the Egyptian national program.

Links with Egyptian and Sudanese programs were further strengthened with the initiation of the Nile Valley project on faba (broad) beans. In May, this joint project, supported by the International Fund for Agricultural Development (IFAD), is aimed at strengthening the research capacity of the national programs, and includes a strong component involving the testing of varieties and cultural practices on farmers' fields.

Other than this, the links between the Food Legume Improvement Program and the ICARDA region as a whole have been expanded in the past year through the Regional Nursery network,through the summer nursery at Shawbak, Jordan through the legumes Training Course (attended by 14 participants from 10 countries) and through the first regional Food Legume Development and Improvement Workshop held in Aleppo in May, 1978 and the International Lentil Seminar also held in Aleppo in May, 1979. An international newsletter on faba (broad) beans has been published which is aimed at strengthening links between researchers in the region and those elsewhere in the world.

Lentils

The lentil is one of the most widespread and adaptable plants in the ICARDA region. About 40% of the world's lentils are grown in West Asia and North Africa (including Ethiopia). The crop is productive in low rainfall areas and in cold high plateau regions. However, its popularity is waning slightly, this being a product of several environmental, social and economic factors, and is at least in part due to the difficulty of harvesting the crop mechanically, an important consideration in these days of rising labour costs.

The Center is looking for higher yielding and more stable lentil cultivars with a range of maturity periods to fit different agro-climatic conditions. Varieties with wider adaptability are being sought, and lines are being tested for drought and heat resistance.

In all its breeding trials ICARDA is looking for three important plant characteristics in addition to high yields and stability. These are disease resistance, ease of harvesting (i.e. tall plants whose pods do not shatter) and good cooking quality.

In previous seasons a number of lines in the germplasm collection have been identified as having certain desirable characteristics such as high yield, wide adaptability, high number of seeds per pod, four pods per peduncle, high harvest index or a tall, erect growth habit. Out of 263 crosses attempted between these entries, 225 were successful, and of these 130 have been planted in the off-season nursery at Shawbak, Jordan.

The crosses were made in an attempt to combine these desirable characters in the development of higher yielding, more widely adapted and stable cultivars.

Agronomy work on lentils at low and medium elevations has clearly established the importance of planting the crop early in order to obtain maximum yields. In areas of uncertain rainfall, however, it may be advantageous for a farmer to delay planting until sufficient moisture has built up in the soil. Thus in a dry year the farmer would not sow lentils, but he would in a year of sufficient rainfall, albeit a late crop. In an attempt to identify varieties which perform well when planted later than usual, about 1800 lines were planted at Tel Hadia in early February, about two months later than normal. Of these about 100 were considered promising and will be further tested next year. In addition to their value for late planting it is hoped that these varieties developed for spring planting will also be drought - tolerant, and hence more stable when sown at the usual time in the drier areas.

The cultivars currently being grown exhibit a very narrow range of adaptability. Lentil types which perform well in

Lentil Harvest

Northern Syria, for example may be of little use in Lebanon or even in Southern Syria. Although the 'universal cultivar' is not being sought, nor is it considered desirable, ICARDA is attempting to develop high yielding cultivars which perform well over larger areas than the present ones.

ICARDA's trials so far are based on the understanding that photoperiodic and thermoperiodic reactions are important factors in the adaptability of lentils. Screening for sensitivity to these factors is currently being carried out in one of the plastic houses at Aleppo. Thirty-six genotypes from diverse geographical regions have proved sensitive to photoperiods and have behaved as long day plants though different types of reactions and daylength requirements have been identified.

An important sub-section of the trials is the screening of material for ease of harvesting. The high rate of plant maturity and drying and the danger of pod shattering demand a large amount of hand labour to allow the completion of the harvest within a short time (seven to 10 days). Development of cultivars with a tall erect growth habit, a relatively high lowest-pod-bearing-node and resistance to lodging and pod shattering is thus an important long-term objective of the lentil breeding program. Such a plant type would be suited to both mechanical and hand harvesting. Promising sources of genes for each of the components mentioned above have been identified. Agronomic trials on the cultural practices required have clearly demonstrated the feasibility of mechanised harvesting, at least on relatively stone-free soils.

Chickpeas

Two main groups of chickpea are found in the world. In the Indian sub-continent, the smaller darker 'desi' type predominates; it is farmed intensively and makes up approximately 85% of the total global production. In North Africa and West Asia, and also in Europe and Latin America, the larger lighter 'kabuli' type is found.

For some years ICARDA's sister institution ICRISAT has been researching into chickpea development. Inevitably it has concentrated mainly on the desi varieties which are more numerous in its Indian homeland. So since 1978 it has been agreed to integrate the two programs, with ICRISAT maintaining the overall international mandate, but concentrating its major research effort on the improvement of desi varieties, and with ICARDA concentrating on the improvement of the kabuli varieties.

ICARDA is now well committed to three basic areas of chickpea breeding. Its 3300 strong germplasm collection is being screened for high yield, cold tolerance and resistance to *Ascochyta* (a severe blight which hits chickpeas, especially in the winter months.) Until now farmers in the region have tended to plant chickpeas in the spring, despite evidence that earlier cultivation can produce higher yields. In most cases it does not, however, because *Ascochyta* blight is more prevalent in winter months. Experiments to see if chickpeas would grow in winter rather than spring began at ICARDA's parent organisation, ALAD, in Lebanon in 1974/75. There 200 lines were planted in the winter and all survived. In 1976/77, when ICARDA was in the process of establishment at Aleppo, 49 lines were grown in the Aleppo University (Faculty of Agriculture) fields. All except one survived the winter, but all except two were subsequently killed by Ascochyta.

Chickpeas

In 1977/78 Ascochyta control was applied to winter plantings of 36 lines of chickpeas. The subsequent yield was 53% to 89% better than equivalent types planted in the spring. Winter planting with fungicidal protection against the blight but no

irrigation produced an average yield of 1640 kg/ha while an average 1025 kg/ha was obtained from the same entries planted under irrigation in the spring.

Screening for resistance to *Ascochyta* began in the 1976/77 season when 1200 germplasm lines were tested. By the end of the 1977/78 season 40 promising lines had been identified, and this year (1978/79) the number has been reduced to 20 with confirmed resistance.

In the 1978/79 season the project looked at the cost benefit ratio of winter planted chickpea with fungicidal protection. The yield advantages of winter planting, in the absence of Ascochyta blight, were clearly demonstrated as was the possibility of growing chickpeas under 250 mm of rainfall (compared to the 400 mm usually associated with the crop). Fungicidal protection, however, was not uniformally effective in all trials, and following the identification of genetic resistance to Ascochyta blight it has been decided to concentrate further research efforts on such resistance rather than relying on chemical control measures. Two or three of the most resistant cultivars will be tested by the program on farmers' fields next season.

As far as potential for high yield is concerned, conventional chickpea plants do not necessarily have the ideal plant type. Higher yields may well be gained by altering the plant architecture. Three possibilities are under consideration: i) tall, compact and erect types maintaining the same yield per plant but occupying less space horizontally to allow more plants per unit area, ii) more seeds/pod possibly without much reducing the number of pods/plant and seed size, and iii) two pods/peduncle rather than one. While efforts in the future will be directed at synthesizing a plant type combining all in one, development of tall cultivars is receiving attention at the moment.

Emasculating chickpea

Seed from the 40 promising resistant lines identified in 1977/78 has now gone out to 15 locations in the region. Advanced yield trials of these lines are in progress, and there is

widespread interest (from Syria, Lebanon, Jordan, Algeria, Morocco and Turkey at least) in acquiring the lines. However seed quantity is low and co-operating institutions may have to wait for receipt of full quotas.

Agronomic trials on spacing and seeding in chickpeas showed that narrow rows 30 cm apart and a high plant population of 275,000 plant per hectare were better in winter planting than wider rows and smaller populations. Yields of spring planted chickpeas increased also as population was increased from 167,000 to 500,000 plants per hectare. Physiological tests examined the branching habits of chickpeas (as well as broadbeans) and the water efficiency of all three main groups of legumes researched by ICARDA. Microbiology trials have concentrated on nodulation studies of chickpeas which were nodulating badly at the farm at Tel Hadia.

Faba (broad) beans

Although fewer faba (broad) beans are produced throughout the world than dry peas and chickpeas, they have the highest production of the pulses in the ICARDA region, which accounts for 10% to 15% of total global output.

Different patterns of cultivation are apparent in the region. North and North East Africa grow 90% of the regional output. But in Ethiopia, Egypt and Sudan the small-seeded varieties are prefered and grown almost exclusively for dry seed use. In Egypt as much as 90% of the crop is for dry seed, being grown under irrigation in the winter season. However in West Asia most broadbean production comes from large seeded types and at least two thirds is for green vegetables.

Till now the main impetus of ICARDA's investigations has been into dry seed varieties grown in the research site environment. But next year a major project will begin to test cultivars and practices on small farms in Egypt and Sudan. In May ICARDA signed an agreement with the International Fund for Agricultural Development (IFAD) which is to provide finance

Bagged faba (broad) beans

for the project. In this way the gap between scientific research and on farm development will be narrowed.

Not that the scientific dimension of the problem of producing higher yielding faba (broad) beans has been easy or is complete. One of the major difficulties of faba (broad) beans research particularly at the co-operative level, is the expense and labour involved in keeping a germplasm collection, with its propensity to natural outcrossing. ICARDA gets over this hurdle by maintaining two separate germplasm collections. The first is a collection of different (1796) unselected open populations. The other is comprised of nearly 2000 pure lines derived by single plant selection from the open populations and maintained under strict conditions of selfing. This year the pure collection will be increased by 600.

The breeding program followed the same broad outlines of yield trials and international nuseries as for other crops in order to select high yielding and stable varieties for use in the region. In trials at Tel Hadia certain high yielding varieties were identified: out of 170 lines tested on site 43 out-yielded the local checks and have gone into further yield trials this year.

Certain entries in the season's yield trials produced in excess of six tons per hectare of dry seed under irrigated conditions, representing a significant increase in yield compared to the local check cultivar. These high-yielding lines will be distributed to co-operators for testing in different countries next season. They are expected to perform particularly well under high rainfall or irrigated conditions.

Several yield trials were also conducted under purely rainfed conditions, with no irrigation to supplement this year's very low rainfall of 232 mm. Such a small amount of rainfall is particularly hard on the faba (broad) bean plant which normally requires at least 400 mm to produce a good crop. Certain cultivars performed very well under these harsh conditions and yields in excess of 2.2 t/ha were recorded for the best entries.

Selections for drought tolerance were made in segregating populations and germplasm grown under rainfed conditions at Tel Hadia. It is hoped that the material identified will form the base for future cultivars able to out-yield the best ones available at present.

Under irrigated conditions selections were made for high yield, a more efficient growth habit and resistance to lodging and pod shattering. In the context of developing a more efficient growth habit, 'topless' mutant genes, which confer a dwarf determinate growth habit, were crossed into locally adapted genotypes. Such a growth habit may be of particular benefit under high fertility and high rainfall/irrigated conditions.

Studies of disease and pest resistance in faba (broad) beans have been made with good progress in screening for resistance to *Botrytis, Ascochyta* and root diseases. While most of the yield and disease studies were made on dry seed varieties, the importance of faba (broad) bean production for use as a green vegetable has not been forgotten, particularly as this is the most popular use of the crop in Syria and in the surrounding West Asian region. About 350 'green vegetable' varieties have been screened for high yield, while in replicated yield trials 25 varieties were evaluated for green vegetable yield, dry seed yield and green/dry seed yield (for dual purpose varieties).

Agronomic studies have shown the importance of early planting of faba (broad) bean, as of the other legumes. Early plantings at the end of November produced the highest yields, with local and regional cultivars performing better than European varieties. Both large and small seeded local cultivars responded positively to applications of phosphorus and nitrogen.

Crossing in the field

FORAGES

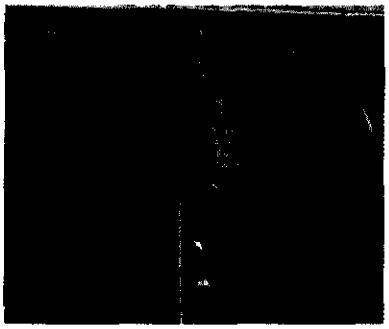
Forage crops, particularly legumes from the medicago species, have great potential for improving livestock and soil productivity in West Asia and North Africa.

While the population in the region has been growing relentlessly by an average of 3.3% per annum over the past 20 years, the increase in livestock production has been limited to around 1% per annum, necessitating large scale imports of meat and milk products. Prices of these commodities have risen steeply, creating the paradoxical situation where, in countries with a generally increasing GNP, many of them oil exporters, animal protein makes up less and less of the average man's daily food intake.

Part of the reason for the crisis in livestock production has been pressure of arable farming on existing good grazing land, coupled with overstocking, which together have led to a severe shortage of animal feed.

Such a situation is ironic if one looks at the extent of the land in the region. There are some 250 million hectares of natural pasturage available. These could provide considerably more animal feed given careful range management, including the introduction of high yielding drought resistant forage crops.

In addition, some 40 million hectares of arable land are currently left fallow each year. Part of the aim of the fallow is to allow regeneration of nutrients and conservation of moisture in the soil.



However, there is ample evidence, mainly from South Australia, that introduction of annual medics into a rotation instead of fallow can bring considerable benefit to the soil, fixing nitrogen in it and encouraging greater yields of the crop sown the following season. The medic rotation could also provide further feed for livestock, helping integrate crop and livestock farming systems and improve the overall efficiency of agriculture. Even at its simplest, higher yielding forage crops would lead to better stability and increased production throughout the region's agriculture.

The key to this work is research on specific forage crops. ICARDA is concentrating on annual medics (*Medicago* spp.), vetches (*Vicia sativa, V. villosa, V. dasycarpa, V. narbonensis, V. ervilia*), perennial medics (especially lucerne or alfalfa-*Medicago sativa*), other annuals such as *Pisum* spp., *Lathyrus* spp. *Onobrychis* spp., *Trifolium* spp., forage cereals (barley, triticale and oats)and grasses, and rangeland grasses and shrubs.

As yet very little work has been done on selection and breeding of these forage crops (mainly legumes) for West Asia and North Africa. ICARDA's efforts so far have been concentrated on building up a germplasm collection, started in 1978. In August 1978, following a field trip through certain areas of Iran and Turkey, 850 important regional entries were added to the collection which now totals 7,269. In the present 1978/79 season, 709 of these entries are being increased in plastic houses and in the field so as to generate enough material for nursery row evaluation in 1979/80.

One basic characteristic ICARDA is looking for in forage plants, apart from yield and stability, is cold tolerance. Currently the period after the winter rains is one of acute feed shortage, since straw produced in the harvest is insufficient. Early winter growth through December, January and February is therefore considered important.

Other characteristics for which selection is made include

nutritional quality, disease tolerance, yield of dry matter, capacity to associate with other desirable species, ease of propagation and adaptability.

Among the annuals, entries from 33 *Medicago* species were planted at Tel Hadia and Terbol, Lebanon in 1978. Preliminary observation shows that few of them, particularly the tested Australian varieties, had much cold tolerance, and future work will be limited to nine main species.

This season 844 entries from 21 species were planted in nursery rows and screened for adaptability and forage potential. In Terbol, Lebanon, where winters are colder, 470 entries were sown for cold tolerance evaluation.

In the *Vicia, Lathyrus* and *Pisum* species, 1978 growth was vigorous, allowing further observation of 860 selected entries in 1979. In addition 242 entries were sown in microswards ($6m^2$ plots) for selection in replicated trials and/or competition trials with forage barley. Lines of these three species are likely to be selected for their compatibility with forage cereals so as to provide both grazing early in the season and hay later on. Yield trials of *Vicia sativa* are also being grown independently.

Among the perennials, 540 entries of *Medicago sativa* were in nursery rows and small plots in 1978. In contrast to the annual species early winter and spring growth has been satisfactory in many of the entries. Over 200 single plant selection and 72 row selections have been made for cold tolerance and regrowth characteristics. The effects of hot dry summer conditions on growth, flowering, seed set and survival are being studied in the 1979 season.

Among the cereals, 261 entries of barley were planted in small plots in 1978 and tested for forage yield. Six were selected for grazing and 13 for hay production, and are being tested in two replicated yield trials for mid-season forage production, late season hay production and seed yield. Screening and testing of triticale and oats was also carried out.

Agronomy trials have been planned to gain a better understanding of regional pasture – how it is established, how it grows, how it is utilised, how it maintains itself over time and

how it might be integrated with other cropping systems. This understanding will then allow suggestions for and evaluation of improved forage production sytems which will form part of a more efficient overall agricultural network.

Four basic agronomy trials have been conducted in 1979. They have looked into the effects of undersown wheat and barley on the establishment of four Australian-derived annual medic cultivars, into the compatibility of four local forage legumes with the same annual medics, into productive capacities of barley/vetch mixtures and into the most suitable time for planting of vetch with barley so as to allow harvesting before the vetch pod ripens and its seed shatters.

Grazing trial.

Preliminary observations show that *Vicia dasycarpa* is one of the most promising legumes and that medics compete badly both with other forage legumes and with cereals.

Replicated microbiological experiments have shown that *Rhizobium* inoculation can increase nodulation of certain *Medicago, Vicia, Lathyrus, Pisum* and *Onobrychis* genotypes.

Work began in 1979 on the rangeland grazing and management area of the Program. An initial collection of perennial legume, grass and shrub species is being made and an area of Tel Hadia fenced off for later rangeland management studies and grazing trials. In this way animal husbandry trials, using sheep to help assess the performance and quality of forage plants, are coming to fruition. Two hundred head of sheep have been ordered, fodder is being kept back from this year's crop, pens are being built, and it is hoped to start these trials next season.

Considerable progress has already been made in off-site trials at four different agro-climatic zones in Syria. At Lattakia, which enjoys relatively high rainfall and warm winters, four Australian medic cultivars (Jemalong, Harbinger, Cyprus and Snail) are performing well in trials for dry matter production and seed yield.

Successful conclusion of a four and a half month Forage Training Course, partially funded by FAO/UNEP and attended by nine participants, provided evidence of strong interest in this area.

TRAINING AND COMMUNICATIONS

Just as crop improvement programs have tended in the past to top-heaviness, concentrating too much on genetic manipulation and too little on integration of scientific advances into overall farming systems, so agricultural communication has generally failed to stimulate grass roots interest and understanding in improved agricultural practices.

ICARDA along with other International Centers for Agricultural Research is trying hard to rectify this state of affairs. Its Training and Communications Program is still producing glossy publications which capture the interest of newspaper editors and the public as well as scientific newsletters which appeal to research scientists. But it is also concentrating on a previously neglected area of activity — training young middle level scientists in West Asia and North Africa towards a better understanding of the four main program areas covered by ICARDA and providing information resources to enable these trained scientists to put across this understanding to their own countrymen. In this respect the Training and Communications program is an integral part of the research effort at ICARDA, supporting the work of agricultural scientists, putting it in perspective and helping communicate the results to a wider public, both within the Center and without.

In order to assess the training and manpower needs of the region, ICARDA has sent fact-finding missions to a number of countries. Some places, like Egypt, Sudan and Iraq, have trained agricultural manpower, but not enough in the areas covered by ICARDA's mandate. Others, such as Syria, Jordan and North Africa, lack even these basic personnel. ICARDA has since organised a number of training courses to help meet the gaps in trained manpower identified by the field trips.

Selection training in the field.

The Center has tried three main ways of delivering its information — long and short term residential courses in Aleppo (the long term ones focussing on overall program areas, the short term on specific topics) and brief booster courses in particular countries.

This year long term training courses have been attended by 42 people from 16 countries and have covered cereals (19 participants), food legumes (14 participants), and forages (9 participants). Length of courses has ranged from four and half months for forages to six months for cereals and legumes. Trainees are encouraged to involve themselves in all aspects of ICARDA activities, meeting research scientists (including those from the Farming Systems Program which, owing to the novelty and diversity of the approach, has yet to be assigned a training course of its own,) working in the field at Tel Hadia on crop breeding, selection, harvesting etc., going on field trips to out stations such as the disease nurseries at Lattakia. Participants are treated as ICARDA field research personnel. They are expected to spend at least 60% of their time working alongside scientists on all aspects of ICARDA's crop development work.

The Food Legume Training Course got a head start by being the only long term course to take place in 1978. Like the Cereals course it has generated and used printed material which has been prepared and published by the Training and Communications Program in manual form. The manuals, which contain much practical and field specific information not available elsewhere, serve to stimulate discussion amongst trainees and to provide the theoretical background to further field study. They are continuously evaluated by the trainees and will be revised each year so that they will improve continuously and remain up to date. It is anticipated that the trainees may use the manuals as a basis for their own teaching and

communication efforts in their particular countries.

To date six Technical Manuals have been completed. These are:

1. Introduction to Food Legumes
2. Introduction to Breeding and Legumes
3. Introduction to Genetics
4. Introduction to the Major Pests of Food Legume Crops in West Asia.
5. Important Legume Diseases of West Asia and North Africa.
6. Introduction to Agriculture in West Asia and North Africa.

A manual entilted 'Introduction to Wheat and Barley is awaiting final publication while Introductions to Breeding Forage Crops, Forage Legumes, Forage Grasses, Range Management and Forage Production under Irrigation are available in draft lecture note form.

The Forage Training Course was conducted in a slightly different manner to Food Legumes and Cereals. It lasted four and half months and it was funded partially with help from the FAO/UNEP. There was greater emphasis on field trips to identify different types of vegetation. Two consultants from the FAO visited ICARDA to undertake, along with scientists from the University of Aleppo and University of Cairo, a major part of the teaching work in the early part of the course.

In the classroom

In addition to these residential courses ICARDA has run short term training courses on topics where a particular need has been identified. One such course was the Cereals Disease Methodology Workshop held in Aleppo from April 8th to 18th and attended by 20 participants from 19 countries.

Subjects for future short term courses include agronomic trials, field plot thechniques and seed production (for cereals) and legume hybridization, pathology,breeding methodology, microbiology, seed technology and agronomy (for legumes.)

Since an important objective of the Training Program is to initiate further diffusion of information on the breeding and

cultivation of plants included in ICARDA's mandate, the Center has also starded short National Level courses. The first one took place in Algeria from February 4th to 15th. The topics covered were cereal improvement, production and weed control. Further specific courses are planned for Turkey and Egypt.

Eventually ICARDA hopes to be training trainees to teach courses on cereals, legumes, forages and farming systems in their own countries using ICARDA materials. Already the Center has teamed up with the University of Aleppo to help establish a graduate program in crop improvement with financial help from the Ford Foundation. Already too the network of trainees who have passed through ICARDA's courses in Aleppo has proved an important asset in the extension of the Center's work throught the Region. Special mention may be made of fruitful relations which have been established with former trainees from Libya, Jordan, Turkey an Algeria.

While its training courses are aimed at the middle level researchers and technicians, ICARDA has also initiated workshops for rather more senior agricultural scientists throughout the Region. A major one this year was the Fifth Regional Workshop on Winter Cereals, held in conjunction with the Algerian government and CIMMYT in Algiers from May lst to 7th. More than one hundred people attended to discuss the main theme which was the gap between existing and potential farmers' yields. Proceedings of the Workshop are to be published by CIMMYT. In addition ICARDA held a seminar on Lentil Research and Improvement in Aleppo from May 5th to 9th. A reference book is being prepared from the seminar material.

Preparation of reference material, primarily in English, but increasingly also in Arabic and French, is a major part of the work of the training and Communications Program.

Apart from the Technical Manuals produced for the Training Courses (and discussed above), the Program has also published material in the following categories —

- Project reports (e.g. 'Farmers' Field Verification Trials').
- Discussion papers (e.g. 'Preliminary Agronomic Studies in Wheat and Barley').
- General newsletters (quarterly reports on ICARDA's work).
- Information Sheets (short glossy reports on specific Programs).
- Progress reports.
- Miscellaneous publications (e.g. 'Lentil Cook Book').

ICARDA publications

An important new venture is the editing and production of an original news and information service which is concerned with world-wide research on faba (broad) beans. The service, known as FABIS, is intended to improve communications between researchers on faba (broad) beans (one of ICARDA's major crops) throughout the world. It will consist of a newsletter published annually and other publications such as details of the work being carried out at different institutions and anotated bibliographies.

The Training and Communications Program also helps to run tours and visits to ICARDA, organizes special Field Days on site at Tel Hadia and coordinates links with the mass media. It is in the process of building up a large slide collection — both general and dealing with specific subjects.

While the Program believes this public relations aspect of its activities is important, it is not trying to sell ICARDA beyond its achievements. Basic scientific research and results are the *sine qua non* of the Program. Which brings us back to the integral involvement of Training and Communications in the Center's activities.