Proceedings of the

INTERNATIONAL FABA BEAN CONFERENCE

Sponsored by the

ICARDA/IFAD NILE VALLEY PROJECT

In Cooperation with

The Government of Egypt

Cairo, March 7 - 11, 1981

THE INTERNATIONAL CENTER FOR AGRICULTURAL RESEARCH IN THE DRY AREAS

ICARDA

P.O.Box 5466 Aleppo, Syria

November 1982

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Introduction

The first International Conference on Faba Beans, sponsored by the ICARDA/IFAD Nile Valley Project in cooperation with the Government of Egypt, was held at the Pyramids Holiday Inn Hotel, Cairo, Egypt, on March 7-11, 1981.

The primary objective of this conference was to focus on the problems of irrigated faba beans in the Nile Valley of Egypt and northern Sudan. The topics covered included the current status of breeding methodology and major breeding objectives, physiology and agronomy of faba beans under irrigated conditions, symbiotic nitrogen fixation, diseases, pests, *Orobanche*, weed control, nutritional quality, and economic aspects. All presentations and discussions were geared to have practical relevance to research on increasing the productivity and food value of faba beans in the Nile Valley.

This conference was planned at a strategic stage in ICARDA's development of its mandated food legume crops. Previously there had been a regional conference on food legumes at Aleppo, Syria, in 1978, as followed by an international seminar on lentils in 1979. The lentil seminar was attended by a number of leading world experts and it culminated with the production of the first book in the English language on this important crop. It was decided subsequently that the next stage should be a scientific gathering to focus attention on ICARDA's other main food legume crop, faba beans. Because of the great importance of faba beans in Egypt and Sudan, it was decided that the international conference should be in Cairo under the sponsorship of the ICARDA/IFAD Nile Valley Project.

Three previous meetings had been held in Egypt and Sudan at which both national programs and ICARDA scientists jointly planned the research of the Project. The first International Conference on Faba Beans was thus held to review scientifically all important aspects of the crop. Scientists were invited not only from the Nile Valley but also from other leading institutions throughout the world to add breadth to the proceedings.

Committee of the conference comprised representatives of ICARDA; ARC, Sudan; ARC, Egypt; GTZ; NRC, Cairo, and Cairo University.

The 136 participants were from 18 nations in addition to those represented by ICARDA, IFAD, and other organizations. Nations represented included Australia, Canada, Cyprus, Egypt, Ethiopia, France, Italy, Jordan, Lebanon, Morocco, Netherlands, Spain, Sudan, Sweden, Turkey, United Kingdom, and West Germany. Organizations were the Ford Foundation, GTZ, ICARDA, IDRC, IFAD, the Egyption Major Cereals Improvement Program, the United Nations University, USAID, and the World Bank, local arrangements were in the hands of Dr. B.Bhardwaj and the staff of ICARDA's Cairo office.

The opening session, chaired by Dr. S.Dessouki, Supervisor General, Agricultural Research Center, included short statements by Dr. H.S.Darling, Director-General, ICARDA, Dr. M.A.Nour, Deputy Director General, and His Excellency the Minister of Agriculture, Sudan, and an opening address by His Excellency, Dr. M.M.Dawood, Minister of Agriculture, Egypt.

The sessions which followed concentrated on different aspects of research on faba beans, and in the last session discussion groups met to prepare recommendations arising from the deliberations of the conference. On the third day there was a trip to Sakha Research Station to look at the trials on faba beans in the field.

The statements by Dr. Darling and Dr. Nour, a summary of the discussions, the country statements, the recommendations of the conference, the concluding statements, and a list of participants are all included in this volume. Most of the main research papers presented at the conference were published separately, in 1982, by the Martinus Nijhoff Publishing Company, in a companion volume entitled 'Faba Bean Improvement'.

Agenda

March 7th — Chairman: Dr. S.Dessouki, Supervisor General, ARC.

09:30 - 10:15	Statement by Dr. H.S.Darling, Director General, ICARDA. Statement by Dr. M.A.Nour, Deputy Director General, ICARDA & In Charge of Nile Valley Project. Statement by H.E. The Minister of Agriculture, Sudan Opening Address by H.E. Dr. M.M.Dawood, Minister of Agriculture, Egypt.	
10:15 - 11:00	COFFEE BREAK	
	Chairman: Dr. M.A.Nour	
11:00 - 11:25	Overview of the Egyptian National Program.	A.A.Ibrahim
11:25 - 11:50	Overview of the Sudanese National Program.	I.Babiker
11:50 - 12:15	Nile Valley Project in Egypt; farm-level constraints to higher yields.	A.Nassib
12:15 - 12:40	Nile Valley Project in Sudan; on-farm trials.	G.E.Mohamed
12:40 - 13:05	How Yield Stability Can Influence Farmers's Yields Adoption Decisions; the case of faba bean production in Egypt	D.Nygaard
13:05 - 14:00	LUNCH BREAK	

Chairman: Dr. A.A.Ibrahim

14:00 - 16:00	National Program Presentations and Discussions. (Cyprus, Ethiopia, Jordan, Lebanon, Spain and Turkey)	
19:00 - 21:00	RECEPTION BY DIRECTOR GENERAL, ICARDA	

March 8th Chairman: Dr. M.M.F.Abdalla

09:00 - 09:25	Genetic Resources of Faba beans.	J.Witcombe
09:25 - 09:50	An Overview of Breeding Methods for Faba Bean Improvement.	G.Hawtin
09:50 - 10:15	Population Improvement in Faba Beans.	A.Nassib
10:15 - 10:40	Development and Performance of Synthetic Varieties of Vicia faba L.	D.Bond
10:40 - 11:05	Male Sterility and Future Prospects for Hybrid Varieties in Vicia faba.	J.Picard
11:05 - 11:30	Pollination Studies on Faba Beans.	L.M.Monti
11:30 - 12:00	COFFEE BREAK	

Chairman: Dr. F.A.Salih

12:00 - 12:25	Mutation Breeding in Faba Beans.	M.F.Abdalla

12:25 - 12:50	Interspecific Hybridization in <u>Vicia</u>.	J.I.Cubero
12:50 - 13:15	Need and Concept of Wider Adaptability Including Breeding Methods.	E.Von Kittlitz
13:15 - 14:15	LUNCH BREAK	
	Chairman: Dr. S.Miladi	
14:15 - 14:35	The Utilization of Faba Beans and Their Role in Diets in Egypt.	G.Gabrial
14:35 - 14:55	The Utilization of Faba Beans and Their Role in Diets in Sudan.	A.El Mubarak Ali
14:55 - 15:15	Protein Quantity and Quality in <u>Vicia faba</u>.	S.Sjodin
15:15 - 15:35	Anti-nutritional Factors in Faba Beans.	L.A.Hussein
15:35 - 15:55	Favism	R.Marquardt
15:55 - 16:15	Cooking Quality and its Relationship to Agronomic Factors and Chemical Composition	A.M.E.Shehata
16:15 - 16:35	Hard Seeds in Faba Bean.	F.A.Salih

<u>March 9th</u> Field Trip to Sakha.

Lunch by the Ministry of Agriculture

March 10th   Chairman: Dr. A.El-Beltagy

09:00 - 09:30	Some Physiological Aspects of Adaptation	M.C.Saxena
09:30 - 10:00	Alternative Plant Models.	G.Chapman
10:00 - 10:30	The Effects of Water Stress on the Growth Development and Yield of *Vicia faba L.*	P.Hebblethwaite
10:30 - 11:00	Flower Drop.	M.M.El Fouly
11:00 - 11:30	Tolerance to Salinity	K.Caesar
11:30 - 12:00	COFFEE BREAK	
	Chairman: Dr.I.Babiker	
12:00 - 12:30	Aspects of Faba Beans Agronomy in Egypt	A.A.Ibrahim
12:30 - 12:50	Aspects of Faba Beans Agronomy in the Sudan	O.A.A.Ageeb
12:50 - 13:10	Symbiotic Nitrogen Fixation in Faba Beans in Egypt	Y.A.Hamdi
13.10 - 13:30	Symbiotic Nitrogen Fixation in Faba Beans in Sudan	M.M.Musa
13:30 - 14:30	LUNCH BREAK	

Chairman: Dr. A.R. Saghir

14:30 - 14:55	Weed & *Orobanche* Control	M.K.Zahran
14:55 - 15:20	Breeding for Resistance to *Orobanche*	A.Nassib
15:20 - 15:45	Characteristics of a Local Collection of Faba Beans and Its Reaction to *Orobanche*	M.M.F.Abdalla
15:45 - 16:05	Film on Chemical Control of *Orobanche crenata* in Broad Beans.	U.Schmitt

March 11th Chairman: Dr. I.A.Ibrahim

09:00 - 09:25	Major Disease Problems of Faba Beans in Egypt	H.A.Mohamed
09:25 - 09:50	Major Disease Problems of Faba Beans (*Vicia faba L.*) in the Sudan	M.M.Hussein
09:50 - 10:15	Virus Diseases of *Vicia faba*	L.Bos
10:15 - 10:40	Breeding for Resistance to *Botrytis fabae*	S.Hanounik
10:40 - 11:05	Breeding for Resistance to Rust	C.Bernier
11:05 - 11:30	Factors Affecting Resistance to Root Rot and Wilt Diseases.	G.A.Salt

11:30 - 12:00	COFFEE BREAK	
	Chairman: Dr. H.S.Salama	
12:00 - 12:25	Faba Bean Pests in Egypt	A.H.Kamel
12:25 - 12:50	Major Pest Problems of Faba Beans in Sudan	S.A.Siddig
12:50 - 13:15	Breeding for Resistance to Aphids	F.Klingauf
	Chairman: Dr. J.K.Coulter	
13:15 - 15:00	Meeting of Working Groups	
15:00 - 15:30	Presentation of Recommendations of Working Groups	Chairmen of Various Sessions
15:30 - 15:45	Summing up	D.A.Bond
15:45 - 16:00	Closing Remarks	M.A.Nour

Opening Address by Dr. H.S.Darling, Director General, ICARDA

It is a great pleasure and privilege as Director General of ICARDA, to welcome distinguished guests and participants to this important and highly significant conference - possibly the first of its kind to be held.

I will endeavour not to discuss the Nile Valley Project as such, although with IFAD support it is the main sponsor of this conference, but will leave that important task to my Deputy, Dr. Mohamed Nour. Having said that, I must comment on the obvious sense of strong maturity that attends this project's affairs. It is only seven short months since the coordination meeting last August, yet there are clear signs of development. My main task is to give, in as few words as possible, the ICARDA context to the conference.

ICARDA is one of a chain of thirteen such centers which circle the world and are located mainly in less developed countries. They are charged with the responsibility for research into the increase of food production. Sponsored by CGIAR, ICARDA was founded in 1976-77. It is one of the younger centers and has regional mandate for agriculture in areas with a Mediterranean climate i.e. winter rain and summer drought. The region includes 22 countries which stretch from Morocco to Pakistan, and from Turkey to Sudan and Ethiopia. They have a total of more than 300 million people and a net overall food deficit.

ICARDA undertakes research and training on cereals (barley, wheat and triticale), forage/livestock and food legumes including faba beans, Farming systems are an important focus of the work.

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Although ICARDA is mainly concerned with rainfed agriculture, faba beans are frequently grown in the region under irrigation, especially in the Nile Valley. As ICARDA is unable to address the special problems of the crop in Egypt and Sudan from its base in Aleppo, funds were sought and obtain from IFAD to support a special project.

The main aims of the Nile Valley Project are :

(a) To integrate research efforts between ICARDA, Egypt and Sudan.
(b) To help coordinate research between various institutions at the national level.
(c) To act as a catalyst in the research process.

The main institutions involved in the Nile Valley project are : In Egypt, the Grain Legume Section of the Field Crops Research Institute, Agricultural Research Council and various other institutes and sections within the ARC including plant pathology, seed technology, statistics, agro-economics, virus research, plant physiology, weed control and soil and water resources. There is also involvement by the universities, especially in Alexandria and Cairo, and the National Research Center.

In Sudan, there is the Agricultural Research Corporation, especially at the Hudeiba Research Station, and also the Shambat Research Station and The University of Khartoum.

I would like to give a special welcome and thanks to the national program coordinators, Drs. Ali Abdel Aziz and Abdullah Nassib (Egypt) and Drs. Ibrahim Babiker and Farouk Salih (Sudan). I am also grateful to Dr. B.Bhardwaj and his Cairo office staff for their work, especially in the organisation of this conference.

This conference is being held as part of the Nile Valley Project, both to review the progress of the project and, perhaps more importantly, to bring together scientists who are working on faba beans from throughout the world to discuss ways and means of increasing the productivity of the crop. I wish to give a special welcome to delegates from national programs in the region and to scientists from other countries, especially from Europe and North America, whose contribution to the conference is particularly welcome. At least 18 nationalities are represented.

I would also like to give a special welcome to representatives from several organisations:

GTZ which is also supporting the National Food Legume Seminar at Mariut which will immediately follow this conference. GTZ has also put a major input into the planning of this conference.
IDRC which has very generously supported food legume research in both Egypt and Sudan, as well as ICARDA.
The United Nations University.
USAID, which supports a major cereals project in Egypt.
The Ford Foundation.
And finally to IFAD and Dr. Eric Sicely who is IFAD's Senior Technical Advisor in Rome, Italy.

In conclusion, I wish to express my grateful thanks to the Government of Egypt, to be conveyed by His Excellency the Minister, for the privilege of having this meeting in Cairo.

Address by Dr. Mohamed A.Nour,Deputy-Director General, ICARDA.

In these brief remarks, I wish to outline some of the background to the association between IFAD, ICARDA and the national programs in Egypt and Sudan.

The Nile Valley Project is concerned with ideas which have been in the minds of scientists in Egypt and Sudan for some time. ICARDA only came on the scene comparatively recently. Although ICARDA was established to work primarily on rainfed agriculture, it was given a broader responsibility for research on three crops, namely barley, lentils and faba beans. On these crops, ICARDA undertakes research and training activities relevant to the needs of developing countries throughout the world.

Egypt and Sudan are considered to be of central interest to ICARDA, from the standpoint both of social factors and because of the importance of faba beans in the agriculture and diets of their people. From its main site at Aleppo in northern Syria, ICARDA was unable to adequately address the problems of the Nile Valley. Thus funds were sought for a project which would bring scientists from ICARDA, Egypt and Sudan together, to jointly focus their attention on the needs of the area. The International Fund for Agricultural Development (IFAD) came forward to finance the project. Very generous funding has been provided by IFAD and I wish to take this opportunity to thank that organization, without which the Nile Valley Project, and even this meeting, would not have been possible.

Through the Project, ICARDA cut a new road in development by adopting a model in which the main responsibilities for planning and conducting the research are firmly in the hands of the national scientists. Each country has appointed two scientists as coordinators. ICARDA's role in the Project has been largely one of providing technical and administrative support and acting as a catalyst. The program of work is developed jointly at an annual coordination meeting between all parties concerned; this model has brought Egypt, Sudan and ICARDA to work together in a planned way, and has resulted in many direct contacts between all scientists concerned. It has also allowed a gathering of this magnitude to take place.

As result of this strategy on which the program has been laid down, it is hoped that in addition to the integration of the programs in Egypt, Sudan and ICARDA, that very close collaboration will also be developed with other national programs in the region, in Europe, Canada and elsewhere.

We are grateful to the Ministers of Agriculture in both Egypt and Sudan for their support in all stages of this process.

This is the fourth meeting on faba beans under the Nile Valley Project; the three earlier meetings of national scientists having been to develop and implement programs. This is the first meeting at which scientists from outside the region have come to give of their knowledge and experience and also, if possible, to take something away. While particular attention will be given to problems of the Nile Valley, the subjects could touch on the interests of other countries of the region and beyond as well. I hope that the discussion groups will draw together the thinking and discussions which will take place, and I look forward to hearing the recommendations of the meeting.

I wish, finally, to pay a tribute to the Egyptian and Sudanese scientists who have tackled this work. ICARDA has encouraged, and I hope adequately supported the national scientists in their task, and is very gratified at their response.

SUMMARY OF DISCUSSIONS ON THE PRESENTATIONS

Overview of the Egyptian National Program. Dr. A.A.Ibrahim.

M.C.Saxena: In which months is frost most severe in Middle and Upper Egypt? How severe is it, and what kind of damage does it cause? Is frost a regular feature in these areas?

A.A.Ibrahim: Night frost is most severe during late December, through January, when temperatures may go down to $0^{o}C$, sometimes to -1 or $-2^{o}C$, resulting in increased amounts of flower and pod shedding. Frost is regular, but its severity is variable from season to season.

Mahmoud Adam Ali: I notice that Giza 3 variety is recommended for Lower Egypt because it is resistant to leaf spots and rust, while Giza 2 is recommended for Middle Egypt. Are these recomendations due to the interaction of the environment with the relationship between the varieties or pathogens, or are they due to different races of pathogens in the area?

A.A.Ibrahim: Giza 3, resistant to *Botrytis fabae* and *Uromyces fabae*, is recommended in Lower Egypt where these diseases are endemic. Giza 2 is recommended in Middle Egypt which is free of these diseases.

M.Talat El Saidi: The level of 71 kg P_2O_5/ha seems to be high.

A.A.Ibrahim: The available P ranges between 2.6 and 5 ppm P (Olsen's method) in Minia Soil. As the soil is so low in available P, it responds to high levels of P_2O_5 up to the amountof 71 kg/ha, recommended as the results of experiments over a 10 year period have shown.

K.A.Agabawi: Very broadly, what are the major four or five constraints, from the farmers' point of view, which contribute to the very wide gap between actual commercial production, and production on research farms? If possible, what percentage increase could be obtained if each of these major constraints could be overcome?

A.A.Ibrahim: The main constraints to faba bean production are plant population, time of applying P and N fertilizers, water stress, *Orobanche* infestation, aphids and diseases. Recommended levels of plant population and fertilizer applications (timing and methods included) have been found to increase the seed yield of low production sites by about 40%. The contribution of these two factors decreases gradually as the overall production level of the site increases. Water stress which some farmers put on faba bean plants, particularly after sowing (50-70 days of stress) may also reduce the yield by 10-15%. Where *Orobanche* is a limiting factor, losses can range from 5-100%.
In some seasons, aphids are a major threat and if not controlled, as happens in many farmers' fields, losses can reach 40%.

A.H.El Nadi: I think that Dr. Abdel Aziz agrees that we should distinguish between the natural flower shedding and the flower drop induced by environmental stresses. The first category of flower drop may not be reduced unless breeding or genetic factors have been involved. The flower drop due to environmental stress could be alleviated through studies on the detrimental environmental factors involved.

Overview of the Sudanese National Program. Dr. I. Babiker.

A.K.El Rafie: Why isn't the human component emphasised as much as the physical component in developmental projects for faba beans in Egypt and the Sudan, in spite of its importance in closing the gap between the yields at experimental levels and farmers' levels?

I.Babiker: The main object of the Nile Valley Project is to increase production at the farmer's level, and all activities should be centered around him. Several socio-economic surveys have been done, but are still being processed. When the results are available, I am sure that your doubts will be removed and that you will be fully convinced tht the human component is very well considered.

M.M.Musa: How do you visualise the role of ICARDA/IFAD in funding activity to overcome the constraint of lack of improved seeds? This could be a special activity between the departments of research and propagation as a model to be adopted for faba beans and other crops.

I.Babiker: The production of improved seeds can hardly be overemphasised, as mentioned in the paper, but it was agreed that a propagation component should be deferred to the second phase of the project. In the meantime, activity should be concentrated on the evaluation of the present situation to help us later to formulate a worthwhile and acceptable project.

A.H.El Nadi: The statement "National Dish for All" may be misleading, especially to the ecconomist who does not know the feeding habits and the main consumers of the faba bean in the Sudan. While I agree that the production of faba bean must be increased in the Sudan to meet the growing demand, due to the increase in population and greater urbanisation, yet the expression "National Dish for All" may induce the economist to consider the per capita consumption for the Sudanese population. This is because a substantial sector of the Sudanese population is rural, nomadic and semi-nomadic and does not usually use the faba bean as a pulse crop. Moreover, the southern part of the Sudan mainly use the local pulse species rather than the faba bean. Estimates on the consumption of faba bean in Sudan will be meaningful if they are related to the city, town and settlers in general.

I.Babiker: I agree with the comment, and say that any economist would be mistaken to calculate per capita consumption in that way. The statement "National Dish for All" should not be taken to mean absolutely everyone in the nation, but definitely it means the large majority of people. With increased urbanisation, the faba bean dish will, no doubt, assume a greater importance, and even some segments of the population mentioned will be faba bean consumers.

Nile Valley Project in Egypt: farm-level constraints to higher yields.

Dr. A.Nassib.

M.M.F.Abdalla: How do you explain that only in four sites, the newly developed Giza 4 surpassed the yield obtained by the variety already with farmers, whereas in seven sites, yields of the farmers'variety were higher than Giza 4. Does it mean that the farmers' seeds are still better?

A.Nassib: This was the first opportunity of evaluating Giza 4 over a wide range of environments at 12 sites in Minia province. It seems that Giza 4 has no advantage over Giza 2 which has been widely adopted by farmers in Minia since the late 1960's.

M.M.F.Abdalla: Population densities may be obtained through different arrangements of plants in the field. What were the arrangements you used in the recommended cultivation?

A.Nassib: The recommend plant population (41.7 plants/m^2) was distributed on 3-row ridges, 60 cm apart.

E.von Kittlitz: I find it hard to understand why some farmers use such low plant populations and some of them use a very high level of fertilizer. This means that they are under the recommended level of plant density and above the recommendation for fertilizer.

A.Nassib: The farmers believe that the plant population they use will give the same yield as the recommended one because greater branching will make up the difference. The farmers use higher amounts of fertilizer but in the wrong way and at the wrong time. The plant utilization of fertilizer is therefore drastically decreased, and the yield increase is probably uneconomic.

Nile Valley Project in Sudan: on farm trials. Dr. G.E.Mohamed.

M.Talaat El Saidi: In Sudan, you do not discuss anything about the fertilizers, especially P and N.

G.E.Mohamed: Faba bean in Sudan has shown no consistent response to fertilization (N,P,K). There is extensive nodulation in faba bean, and it seems that the indigenous Rhizobium strain is quite effective in nitrogen fixation. For phosphate, the soil is alkaline and, consequently, fixation of added fertilizer is expected. However, the level of phosphate in the soil is moderate, and different methods of application are being examined. In contrast, potassium in the soil is relatively high. Consequently we have given no recommendations for fertilizerr so far.

H.W.Tawdros: How many applications of irrigation water do you make in a season? What is the type of soil? What are the field capacity and wilting percentages?

G.E.Mohamed: The recommended irrigation frequency at Hudeiba Research Station is a 7 to 10 days watering regime, giving 12 to 14 irrigations in a season. This research farm is characterized by a calcareous heavy clay soil. Field capacity of this heavy clay soil is 55 to 60%, and the wilting point is 20 to 25%. It must be mentioned that the wilting point is dependent on soil characteristics e.g. salinity and alkalinity, in addition to other factors. The recommendation on the frequency of irrigation has to be tested at different locations and on different soil types.

M.Saber: Have you noticed any relationship between irrigation regime and flower drop (abscission)?

G.E.Mohamed: I have not examined systematically the relationship between irrigation regime and flower drop, but it is found that water stress during the reproductive phase causes considerable reduction in grain yield.

M.Saber: Did you inoculate the seeds before sowing with a specific Rhizobium strain in your experiment? Do farmers do that?

G.E.Mohamed: Experiments at Hudeiba showed that there was no yield response to bacterial inoculation except where faba bean was not grown previously. However, there might be an increase in the number and/or size of nodules as a result of inoculation.

How yield stability can influence farmers' adoption decisions; the case of faba bean production in Egypt. Dr. D.Nygaard.

A.M.Nassib: Do you think that the relationships which you have just mentioned still function in a country such as Egypt where prices of faba beans are controlled by the Government and, inputs are subsidized?

D.Nygaard: If prices were actually controlled by the Government, this would indeed increase stability with respect to production decisions regarding this crop. However, in Egypt, the amount of inputs which are available at fixed government prices, which are lower than market prices, are not sufficient to fulfill farmers' needs. Therefore an active market exists outside government channels for those inputs which are traded at significantly higher prices. This, of course, adds instability to the system.

F.Klingauf: There is usually a positive and only seldom a negative correlation between fertilizer and pesticide application, hence farmers regularly cannot replace fertilizer by pesticide; moreover they usually have to use more pesticides after high fertilizer input.

D.Nygaard: It is true that interactions such as this, are important. However farmers have been shown to adopt only pieces of a technological package in the first instance. While a farmer may get the biggest increase from using fertilizer and pesticide together, he may not adopt both of them simultneously. Therefore the question becomes "which technological change should we recommend first?" This model suggests that it may be easier to get risk-averse farmers to adopt pesticide first as a yield stabilizer, rather than fertilizer which will increase yield instability.

D.A.Bond: It is often easier to breed or improve response to good environments (and therefore to higher mean yield) than for higher yield in poor environments. If a breeder estimated that for a given input, he would expect to raise yields under good environments by, say 10%, but under poor environments by, say, only 5%, would you still advise him to give yield stability top priority over yield responsiveness?

D.Nygaard: For a particular farmer, it is possible to show how much yield would have to be increased before he would be willing to accept more variability. The problem is that this varies among farmers. For example, poorer farmers who may be more risk averse, may need higher yields before they will accept more instability than richer farmers. Therefore, if the development program were aimed at a group, say poor farmers, yield stability may indeed dominate yield gains. The theory allows one to calculate this trade-off if one has the information on the farmer's utility preferences. Without that information, I cannot give you a "yes" or "no" answer.

K.A.Agabawi: Variability in yield is caused by many factors, some of which may be the susceptibility of genotypes to environmental factors, and some may be due to man-made factors, including levels of inputs. As such, I agree with the speaker that it is important to try to reduce variability in yields, but it is impossible for stability to be brought about only by breeders. All scientists who are concerned with a crop should aim within their speciality to reduce the causes of yield variation.

Genetic Resources of Faba beans. Dr. J.Witcombe.

C.Bernier: What are the consequences or effect on autofertility, of maintaining collections as inbred lines? Is this not selecting for autofertility? (Handed to Geoff Hawtin).

G.C.Hawtin: This is a problem in the maintenance of our pure line collection, especially in accessions which originate in northern Europe. Although seed yields in the screen houses might be low in such lines, it is rare that no seed is set at all. We have lost very few accessions due to this, and feel that it is impracticable to hand trip in the screen house on a large scale. Last year, we only hand tripped about 12 lines to ensure maintenance of seed stocks.

E.von Kittlitz: I am missing a reflection on the effect of natural selection within a population. The effect of this may be loss of genes. This is to be avoided. So the best thing one could do is to maintain the collection on the basis of inbred lines.

J.Witcombe: In practice, if the open-pollinated populations are grown under optimum conditions and at low population density, the effects of natural selection are slight. They can be eliminated by using constant seed descent. It is also a policy of IBPGR that material should be first muiltiplied in the country or region from which it was collected. The effects of this policy are to reduce natural selection.

D.A.Bond: In your survey of collections, did you gain an impression of the proportion of accessions by seed size? The maintenance of accessions thought to be evolutionary more primitive would seem to me to be the most important aspect of preserving genetic resources.

J.Witcombe: I agree with your remarks concerning the importance of preserving small-seeded types. Unfortunately the documentation of existing collections is not of sufficient quality to answer your question.

M.Solh: With respect to population size, particularly for open pollinated accessions, what are your recommendations for maintenance of these accessions?

J.Witcombe: Arbitrary figures of 12,000 seeds can safely be ignored. I would recommend a sample size of 200 seeds as being practical in the case of large-seeded faba beans.

R.Boulter: What are the best storage conditions for seeds of V. faba for the 'general' experimenter?

J.Witcombe: Even at $0^{\circ}C$ and low moisture content, seeds remain viable for long periods.

E.von Kittlitz: If you will maintain the original variability between accessions, I think it can be done best with inbred lines.

J.Witcombe: Although agreeing that inbred lines are an excellent way of handling cross-pollinated germplasm, only the original open-pollinated population preserves all of the variability.

An Overview of Breeding Methods for Faba Bean Improvement. G.C.Hawtin.

F.A.Elsayed: What is the percentage of heterosis for the economic traits?

G.C.Hawtin: Heterosis commonly reaches 20-30% but higher levels than this have been reported for specific crosses in particular environments.

M.El Sherbeeny: Autofertility in faba beans,is it due to the structure of the flower or to the maturity time of male and female parts?

G.C.Hawtin: A number of mechanisms influencing autofertility have been reported. e.g. a. the degree of scarification required by the stigma, b. blockage of the ventral passage in the flower by the keel petal or the dorsal passage by long stylar hairs or styles, and c. the amount of pollen present. F_1 hybrids tend to produce more pollen than inbred lines.

The degree of protogyny may also vary and would be expected to influence outcrossing percentages, but it may have little effect on autofertility.

M.Frauen: Yesterday, Dr. Nassib pointed out that straw yield was economically important for Egyptian farmers. Do you think that you can improve seed yield by selecting for better harvest index, neglecting the straw, or is it necessary to improve total biological yield?

G.C.Hawtin: In general, the straw of faba beans is of very low value compared to the seed, and I believe this is so even in Egypt, although faba bean straw may have a higher value in Egypt than in other Mediterranean countries. In lentils, for example, the situation is different; the returns to a farmer from lentil straw can even exceed those from the sale of grain.

In ICARDA, we are selecting only for yield in faba beans (both green pods and seed as well as dry seed) and do not consider total biological yield.

M.M.F.Abdalla: Since there is no strong correlation between performance of the stocks in different sites in different countries, would it not be more beneficial if ICARDA supports faba bean breeders with early segregating generations rather than the later ones.

G.C.Hawtin: We are supplying early generations (F_2 and F_3) populations to many breeders. Some make use of the materials through selection in their own environments, others do not; often because of the lack of facilities, manpower etc. In such cases, feedback of data on population performance in early generations provides a guide for selection (between populations) of material which is distributed in later generations as F_4 - derived lines.

Population Improvement in Faba Beans. Dr. A.Nassib.

M.Solh: Do you have a limit on the number of parents you originally used to form your population for improvement?

A.Nassib: We choose only one single multiple cross to establish one population. In this population, we put all the elite F_3 lines of this cross.

F.A.El-sayed: What was the basis for selecting the original?

A.Nassib: There are different breeding objectives, e.g. disease resistance, adaptability, Orobanche resistance, and protein content.

E.von Kittlitz: You got a very high rate of outcrossing in one of your crosses. Was this a random event or have you a certain system to get such high rates of outcrossing?

A.Nassib: We use honey bees in the cages during flowering. The high percentage of outcrossing is reported in one instance. We are still standardizing this method to be reproducible.

Samir Salem: i. What is the selection intensity used in the mass selection program? ii. What characters do you mainly select for in your breeding program?

A.Nassib: We start with a selection of 1000 plants which is reduced later to a few hundred. Selection based on visual rating of the progeny lines of these plants was done for seed yield and uniformity in seed size and colour.

Development and Performance of Synthetic Varieties of Vicia Faba L.

Dr. D.A.Bond.

F.A.El-sayed: General Combining Ability (GCA) is part of a definition of a synthetic variety. Since you have dropped GCA from the definition, how do you make a distinction between a synthetic and composite variety?

D.A.Bond: The components of the varieties which I have described as synthetics have all been identified through replicated trials and evaluated. I would suppose that the components of a composite variety could be any accessions, including those without comparative data. I have extended the term 'synthetic' to include varieties whose components have not been tested for combining ability (or only indirectly by an assumed correlation with component performance or via the performance of the synthetic variety) because such varieties are already known as synthetics. However it is only a question of a name, and I am willing to call them by some other name such as 'composites' or 'pseudo-synthetics' if there is common agreement about the definitions.

J.Sjodin: According to your scheme, syn-4 seems to be the first generation that the farmer can use. How many generations can he expect to have an optimal yield?

D.A.Bond: We have not detected any decline in yield from syn-4 to syn-8. Data for after syn-8 is spare and the decision to periodically reconstitute from an early generation (e.g. syn-1) is based on the assumption that after syn-8 there is liable to be some detectable genetic drift or contamination due to incomplete isolation during syn-3 to syn-7.

J.I.Cubero: Do you think that the 'pseudo-synthetics' (there is no calculation of GCAs) will be more convenient from the point of view of ease in obtaining them, than true synthetics?

D.A.Bond: Yes, 'pseudo-synthetics', if you like to call them that, require less effort to develop than those in which the GCAs of the components are calculated, and would be more appropriate to breeders with limited resources. Also, some time is saved by omitting the one or two generations required to assess GCAs; the 'pseudo-synthetics' can be consisted as soon as the performance of the inbreds *per se* is known, and the performance of the pseudo-synthetics becomes, in a way, a measure of the GCA of the components insofar as it operates in this partially allogamous species. The best 'pseudo-synthetics' are then already at a stage when they can be multiplied for commercial use.

A.A.Ibrahim: To what extent might genetic drift interfere during the sequence of the synthetic increase and distribution to farmers?

D.A.Bond: The rate of genetic drift has not been measured but it is always possible that it will occur. Our practice at the Plant Breeding Institute, Cambridge, is to allow the generations syn-4 to syn-8 to go to the farmer. Generations syn-1 to syn-3 are under close control so there are up to four generations in commerce. Successive new stocks are periodically reconstituted from stored seed of syn-1 (or parent lines). The importance of drift will depend on the degree of contrast of the parents. In the case of white-flowered synthetics or small-seeded synthetics (in which large seeds are unwanted) pollen contamination from outside is more often a reason for reconstitution than genetic drift within the synthetic.

M.Frauen: You pointed out that combining ability can be estimated very well by measuring the yield of inbred lines _per se_; this is ratehr unexpected for me. One reason could be that we don't have two distinct gene pools in _Vicia faba_, which result in high heterosis when crossed together. I think that in order to use heterotic effects systemically, we should build up two, or more different gene pools, select inbred lines within these pools and develop synthetic varieties from these lines.

D.A.Bond: Your prediction could be correct, but the evidence we have at the moment is that most of the variation between crosses is due to GCA, very little to SCA, and that most of the GCA variance can be attributed to regression on performance of the inbreds _per se_. In view of these results, the refinement in selection which could be made by recognising and utilizing this residual variance, has to be balanced against the effort involved in making the crosses and against the fact that faba bean synthetics undergo only 30 or 40% natural crossing. The extra heterosis which might come from inbreds selected from your two contrasting gene pools could alter this argument if it were shown to be more attributable to SCA or less well releated to the inbreds' performances. Does a higher degree of heterosis necessarily implay that crosses will be less well predicted from their mid-parent values?

H.Weltzien: Was the concept of increased disease resistance by gene combination included in any of the synthetic varieties mentioned?

D.A.Bond: No. This was only mentioned as a concept for the constitution of future synthetics.

S.A.Salem: What is the best number of inbreds we should use for yield stability in a synthetic variety?

D.A.Bond: As with mean yield, so with stability. If all potential components, e.g. inbreds, of a synthetic are ranked in order of yield stability, then the number of components to include in a synthetic will be a compromise between, on the one hand (a) choosing the higher ranked (few in number) and, on the other (b) avoiding further in breeding during multiplication of the synthetic as a result of natural crossing between related plants (higher number). The best compromise is probably four to six inbreds. I do not think that increasing the number of inbreds would necessarily improve stability, and it would almost certainly decrease mean yield.

S.A.Salem: What is the number of Random Advanced Generations used to reach genetic equilibrium?

D.A.Bond: Genetic equilibrium seems to be reached at syn-3 or syn-4 generation. This was predicted by Dr. A.J.Wright (J.Agric. Sci. 1977) and has been found in practice.

J.Witcombe: Since the synthetic varieties and inbred lines had means and variances that were correlated, a Findaly and Wilkinson analysis only reveals this relationship. A simple way of overcoming this problem would be to use coefficients of variabilities as a measure of stability.

<u>Mutation Breeding in Faba Beans</u>. M.M.F.Abdalla.

F.A.El-sayed: Please elaborate on why you feel that genetic variability is narrow in this crop. My feeling is that there is ample genetic variation in beans.

M.M.F.Abdalla: There is rich variation in some characters, but many characters suffer really from lack of useful genetic variation.

M.H.El Sherbeeny: The short mutant is too compact, and this will affect the total yield. Also, under the Egyptian irrigation system, this will encourage fungal diseases and other pests.

M.M.F.Abdalla: Our experience is that determinate growth mutants should not be used directly in Egypt. They are poor yielders.

G.P.Chapman: The speaker's requirement for more 'useful' material needs to be related to particular plant models since what is useful under one set of circumstances may not be in another. There is, in fact, a lot of genetic variation available to answer the larger questions about alternative models. Mutation breeding has already yielded more variation than breeders can handle at present.

M.M.F.Abdalla: If you thought that mutation breeding has yielded variation that could not be handled by breeders, I would ask you how many variants are known to be immune or highly resistant to chocolate spot, <u>Orobanche</u> etc. As you will hear later from Dr. Sjodin, variability in amino acids is not sufficient, and we have to search for new genotypes; and do not forget that the determinate growth habit used now in altering the plant model, originated from mutation research and not from the available variability.

G.C.Hawtin: Pure line collections offer the best opportunity for identifying recessive genes, especially for disease resistance characters, which can best be screened on a line rather than a single plant basis. Good progress in this is being made at ICARDA. I am convined there is adequate variation in V.faba.

F.A.Salih: All the genotypes received from Ford Foundation, ALAD or ICARDA failed to adapt in Sudan. They need a longer cooler season than we have in Sudan. We find that there is nothing better than the genes controlling our local genotypes in adaptation and yield. The future for mutation breeding will be to create variability in our local material so as to have a better chance of selecting better yielding resistant types.

K.A.Agabawi: My understanding is that the environment is the sum total of all factors influencing production both above and below ground. Would you please give your concept of environment? Do you mean that mutation research aims at enriching the variability for adaptation to different environmental conditions or do you mean enriching variability for tolerance to adverse prevailing conditions?

M.M.F.Abdalla: We do hope that part of mutation research will be directed towards developing stocks that resist fluctuating environmental conditions. This may occur in addition to breeding against other factors that will affect yield stability e.g. pest resistance.

Interspefic Hybridization in Vicia. Dr. J.I.Cubero.

M.Solh: What are the possible advantages for hybrids between *Vicia faba* and *Vicia melanops*?

J.I.Cubero: First and possibly the only one is the theoretical demonstration that interspecific hybrids involving *V.faba* are possible. Second, once the alloploid (or simple hybrid) is obtained, we could have a way to transfer some *Vicia* characters to faba beans. *Melanops* itself does not show more convenient characters than for example, *Aegylops squarrosa* concerning *Triticum aestivum*. But as in this latter case, the results to be obtained with interspecific hybridization are unexpected.

C.Bernier: How variable is *V.narbonensis*?

J.I.Cubero: If you consider the complete *narbonensis* group (*narbonensis*, *serratifolia* etc.) as a set of conspecific species (this has not been completely worked out, but it is a very likely possibility) then there is a large amount of variation. Up to now, this is more easily seen in *herbaria* than in living collections. A good deal of systematic study in the *Vicia* genus is required.

C.Bernier: How many accessions of *V.narbonensis* have you used in your crossability studies?

J.I.Cubero: We have used two, but if you consider that all people who have crossed *narbonensis* with *faba* have used different strains of *narbonensis*, this number can be about 20, only considering published results; also many attempts have never been published.

The Utilization of Faba Beans and Their Role in Diets in Egypt. G.Gabrial.

M.M.F.Abdalla: I suggest that you remove the topic 'history of broad bean' from your article. I know it is not yours, but it is certainly incomplete and may, in some places, be inaccurate.

G.Gabrial: The history of faba bean mentioned in the paper, is concerned only with the place in which broad bean probably originated, when it was known in Egypt, and which group of Egyptians used to eat it in the past. The paper is not concerned with the whole history of faba bean which would need a lot of space. About the accuracy, the information is based on the book "Legume in Human Nutrition", by Aykroyd and Doughty, published by FAO in 1964.

G.C.Hawtin: Do you have any breakdown of the consumption with income, and comparing consumption by different members in the family e.g. consumption by children compared with adults.

G.Gabrial: According to my personal knowledge, the consumption of cooked faba beans in urban areas is more than in rural areas because of the large numbers of shops and restaurants in towns which specialize in selling stewed faba beans and bean cake. In rural areas, cooked faba beans are made at home because of the limited number of shops. The consumption of green pods is less in urban areas than in rural areas. Faba beans used to be eaten by low socio-income groups but recently they have been eaten by most Egyptians, especially at breakfast.
It is hard to make any comparison about the consumption of faba beans by different members of the family because it is a habit among low socio-income people for every one in the

family to eat from the same dish. Mothers used to feed their weaned babies at the same time by putting small portions of food in their mouths.

Protein Quantity and Quality in *Vicia faba*. Dr. S.Sjodin.

M.M.Musa: It was evident from the presentation that there was marked variation in crude protein content of faba bean seeds in different seasons. Do you have an explanation for this and which environmental factors do you think are most related?

S.Sjodin: No. I do not have an answer but it is probably a question of water, temperature and those other factors that determine the development of the crop. Maybe *Rhizobium* effectiveness is also involved.

A.M.Shehata: What about variations in the non-protein content of faba bean seeds?

S.Sjodin: We have not measured that separately.

Phil Williams: Did you attempt any fractionation of proteins to explain the lack of transmission of higher methionine to progeny? e.g. in high lysine corn, it is variation in proportion of zein relative to other proteins that gives rise to the differences in total lysine.

S.Sjodin: We have made some attempts to change the legumin-vicilin ratio but have not obtained any positive results; probably mainly because we have not worked with a constant protein content. Maybe Dr. Boulter can comment.

R.Boulter: Vicilin and legumin are the major proteins of faba beans. The ratio of the amounts of vicilin to legumin decreases during the later stages of seed development. Vicilin contains a higher content of lysine and lower levels of cysteine and methionine, especially the latter than legumin. These facts explain, at the molecular level some of the amino acid content/protein content relationships presented by Dr. Sjodin.

High sulphur amino acid proteins of seeds are the trypsin inhibitors, (the cystine of which is not readily available for the rat even in heat-treated meals where the trypsin inhibitor is inactive). There is also a high sulphur containing albumin which can play an important part in some methionine containing faba lines.

R.Marquardt: Does the non-protein nitrogen content, which may be as high as 10% of total nitrogen, vary between the high and low protein lines? That is, is part of the change in protein attributable to a change in non-protein nitrogen?

S.Sjodin: We have not measured the amount of non-protein nitrogen so I have no information to give.

M.Obeedat: Why does the protein content decrease in pods which are situated on the higher nodes of the plant?

S.Sjodin: We don't know, but it might depend upon differences in the time of development between the nodes or it can depend upon differences in the transport system of nutritional substances.

Anti-nutritional Factors in Faba Beans. Dr. L.A.Hussein.

F.A.El-sayed: As a breeder, I would like to know how much variation there is for anti-nutritional factors; how long it takes to measure one sample for anti-nutritional factors; and how much a measurement costs?

L.A.Hussein: Tables 1, 2 and 3 answer the initial question. They demonstrate the range of anti-nutritional factors in three cultivars. One can select for tannin-free and lectin-free cultivars.

The trypsin-inhibiting assay is a fast assay. It depends on a kinetic reaction whereby the release of p-aniline, the product of trypsin hydrolgsis of the synthetic substructure n-benzol-arginine nitroanilide is followed spectrophotometrically at the wave length of 410 mm. The most tedious assay is that of tannin. The assay of lectins is quite a routine assay, as also is that of aligosaccarides.

The trypsin inhibitor assay and lectin assay are not expensive. Assay of oligosaccarides requires the availability of gas chromatographs. Equipment is expensive. The assay of condensed tannin requires large amounts of ether and is time consuming and expensive.

K.A.Agabawi: From what we have heard this afternoon, it seems that is deficient of some nutritional ingredients and, at the same time, there are certain harmful ingredients to health. How can we make good these deficiencies and avoid the harmful effects of Vicia from a practical point of view.

L.A.Hussein: We have carried out an animal feeding experiment to assess the nutritional quality of raw and stewed (cooked) broad beans. (Hussein,L., Gabrial,G. and Marcos, S. 1974. J.Sci.Fd. Agric. 25, 1433). The beans were incorporated into diets as the sole source of protein, or mixed with baladi bread (87.5% extraction) at different proportions. At all levels, the sulphur containing amino acids were first limiting, and the nutritional quality was corrected by methionine supplementation.

The commercial food industry is capable of producing foods based on faba beans, in which methionine is corrected by covalent bonding through the plastein reaction.

Further, the results of Rachis et al. should be considered carefully since they showed that the ingestion of low levels of protease inhibitors over a longer period of time, may increase the requirement of vitamin B_{12}.

FAVISM Dr. R.Marquardt.

Phil Williams: Have you screened any cultivars for vicine and, if so, what is the range?

R.Marquardt: We have not screened any cultivars for vicine and convicine, but the method can readily be adapted to routine analysis of faba beans. Approximately 20 to 40 samples per day can be analysed on a routine basis.

A.El Beltagy: Do you use any purification methods before using the HPLC? It seems to me that without this, your column efficiency will decrease.

R.Marquardt: The method of extraction involves homogenization of samples in 5% perchloric acid, followed by centrifugation of the sample and filtration through a cellulose acetate membrane having an effective pore size of 5 microns. The filtrate is injected directly into the reverse phase column. The yield, recovery, precision and accuracy using the crude extract were the same as that obtained when using pure preparations of vicine and convicine. However the column must be washed with the appropriate solvent after approximately 30 analyses, so as to remove absorbed compounds.

D.A.Bond: What is the relative anti-nutritional significance of L-dopa compared with vicine? Would a cultivar lacking in L-dopa (e.g. Triple White, see FABIS Vol. 1) have any advantages?

R.Marquardt: Our studies with the laying hen would suggest that a relatively high level of dietary DOPA (1%) did not have an adverse effect on bird performance or on certain biochemical parameters. *In vitro* studies by Mayar with glucose 6-phosphate dehydrogenase deficient erythrocytes also demonstrated that DOPA did not affect glutathione or ATP levels. There appears to be a synergystic interaction, however, between vicine, convicine and DOPA in erythrocytes. It may be concluded that DOPA does not cause favism but may synergistically enhances its effect.

Cooking Quality and its Relationship to Agronomic Factors and Chemical Composition. Dr. A.M.Shehata.

F.A.El-sayed: In a practical breeding program with limited resources, what are the quality traits that you would recommend for a plant breeder to take into consideration to produce a good quality variety?

A.M.Shehata: Easiness to cook, i.e. short cooking time, and soft texture are of prime importance for consumers. Seed weight, volume and relavite density should be taken into consideration. The percentage of hulls (seed coats) affects the nutritive value as well as seed qualities. This trait deserves more attention from the breeders.

G.El Sarrag Mohamed: Have you examined the relationship between seed size and cooking quality?

A.M.Shehata: The relationship between seed volume and the various cooking characteristics has been studied for the past two years, and no significant relationship has been found between seed volume and any of the studied characteristics of stewed faba bean. Moreover the largest and smallest seeds of the same sample were compared and no difference was found between them with regard to penetrometer reading and taste panel score for softness.

R.Marquardt: Do the organolyptic properties differ in tannin-containing cultivars from those in tannin-free cultivars.

A.M.Shehata: Research has not been done. Dr. Bernier teels me that such research is currently being done in the Plant Science Department at the University of Manitoba, Canada.

M.C.Saxena: In your table on relationships between the soil properties and the cooking quality, you have shown a high positive relationship between 'saturation' and cooking quality. Does this 'saturation' refer to the saturation capacity for soil moisture or to 'base saturation' or something else?

A.M.Shehata: Saturation percentage here refers to the moisture content of soil on an oven-dry basis in a saturated soil paste.

Hard Seed in Faba Bean. Dr. F.A.Salih.

A.H.El Nadi: It is noted that from the results of different experiments, some of the factors conducive to high yield e.g. increasing plant populations, frequent irrigations (in some cases) and phosphate fertilizer, are all associated with an increase in the percentage of hard seeds. It is therefore suggested that the percentage of hard seeds could be investigated further in order to evaluate the trade off between the beneficial effects of inputs on the yield and the resulting increase of hard seeds.

F.A.Salih: This subject of hard seeds in faba beans is a complicated one in which a lot of factors are involved. Hence a lot of work is still needed. Studies are needed on the genetic inheritance and the history of the seed coat and the role of various factors of environment and crop husbandry practices in relation to the hard seed characters. I am not giving any recommendations or releasing any information to be taken for granted.

Some Physiological Aspects of Adaptation: Dr. M.C.Saxena.

F.A.El-sayed: Could you elaborate on the effect of day length on the productivity of beans?

M.C.Saxena: When one compares the performance of the crop under natural day length conditions (where the day length is increasing with advancement in the crop age) with that under continuously long photoperiods, there is generally no advantage in the productivity with those under continuous long days. In fact, some Japanese work suggests that productivity is largest with the naturally increasing day length. But when comparison is made with shorter days of 8 hrs. photoperiod, advantage of the extended photoperiods is quite conspicuous. For proper development of florets and pods, most of the genotypes, particularly the winter types from Europe, seem to have a specific requirement for long days.

D.A.Bond: Is the frost resistance found in Syria of the same type as that studied in European cultivars by Herzog, and, if so, would a breeder expect to be dealing with the same set of genes?

M.C.Saxena: Herzog's work showed that winter types had only slightly higher frost tolerance (a difference of 0.5 ^{o}C) than spring types when they developed under non-inductive conditions (long days, high temperatures) and a similar difference was maintained in tolerance after the cold tolerance induction had occurred. The frost tolerance found in Aleppo may partly be of a similar nature. But an additional factor contributing to the tolerance in some of the Mediterranean types found in Syria, is their ability to recover from frost damage by regrowth of the shoots from the buds which may otherwise remain dormant.

K.Caesar: What was the vernalisation temperature, and is it equal for all varieties?

M.C.Saxena: The vernalisation for all varieties in our studies was done at about $5^{o}C$ temperature for various lengths of time, depending on the nature of treatment. Others have used vernalisation temperatures ranging from $2^{o}C$ to $14^{o}C$. General observations are that the vernalisation is most effective at temperatures above $4^{o}C$ and below $14^{o}C$.

H.C.Weltzien: The plants in the irrigation experiments at Sakha Research Station had very strong vegetative growth but little fruit setting. Do you think better adapted varieties can be recommended?

M.C.Saxena: The overall growth in those plots was very good, as would be expected from a well adapted cultivar. The close examination of those plants revealed that they all had a large number of reproductive nodes but only a few of them had any developing pods. It was told to us during the visit that there were severe dry winds a few weeks back for several days, which resulted in serious flower and young pod drop. It appears that if the temperature does not rise excessively, there may be some compensation by the setting of pods formed from newer flowers. It may be difficult to recommend varieties that may stand such adverse conditions, but the indicating the environmental heat stress in several other crops as well.

C.Bernier: What is the variability within a cultivar to the vernalisation response? How many plants of each cultivar were used in your tests?

M.C.Saxena: There is a large variability within a cultivar insofar as days to flower initiation is concerned. That is why the standard errors are relatively high. The treatment differences have become evident in spite of these large variations within a cultivar.

Alternative Plant Models: Dr. G.P.Chapman.

P.Hebblethwaite: Many workers have correlated the amount of intercepted radiation with yield. Obviously your short generation time decreases the duration of growth and potential for intercepting radiation. Future breeding would need to take this into account.

G.P.Chapman: I agree. Rapid turnover allows us to recombine genes and answer some questions now current. Lengthening the life cycle eventually is, I suspect, very simple, especially when one considers that the indeterminate parents could also be expected to contribute useful genes such as *Botrytis* resistance or low tannin seeds.

D.A.Bond: Which component(s) of yield - number of podded nodes, seeds per pod, or weight per seed-should the breeder concentrate on in order to increase the yield of determinate types?

G.P.Chapman: Given the variation now available, the problem is to choose which phenotypes to grow and at what optimal density. We therefore adopted the following interim solution. With increasing density, a given determinate type concentrates its yield on the main stem. We have also found that planting up to $150/m^2$ will increase yield per unit area. Our approach was to look at this stage for high seed number per plant favouring those that concentrate their yield (even at low density) on the main stem. After bulking, this material can be used to give a fuller answer to your question.

G.A.Salt: It seems to me that a crop with all its pods exposed at the top, will show considerable resistance to some seed-borne disease such as Ascochyta. This would be field resistance or disease escape rather than inherent resistance. Ascochyta is spread mainly in rainspots so that pods at the top would escape much more of this than pods carried within the leaf canopy.

G.P.Chapman: The evidence so far is conflicting. Dr. Bond found increased Ascochyta susceptibility in determinate types. Again, pathologists in the field cannot always readily distinguish between Ascochyta and Botrytis. We found that a segregating F_2 showed heterogeneous response to what subsequently was shown to be Botrytis and the parent types replicated through the F_2 showed relatively uniform response.
Material selected from the plot showed, in detached leaf tests, evidence of different levels of susceptibility to Botrytis.
Our provisional conclusions were that Ascochyta

susceptibility need not be associated with determinacy and that resistance breeding for *Botrytis* etc. was feasible.

G.C.Hawtin: On the question of the relationship between the determinate habit and diseases, our experience at ICARDA indicated that the original mutant material received from Svalof was highly susceptible to *Ascochyta* blight. Crosses between this material and local *Ascochyta* blight tolerant lines gave rise to segregants combining tolerance with the determinate habit. We concluded that the high susceptibility of the Svalof lines was due to a highly susceptible genetic background, and was not related to the determinate habit *per se*.

G.El Sarrag Mohamed: The determinate type of growth might be advantageous in environmental conditions where the effective growing season is very short e.g. in Sudan, and luckily, Dr. Shaaban of Egypt has observed determinate plants in our recommended local variety, H 72. The breeders will be able to use this material in their breeding programs.

G.P.Chapman: I should like to urge that such determinate material be offered to ICARDA and that in one or both stations efforts should be made to determine whether or not a single recessive allele is involved, and the results reported to FABIS.

There is a wider issue. Sjodin's original mutant has created great interest but breeders' experience has revealed problems such as restriction of flowering node number. The retention of natural mutants for breeders would give them wider choice. It should be stressed that such variants would normally only be seen with careful search, and would be at a disadvantage in an indeterminate population.

M.M.F.Abdalla: Do you have data concerning(yielding ability and stability of yield in your determinate types compared to normal growing one?

G.P.Chapman: The answer to this question is essentially the same as that given to Dr. Bond. What needs to be stressed for the benefit of agronomists, is that breeding generates an immence number of alternative types, all available initially in very small amounts.

The breeder has no real alternative at that stage but to make what he thinks are commonsense selections which can then be bulked (which consumes time). Only after this can he (the breeder) then answer the question which Dr. Abdalla asked.

M.C.Saxena: Do you think that the stability of yield of determinate types will be less because of the lack of plant's ability to compensate for the flowers that may be damaged by adverse factors (frost, heat stress, damage by chewing-type insects etc.).

G.P.Chapman: One feature that I should like to explore in detail experimentally is the relative morphological stability of these rather 'simple' phenotypes. So far, we know that particular selections can perform (in this sense) similarly in the open or in a winter glasshouse, but stem extension can be influenced by flourescent versus sodium light. Since (arguably) there is less to vary in these 'simple' plants, perhaps it would be useful to test these systematically against a representative indeterminate.

At a more directly practical level, probably concentrating germination, emergence, flowering and setting into the period when water is available in arid environments, might comprise a useful drought avoidance. Compensating for flower loss is possible in two ways, either repeat flowering along the main stem or by giving new flowering branches, (the 'cereal' method.

L.M.Monti: It seems to me that the determinate model of plants you showed could react much better than the indeterminate types to Rhizobium inoculation. Have you any data on Host-Rhizobium interactions with the neotenous plant types?

G.P.Chapman: All we know at present on the basis of a very limited project at Rothamsted, is that our system appears not to differe from teh normal indeterminate plant/Rhizobium interaction.

D.A.Bond: It has been suggested that the vegetative top of indeterminates may be supporting the continued activity of nodules. Might determinates be at a disadvantage in this respect?

G.Chapman: The photosynthate from an indeterminate might sustain nodules which might allow cytokinin production that could then be available to fruits. Applying cytokinin exogenously to flowers certainly is stimulating to fruit setting and development, as we have shown at Wye with the work of Dr. Aswaf Sadjadi.

What remains unresolved is that even if the indeterminate type can better support its nodules, the efficacy of any presumed cytokinin transfer from nodule to infloresene can still be augmented by exogenously applied cytokin.

The Effect of Water Stress on the Growth, Development and Yield of *Vicia faba* L.: Dr. P.Hebblethwaite:

G.J.Koopman: Could you be more specific about the range of harvest index and relationship to total water use? Your graphs 3 and 4 seem to indicate a rather stable ratio between total dry matter and seed yield as water consumption increases. Do you have any information on the relocation of photosynthates to the root system, promoting root development and reducing vegetative growth during temporary periods of water stress?

P.Hebblethwaite: The ratio appears stable because the total and seed yield lines are parallel. This is because the regression analysis gives the best fit through both sets of points. However individual yield points for different treatments fluctuate either side of the lines, and when fluctuations are wide, the harvest index is not constant. I am therefore indicating that this is the reason for the fluctuation. I have no data on the subject of relocation of photosynthates.

A.M.El Nadi: You have stated that your work has shown, unlike the findings of workers in different parts of the world, that water stress did not result in earliness of the flowering time. Would you accept to reconcile your findings in this respect with other workers who found earliness in flowering to be induced by water stress, in view of the very demonstrable facts that the onset of flowering can also be affected by temperature, day length, the interaction of day length and temperature, and by variety?

P.Hebblethwaite: I have made the statement on the basis of published data in international journals. I would welcome additional data showing that the start of flowering is influenced by water stress as this has been shown in many other crops. I agree that this effect is likely to be greater in the Middle East where day length and temperature are likely to give additional interactive stress effects.

M.Musa: As indicated, the soil moisture stress plays a major role in biological nitrogen fixation. It will be worthwhile to know if the interaction of soil moisture stress and soil temperature has been studied to any extent. In arid warm environments, this is probably most important.

P.Hebblethwaite: You will note from the final section of my paper that a number of British scientists have looked at the effects of water stress on nitrogen fixation. However, work in the Middle East is very limited, and research is needed urgently in that area. This is particularly important in relation to the high cost of nitrogen.

H.W.Tawdros: On the point about the effect of soil moisture stress on the earliness of flowering, I have noticed that drought conditions have an effect on the earliness of flowering and, in turn, with maturity.

P.Hebblethwaite: I hope that this information will be published. I agree that maturity is delayed in irrigated crops, and we have measured this in all of our trials.

M.C.Saxena: Our studies on moisture extraction by faba bean genotypes, using neutron scattering technique, have shown that faba bean

roots extract moisture down to 150 cm deep. There are also genotypic differences in the moisture extraction pattern.
In your Fig 5, what is the soil depth/to which the maximum potential water deficit has been computed?
How do you explain the improvement in the efficiency of bottom roots to extract moisture with advance in the age of the crop?

P.Hebblethwaite: This is most interesting since no other published work has shown a greater extraction depth than 0.9 m. Are you certain that your soil water scientist has adjusted his subsoil water data for late drainage? If he has, it seems that your genotypes are deeper rooting. I suggest that further work should measure roots directly to confirm these extraction depths. It may also be worthwhile growing faba beans in transport pipes containing material with low resistance to root growth in order to measure the maximum root depth. I have done this with *Pisum sativum* and have never been able to encourage the plants to root deeper than 1 m. It is also interesting to note your genotype differences in rooting depth. This must have a potential for breeding.
The maximum potential deficit was calculated from waterlogged data (Penman, 1960). The water use data was calculated on the basis of extraction to rooting depth.
I am not sure what the mechanism for this is. However this has been shown in other crops e.g. wheat, barley. I feel it is a natural adjustment to water availability.

S.Khalil: In Table 1 you mentioned that the non-irrigated treatment resulted in short internodes. Do you think that the reasons are due to irrigation or to soil structure.

P.Hebblethwaite: I feel that soil structure has nothing to do with it.

Tolerance to Salinity. Dr. K.Caesar.

M.M.Musa: We will be reporting today on the effects of salinity *in vitro* on the *Rhizobium* component. One would like to relate the concentrations reported in your paper to levels of electric conductivity in soil. This would be worthwhile for comparison's sake.

K.Caesar: I agree with this suggestion. Indeed the salt concentration should be given in terms of electrical conductivity in order to make comparisons easier.

M.H.El Sherbeeny: You studied the effect of each salt alone, and this is not the real picture in the soil. I believe it would be more effective to study a mixture of salts.

K.Caesar: I have already pointed out that this will be the next step of research which I have envisaged.

M.Solh: The main limitation in tissue culture is redifferentation to whole plants. This has been done only in a very limited number of crop species e.g. rice and tobacco. So far, to my knowledge, no work has shown that this is possible in *Vicia faba* or in any other legume crop. In addition, you have no assurances that selection for salinity tolerance at the tissue level would hold for the redifferentiated plant under natural conditions.

P.Hebblethwaite: The main effect of utilizing saline water for irrigation would likely be to decrease water use in the plant. To confirm this, future experiments should measure water use and its effect on yield when using saline water. This data could be used to see if it fits the yield water use response model proposed in my paper.

G.P.Chapman: If you look at the available range of salt tolerance (even with rapid screening techniques), you need also to know the rate at which soils are becoming saline. If the upper level of tolerance is identified, it then has to be incorporated faster than soils becoming excessively saline. Unless a realistic estimation of salinization can be given to the breeder, I would strongly advise against anyone becoming involved in breeding for salt tolerance. The alternative would be that his best material (with its substantial committement of time) will arrive too late.

K.Caesar: There are no indications that increasing salination is a steady process. Soil salinity is changing and we will always find a whole range of salinationn levels.
Tolerance to salinity in plants will find a physiological limit. We will not be able to breed for tolerance to high levels of salinity. Before breeders start work on that problem, physiologists should know more about the nature of salinity tolerance.

A.B.Saghir: It is known that salt tolerant plants have C_4 type or CAM type photosynthesis. It may be worthwhile for the plant breeders to screen for varieties which have high levels of organic acids or anions which may counterbalance the effects of cations such as Na^+ and thus be of value as salt tolerant

M.C.Saxena: It appears from your slide on the root growth that your plants in salinity tests were not nodulated and they should have depended on the combined nitrogen. Do you think that the differences in treatment effect would have been further modified if your plants were to depend on symbiotic N fixation? Since the plants in the field depend on the symbiotic N fixation for most of their N-need, would it not be better that salinity screening tests are done with nodulatd /inoculated plants?

K.Caesar: Perhaps it is not possible to identify nodulation on but, of course, we had nodulation which seems to be affected also by the salinity treatment. According to a publication concerning trials inn Sudan on salinity effects on faba beans, it was mentioned that there was nodulation but it was reduced by, for example, 18-50 nodules per plant under non-saline conditions, and 8-20 under saline conditions. Inoculation in our trials was therefore not necessary because there was nodulation in all the varieties.

Flower and Pod Drop. Dr. M.M.El-Fouly.

Gaafar El Sarrag: My comment is that flower drop in faba bean is analagous to grain set in wheat where there are about six to eight florets per spikelet and only two or three grains are produced per spikelet. I have studied the effect of tiller removal, light regime, and nutritional level on grain set in wheat and have found that tiller removal increased grain set greatly, even

under optimum light and nutrient levels.
It seems that growth regulators, espcially those produced in the root system e.g. cytobinin, play a big role in both grain and pod set. It might be of advantage for breeders to look for plants with an extensive rooting habit.

Aspects of Faba Bean Agronomy in Egypt. A.A.Ibrahim *et al.* presented by Dr. M.H.El Sherbeeny.

C.Bernier: In Table 3, to what do you attribute the high differences in yield between the best treatment at Sakha and Bahteen?

M.H.El Sherbeeny: These differences are mainly attributed to differences in climatic conditions in the two regions; soil fertility and disease incidence.

K.Agabawi: When testing certain variable treatments, do you use all the recommended inputs, other than your variables, as base treatments on all plots. e.g. ferilizer, crop protection etc.?

M.H.El Sherbeeny: Yes. All the recommended inputs were used, other than the variable being tested.

N.Haddad: Do you notice different disease incidence under different plant population treatments? If yes, how does this affect the results if you control the disease?

M.H.El Sherbeeny: Yes. Disease incidence was mugh higher in the high plant population than in the lower densities.

M.S.Hassan: Egypt is considered to be the Mother Country for faba beans. As such, a lot of basic agronomic factors such as sowing date, should have been well established with the exception of the development of new cultivars. Also, was no work done before 1969 when your review starts? No report is made of interaction experiments for sowing date and plant populations;sowing dates and fertilizer or irrigations etc. Has there been any such work?

M.H.El Sherbeeny: This year, we are trying factorial trials concerning sowing dates x fungicides x plant population; variety x fertilizer levels; tillage x varieties; and tillage x preceeding crop x fertilizer level.

S.A.Salem: Why did you not use combined analysis in the different experiments?

M.H.El Sherbeeny: Because we used different varieties in the different experiments.

P.Hebblethwaite: I feel that interaction multifactorial experiments rarely give significant interactions. I would prefer agronomists to look at more detail in single factor experiments rather than spending time on the complexities of multifactorials. Multifactorials can be useful when a large number of workers from a large number of disciplines do detailed work on the trial e.g. see McEwen et al. (1981) in J.Agric. Science. Such an approach is normally out of the scope of most research stations.

W.P.Schroder: i. How do you explain the fact (Table 6) that there is a positive advantage of N= 17.86 kg and a negative impact of a dosage of 35.75 kg?

ii. Did you have any experience about giving the N dressings immediately on the date of seeding?

M.H.El Sherbeeny: i. There were significant differences due to different levels of N application in only 50% of the experiments. This is to be expected since the specific Rhizobia for faba beans are well established in most Egyptian soils. Hence a little dose of nitrogen fertilizer stimulates the nodulation and nitrogen fixation, and any increase over this level might inhibit the nitrogen fixation process.

ii. The N dressing at sowing time is indicated in the paper.

Aspects of Faba Beans Agronomy in Sudan: O.A.A.Ageeb *et al*. Presented by Dr. M.T.Babiker.

P.Hebblethwaite: I note in your summary that you quote the amount of water used and its relationship with yield. However, I am unable to find the full data in the text. It would also improve the paper if you quoted the data using the internationally accepted unit of mm of water used. I could then see how your data fitted my linear response model.

M.T.Babiker: It would certainly be useful if these amounts were converted into mm of water. It is unfortunate that the full data are not included in this paper.

H.W.Tawdros: You have mentioned that faba beans plants use about 6000 m^3 of water per hectare. Would you please let me know if this is applied water or is it conserved by plants?

M.T.Babiker: This is the amount of water used by the crop when it is watered every seven days.

M.S.Khadr: You mentioned that faba beans did not respond to application of phosphorus. What is the level of available phosphorus in such soils? What is the pH value of such soils?

M.T.Babiker: I do not know exactly the value of available phosphorus in the soil but it is generally considered adequate. It could be around 10 ppm. The soil pH is higher than 8.0.

M.C.Saxena: The chairman of the session has asked me to summarise the results of the International Faba Bean Fertilizer-cum-Inoculation Trial. The data for Sudan and Egypt have already been presented by the cooperators from these countries. At other locations, positive responses to phosphorus application were obtained only when available P content was less than 5 ppm. No response was obtained to potassium application, and there was no response to inoculation at most of these locations.

Weed and Orobanche Control. Dr. M.K.Zahran.

M.H.El Sherbeeny: Did you find any relationship between soil type and the degree of infestation with *Orobanche* ?

M.K.Zahran: The rate of *Orobanche* parasitism is lower in the heavy compacted soils than in the light soils.

F.A.El-sayed: What is the percentage of economic losses from <u>Orobanche</u> compared to other weeds in beans ?

M.K.Zahran: The loss in faba bean seed yield to <u>Orobanche</u> parasitism depends on the rate of infection. In some fields, such losses might reach 100%. The loss due to weeds is 25-30% on average. Here again, the loss depends on the weed species which are prevailing in the field.

M.T.El Saidi: The residues from most of the herbicides may persist in seeds and prove harmful to humans and animals.

M.K.Zahran: Before making recommendation for any chemical, we have to make sure about toxicity. As we heard from Dr. Saghir, the study of the residual analysis of glyphosphate in the treated seeds showed a residue of 0.05 mg per kg which is below the toxic level. However we will try to get more information before the release of such herbicides for commercial use.

T.O.El Badawi: i. I did not find in your tables on weed competition any reason for the six weeks to be the critical period beyond which delaying the weeding could lead to yield reduction.
ii. What do you think the effect would be if unfavourable conditions prevailed when you apply glyphosphate for the control of <u>Orobanche</u> ?

M.K.Zahran: i. Table 1 shows quite clearly that where the weeds were left to compete with the crop for more than six weeks, the seed yield appeared to be significantly reduced.
ii. Under the conditions of the present work with the adjusted rate of application, there was no serious effect with glyphosphate. Phytotoxicity might have occurred with

overlapping or with overdose.

H.Weltzien: Has a survey on Orobanche occurrence and intensity been conducted in Egypt, and are there differences between the various growing regions in the country ?

M.K.Zahran: General observations reveal that Orobanche parasitism occurs much more in Upper Egypt than in Lower Egypt. Noticeably, growing faba beans after rice could save the crop from Orobanche parasitism because of the relatively high soil moisture and the consequent poor aeration in the soil which affect the development and emergence of the parasite spikes.

Breeding for Resistance to Orobanche: Dr. A.Nassib.

M.M.F.Abdalla: It is puzzling for me to find that the newly developed varieties Giza 3 and Giza 4 are more susceptible to Orobanche than old varieties Rebaya 40 and Giza 2, when work on Orobanche has been going on for more than 15 years. And you have told us now that the "Resistant" 402 F has been outcrossed with an unknown genotype. Does this mean that this is a segregating stock ?

A.Nassib: The new varieties Giza 3 and Giza 4 were never selected for Orobanche resistance during the course of breeding. They were developed from a cross between landraces and an introduction from Holland which was tolerant to Botrytis but probably susceptible to Orobanche. Giza 2 and Rebaya 40 are selections in landraces which have some tolerance to

Orobanche. As to F 402, please see Fig. 1 and you will find that this line was selected in 1973. Since that date, it has been subjected to several cycles of selection against *Orobanche*. But as it has never been propagated in isolation, we feel that further selection in this variety may raise the level of resistance to *Orobanche*.

J.I.Cubero: These comments refer to the papers by Dr. M.M.F.Abdalla and by Dr. Nassib.

i. The number of broomrape/plant does not show a normal distribution but the gamma one. Natural data have to be transformed by a logarithmic conversion. The best results are obtained by using $\log(x + 0.5)$.

ii. Recurrent is preferable to mass selection because the heritability of the number of parasitic plants/host is extremely low.

iii. There are at least three types of responses: a. complete fading (drying) of the host, b. green appearance but some fading and no pods (or very very few). c. green, almost normal appearance, with pods. Tolerance can be related with c.

iv. It is important to collect seeds from isolated farms in all the *Orobanche* region. Farms have been producing the faba bean seeds for a long time. By natural selection, there may be genes for resistance.

M.M.F.Abdalla: We, as reported in the article, collected seeds from farmers who do not use improved varieties (landraces). These are evaluated in the *Orobanche* field. What interests us is the relative quantitative resistance of the stock, using the concept of uniform resistance. The number of *Orobanche* per plant is not given significant weight by us at present. We need to collect information on many other aspects in order to have as complete a picture as possible about th whole relationship between host and parasite and their interactions as affected by different factors.

A.A.Ibrahim: i. Can I have an explanation for the increased number of tillers under Orobanche infestation ?
ii. Do you think that landraces still exist, taking into consideration the Ministry of Agriculture's practice which aims at producing enough certified seeds to cover the area under crop every three years since 1965 ?

M.M.F.Abdalla: i. The increase in the number of tillers in Orobanche-affected plants might be explained as being due to the direct effect of Orobanche attack or to an indirect effect due to compensation, but the exact reason is not fully known.
ii. The fact that landraces still exist in Egyptian agriculture is valid from our observations and studies on collecting local material.

Major Disease Problems of Faba Beans (*Vicia faba* L) in the Sudan: Dr. M.M.Hussein.

M.A.Ali: i. The paper does not contain th work on Powdery Mildew at Wad Medani (South of Khartoum) where it has been going on since 1975. The results in this area show clearly that higher plant population and closer spacing and early sowing result in higher rates of disease, but they all give higher yield.

ii. The nature of phyllody, causal factor and vector of the pathogen have to be investigated.

M.M.Hussein: i. I was not aware that such work was being done at Wad Medani.

ii. My observations for the past 10 years consistently showed that incidence of phyllogy did not exceed 2%. The drastic effect of infection leading to sterility makes it of potential, though at present minor, importance. The disease is known to be caused by a leafhopper transmitted mycoplasma.

H.Weltzien: Which are the diseases of economic importance, and is there any estimate of the yield losses caused especially by the powdery mildews ?

M.M.Hussein: Wilt, root rot, mosaic and powdery mildew are the main diseases of economic importance in faba beans. Wilt and root rot are responsible for early deaths in faba beans, and crops sown in mid-October could be wiped out completely. Artificial infection by mosaic causing viruses at two weeks after sowing, resulted in more than a 50% reduction in the number of pods and seed weight per plant. With powdery mildew, no real assessment of yield losses have been made yet.

K.Agabawi: Since the seedborne diseases reported inflict their greatest damage on early sown crops when temperatures are highest, and since in October the ridge laid east-west would have a cooler north side and a warmer south side, could we avoid the incidence of the disease by sowing our seeds on the cooler north side of the ridges which should be laid east-west.

M.M.Hussein: This is a good question. In the last few years, we have come to realise the effect of plant orientation on the incidence of root rot and wilt. Plants sown on the western side of a north-south laid ridge showed lower incidence than those on the eastern side under our conditions at Hudeiba. This aspect is now given due attention in our investigations.

M.M.Musa: It seems that the dilemma of sowing date in Sudan is coming up again. Root rot and wilt diseases, the most serious diseases, are encountered by early planting whereas virus and mildew diseases are favoured by late planting. This calls for more attention to the sowing date and the need to relate it to well defined parameters, rather than fixed dates.

M.M.Hussein: I quite agree.

G.A.Salt: It is clear that root rot and wilting are the direct effect of high temperature. You have shown that root disease is severe when crops are sown in October and only slight when sown only four weeks later in November, yet inoculum levels in the soil could not have changed much in this time. In selecting plants for resistance, you are probably selecting for tolerance to high temperature rather than direct resistance to disease. I also agree with an earlier comment that direction of ridging and the pattern of seeding on the ridges could be important in reducing soil temperature near the surface roots.

M.M.Hussein: Wilt and root rot diseases are favoured by higher temperatures in October just before the onset of cooler weather. Plants surviving in high temperatures without showing symptoms can be selected as tolerant or resistant to root rot and wilt disease. I quite agree with the second comment.

M.A.Ali: This is a comment to clarify partly the role of meterological data on the incidence of powdery mildew, using thermohydrographs in faba bean experimental plots in Hudeiba in 1963-64. It was found that the micro-climate of plants affects the incidence of the disease. Infection was found to be higher on the leeward side where the thermohydrographs recorded higher relative humidity and temperature.

M.M.Hussein: I agree that there is a need to relate meterological data to incidence of diseases, especially root rot and wilt.

Major Disease Problems of Faba Beans in Egypt: Dr. H.A.Mohamed.

H.Weltzien: Neither of the last two speakers has mentioned nematodes. As the stem nematodes *Ditylenctus dipsaci* is widespread in Morocco and was recently found in Syria as well, it is important to know if it is in the Nile Valley. As this nematode is seed transmitted, it is of special importance to ICARDA work.

H.A.Mohamed: Some work is being done on nematodes in leguminous crops, including faba beans; mostly root knot nematodes belonging to the genus *Melodogine*.

I.Ibrahim: i. If the date of sowing was the important factor affecting disease incidence (leaf spot), I would like to add that temperature has other side effects such as the effect on relative humidity and soil humidity. It has been observed that leaf spots are more severe in Lower Egypt where humidity is high while they are not pronounced in Middle and Upper Egypt.

ii. Does the use of fungicides for seed dressings affect nodulation in the plants ?

H.A.Mohamed: In a study of root rots of leguminous crops including faba beans, it was found that planting in soil infested with fungi causing root rots (Fusarium solani, Rhizoctonia solani), no nodules were formed. However when seeds were treated with fungicides, nodules were formed. Also, differences were noted between the fungicidal treatments.

D.A.Bond: Do you recognise the non-aggressive phases of Botrytis fabae as described in Europe and, if so, do you find a correlation between scores for the two phases ?

ii. Do you find good correlations between results of your detached leaf test and field scores, when comparing genotypes?

H.A.Mohamed: i. During this growing season, the aggressive stage was observed on many entries when planted in the plastic house at Giza. This shows that conditions in the plastic house are favourable to induce the aggressive stage. We shall evaluate our lines to this phase of the disease.

ii. The detached leaf test is still under investigation. However we have found a correlation between both tests in the few trials which we have done.

C.Bernier: The question of the effect temperature on chocolate spot, early work by Willis has indicated that temperature is important and that the pathogen because aggressive in a temprature rasing of 17-20°C with high Relative Humidity.

Breeding for Resistance to Botrytis fabae. Dr. S.Hanounik.
(Presented by Dr. G.C.Hawtin)

H.Weltzien: I wish to draw attention to the fact that mass infection under field conditions, does not identify resistance mechanisms based on reduced spread of the pathogen, such as sporulation or spore viability. To identify these resistant genes, the infection techniques need to be adapted. A broad based resistance is especially important with a pathogen which is as variable as *Botrytis fabae*.

M.M.F.Abdalla: I am glad to hear from Dr. Hawtin that there is a lack of variability in faba bean concerning disease resistance. This certainly goes also for other diseases. My question is, can somebody tell me whether there are physiologic races, and materials that may be considered as differential hosts. Under such conditions, would you agree with me that selection should be done on the concept of uniform resistance.

G.C.Hawtin: I strongly disagree with the suggestion that there is a lack of variability with respect to disease resistance. Resistance (but may be not immunity) has been reported to many diseases of faba beans, including *Botrytis fabae*, *Ascochyta fabae*, *Uromyces fabae*, and certain viruses. It is only a question of using the right screening methods on a wide enough range of materials, preferably pure lines. There is no information available yet on the existence of different physiologic races of _Botrytis fabae_. Only now, with the identification of good resistance sources can such studies become possible. The search for any source of resistance, whether under polygenic or single gene control, should be intensified. Let's worry first about identifying resistance and then adapt our selection approaches to the nature of the resistance identified. In theory, I agree that horizontal resistance is a good approach. But if I found a major gene conferring "vertical" resistance, I would certainly not ignore it.

G.P.Chapman: In compiling the list of genetic variation in _Vicia faba_, it was not always possible to attribute the appropriate status to claims about disease and pest resistance. The work of Conner and Bernier was a notable exception.
I would like to urge workers to attempt to define the status of resistance and to report progress in FABIS. This will make periodic revisions much more straightforward.

M.H.El Sherbeeny: How much damage is caused by _B. cinerea_ compared with _B. fabae_ ?

G.C.Hawtin: In Syria, _B. fabae_ is certainly the more dangerous. Perhaps Dr. Bond would like to comment.

C.Bernier: _B. cinerea_ differs from _B. fabae_ in that it causes only chocolate spot and does not become aggressive. Sporulation of _Botrytis_ occurs only on aggressive lesions i.e. in the case of _B. fabae_. This is why _B. fabae_ is destructive and _B. cinerea_ is not.

D.A.Bond: i. Screening of inbred (pure) lines will give the best discrimination for resistance, but tolerance, as measured by yield under heavy infestation may have to be assessed in synthetic varieties constituted from selected inbreds because of the vigour of the synthetics in overcoming the disease.

ii. Yield loss due to B. cinerea is thought to be very small.

H.Weltzien: The increased resistance in synthetic varieties may well be due to decreased spread, as observed in multiline varieties in cereals.

Abdel Hafiz: Selection for field resistance against B. fabae would obtain forms that have "disease escape" only, as infection with this disease depends strongly on environmental conditions. In our case where race identification is not yet known, we can use the Virulence Analysis technique suggested by Wolfe and Schwarzback (1975) in barley mildew. Using this method, one can, with the help of known resistant and highly susceptible genotypes , do screening for resistance.

Breeding for Resistance to Rust. Dr. C.Bernier.

J.I.Cubero: Have you tried the ratio 13:3 instead of 27:5 in these cases which you have mentioned ? There are reports in the literature concerning rust resistance in cereals. It seems that in the classical Mendelian ratio 9AB: 3Ab: 3 aB: 1 ab, the only susceptible (or resistant) are the aaBb + aaBB genotypes.

C.Bernier: Thank you for your suggestion: we will try this ratio.

S.A.Khalil: Do you think that there are any relationships between leaf age and infection, and for the breeding program, can selection be done according to the lower leaves or the upper ones ?

C.Bernier: We have worked mostly with young plants (three weeks from emergence) where susceptible and resistant reactions are clearly distinguished. In resistant accessions, older leaves are also resistant.

Honsi A. Mohamed: i. We have not observed the pycnial or aecial stage under Egyptian conditions, though this rust is an autocious rust.
ii. Some work was done in Egypt on the host range of *Uromyces fabae*, the isolate used infected only faba beans and peas but not other leguminous crops.

C.Bernier: Contrary to your observations, we have repeatedly found the pycnial and aecial stages of rust in the field on native *Vicia americana* as well as on cultivars of *Vicia fabae*. However these structures are not numerous, especially on faba bean cultivars, and are difficut to find.

Factors Affecting Resistance to Root Rot and Wilt Diseases. Dr. G.A.Salt.

Hosni A. Mohamed: One of the virologists in the Plant Pathology Institute, Giza, maintains that there is a virus symptom which resembles the symptoms of wilt caused by fungi on faba beans.

G.A.Salt: Yes, you are right. I have not seen the disease caused by broad bean wilt virus, but if one is not familiar with it, I imagine that it could be confused with wilt caused by a vascular wilt fungus e.g. Fusarium oxysporum f. fabae.

H.Solh: What is the rate and method which you use in applying the insecticide aldicarb ?

G.A.Salt: Aldicarb was applied at 10 kg/ha active ingredient, and worked into the seed bed.

Virus Diseases of Vicia faba. Dr. L.Bos.

S.Khalil: i. How can we distinguish the symptoms of broad bean stain virus on the leaves ?

ii. Do you think that virus infestation could be transmittted to nodules ?

L.Bos: i. Symptoms of broad bean stain and broad bean true mosaic virus are practically indistinguishable on leaves. Distinction between these viruses is usually by serology. However their symptoms often differ from mosaics caused by other viruses in being associated with irregular leaf deformation. Further development is often cyclic in infected plants.

ii. Most viruses go systemic in plants and infect all parts of the plant invaded. Bean yellow mosaic virus has been recorded to decrease root nodulation in faba bean.

L.A. Hussein: Papaya latex milk with enzymatic papain activity was found to prevent the viral lesions in viral infected leaves. The extent of viral inactivation was proportional to the papain activity of the latex milk extract. Can you kindly tell us the mechanism by which the virus is inactivated ?

L. Bos: Virus multiplication is closely associated with normal host nucleic-acid metabolism. Hence chemical therapy is supposed to be difficult if not impossible. However, recently, some reports have appeared on "antiviral" substances reducing virus multiplication in plants. So far, no "viricide" has been developed for practical application.

Faba Bean Pests in Egypt. Dr. A.H.Kamel.

H.S.Salama: The speaker gave a good account of the major insect pests of faba beans in Egypt. What is the possibility of using pheremone traps for the control of pests which infest faba beans ?

A.H.Kamel: There is no common pheremone for a range of insect species since the pheremone is specific. Hence a mixture of more than one pheremone would have to be used.

S.Khalil: What is the relationship between the sowing date of faba beans and the detection of bruchids in the field ?

A.H.Kamel: In a study, it was found that bruchids, hidden under the bark of nearby trees begin their activity when the flowers begin to form and work on the flowers until the pods form.

In other words, there is no definite relationship between the time of sowing and the field infestation by bruchids. The relationship is between the time of blooming and pod forming and the activity of the bruchids.

M.C.Saxena: Could you please tell us the safe method of eradicating /controlling the bruchids in the seeds of faba beans without causing damage to the seeds. I would like to know the chemicals, their rate of application and the duration of treatment.

A.H.Kamel: The following fumigants, doses and periods of exposure could be followed:

i. Phostoxin tablets at the rate of 2-3 tablets per ton for a 3 day period of exposure in the summer. This period is extended to five days during the winter.

ii. Methyl bromide at the rate of 24 grammes per cubic metre of space for a 24 hour period of exposure. Local tests on different varieties of faba beans should be conducted.

G. El Sarrag Mohamed: The importance of aphids as major pests as well as vectors for diseases is very much indicated during this conference. Would it be possible to put a forecast in the news media (television and radio) about outbreaks in developing countries such as Sudan and Egypt ? I would also like to hear comments on this subject on the state of affairs in European countries.

A.H.Kamel: If this forecasting was possible, it could be a very good achievement, but, in my opinion, periodic inspections for aphid infestation in faba bean fields should be conducted. On this basis, the time of applying insecticides could be fixed for each field separately. This highlights the need for forecasting as a guide for the whole area. The application of insecticides against aphid infestation on faba beans should also depend on the threshold limit of infestation.

M.M.F.Abdalla: What about bird attack on faba beans ? Clever farmers who sow their fields early lose much because of bird attack, consequently it has proved safer to plant later so that the bird attack will be distributed more evenly. Of course, late sowing will reduce yield. What measures can be taken to avoid such problems ?

A.H.Kamel: It is true that early sowings of cereal grains, particularly in the northern part of Tahrir Province in Egypt, are completely lost and devoured by sparrows when the ears are in the milky stage. This is mainly correlated with the time of migration of a certain species of sparrow. Concerning faba beans, this problem is very complicated and needs an extensive program of research aimed at studying the behaviour of these birds, besides the best time of sowing faba beans in relation to yield and a decision could be made on the basis of results obtained. Needless to say, such research should be very general to cover all crops in the field at the time when this pest is active.

Major Pest Problems of Faba Beans in Sudan. Dr. S.A.Siddig.

M.Hussein: The statement in your paper that "*Spodoptera exigua* is responsible for the transmission of SBBMV is not correct.

The small number of infected plants in your tests could have come from seed-borne viruses or through mechanical contact.

S.A.Siddig: This was a joint experiment between me and Prof. Abusalih (plant pathologist). Consequently, being an entomologist, I am not in a position to argue this statement.

Breeding for Resistance to Aphids. Dr. F.Klingauf.

H.S.Salama: The presentation is very interesting. What is the role of olefactory stimuli in the dispersion and feeding of aphids infesting faba beans ?

F.Klingauf: The colour seems to be predominant. Very little work has been done on this matter.

G.P.Chapman: Given the possibility of breeding for resistance to aphids, will less attractive plants prompt increased virus spread ? Given that we can, in view of the speaker's qualifications of his remaks, should we breed for aphis resistance?

F.Klingauf: The behavior of aphids and therfore virus transmission, depends on different stimuli during the successive stages of host plant selection. If attraction is altered by a resistant variety, the aphids may show a decreased alighting freqency, resulting in decreased virus transmission. If stimuli are working after alighting, that means that the plant now becomes a deterrent, an increased virus spread seems possible. But this is not always necessary: e.g. resistant alfalfa lines with apparently disturbed stimuli during the probing and penetration behaviour of aphids, act as a trap and the aphids die of starvation, consequently reducing virus transmission. Also where resistance results in a lowered fecundity and decreased production of winged progeny, virus transmission is not promoted but limited.

Discussion which followed the film on the Chemical Control of *Orobanche crenata* in Faba Beans in Morocco: Dr. Ute Schmitt.

A.M.El-Nadi: I noticed that the chemical control of *Orobanche* began when the plants had grown to a considerable height (maybe near to flowering time). Is this due to the fact that chemical spraying before this stage of growth have caused phytotoxicity ? If yes, then the *Orobanche* will already have caused great damage to the crop.

U.Selmit: Infection by *O.crenata* of economic importance does not take place before faba beans begin to flower. The first application of glyphosphate should be done at the tubercule stage or bud stage of the subterranean stage of the development of *Orobanche* to minimise host damage by the parasite. The tubercule stage is not reached before the faba beans form flowers. The use of chemicals before this stage proved ineffective. For this reason, chemical controlis normally done after the beginning of flowering time for faba beans. Phytotoxic injury to the host plants was never observed as the recommended dose of the herbicide (60 ml a.i./ha) is extremely small.

K.Agabawi: Though my comment is mainly based on experience with <u>Striga harmontheca</u>, it is relevant to mention some points which are in common to both parasites because of their similarity.

i. Because the parasite would already have inflicted damage on the plant by the time its presence was detected, the subsequent chemical control is less effective than control throgh resistant varieties which might resist the attack. They might not be attacked.

ii. Infestation by parasite seeds, as shown in the slide presented by Dr. Nassib, by spreading parasite seeds on already developed roots concentrated at the bottom of the earthen pot does not simulate infestation in the soil since, in the soil, the whole profile is infested and infection can take place at any level in the soil. In this context, it may be remembered that the depth of infection is negatively correlated with damage to the host plant.
So if the roots are infected at a greater depth, as shown in the slide, the damage they cause may be less than what occurs in soil. All of the soil should be infested and well mixed.

iii. Breeders will have to be careful not to select plants considered to be resistant simply because they are not infected. Such plants might have escaped infection simply because there were no <u>Orobanche</u> seeds in the vicinty of their roots. Therefore in fields, we should not assume that all of the land is naturally infested. Artificial infestation must be made.

U.Schmitt: The first application with glyphosate is made at the tubercule stage of subterranean development of _Orobanche_. Up to this stage , damage to the hostplant can be neglected as it is of no economic importance.

H.Weltzien: What is the expected percentage of the faba bean area to be sprayed in Morocco this year?

U.Schmitt: In the 1979-80 campaign, 10,000 ha, about 4.5% of the total Moroccan area, has been sprayed with glyphosate. I cannot give a concrete answer to this question as I cannot judge the farmers' reaction in this year. Remember that 70% of the total Moroccan faba bean area is infested by _O.crenata_. But because this year is only the second extension campaign, we expect that a lot of extension work has to be done to make farmers familiar with the control method.

A.M.Nassib: Does a farmer who applies glyphosate once, expect to have a lower infestation of _Orobanche_ later in his plot?

U.Schmitt: Certainly! By applying glyphosate, the development and subsequent seed production of _Orobanche_ will be prevented. You should realise that one spike of _Orobanche_ produces an average number of 150,000 seeds. Each successful treatment will cause a decrease of inoculum, thus gradually diminishing infestation of the plot.

A.R.B.Saghir: The application of synthetic stimulants to soils infested with _Orobanche_ will be a better approach for control than with glyphosate after havstoria development.

M.C.Saxena: Would you please elaborate on the threshold value for the spraying of glyphosate? In other words, what minimum number of haustoria should be present before spraying is recommended?

U.Schmitt: At an infection level of more than one Orobanche shoot/10 host plants, spraying with glyphosphate becomes economical under Moroccan conditions. However, below this level, removal of Orobanche shoots is necessary to prevent further infestation of the field; in other words, multiplication and spread of the parasite must be prevented as much as possible, otherwise no long term control can be expected.

A.M.Nassib: What happened to the resistant line F331, developed by Dr. Boorsma in Morocco, and is the breeding program still going on in Morocco?

R.Pieters: Line F331 is still used as a source of resistance in the Horizontal Resistance Breeding Program on faba beans in Morocco.

M.B.Taha: What is the mode of action of glyphosate in the control of Orobanche?

U.Schmitt: The effect of glyphosphate on green plants is reported to be an action on different enzyme systems and on the biosynthesis of important amino acids. Up to now, no research has been done on the mode of action of the herbicide on Orobanche.

VICIA FABA L IN CYPRUS

Athena Della

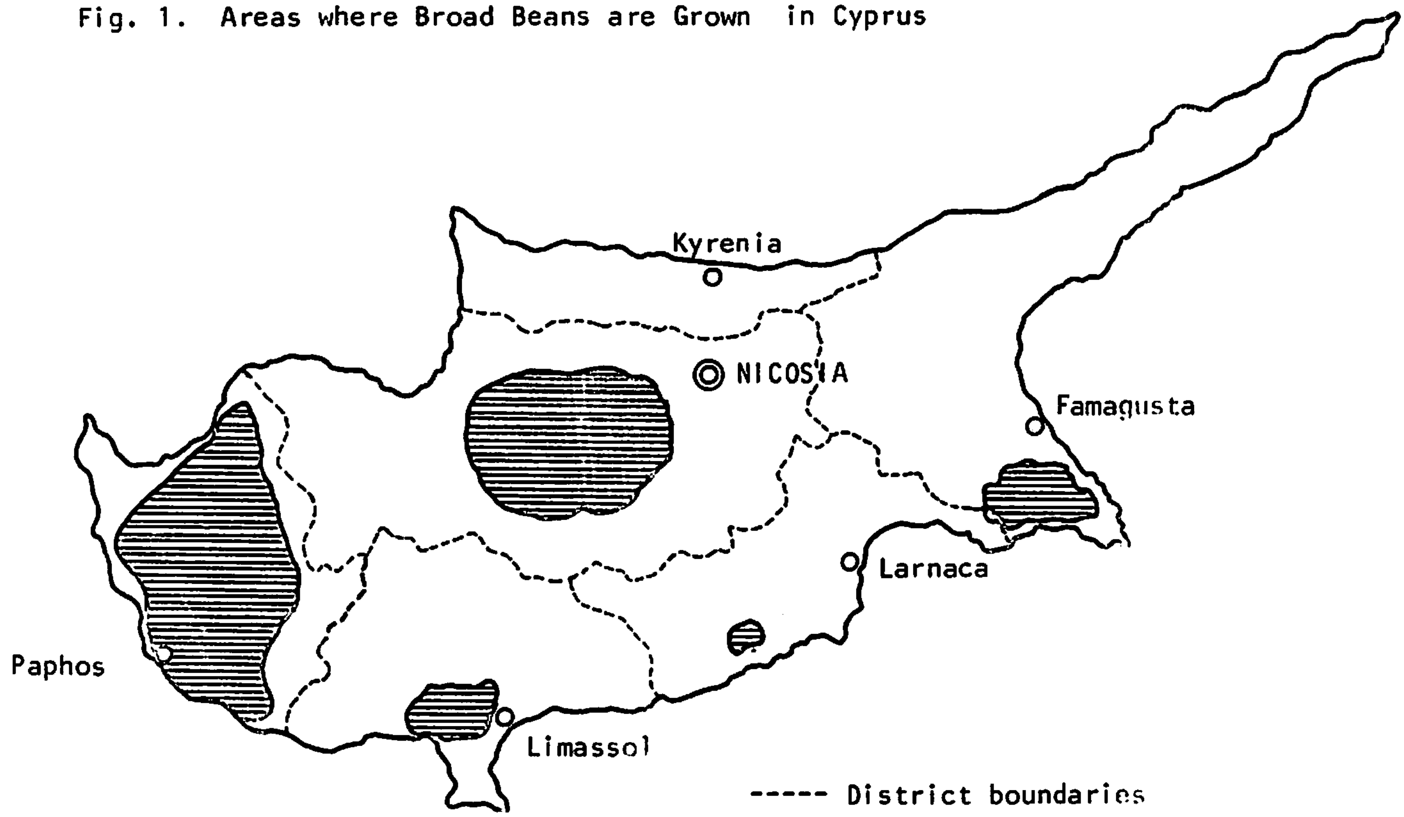
In Cyprus, faba bean is one of the major pulses, (Table 1). The crop is traditionally grown in some villages of the Nicosia and Paphos districts. On a smaller scale, it is usually grown with other crops for family use only. Fig. 1 shows the distribution of the crop.

Table 1. Area, production and value of faba beans, 1975-79.

		Fresh			Dry		
Year	Area (ha)	Production m. tons	Price (CL/m. tons	Value in 1000's CL at current prices	Production m. tons	Price (CL/m. tons)	Value in 1000's CL at current price
1975	1350	313	52.5	42.7	1524	122.0	186.0
1976	1600	1016	64.4	65.4	1778	141.7	252.0
1977	1350	1168	80.9	94.5	1422	185.1	263.2
1978	1350	1219	72.9	88.9	2032	196.9	400.0
1979	1500	1168	104.6	122.2	1828	208.8	381.6

CL = Cyprus pound

Fig. 1. Areas where Broad Beans are Grown in Cyprus



Faba bean, grown in rotation with cereals and vegetables, is usually sown between December and February and matures during May and June; depending on the earliness of the year and the locality. In the Larnaca area, it is sown in late September or early October to supply the market with green pods. Seed is all sown by hand; either broadcast or in rows 30 to 90 cm apart. A mouldboard plough or a ridger plough covers the seed. Seed rates range from 150 to 200 kg/ha.

The land is cultivated once or twice before sowing to control weeds, incorporate fertilizer or manure, and prepare the seedbed. Fertile soils receive no additional fertilizer, although up to 100 kg/ha of phosphorus and 30 kg/ha of nitrogen and potassium may be used on the poorer lands. Almost any type of soil is suitable for faba beans (1).

Harvesting is traditionally by hand. However a specially modified combine harvester has been used to successfully harvest large areas of faba beans in the west part of the country. Bean fields are usually weedy, post-planting weed control, when it is done, involves spraying with Grammoxone upon the emergence of the first few seedlings, followed by hand hoeing later in the season when the plants are about 15 to 20 cm high. However, Treflan, a pre-planting herbicide covering the growing period of the crop, is now being used in certain areas.

The crop is given supplemetary irrigation in most places where mean rainfall is usually low (200 to 400 mm). In the Paphos area, where the annual rainfall is usually higher than 500 mm, faba beans are grown mainly under rainfed conditions.

Utilization, Processing and marketing

Faba beans are eaten locally as immature green pods, green grains or mature dry grains, while a large amount of seed is exported every year. A small amount of green grains as well as the imported dry small grains are preserved by canning, mainly for export. Byproducts of seed production, which include the stubble and the pods from green grains as well as the discards dry seeds, are used for animal feed. The trade is conducted by private companies. Table 2 shows the exports and imports of faba beans in recent years.

Table 2. Exports and imports of faba beans, 1975-1979.

Year	Exports			Imports		
	Quantity exported m. tons	Price CL/m. ton	Value at f.o.b.price in 1000CL	Quantity imported m. tons	Price CL/m. ton	Value at c.i.f.prices in 1000CL
1975	411	233.7	69.1	49	235.8	11.6
1976	645	239.7	154.6	59	252.2	15.0
1977	536	247.3	132.6	122	215.7	26.3
1987	1644	266.1	437.5	91	135.2	12.3
1979	1313	283.8	372.7	80	174.2	14.0

CL = Cyprus Pound

Pests, diseases and other prdoction constraints

Broomrape (*Orobache crenata* is a great obstacle to faba bean production; often totally destroying the crop. Other pests include Sitona weevil (*Sitona lineata*, *Sitona limosa*), aphids, and seed beetles (*Bruchus rufimanus*) (2). Common diseases include chocolate spot (*Botrytis fabae*), *Cercospora fabae*, rust (*Uromyces fabae*) and *Fusarium* spp.

Research priorities

Increase in yields may be achieved by:

(a) Crop protection. Selected herbicides and pesticides must be tested under local conditions and demonstrated to the farmers.

(b) Mechanization of sowing and harvesting.

(c) Certified seed of improved cultivars.

Possible use of faba beans as a home grown protein source for animals should also be studied.

Structure and Scope of current research

In Cyprus, the research work on faba beans has been restricted to the introduction and testing of a few cultivars none of which has proved to be better than the local ones. In 1980 the Agricultural Research Institute, Cyprus, in cooperation with the International Board for plant

Genetic Resources collected 100 accessions from the local landraces representing the existing variability throughout the island. These populations are now under preliminary evaluation with the aim of selecting a more unifrom large seeded cultivars.

Lines selected by ICARDA, Syria, are being tested under local conditions for food and feed purposes. In addition, a weed control trial is being conducted in cooperation with ICARDA. The animal Husbandry Section has initiated studies on the nutritional value of local faba beans as a substitute for imported soybean meal in lamb fattening diets.

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FABA BEAN PRODUCTION AND RESEARCH IN ETHIOPIA

Imru Assefa

Production

In Ethiopia faba bean are produced on about 300,000 ha annually. This represents, on average about 43% of the land cropped to pulses and about 5.4% of the total cropped area (Tables 1, 2, and 3). They are grown as a field food crop during the main rainy season and the bulk of the production comes from the peasant farmers.

Table 1. Area of Pulses in Ethiopia from 1974/75 to 1978/78 (1000 ha)*.

	1974/75	1975/76	1976/77	1977/78	1978/79
Total Pulses	767.5	639,5	666.3	623.0	643.3
Faba beans	329.8	263.6	270.1	281.8	295.9
Chickpeas	151.8	181.3	152.9	138.5	141.6
Haricot beans	68.1	42.6	49.3	21.3	20.0
Peas	102.3	103.7	134.4	122.2	127.3
Lentils	115.5	48.3	59.6	59.2	58.5

* Estimate includes holdings by peasant farmers, Cooperatives and State Farms.

Table 2. Yield of pulses in Ethiopia from 1974/75 to 1978/79 (kg/ha)*

	1974/75	1975/76	1976/77	1977/78	1978/79
Total Pulses	65*	720	940	830	730
Faba beans	860	910	1260	1000	900
Chickpeas	620	540	710	720	550
Haricot beans	480	1080	650	700	670
Peas	440	440	760	700	690
Lentils	400	680	710	560	460

*Estimate includes holdings by peasant farmers, Cooperatives, State Farms.

Table 3. Production of Pulses in Ethiopia* from 1974/75 to 1978/79 (1,000 tons).

	1974/75	1975/76	1976/77	1977/78	1978/79
Total pulses	499	462	625	515	470
Faba beans	282	240	340	282	265
Chickpeas	93	97	109	100	77
Haricot beans	33	46	319	15	13
Peas	45	46	102	86	87
Lentils	47	33	42	33	27

* Estimate includes holdings by peasant farmers, Cooperatives and State Farms.

Planting is done during June - September depending on the soil type. In light soils early planting is practiced some time in late June wheras late planting is done on heavy black soils (vertisols). Some regions are know to grow faba bean during the small rains (February - April) but this only comprises about one per cent of the main season crop.

Good plant stands are normally found and fields even appear over-seeded at times. An average seed rate of about 200 kg/ha has been estimated. Faba bean fields may or may not be weeded depending on the farmer and the seriousness of the problem.

Marketing and Utilization

Pulses are grown both for domestic use and for export market with the domestic component being predominant for traditional highland pulses like faba bean (1).

Pulses are recognized in Ethiopia as soil enrichers, and they are planted in rotation with cereals for the main purpose of revitalizing the land and increasing the yield of the following cereal crop.

Faba beans, like other traditional pulses, are eaten in a multitude of forms and preparations as follows (2)

a) Green seeds are shelled and consumed, sometimes following roasting.

b) The dry seed is soaked and boiled or roasted and then boiled, either alone or with other pulses and cereals.

c) Ground to fine powder or split and prepared into a thick seasoned sauce or "Wot".

d) Prepared into Injera ; an unleavened, but fermented flat bread, mixed with teff, wheat, barley or sorghum.

e) Prepared into spirits and into a thick paste called "Elbet" during the long fasting period (lent).

Farmers always keep enough beans at home to last until the next season for consumption and for seed. The remaining is sold to local consumers or dealers who in turn may process them for export.

Faba beans were an important export crop. From 1948 to 1961, the average composition of pulse exports was reported to have been 36% faba beans , 33% lentils, 13% haricot beans, 13% chickpea and about 5% field pea (1).

During this period, and up until 1975 pulses used to be among the most important earners of foreign exchange, being second only to Coffee in value of export in 1974. In recent years, however, production has failed to keep up with population growth (1). Even if rapid increases in production can be made, it is anticipated that these are unlikely to be sufficient even to satisfy domestic consumption, let alone provide a surplus for export.

Production constraints

The average yield of faba beans is about 1020 kg/ha which is low in comparison with many other countries. Low yields in Ethiopia result from many problems including biotic (diseases and insects) environmental, physiological and human factors. No figures on yield loss are available but the following are known to cause considerable damage:

a) Chocolate spot (Botrytis fabae) and rust (Uromyces fabae) are the two most important diseases, with occasional damage in some areas being caused by root rot and powdery mildew.

b) Among insects, bollworm (Heliothis armigera), aphis (Aphids fabae) and thrips (Taeneothrips sjostedti) can be important in some seasons.

c) Frost is a common hazard especially at higher altitudes. High flower and pod abortion is also recognized as an important problem, although the causes of this are not yet fully understood.

Given all these problems, faba beans appear to lend themselves well to yield improvement. However it may not be possible to increase yield using traditional production technology, and therefore, new practices and implements are required.

Structure and scope of current research

Research activities in the past can be roughly divided into two periods: before and after 1972. Little research work was/ done on faba beans during the pre - 1972 period in comparison with that on cereals and even some lowland pulses such as haricot beans. Research activities concentrated on cultivar selection and agronomic trials and these were generally carried out by individual organizations, development units, and even research stations in an uncoordinated manner.

Coordinated research on pulses started in 1972 when the Institute of Agricultural Research, through the National Crop Improvement Committee established a Pulses Sub-committee.

The work on faba beans and peas, along with the other pulses, was then coordinated from Nazareth Research Station until 1976. Since then, the coordinating center for faba beans and peas has moved to the highland site at Kulumsa in 1977 and to its present center at Holetta in 1979.

Since 1980, a new approach, based on multidisciplinary team work on one crop or few similar crops, has replaced the previous departmental approach. The Pulse Team is subdivided into two groups :- highland pulses and lowland pulses. The team comprises two breeders, two agronomists, one soil scientist, two entomologists, one pathologist, two seed scientists and a food sceintist.

Past research highlights

Collection and evaluation of landraces of faba beans in Ethiopia started as early as 1960 (2). Earlier collections were predominantly market samples and little documentation was available. Some collection was also done by the Chilalo Agricultural Development Unit (CADU now ARDU) in 1966 and 1967 and by Dr. K.Yamashita of Kyoto University Scientific Expedition in the same years. Systematic collection was started in 1974 by IAR in conjunction with Ministry the of Agriculture.

Repeated screening of germplasm for frost, chocolate spot and rust resistances has indicated that the indigenous material is susceptible to these while some of the materials introduced from Europe has better resistance.

The first national coordinated yield trial on faba beans was started in 1972. Since then a number of entries have been identified which have performed consistently well over seven years. These include selections from llocal landraces (CS 20D, CS 38B, CS 11A,KUSE 2-27-33, NC 58 and NC 67), some introduced materials from Europe (F-305 Morocco, FAO-31385 and Italian ex. D.Z.) and a local variety (Kasa).

Sowing date, seeding rate and fertilizer rate studies have been conducted for few years in different locations.

Sowing date, and to some extent seeding rates, vary depending on the soil type and whether the soil is well drained or not. The period around 25th June on red soils and 5th July on black clay soils is the optimum planting time at Holetta while at Debre Zeit, the best sowing date appears to be around 7th July on light (red) soils (Table 4).

Table 4. Sowing Date Trial with faba beans, 1970-1972 (yield in Quintals/ha).

		RED SOILS Dates				DARK GRAY CLAY SOILS Dates			
	Year	15 June	25 June	5 July	15 July	15 June	25 June	5 July	15 July
	1970	10.8	6.6	10.2	8.9	8.2	15.1	15.2	9.7
Holetta	1971	10.8	11.0	10.1	8.6	8.6	11.2	12.4	7.8
	1972	14.1	13.1	17.8	15.1	17.9	23.6	22.2	3.3
	Mean	11.9	10.2	12.7	10.9	11.6	16.6	16.6	6.9
Debre Zeit*		27 June	7 July	11 July	27 July				
	1972	42.2	44.0	28.6	24.5				

*Light Soil

From seeding rate studies, approximately 250 - 275 kg/ha on red clay soils and 350 kg/ha on dark gray soils appeared to be optimal seed rate in the Holetta area.

Chocolate spot (Botrytis fabae),rust (Uromyces fabae) and a root-rot complex are known to cause considerable damage in some regions.

Chocolate spot is more of a problem in the higher elevations while the severity of rust increases with a decrease in elevatin. Root-rot is not a serious problem on farmers fields except in soils with poor drainage.

Screening for resistance to diseases was started in 1977 as part of the USAID supported Pulse Improvement Program. This program was terminated, however, and only began again in the 1980/81 season.

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FABA BEAN PRODUCTION IN JORDAN

Nasri Haddad
and
Mohammad Obeidat

Faba beans are produced in Jordan as dry beans under the rainfed conditions, and as fresh or green beans under the irrigated areas of the Ghor (Jordan Valley) and the highlands. Table 1 shows the areas, production and yields of this crop in Jordan for 1971 - 1980. The wide range of dry bean yields from year to year is mainly due to the erratic rainfall in the rainfed production areas. The low yields under irrigatin in some years, are mainly due to the frost damage in the early autumn planting.

Production practices

Faba beans, under rainfed cultivation, are usually grown as a part of three year rotation with cereals and summer vegetables. Seedbed preparation is minimal. Faba beans are hand-seeded into a furrow opened with a local plough, at a rate of about 80-100kg/ha. Planting usually begins in November-December, and harvesting, by hand, is done in May-June. Weeding, if practised, is done by hand.

Production under irrigation is mainly for green pods. A good seedbed is prepared, the crop is hand-seeded in furrows 75 cm apart and 10-15 cm between seeds and usually on both sides of the furrow. Green pods are picked at the suitable stage. Two crops per year can be easily produced in the Jordan Valley. The first crop which is the most common, is planted in October; the second during early spring.

Table 1. Area (ha), production (tons) and yeild (kg/ha) of dry and green faba beans in Jordan, 1971-1980.

Year	Green beans			Dry beans		
	Area	Production	Yield	Area	Production	Yield
1971	630	4100	6508	1306	730	559
1972	670	7100	1059	1055	833	789
1973	900	7200	8000	670	370	552
1974	850	7500	8823	1135	1290	1136
1975	1340	16600	12388	812	240	395
1976	990	7100	7172	793	482	608
1977	990	8200	8283	591	291	492
1978	1670	10300	6168	1044	653	625
1979	1850	13900	7513	652	110	169
1980	1330	7000	5263	868	823	948

Source : Ministry of Agriculture, Department of Agriculture Economics, Amman, 1981.

Utilization and marketting

Faba beans, along with other legumes, provide a very usefull source of protein as dry seeds, and as fresh pods. Jordan is self sufficient in fresh bean production and for many years, it exported fresh beans. However, Jordan is now importing relatively large quantities of dry beans from Syria, Ethiopia, Cyprus, Turkey and China. Inports and exports of faba beans in recent years are shown in Table 2.

Table 2. Imports and exports of dry seed faba beans in Jordan for the period 1971-1978*

Year	Imports		Exports	
	Quantity (tons)	Value (JD**)	Quantity (tons)	Value (JD)
1971	2104	87,025	39	1978
1972	1780	83,314	38	1878
1973	2544	153,071	-	-
1976	3986	377,852	-	-
1977	1787	204,968	32	3254
1978	3580	408,157	88	7536

* Data for 1974 and 1975 are not available

** One JD = US 3.00 Dollars approx.

Source: Department of Statistics. External Trade Statistics.

Pests and diseases

Faba bean production under irrigation is limited by a number of diseases and insects. Important fungal diseases are chocolate spot (*Botrytis fabae*) and rust (*Uromyces fabae*) (2). With respect to insects, black aphids (*Aphis fabae*) and spider mites are common.

Chemical control is usually practised. Infestations of Orobanche ramosa have been reported in many areas in the Jordan Valley (1). Some less important diseases are: Rhizoctonia spp., Alternaria spp., and Erysiphe polygoni. Insects such as Sitona lineatus, Bruchus rufimanus, and Kakothrips robustus, have been also reported.

Research activities, constraints and scope

Research on faba beans is limited in Jordan to finding the optimum cultural practices, including proper date of planting and seeding rate, under rainfed and irrigated conditions. Identification of disease and insect problems and their chemical control is another research activity. Varietal evaluation trials to select good and well adapted cultivars are also conducted. Good contact has been established with ICARDA.

Perhaps the most serious problem facing faba beans and other food legumes in Jordan is the dependence on hand labour for most production operations, especially harvesting when labour is scarce and expensive. This is coupled with disease and insect problems.

The work on faba beans in Jordan may not be improved or extended, before a comprehensive research program is established to cover all the problems facing faba beans production under rainfed and irrigated cultivation. It should establish the facts about the significance of the crop in the rotation, and some other optimum cultural practices including improved and adapted cultivars. Defined objectives should aim at production of sufficient quantities for domestic consumption for food and feed for export as well.

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FABA BEAN PRODUCTION AND RESEARCH IN LEBANON

A.R. Saghir and M. Solh

Faba bean production in Lebanon is of minor importance compared to other intensive cash crops such as fruits and vegetables. Conisdering food legume crops, faba beans come fourth in dry seed production after chickpeas, lentils and dry beans. However as more than 80% of the area is harvested for green pods and seeds, faba beans become as important as chickpeas and lentils. FAO estimates (1977) showed that about 1000 metric tons of dry seeds are produced each year. Large seeded Lebanese Local cultivar (referred to as Cypriot faba beans) is used only for green pod and seed production. Both large and small seeded Lebanese local cutlivars are used for dry seed.

Distribution, production practices and utilization:

Faba beans are produced throughout Lebanon in plantings which are mostly less than one hectare. Beans are usually planted between December and January. A few coastal areas are sown early in October to supply the early market with green pods. The seed is either broadcasted or sown in rows about 50cm apart behind local ploughs drawn by either a tractor or oxen. The planting rate is about 150-300 kg/ha depending on seed size. Up to 200 kg P_2O_5/ha is applied. Early green pods from coastal areas, appear around the middle of March. Production in the mountain region and the Beqa'a valley begins early in May, and continues into July with supplemental irrigation. Faba beans are consumed locally as green pods, green seeds, and dry seeds. Large quantities of green and dry seeds ar canned.

Pests and other production costraints

Pests include the bean aphid, spider mites, bean fly, broadbean weevil, cutworms, mole cricket and thrips.

Common diseases include *Ascochyta* blight, *Fusarium* root rot and wilt, chocolate spot, *Alternaria* spot and rust. Reports indicate the presence of common bean mosaic, bean yellow mosaic and broadbean mosaic viruses; however very little work has been done in Lebanon on virus diseases of legumes. Serious weed problems occur in faba beans where annual weeds compete with the crop for water, nutrients and light. In addition to causing serious crop losses, weeds harbour disease organisms and insects, and interfere with harvesting operations. One of the most serious weeds is *Orobanche crenata* which under some conditions has caused total crop loss in Lebanon.

Research priorities:

To improve faba bean production in Lebanon and the Middle East, it is important to identify and assess research priorities for the production and protection of this crop.

Considering the predominantly intensive agriculture on large areas in Lebanon, selection of early and high yielding cultivars of faba beans is needed for green pod, green seed, and dry seed production to fit in a multiple cropping season.

Weed control is essential for maximizing faba bean production. Weed surveys should be conducted, and efforts should be concentrated on studying the biology and control of special weed problems such as Orobanche.

Research should be done on changes in tillage practices, crop rotations, row distances and plant densities in relation to weed-free situations.

In additional to screening new herbicides for weed control in faba beans, research should stress the use of existing cheap herbicides by developing antidotes and formulation addititives which protect the crop, and improve on the selectivity and application of these herbicides.

Studies are needed on the biology and control of the most important economic insect pests. Resistance to aphids should be investiagated.

A thorough survey of the incidence and severity of faba bean diseases is required, with assessment of crop losses. Disease resistant cultivars are needed, especially against Ascochyta blight.

Since farmers usually produce their own seeds, it is important to establish seed health testing programs for bacterial and fungal diseases, with the help of the international centres.

There is need to identify viruses which attack faba beans in the region, and to study how they spread.

Since many of the bean viruses are seed-borne, seed health testing and screenig of gerplasm reaction to viruses is needed. Priority should be made to screen different varieties of faba bean to the most prevalent virueses such as the bean yellow mosaic virus, using new, rapid and sensitive methods such as the ELISA (Enzyme Linked Immuno Sorbant Assay) technique.

Screenig of bean cultivars for lodging resistance under conditions of supplementary irrigation is needed.

Sturcture and scope of current research:

Multiple cropping:

Research on multiple cropping was conducted in the Beqa'a valley using faba beans as a winter crop for green pod and dry seed production (1). The summer crops following faba beans were sweet corn and potatoes. Large seeded Lebanese local cultivar was planted on November 1, 1979 at a desity of 100,000 plants/ha. Rows were 50cm apart. Fertilizer was applied before planting at the rate of 60kg P_2O_5/ha and 40 kg /ha. Seeds were inoculated before planting. Weekly supplemental irrigation began on May , 1980. Green pods were harvested on May 20, May 31, June 6 and June 13, 1980. Yields were 680, 8200, 2600 and 2520 kg/ha, respectivley for the four harvests. The total green pod yield was 14,000 kg/ha. Dry seed yield was harvested on July 2, 1980 and the yield was 2600 kg/ha. The second year study is under way, using five early cultivars obtained from ICARDA.

Screening nursery

A large seeded faba bean screening nursery and yield trial will be evaluated this season with the intention of selecting parents for the development of synthetic cultivars.

Weed control

A replicated and randomized trial on chemical weed control in faba beans was initiated in cooperation with ICARDA in November 1980, at the experimental farm in the Beqa°a. Methahenzthiazuron (Tribunil), chlorbromuron (Maloran) and terbutryne (Igran) were sprayed pre-emergence, each at three rates. Behtazon (Basagran) was applied post emergence, also at three rates. Hand-weeded and unweeded controls were included in the trial. Studies will be made on the efficacy of these herbicides on weed control and crop yield, as well as on their effect on faba bean nodulation.

Orobanche control

a) Greenhouse experiments were conducted using glyphosate (Roundup) and terbutol (Azak), applied as post-emergence sprays 4 and 6 weeks after faba bean planting, in 1973-74 (2). The results showed that dusting of terbutol at 16 kg/ha (a.i.) at the time of planting and spraying of glyphosate at 0.20 (a.i.) kg/ha. 6 weeks after planting reduced *Orobanche* incidence and delayed its appearance in the treated pots. In a field experiment at Adloun, south Lebanon, in 1974, terbutol at 16 kg/ha (a.i.) gave 80% control of *O.crenata* with a significant increase in the yield of green pods of faba beans (3).

b) Work is underway on the use of synthetic germination stimulants of *Orobanche* seeds. The aim is to stimulate the germination of *Orobache* seed in the absence of the host plants, thereby depleting the parasite seed potential in the soil.

A comparative evaluation was made using a series of strigol analogues obtained from Professor A.W. Johnson, University of Sussex, England, to test their activity *in vitro* and in the soil. The results indicated that the compounds GR 7, GR 24 and GR 28 were the most active in stimulating seed germination of the parasite.

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VICIA FABA IN SPAIN

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and

Maria Teresa Moreno

In this paper,"field bean" means the extensive field culture, and "broad beans" the intensive one, without reference to the size, shape and so on of the seed. In Spain, "broad (faba) beans" are always "broad", but "field beans" can be small or large. The term faba bean denotes the entire species, *Vicia faba*.

Figures 1,2 and 3 show the trends of faba beans area and yield during the past 60 years. For field beans, the cultivated area can be estimated at around 100,000 ha; the tendency is towards stability, and even to increase in the near future if the National Program started in 1978 succeeds in solving the problems of this crop. The big competitor of the field beans are the imported soybeans, which have grown in importance during the past 20 years; a fact that together with the lack of interest in legume research by the Spanish Ministry of Agriculture, produced the decline of field beans. The big decrease during and after the 1940's (see Fig. 1) must be attributed to the consequences of the Spanish Civil War. The increase in yield can be attributed to the restriction of cultivation to better soils.

On the contrary, broad beans for human consumption have made a slow but steady increase both in area and yield. Freezing and canning of young seeds are also helping to maintain this progress.

The picture for faba beans is strongly determined by the situation with respect to field beans (Fig. 3) because the broad bean area is of little importance in proportion with that of field beans. The situation just described can also be shown by comparing area, production and yield averages during 1925-1930 and 1972-1976 (Table 1).

Table 1. Mean annual area, production and yield of faba beans in the two periods 1925-1930 and 1972-1976.

Mean Area ('000 ha)	Field beans	Broad beans
1925-1930	207.20	1.10
1972-1976	116.70	16.00
Mean Production ('000 t)		
1925-1930	189.20	5.80
1972-1976	113.60	131.10
Mean Yield (kg/ha)		
1925-1930	920	513
1972-1976	970	808

These figures stress the decreasing importance of field beans and the increasing importance of broad beans. For example the yield of broad beans is 60% higher than 50 years ago. On the other hand field beans, seem to be stationary. Hence broad and field beans can be said to represent modern and old-fashioned agricultures, respectively.

Fig. 4 shows the distribution of the cultivated area in Spain. The greater importance of the Mediterranean zones is apparent.

Fig. 1. Development of Area and Yields of Field beans in Spain

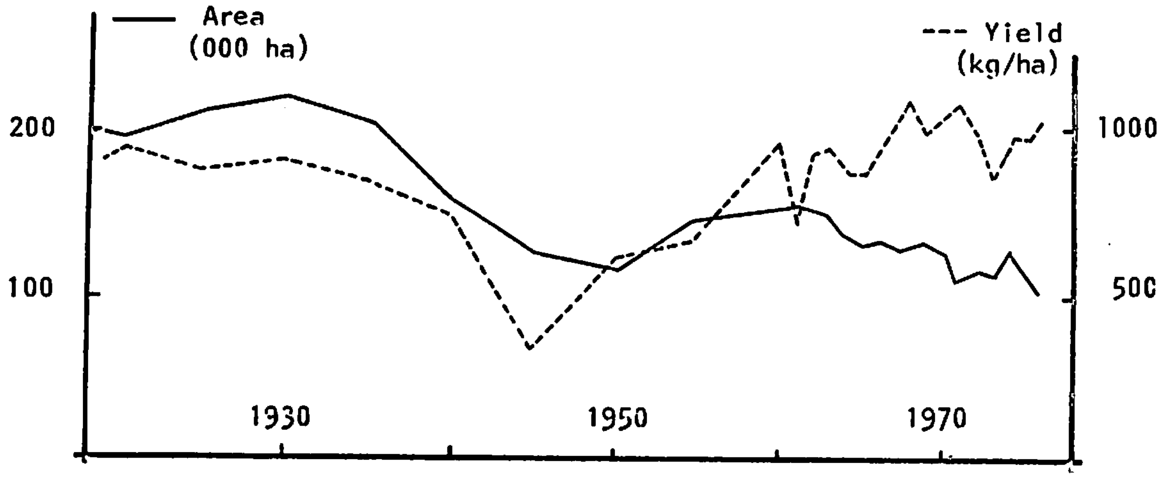


Fig. 2. Development of Area and Yield of Broad beans in Spain

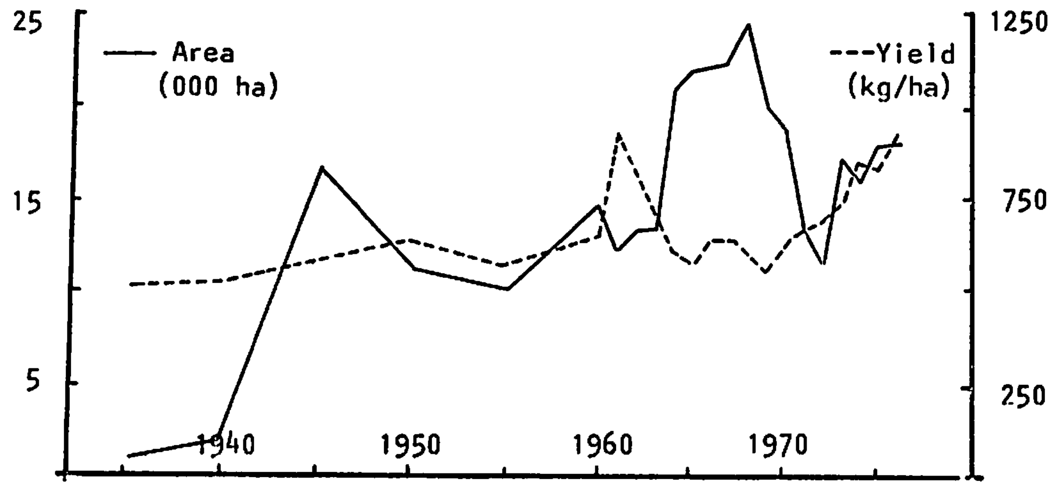
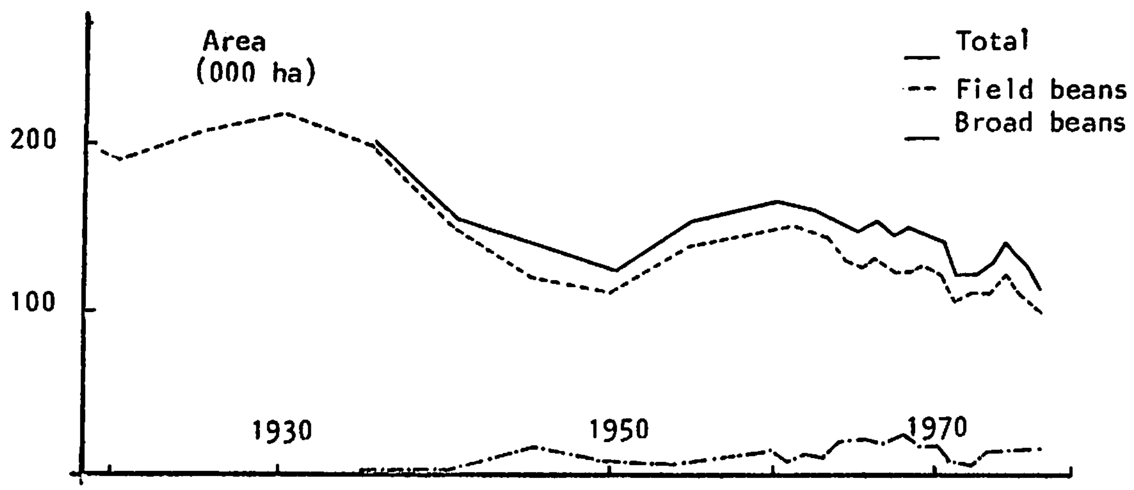


Fig. 3. Development of the Area under Field bean and Broad beans in Spain



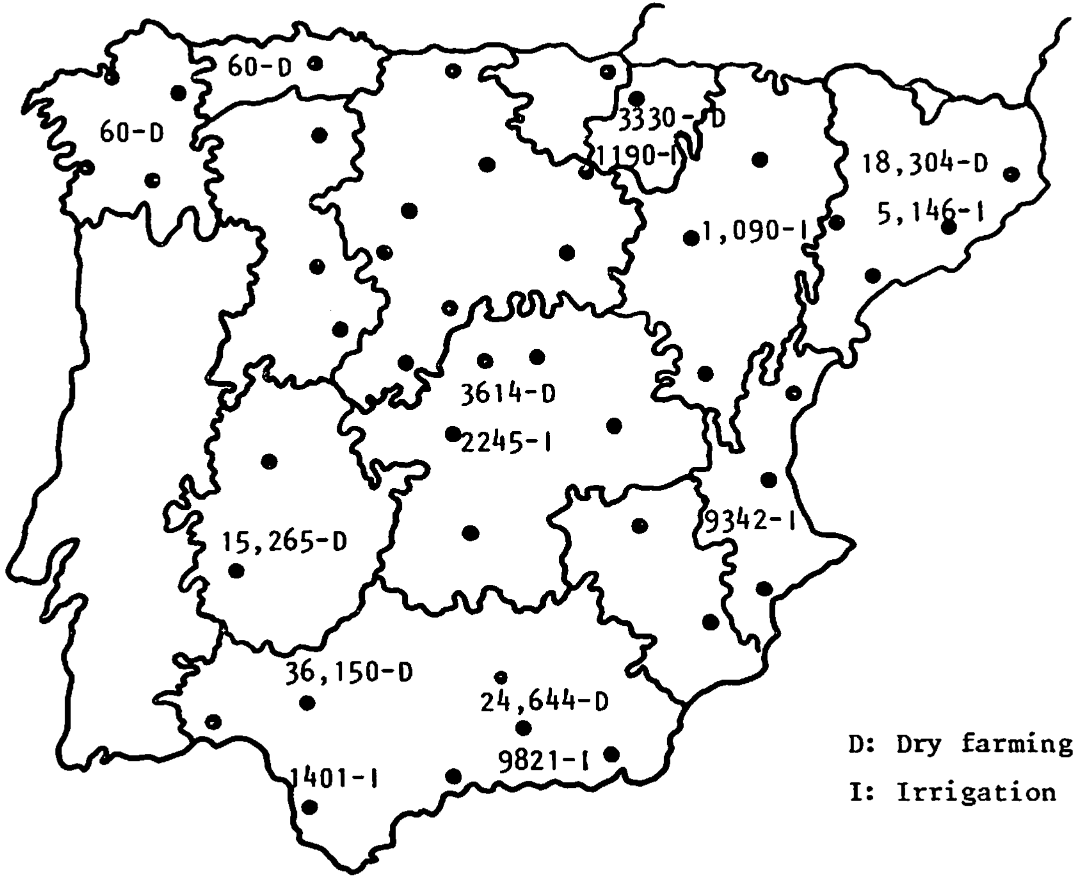


Fig. 4. Faba bean cultivated areas in Spain (ha)

Production practices

Only in recent times has the use of selected cultivars of field beans been introduced into farming practices. Traditional landraces occupy most of the cultivated area. It is not easy to determine the proportion of the total area covered by selected cultivars but it must hardly exceed 10%. A cultivar selected in our Department (Alameda) is sown on about 2,000 ha, and it probably is leading the list of cultivars in Spain. Private firms have started their own programs only in recent years. There is a National Trial to test Spanish bred cultivars as well as those from other European countries. One of the aims of this National Program is to offer better materials and adequate information about crop husbandry to the farmers.

Spain has always been very rich in different broad bean types; the most famous being Aquadulce (the name of the village near Sevilla), Muchamiel (the typical early type, named after a village of Alicante), Mahon (in the Baleatic Islands), Tarragona (on the Mediterranean coast), and Mazagana (derived from Mazagan, a village on the western coast of Morocco and introduced in the 17th and 18th centuries). However, these names correspond to clusters of populations and are, in fact, landraces. From these, private firms and farmers have produced many selected cultivars: earliness and yield have been the two main objectives.

In the case of field beans, big farms have reached a high level of mechanization, demanding cultivars with smaller seeds than those of the traditional landraces. Phosphate is the most common fertilizer used.

Pesticides are used commonly. On the other hand, small farm cultivation methods must be very similar to those of the 18th century: sowing and harvesting are manual operations; no fertilizers and no pesticides are applied. In such cases, faba beans are considered a "fallow crop".

In general broad beans are carefully cultivated in small plots of rich soils. Operations are by hand, but this is because of the price of the product (almost always green pods). Some farmers are producing broad beans as an extensive crop, harvesting with the same viners which are used for green peas. In this case, the product is destined to freezing and/or canning.

Utilization, processing and marketing

Dry seeds are generally used to feed animals on the farms where the crops are grown, or, in small quantities for the animal feeding industry. Soybean imports are blocking a more intensive use of faba beans. As a reference, the price of dry seeds on the farm is about $ 0.30/kg.

Broad beans are generally used only for human consumption. Usually the young green seeds are cooked, but, in some places, the whole pod is used. The direct use of medium size green seeds with salt is disappearing. Salted toasted seeds, however, are a popular snack. A thick soup is another common way of consuming faba beans.

The price of green pods varies considerably according to the region and the season. First pods arriving on the market can cost about $ 2.50/kg, but in the full season, the price drops to about $ 1.00/kg.

Pests, diseases and other production constraints

The main problem is broomrape Orobache which does most damage in Andalucia and on the East Coast. Damage is difficult to evaluate. Many farmers do not sow faba beans because of the damage by Orobanche and many others plow their land as soon as the broomrape emerges.

Bruchids and aphids are important insect pests. Chemicals are the only way to control the attack, but depending on the climatic conditions, even the chemicals can fail.

Uromyces, Ascochyta, Botrytis, and some viruses have intesified their attack in recent years, but they are not generally a serious problem. Mildew appears from time to time. Sclerotinia is a serious problem in some places, but is not a national problem.

As mentioned already the lack of selected cultivars is really serious constrain for this crop.

Research priorities

Briefly the main areas requiring research are:

1. Resistance to Orobanche. It has been said that the area devoted to faba beans would double if broomrape could be eliminated. Research on herbicides to control Orobanche must have the highest priority.
2. Selection of productive cultivars, suitable for mechanical harvesting, with stabilized yield.
3. Research on industrial formulation of animal feed, using faba beans.
4. Agronomic information: e.g. plant densities, fertilization, and use of pesticides, which area suitable for the different zones of the country.

5. Freezing and canning processes.

Structure and scope of current research

The oldest and largest research team is the group formed by the Department of Genetics of the Escuella Tecnica Superior de Ingenieros Agronomos (Universidad de Cordoba) and the Unidad de Leguminosas of the Centro Regional de Andalucia (Instituto Nacional de Investigaciones Agrarias, INIA). About ten people are directly engaged on different aspects of genetics (quantitive and qualitative), cytogeneties (tetraploids trisomics), and breeding (only field beans). Some explorations are being made to collect landraces accross the country.

INIA maintains, in Sevilla, a small program of faba beans Rhizobium. In Madrid, another INIA team is working on some physiological aspects of the crop, as well as on problems concerning protein quality, but no reports of this work have so far been published.

Some work is being done on problems concerning the use of faba beans as human food in the Department of Pharmacology, University de Navrra. Also, some private firms maintain active applied research programs for selecting new cultivars.

FABA BEAN PRODUCTION AND RESEARCH IN TURKEY

Yusuf Ziya Kutlu
and
Ayse Akdemir

The faba bean, with about 30,000 hectares growing area and 53,000 tons production occupies fourth position among the food legumes in Turkey. More than 75% is in the Aegean region.

Faba bean Production is not mechanised. Fifty percent comes from Canakkale and Balikesir provinces, as a mono-crop. In the remaining areas the faba bean is sown as an intercrop, green manure crop and vegetable crop. The seed rate is 150 kg/ha. The farmers do not usually apply any fertilizers.

Generally the large seeded traditional cultivars are grown. The green fresh harvested pods are cooked and consumed as a vegetable. The green pods are also used in the canning industry. The remaining pods in the field are harvested dry. The small seed cultivars are grown in a limited area of Aegean region. Because of low yield and high production costs, the feed industry can not utilise this crop. But the small farmers use faba bean as a feed for their animals. There is a very limited export.

Faba bean yields are very low in Turkey. Ascochyta fabae, Botrytis sp. and Alternaria sp. are the important fungal diseases which cause low yields. Aphis fabae and Bruchus sp. bring in heavy losses if proper chemical control measures are not applied. In some parts Orobanche is also a problem.

Research Priorities:

To improve faba bean production, we have been aiming to breed high yielding cultivars, improve crop management practices, and introduce mechanization.

The plant density trials showed that 25 plant/m^2 in low land and 30 plants/m^2 in dry land yielded up to 6810 kg/ha and 4250 kg/ha, respectively; thus indicating the possibility of doubling or tripling the yield of faba beans by simple agronomic practices. In addition any improvement in mechanization should automatically increase the area and yields of faba beans.

Structure and Scope of Current Research:

The objectives of faba bean research, which is included as a sub-project of the National Food Legumes Project, are:

- To survey the problems in faba bean growing areas and potential new areas.
- To increase the quantity and quality of yields.
- To evaluate research results under farmers'conditions.

A faba bean research project, initiated in 1974, is located in Izmir. Most of the work is concerned with breeding based on Sakiz faba bean landrace (large seeded); Milas faba bean landrace (small seeded); and material from numerous indigenous and exotic sources.

Single line selection and mass selection methods are being used. Characters of importance include high yield, earliness, diseases resistance, drought resistance, resistance to lodging and shattering and cold resistance. Some promising lines, based on regional yield trials, have been identified.

Recommendations

Breeding

1. That increased international cooperation between all faba bean breeders is required.
2. That breeding objectives should stress increased yield potential and resistance or tolerance to pests, diseases and adverse environmental conditions. Improved resistance levels should lead to greater yield stability.
3. That there is a need for an institution to be identified as the main center for faba bean germplasm. ICARDA would be ideal for this purpose.
4. That seed of all variants be sent to ICARDA for maintenance, and distributed, on request, to all interested scientists.
5. As variability within V.faba is wide and, to a great extent, under-exploited, it is recommended that all variability and linkage relationships, should be communicated through FABIS. The list of variation drawn up by Dr. Chapman should be updated periodically.
6. That efforts should be made to collect landraces, especially paucijuga and minor types, which are under represented in existing germplasm collections.
7. There is a need for development of descriptor lists for germplasm.
8. That there is a need for greater involvement by scientists from different disciplines to work together in multi-disciplinary teams on the improvement of faba beans.
9. Ascochyta, Botrytis and Uromyces have special significance in being of wide occurrence and importance. By inter-relating the work at several centers, it would be possible to test systematically a range of resistant lines against a number of pathotypes. The breeder would then have available resistances of known status for

incorporation. It is therefore recommended that ICARDA help towards this end.

10. That in view of the importance of off-season nurseries and techniques for rapid generation turnover, these should receive greater attention by breeders.

11. That work should be encouraged on faba bean cytogenetics of relevance to plant breeding.

12. It was expressed that genetic engineering and regeneration techniques were advancing very fast, and should be available for use by faba bean breeder in the not-too-distant future.

Agronomy

1. That agronomist and physiologists should get together in the field on the same trials. This would enable more predictive data to be collected, and yield responses could then be explained and related to growth and development.
2. That environmental conditions should be measured and related to field trials, e.g. accumulated temperature, water and light use. Such measurements are fairly easy and cheap. Again, such information should give a greater predictive basis for responses.
3. That experiments on agronomic areas such as sowing date, plant populations, irrigation etc. should continue, but there is a strong need for present data to be utilized and analysed in a more predictive manner e.g. the use of Holiday's population model, or to relate water use and yield. This would enable future trials to be designed with greater precision and efficiency.
4. That greater emphasis should be placed on understanding in detail the effects of simple measurements. Multi-factorial trials, while they may have a role if adequate resources are available, are often expensive and difficult to interpret.

5. That work on nitrogen fixation should be increased. Trials vare particularly needed on the residual effects of faba beans on the crops which follow them.
6. That future work on fertilizer use should always account for the residual soil fertility, either on a historical or directly measured basis. Without such background data, fertilizer experiments are almost worthless. Such measurements should be utilized when response data are presented.
7. That further work should be undertaken on seedling emergence and establishment, and should include quantification of soil physical conditions and the role of seed quality.
8. That work should be increased on water conservation, i.e. the potential of growing faba beans in marginal areas where irrigation is not available or limited.
9. That information be obtained on the limiting moisture deficits of soils in different areas.
10. That on-farm trials should continue and, if possible, be extended, and that research findings should be rapidly disseminated to the extension service. On-farm trials should be simple and realistic so that they can be easily understood by farmers.
11. That research findings should be related to economics and on-farm trials should contain economic alternatives. Consequently there is a need to define economic responses and not only optimum responses for yield.
12. That work be undertaken in relation to the rotational aspects of faba bean.
13. That work should be done on short term water stress at particular growth stages. Water stress and its interaction with cultivars is needed partiuclarly as there seem to be differences in water extraction depth between cultivars. With such an increased potential for greater exploration of soil volume, selection for these cultivars for stress regions should be made. This work should

include measurements on water extraction depths and quantities by different cultivars; the efficiency of roots at different depths in relation to water stress; the effects of short term stress cycles, and measurements of plant water potentials.

14. That under flood irrigation, information is needed on the effects of excess water.
15. That detailed work on saline water and its effects on growth and yield of faba beans should be intensified.

Weed Control

1. That the screening of varieties for resistance against *Orobanche* should be continued and intensified and the mechanisms of resistance studied.
2. That the screening of herbicides and other chemicals for *Orobanche* control should be continued. Successful herbicide application (glyphosate, pronamide etc.) as well as other control methods, should be evaluated under field conditions in different countries. Residues should be studied on all edible parts of faba beans, as well as in the ecosystem as a whole.
3. That work on the use of synthetic germination stimulants of *Orobanche* seeds should be continued.
4. That the screening of chemicals for selective and wide spectrum weed control should be continued.
5. That methods should be developed for surveying *Orobanche* and other weeds of faba beans. Surveys should be conducted in different countries, and economic thresholds established.
6. That integrated programs for the control of *Orobanche* and other weeds should be initiated.
7. That ICARDA should encourage workshops and specialized meetings on *Orobanche* and other weeds.

Plant Pathology

1. That closer cooperation between plant pathologists and plant breeders be encouraged.
2. That ICARDA should ensure knowledge of the risks involved in the distribution of germplasm.
3. That in view of the clear lack of research on biology and epidemiology of key pathoges, these areas should receive more emphasis.
4. That ICARDA should strive to standardise disease assessment methods, prepare leaf diagrams for estimating the percentage of disease on leaves, and provide instructions about how leaves can be assessed during different growth stages. Similar methods for assessing root diseases should be developed.
5. That international testing of lines found resistant to *Ascochyta* blight, chocolate spot and/or rust should be organised by ICARDA. This would ensure the testing of resistant lines to a range of different pathotypes.
6. That in future on-farm trials, more attention should be given to monitoring the incidence of pests and diseases. Demonstration trials for the chemical control of pests and foliage diseases should be set up.
7. That ICARDA should coordinate the publication of a "field guide" on faba bean diseases. Rating scales for key diseases might also be included.

Nutrition

1. That dietary surveys on faba bean consumption among population groups, including urban and rural populations, be conducted.
2. That surveys on faba bean utilization should be conducted in countries other than Egypt and Sudan.

3. That an assessment be made on the prevalance of favism in the different countries where faba beans are consumed, with special reference to age groups, sex, etc.
4. That the mechanisms by which these antinutritional factors react-with and affect faba bean utilization by people and animals, should be investigated.
5. That the breeding programs should develop cultivars that have low levels of antinutritional factors, including vicine and convicine.
6. That selected new varieties should not be below the nutritional quality of current varieties, and not inferior in their cooking quality and acceptability.
7. That studies should be encouraged on the determination of the nutritional quality of faba beans, as incorporated into the diet.
8. That special attention should be given to the development of techniques for the measurement of the physical, chemical and organoleptic properties of faba beans, related to cooking and processing.
9. That an assessment be made of faba bean losses during storage at the village level, and develop suitable methods for reducing these losses, using locally available materials at the village level.
10. It is highly recommended that, where possible, the maximum use of national institutes be made in meeting the objectives for research training of necessary personnel and dissemination of information.

Pest Control

1. That further evaluation of the main pests of faba beans, both in the field and during storage, is required throughout the region.
2. That there should be an analysis of field data and reports for confirmation of the pest status of different insects which attack

faba beans. Although certain species occur in high numbers, the damage which they cause may be of less importance, e.g. relatively low damage by <u>Aphis pisum</u> compared with that of <u>A.fabae</u> or <u>A.craccivora</u>.

3. That maps be prepared showing the geographic distribution of patterns of the pests throughout the dry region. (distribution maps).
4. That maps of the main infestation areas of important pests, be prepared. (infestation maps).
5. That a simple guide be prepared to describe the main pests and provide indicators for differentiation between similar species.
6. That a plant protection manual be produced for the main pests. Attention should be paid to establishing economic thresholds to avoid unnecessary control measures, and should be incorporated in the manual.
7. That studies of the population dynamics of the important pests of faba beans be made in order to develop adequate strategies for pest control and plant breeding. For example, earliness which amy be an effective way of escaping late infesting pests, is probably easier to achieve than resistance or tolerance.
8. That an evaluation of the host spectrum of faba bean pests may be valuable in identifying resistance <u>Vicia</u> species, which may be used as a source of resistant genes for faba beans when techniques for interspecific hybridization have been developed.
9. That a description of the many beneficial insects be prepared. Pheramone traps may be useful in reducing the losses by bean pests in stores, and research is needed on the control of faba bean pests by insect parasites, whether in the store or in the field.

Closing Remarks. By Dr.D.A.Bond, Plant Breeding Institute, Cambridge, U.K.

My suitcase is nearly full, filled with the large number of excellent papers which have been prepared for this conference. But, looking at this pile of papers, I am afraid that I cannot possibly do justice to them in trying to sum up in few minutes (By the way, we have found the papers most useful to refer-to during the meeting and to be able to take them away with us. This is preferable to having to wait several months for a written report of the meeting as happens with some conference. So, for this reason, I would like, on behalf of participants, to thank the organisers for the large amount of trouble they went-to in getting th papers duplicated).

However, I hope you will agree, Mr. Chairman, that not only is there a heavy weight in the papers in "Kilos per cubic meter" but also that they contain a fair amount of weight in terms of scientific merit.

Admittedly, I had some slight doubts about this conference when I left England. The program looked promising in terms of speakers and subjects, but some people had spoken about the "two worlds of *Vicia faba* (some even say three or four worlds); and so the questions was whether there would be enough in common between the highly mechansied culture of the small-seeded types, mainly for animal feed in areas such as N.W. Europe, and the hand-planted large-and-medium-seeded types, grwon mainly for human food in the Middle East.

Also, there are the long traditions of culture of faba beans in Egypt for which we from North and West have great respect. The Pyramids were probaly build on the strength of faba beans, one speaker said during the conference. So being here almost in the shadow of the Pyramids, we from the West are inclined to feel "What can we modern 'westerners' contribute to discussions about a crop which has been cultivated and developed by the local people for more than 5000 years?"

There was also a similar slight uncertainty in the mind of some of us on the first day of the Conference when we heard in some of the early papers local crop rotations and (later) hard seeds and Orobanche; aspects with which we from the North and West are not familiar.

But any fears such as these were soon dispelled when we heard, during the first day, the ably presented descriptions of the projects in Egypt and Sudan. We soon began to feel part of the local scene and, I trust, began to understand some of the problems.

Of course, on a number of occasions, the conference has, quite rightly highlighted the contrasts in methods of culture, uses and courses of development of the faba bean in different parts of the wrold. But, from the first day, it seemed to me that the two contrasting worlds were coming together; we were talking to each other at coffee and lunch, and the whole conference seemed to coalesce.

Also, on the first day, we had a timely reminder of the risk taking which farmers have to take; especially when faced with an unreliable crop such as faba beans. This point is also now valid in the developed countries where a large amount of capital is now invested in land and machines. So, in both worlds, we are very much aware of the need to give top priority, both in breeding and agronomy, to improving stability. Unfortunately this is not easy to achieve, from a breeding point of view at any rate , and some of the reasons for this became clear on the second day when we heard the latest results on the complexities of the breeding system, in particular the pollen mechanisms. Also, the concept of wider adaptability has to be approached with caution lest we fail to exploit fully the potential of suitability for special conditions where the plant is grown already.

Genetic variability was a recurring theme throughtout the conference. More variation is rapidly being uncovered, and recommendations about the maintenance of germplasm have already been made by the Breeding Group. My own view is that variation is a commodity which we cannot have too much-of, and all means to increase variabiliy should be encouraged . But the imoportant point is that although we may not all agree about the sufficiency of variability, this conference has allowed us to get together to discuss it and see more clearly where the deficiencies lie.

The main point about breeding methods was that the faba bean, or rather its growers, are in a hurry for improved cultivars, especially in the Middle East, and so advance in the short term are most likely to come from population improvement by mass or recurrent selections. It seems to me that we must fight the faba bean battle on two fronts - and this may apply to other disciplines as well as breeding - but for the development of new cultivars, there are the front line men who are assembling suitable parental populations and applying as much mass selection pressure as possible and, in the case of agronomy, conducting field experiments which could have immediate implication, through the extension services, for the farmers, while, at the same time the scientists whom I will call the "back room boys" work out new strategies.

But my impression is that the gap between the front line men and the back room boys of Vicia faba has been widening in the last few years, hence the need for conferences such as this, to bridge the gap between them and keep communication going. The utilisation of advanced technology by the back room boys was another recurring theme. It was mentioned in connection with interspecific hybridisation, chromosome manipulation, tissue culture, salt tolerance, and the analyses of different protiens and anti-nutritional, factors. Genetic engineering is coming, and as there are a number of deficiencies in faba bean which could be considered as candidates for genetic engineering, we don't want to be left out of the race.

In this respect and for more refined and extended screening on a larger scale of nutritional factors, I have heard it said during the conference that the faba ban lacks biochemists. The discipline of biochemistry is rather poorly represented at this conference and, although it is too soon to be thinking about another international faba bean conference, may be the time will be right at some future conference, for a better representation of the biochemistry discipline. But it will not simply be a case of inviting in biochemists and expecting all our problems to be solved. We will have to meet them half way by pointing to the particular problems which might, for example, be candidates for solving via genetic manipulation, and we may have to learn the new techniques ourselves.

The next session brought some clear statements on the results of recent research on protein, anti-nutritional factors, favism and cooking quality. We do not seem to be near to solving the sulphur amino acid deficiency, but protein content can be increased by selection and it is important to note that increase in protein content can help to increase yield of protein. We are fortunate with faba beans, as compared with some other grain legumes such as soya and Phaseolus beans, that anti-nutritional factors such as trypsin inhibitors and haemagluttins are in quite low concertrations; we can get rid of tannins by introducing the white flower gene,and, therefore, the review of the work on favism was most appropriate and may lead, we hope, to a determined tackling of this problem.

It was a most interesting trip through the Delta to Sakha Experimental Station, and revealing, for those of us who had not seen the Delta before. Personally, I felt quite at home at Sakha. The flowers were dropping off just like they do at Cambridge. We obviously have a problem in common there; and it did, in fact, lead to a great deal of useful discussion

I would like also to remark on the enthusiasm with which those plots and trials were demonstrated. Indeed the enthusiasm of the discussions by the local participants in the conference has been most heartening. Have you seen, Mr. Chairman, the dilemma of other Chairmen at question times in this conference when hands have gone up all over the room, seeking to raise a question or comment?. This is the sign of a good conference, I think. And if there is as much enthusiasm on the projects in the field as we have seen in this room and at Sakha, then I suggest this augurs well for the success of the Nile Valley Project. We would also like to say to people who are involved in the project, that as a result of this conference, it is not only ICARDA acting as a catalyst, as has been said, but many faba beans workers in other parts of the world are, if not actively collaborating, going to be showing keen interest in the progress of the project.

After seeing the flower drop at Sakha, it was appropriate to have more of this phenomenon next morning, and it appreas that the effects of growth-retarding substances can now be more precisely defined and that, perhaps, they can be utilised to prevent some dropping of flowers. Breeders are no longer just dabbling with the idea of plant models, they are seriously working at the problem, and it is becoming clear that fewer but stronger physiological sinks are necessary if we are to reduce some of the flower drop. The dream that some of us had of an entirely new plant type, may, in time with the helps of that mutation and selection, become a reality.

What was most striking about the physiological contributions was the extraordinary wide adaptation shown by the species since it spread from its centre of origin (probably the Fertile Crescent). This gives us encouragement to push it further, perhaps even into saline soils. But the faba bean remains a very moisture-sensitive plant, and I suspect that this still has a lot to do with its yield variability. I agree that agronomy experiments in the Nile Valley Project should not become too complex with many superimposed treatments; however we were reminded, in a later session, about irrigation x disease interactions.

It was refreshing to hear the underground parts of the plant being discussed (some of us guilty of giving attention only to the above-ground parts), and also to hear beter definitions than previously of regions and soils in which there is a response to Rhizobium inoculation. Perhaps we are getting near to the time when a map of the world can be produced, showing regions where faba bean Rhizobium is deficient.

What a terrible scourge this Orobanche is. Of course, you will all be welcome to visit England, but please could those of you from the Mediterranean area first empty your pockets of Orobanche seeds -at least before you reach Cambridge. We do not have O.crenata or O.aegyptiaca in the U.K, nor do we want to have them as might happpen with the accidental import of seeds and subsequent natural selection for tolerance of cold conditions.

However, I thought I detected in this conference session, a definite note of hope in terms of both chemical control and genetic resistance to Orobanche. By the way, we yesterday left small group discussing possible toxic residue of glyphosphate. I hope that this problem was resolved, becuase it seems vitally important to clear this question before proceeding to a widespread use of this promising herbicide.

What we have heard today about the diseases and pests, also gives cause for optimism. There were reports of genetic resistance to some of the diseases in the Sudan and to rust (Uromyces) and chocolate spot(Botrytis) in the Delta. These together with evidence of some resistance to Botrytis at Lattakia, Syria, and the use of inbred lines in Canada, suggest to me that if there is not already a break through in disease control in faba beans, we are on the verge of a breakthrough.

But what is clear from the discussions and recommandations, is that if we are to capitalise on these recent findings, then full international cooperation is essential. Now that we have some resistance, there will, sooner or later, be the problem of phyiological races and the needs to maintain a set of internationally recognised lines with which to test them. Of course, it will not only be on the disease front that international collaboration will be needed; there are several other aspects, for example the listing of the gene bank is already under way, and the importance of maintaining recognised germplasm has been reinforced by the breeding group.

Fortunately, ICARDA is already in existance and is generously coordinating or has expressed willingness to act as the central point for some of these international activities. ICARDA already has unilateral arrangements for pojects with individual associations and institutes in various countries and, from what we have heard of these I can say without any doubt, that though ICARDA is relatively young organisation, it is already held in high esteem in many parts of the world. The inauguration of FABIS, and soon Faba Bean Abstracts, is providing an effective vehicle for some of the international activities on faba beans which we have been discussing. This, together with some other conferences and workshops which ICARDA has organised recently, leads me to think of ICARDA not only as catalyst in the Nile Valley Project, as was mentioned in the beginning of this conference but is kindling the flame of international faba bean research generally.

What we have been talking about is the application of science to agriculture with special referecne to the faba bean. The scientific method consists, as you know, of formulating a hypothesis, then testing it, usually by experiment. One of the functions of a confernece, such as this, is that we put the reults of our experiences to the scrutiny of fellow scientists to make sure we draw valid conclusions. But another, and I think more important function, is to do with the fact that before a hypothesis can be formulated, some new ideas have to develop; some spark of imagination has to be created. And one rarely gets new ideas while sitting in one's laboratory or walking around one's own field plots. They are more likely to come through the interaction among participants. It is only the observing and discussion of each other's material which can provide the germ of an idea which could lead to the progress which is needed in faba bean research. It is rather like Darwin in the Galaphogus, the concept dawns only when the phenomena are seen. I feel sure that some sparks of imagination have been kindled during the presentations and discussions of this conference. But, of course, the real spark of imagination when someone said "We must have this conference", somebody in ICARDA, I guess.

Now, Mr. Chairman, I have come to the end of my "summing up", inadequate though it is;but because of the strongly-felt and perhaps shared sentiments which I have just been trying to express, I would now like to take it on myself to speak on behalf of the "outsiders" (those of us outside ICARDA and the Nile Valley who were invited to the conference) and propose a vote of thanks to ICARDA, and to our Egyptian hosts and to the Sudanese delegation for this most stimulating conference. I would particulary like to thank our unflappable organisers who looked after our every comfort, including travel which I know is a very time-consuming task. We have enjoyed our stay, and it has been a privilege to have participated in the conference. We wish you success in your project, we hope we meet again soon.

Closing Remarks. By Dr. M.A.Nour, Deputy Director-General, ICARDA

Dr. Bond has covered a considerable area which I had originally planned to cover, with clarity and conciseness which commands my deep esteem, if not my envy as well. He has stressed the scientific merit of the papers with their weight of thoughts and work - not only their physical weight. It is most gratifying to know the esteem in which ICARDA is held in lands which are beyond its mandate territory.

I have been most interested in the recommendations which have been brought forward from the discussion groups, and look forward to considering matters which can be implemented.

However, there are messages of sufficient significance which warrant stressing in their own intrinsic nature, and I will try to point some of them out. No doubt, all of you have your own overview impressions, and both the editor and I will be only too pleased to incorporate them in this section of the proceedings. My own impressions are:

a) This Conference has proven to be a bench mark which is a milestone in the life of the young ICARDA. From now on, ICARDA will probably be looked upon as a focal point on faba bean research and research information. FABIS has given a pointer in that direction. This Conference has christened ICARDA, as it were, as a Center to look to for progress in faba bean research. Whether ICARDA is able to perform such a task, or part of it, is only for the future to tell.

b) Within this umbrella, the Conference has highlighted the practical "socio-economic" utility of research results. Seldom do we find in an international conference of this nature, such a clarity of vision in this direction - to bring research orientation closely to farmers' needs and capabilities. ICARDA's Farming Systems Program has produced its impact with incisive effect, including emphasis on the need for the nutritional aspects.

c) The harmonious mixture of pure and applied research has emerged vividly as the only appropriate approach in our research direction. Over the past few years, ICARDA has concentrated on applied research in its quest for a success story to establish its utility and value within the region and throughout the world. Other Centers have had their respective success stories: CIMMYT with its "Green Revolution" with Dr. Borlaug carrying the banner; IRRI with its miracle rice, and so on. ICARDA is seeking to tell a success story, and we hope that faba beans will be one of our breakthroughs. In its own way, this Conference has helped in that direction. However, more than ever before, this Conference has shown that ICARDA must conduct more basic research and strengthen its own input in that area.

d) Further to this end, too, ICARDA must foster stronger and more effective links with universities and research institutions which are conducting long range research - basic research - in Europe, North America and other countries where resources, tradition and sustained programs are under way. Where its own present facilities do not enable ICARDA to build up basic research supportive programs, it should seek to contract, with respective centers of excellence, such research as is needed in that direction. This Conference has provided valuable guides of where such contracts might be made.

e) Whereas ICARDA conducts valuable training programs, it too may seek training in the wider field where much can be learned from older and more experienced organisations.

f) At the same time, the regional approach must not be lost sight of. The Nile Valley Project with participation by Egypt, Sudan and ICARDA is a fine example of how a regional problem can be tackled cooperatively.

In conclusion, I have several "thank you's":

1. To you scientists who have come from abroad.
2. To the national scientists of Egypt and the Sudan.
3. To Egypt for giving us such a good location and hospitality.
4. To you, Mr. Chairman; both personally and as a representative of IFAD.

This is the first time on which faba bean scientists from many parts of the world have come together and shared their thoughts and experiences with this important crop plant. It has been a singularly rewarding experience. Tomorrow will see many of us reassemble in Mariut to discuss other food legumes as well. So this is not really a "Good bye" statement from the Nile Valley. You will still be drinking the Nile water yet.

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