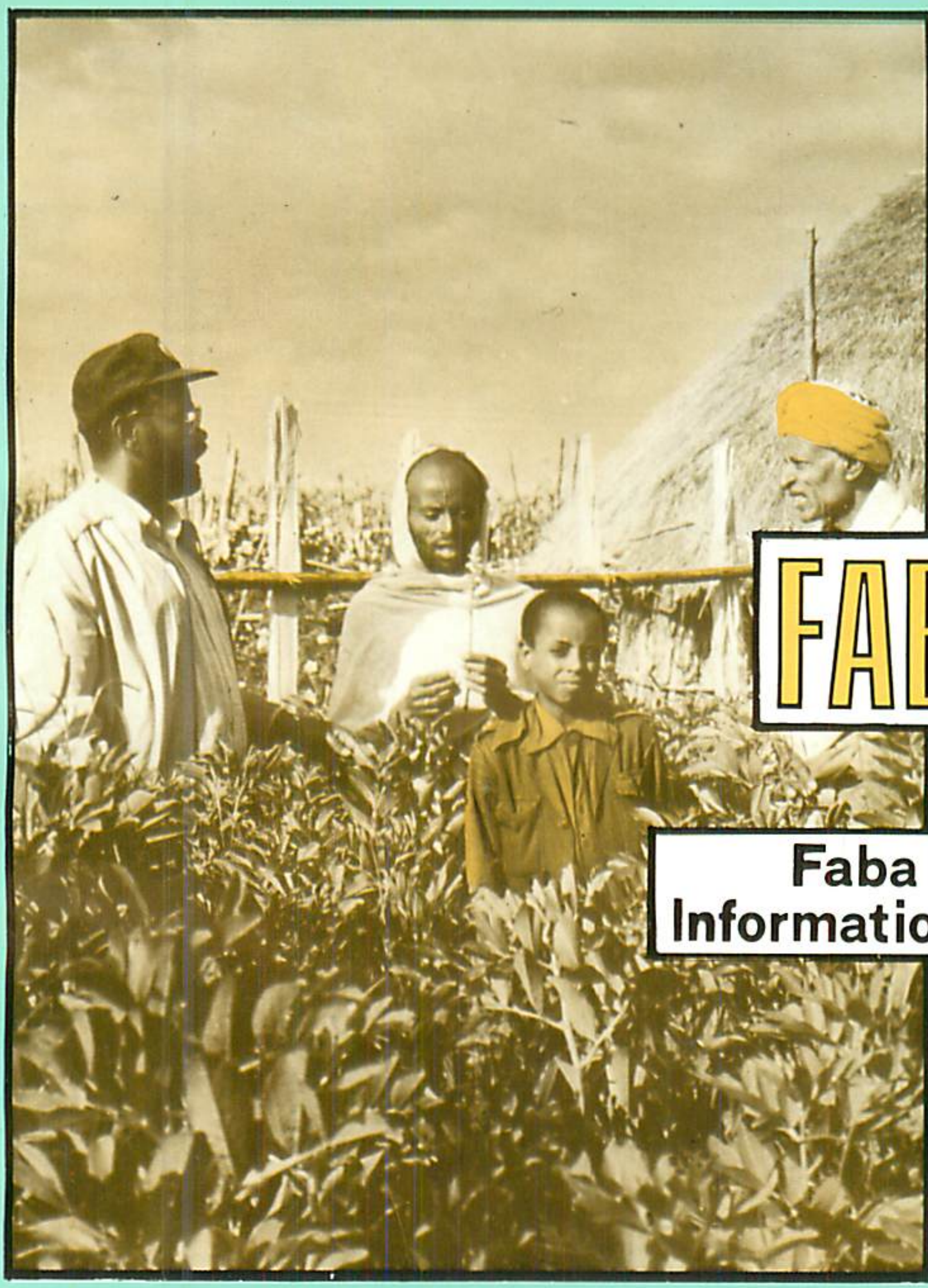

FABIS

Faba Bean Information Service

NEWSLETTER
No. 12
AUGUST 1985

INTERNATIONAL CENTER FOR AGRICULTURAL RESEARCH IN THE DRY AREAS
(ICARDA)

ICARDA and CGIAR

The overall objective of the International Center for Agricultural Research in the Dry Areas (ICARDA) is to increase agricultural productivity and food availability in both rural and urban areas, thus improving the economic and social well-being of people in developing countries, particularly in North Africa and West Asia. The center focuses mainly on winter rainfall areas with 200-600 mm annual precipitation. When appropriate, research also covers environments with monsoon rainfall or irrigation.

ICARDA is a world center for the improvement of barley, lentil, and faba bean, and a regional center for improving wheat, chickpea, farming systems, livestock, and pasture and forage crops. The training of agricultural researchers from developing countries and the communication of research results are an important part of ICARDA's activities.

ICARDA is a non-profit research center established in 1977 by the Consultative Group on International Agricultural Research (CGIAR). The CGIAR, an informal association of donors including governments, organizations, and private foundations, supports agricultural research worldwide to improve food production in developing countries, through a network of 13 international research institutions, including ICARDA. The network covers crop and livestock systems that supply three-quarters of the food of the developing world.

FABIS

FABIS Newsletter is produced three times a year at ICARDA with the financial support of the International Development Research Center (IDRC), Ottawa, Canada. FABIS, the newsletter of the Faba Bean Information Service, is a forum for communicating faba bean research results. Short research articles provide rapid information exchange, and comprehensive reviews are invited regularly on specific areas of faba bean research. The newsletter also includes announcements. The Faba Bean Information Service provides information on faba bean research free of charge through a question and answer service, photocopies, and searches of a faba bean document collection.

DEADLINE: Contributions must reach FABIS for No. 14 by February 28, for No. 15 by June 30, and for No.16 by October 31, 1986.

SUBSCRIPTIONS: FABIS Newsletter is available free to faba bean researchers under an IDRC grant. To subscribe, write: FABIS/Documentation Unit/ICARDA/P.O. Box 5466/Aleppo, Syria.

COVER PHOTO: Mr. Asfaw Telaye, Ethiopian faba bean breeder and highland pulses team leader at the Institute of Agricultural Research, Addis Ababa, examines the faba bean crop of a farmer in the Arsi area of Ethiopia. Mr. Telaye wrote the review of faba beans in Ethiopia in this issue of FABIS.

ISSN 0255 6448

FABIS

Faba Bean Information Service

NEWSLETTER No. 12

CONTENTS

Page

REVIEW ARTICLE

3 Faba Beans in Ethiopia
Asfaw Telaye (ETHIOPIA)

SHORT COMMUNICATIONS

Breeding and Genetics

5 Multivariate analysis in faba bean (*Vicia faba* L.)
J. S. Sindhu (INDIA)

7 Selection indices in faba bean (*Vicia faba* L.)
J. S. Sindhu, O. P. Singh, and R. P. Singh (INDIA)

8 Proposed use for a newly – discovered dominant male sterile allele for breeding purposes in *Vicia faba* L.
G. Duc, J. le Guen, J. Picard, and P. Berthelem (FRANCE)

Agronomy and Mechanization

11 Effect of sowing date, ridge direction, plant orientation, and population on faba bean grain yield
Ali Khalafalla Mohamed (SUDAN)

12 Comparative performance of faba bean and some other grain legumes in the north of Scotland
J. M. Sutherland, A. Fyson, and J. I. Sprent (UK)

Pests and Diseases

14 **Field biology of the faba bean stem borer, *Lixus algirus* L. (Coleoptera: Curculionidae) in Syria**
C. Cardona, A. Joubi, and O. Tahhan (SYRIA)

18 **A comparison of timing of insecticide applications for black bean aphid control in faba bean**
K. Ali (ETHIOPIA)

20 **A greenhouse technique for screening faba beans (*Vicia faba* L.) for resistance to *Orobanche* spp.**
S.T. Kukula and H. Masri (SYRIA)

Seed Quality and Nutrition

24 **The effect of desiccation, heating and supplementation with methionine of faba bean on mice performance**
Janusz Zurek, Michal Ploszynski, and Piotr M. Gorski (POLAND)

27 ANNOUNCEMENTS

28 Forthcoming Conferences 1985/86

30 BOOK REVIEWS

REVIEW ARTICLE

FABA BEANS IN ETHIOPIA

Asfaw Telaye
Institute of Agricultural Research, Addis Ababa, ETHIOPIA

Abstract

Faba bean is grown in Ethiopia in different agroecological zones, but the "Wyna Dega" zone is the most important. The crop is generally rainfed, mainly raised on moisture from rains in June-August, on soils of poor fertility. Faba bean area has doubled since 1971, but yield has remained stagnant. Most of the production is from small holdings and is used for domestic consumption. The traditional agronomy as practiced by farmers is described. Common pests and diseases are also described, which differ in different agroecological zones. Research on crop improvement has been carried out since 1968 and information on optimum agronomic practices has been developed; the system of varietal improvement and release has been explained.

Introduction

Ethiopia is divided into four agroecological zones:

- "Qula", or hot zones below 1800 m above sea level, with annual average temperature above 24°C. Faba bean production in this area is limited by the high incidence of *Uromyces* spp., *Botrytis fabae,* and *Levellula* spp.

- "Wyna Dega", or temperate zone, between 1800 and 2400 m altitude, with annual average temperature of 16°C. Faba bean cropping increases with altitude. This is the most important of the agroecological zones for faba bean production.

- The "Dega", or cool zone, from 2400 to 3800 m above sea level, with average temperatures in the range of 10-16°C. Faba bean cultivation extends up to 3200 m. However, above 2900 m, *B. fabae* is a serious problem.

- The "mountainous zone", with an alpine climate, extending above 3800 m. Alpine flora predominate in this zone.

Rainfall

In most of the highland areas there are two rainy seasons: March-May, and June-August, with heavier rains in the latter season. Total annual precipitation is in the range of 950-1500 mm.

Soils

In the highlands the soils are predominantly Alfisols, Vertisols, and Inceptisols. Major soil-related constraints to cropping are erosion on the slopes, lack of drainage on low-lying land, acidity, and low phosphate availability (Huffnagel 1961).

Production

From 1971-81, the area under faba beans has more than doubled from 150 thousand to 332 thousand hectares. However, in that period the average yield did not change markedly (1.02 t/ha in 1971 compared to 0.92 t/ha in 1981).

The majority of the production is from small-holders, and most goes for local consumption. Of the total production of 339.8 thousand tonnes in 1976/77, only 26.7 thousand tonnes were exported.

Agronomy

The crop is used in the farmer's rotation systems, usually as a break crop when the soil has become depleted through continuous cereal cultivation.

To prepare the seed bed, the land is ploughed up to three times using a crude plough drawn by animals. The plough breaks up the soil but does not turn it adequately, so a number of cultivations are required.

Planting takes place in June and July, by broadcasting, and the seed is covered through another cultivation. The depth at which the seed is placed thus varies greatly. The average seed rate employed is estimated at between 75 and 120 kg/ha, much lower than the recommended levels of 200-250 kg/ha.

Weeds are not controlled, but are allowed to grow and harvested for animal feed during the early podding stage of the crop.

Fertilizer is not generally used on faba beans; instead, the farmers use the crop itself to restore soil fertility.

The crop is harvested in late October to early November at altitudes between 1800 and 2500 m, while at higher elevations the harvest is later, from November to January. When the majority of pods are black, the plants are cut and arranged in stacks in the field, where they are left to dry for at least six weeks. The beans are then transported to the threshing area, where they are threshed through trampling by cattle or horses. Winnowing is done by hand.

Pests

The major insect pests are the American boll worm *(Heliothis armigera)*, aphids *(Aphis fabae)*, and thrips *(Taenothrips* spp.). Insufficient information is available on the amount of damage caused by these pests, and further research is required.

Diseases

Below 1800 m, *Uromyces fabae* infection is devastating to the crop. However, at higher altitudes it does not attack the crop until late in the grain filling stage, and does not significantly affect yield.

At altitudes above 2800 m, chocolate spot *(B. fabae)* may result in total crop loss; consequently, the cultivation of faba bean is restricted to lower altitudes, where infestation is only moderate.

Powdery mildew *(Erysiphe polygoni)* causes serious crop losses below 1600 m, where the climatic conditions are conducive to disease development. Faba bean planted during the "off-season" in the highlands may also suffer severe attack from this organism. But it occurs late in the growth cycle, and thus does not cause serious crop losses. The disease has never been reported as a serious cause of yield reduction in the main crop.

Virus diseases are not a major problem in Ethiopia, since the population of aphids is low in the faba bean growing regions during the crop season.

Review of research on faba beans

Agronomic studies investigating sowing date, plant population, and row spacing were conducted at Holetta and Debre Zeit research stations between 1968 and 1972 using landraces. The optimum sowing dates were from end of June to early July. Seed yield increased with increasing seed rate up to 275 kg seed/ha. In more recent studies (1980-82) conducted in collaboration with ICARDA using improved cultivars (20 D, Kuse-2-27-33, and NC-58 at Holetta, Kulumsa, and Debre Zeit, respectively), the optimum dates of sowing for different locations were found to be early June (for Holetta), mid-June (for Kulumsa), and late June (Debre Zeit). The optimum plant population appeared to be about 450,000 plants/m^2. Good responses to fertilizer (N and P) application were obtained at Holetta research station in studies conducted from 1970 to 1972. On red clay terraced beds, the highest yields were obtained with a combination of 60 kg N and 90 kg P_2O_5/ha, whereas on dark gray clay cambered beds a combination of 60 kg N and 60 kg P_2O_5/ha gave highest yield. Response to fertilizer under farmer's conditions has yet to be studied. In view of the fact that there is a positive response to nitrogen application, the possibility of improving symbiotic nitrogen fixation using more effective strains of *Rhizobium* should be investigated.

The faba bean varietal improvement program is rather young. The first national yield trials (NYT's) were initiated in 1972 with very limited entries. The NYT's are conducted at various research stations and include varieties that have been screened three-five years at the center concerned prior to their inclusion in NYT's. The results of NYT's are presented to the National Crop Improvement Committee (NCIC), which decides whether a variety should be released to farmers. However, before release, the variety is further studied by the National Seed Release Committee, and when approved, it undergoes on-farm evaluation through the Department of Socio-economics. Table 1 gives the results of a National Yield Trial conducted from 1979 to 1982 at various locations. There has been an increasing effort to conduct trials in different agroecological zones using genotypes with better yield potential than in the past. It is hoped that as a result of this effort, improved varieties and production technology will be available for Ethiopian farmers.

Table 1. Summary of national yield trials on faba beans in Ethiopia, 1979-82.

Year	Number of locations	Number of test entries	Number of cultivars out-yielding checks: Local check	Standard check	Best cultivars	Yield of best cultivar (kg/ha)
1979	5	17	NI *	None	NC 58	1937
1980	6	13	10	8	MKT 8 Bedolo	2339
1981	13	16	15	3	MKT Addis Ababa	1696
1982	11	16	14	16	Coll 26/78	3376

*NI = Not included.

Reference

Huffnagel, H.P. (ed.). 1961. Agriculture in Ethiopia. FAO, Rome, Italy.

SHORT COMMUNICATIONS

BREEDING AND GENETICS

MULTIVARIATE ANALYSIS IN FABA BEAN (*VICIA FABA* L.)

J. S. Sindhu
C.S.A. University of Agriculture and Technology, Department of Genetics and Plant Breeding, Kanpur-208002, INDIA

Abstract

Genetic divergence in 24 strains of diverse origin was estimated on the basis of 10 characters using Mahalanobis D2 statistic. On the basis of minimum generalized distance, the strains were grouped in 11 clusters. The clustering pattern indicated a positive relationship between geographic and genetic diversity. Based on the maximum diversity in the agronomic attributes, it is recommended that the 'Syrian medium large pod' and 'Indian local' may be used as parents for a distant hybridization program.

Introduction

The spectrum of variability in segregating generations is usually wide when diverse parents are involved in hybridization. This paper examines the diversity among 24 faba bean strains of different eco-geographic origins to enable selection of the right parents for initiating a hybridization program.

Materials and Methods

Observations were recorded on 10 characters for each of 24 strains from nine countries. Genetic divergence was estimated using Mahalanobis D2 statistic and the genotypes were grouped on the basis of minimum generalized distance using the method described by Rao (1952).

Results and Discussion

The experiment was conducted at Kanpur, Northern India during the winter season of 1983/84. The seeds were planted in October and the crop was harvested in the first two weeks of April. The relevant weather data during the crop period are given in Table 1.

The 24 strains were grouped into 11 clusters (Table 2). Cluster V was the largest with 10 strains representing five countries. This genetic affinity could be attributed to frequent exchange of seed material between countries.

Table 1. The weather data during the crop period.

Month/Year	Rainfall (mm)	Atmospheric temperature Max.	Atmospheric temperature Min.	Relative humidity (%)
Oct 1983	Nil	30.13	19.52	66.85
Nov 1983	Nil	26.87	11.30	57.25
Dec 1983	20.0	22.13	8.74	66.53
Jan 1984	7.2	20.16	7.84	64.87
Feb 1984	2.3	21.90	9.8	59.57
Mar 1984	Nil	31.29	14.6	55.85

The seed was received from ICARDA's Food Legume Program.

Table 2. Distribution of 24 strains of faba bean in different clusters.

Cluster no.	Number of strains	Name of strain(s)	Origin
I	1	Syrian medium large pod	Syria
II	1	Giza 3	Egypt
III	2	Lebanese small seeded	Lebanon
		74TA367	Spain
IV	3	747A12	Cyprus
		74TA59	Syria
		78S48476	Lebanon
V	10	78S48428	Lebanon
		74TA498	Egypt
		74TA-95, 75TA26062	Iraq
		77Sd92, 77Sd13, 77Sd70, 77TA88, 77TA80023	ICARDA
		75TA26467	Uruguay
VI	1	77MS88323	Lebanon
VII	1	77TA148	ICARDA
VIII	1	78S49288	Ethiopia
IX	1	Aquadulce	Spain
X	2	77TA82	ICARDA
		74TA91	Iraq
XI	1	Indian local	India

Table 3. Intra-and inter-cluster distances among 11 clusters in faba bean.

Cluster	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
I	0	81.17	49.39	35.81	41.54	84.90	100.60	82.53	56.00	40.43	255.53
II		0	38.40	85.94	56.35	36.14	56.27	61.88	50.60	47.18	234.51
III			17.20	59.90	39.99	55.40	74.68	66.42	43.34	23.67	235.59
IV				20.05	45.55	86.06	102.36	83.09	69.75	60.75	250.94
V					22.30	58.89	74.20	53.12	35.03	35.65	255.43
VI						0	52.50	39.45	23.79	32.78	251.67
VII							0	67.6	26.20	46.80	231.23
VIII								0	31.25	37.12	259.17
IX									0	60.79	247.60
X										17.93	272.12
XI											0

Table 4. Cluster means for 10 quantitative traits in faba bean.

Cluster	Days to flower	Number of primary branches	Height (cm)	Number of flowers/ plant	Days to maturity	Number of pods/ plant	Seeds/ plant	Grain yield (g/plant)	100-seed weight (g)	Protein content (%)
I	150.0	3.1	68.7	121.5	168.0	9.4	27.1	28.3	104.6	20.5
II	148.0	3.2	86.3	155.1	167.8	23.5	48.4	37.6	77.1	27.0
III	150.0	3.4	77.0	149.6	168.6	17.1	44.6	36.5	82.3	25.5
IV	146.0	2.7	71.4	104.9	168.4	10.2	23.6	18.8	78.2	26.3
V	148.0	2.9	78.5	122.3	168.9	13.3	30.1	24.2	78.8	26.1
VI	146.0	3.5	89.1	184.5	169.5	21.9	46.7	29.5	64.0	24.4
VII	143.0	3.5	94.5	159.9	170.2	16.4	41.1	27.6	66.3	25.4
VIII	146.5	2.8	89.0	115.1	172.5	10.9	25.8	22.0	84.9	25.7
IX	154.8	2.8	83.4	115.5	167.3	11.5	28.6	27.3	97.2	27.4
X	147.5	3.4	79.0	143.5	169.0	16.2	35.8	35.5	99.6	28.1
XI	125.5	4.2	61.6	229.9	150.8	65.1	161.5	42.8	26.2	30.7

However, the strains Giza 3, 77 MS 88323, 78S49288, Aquadulce, Indian local, Syrian medium large pod, and 77 TA 148, from Egypt, Lebanon, Ethiopia, Spain, India, Syria, and ICARDA, respectively, could not be grouped with any other genotype and thus formed separate clusters. By and large, the clustering pattern of populations indicated a positive relationship between geographic and genetic diversity. Similar observations have been reported in other crops by Joshi and Dhawan (1966), Moll *et al.* (1962), Ram and Panwar (1970), and Rao *et al.* (1981).

Intra-and inter-cluster distances are presented in Table 3. The maximum inter-cluster distance was observed between clusters X and XI; if strains from these clusters are selected as parents in a hybridization program, they would be expected to produce a wide spectrum of variability in segregating generations.

Cluster means for various characters are given in Table 4. Appreciable differences were found in the mean values for the different characters under study. Based on analysis of mean values, it is suggested that Syrian medium large pod (cluster I) and Indian local (cluster XI), which had maximum diversity for all the agronomic attributes may be used as parents for a distant hybridization program.

References

Joshi, A.B. and Dhawan, N.L. 1966. Genetic improvement of yield with special references to self fertilizing crops. Indian Journal of Genetics and Plant Breeding 26A: 101-113.

Moll, R.H., Salhuna, W.S. and Robinson, H.F. 1962. Heterosis and diversity in variety crosses of maize. Crop Science 2: 197-199.

Ram, J. and Panwar, D.V.S. 1970. Interspecific divergence in rice. Indian Journal of Genetics and Plant Breeding 30: 1-10.

Rao, C.R. 1952. Advanced statistical methods in biometrical research. John Wiley and Sons, New York. Pages 357-364.

Rao, A.V., Prasad, A.S.P., Srikrishna, T., Sahu, D.V. and Srinivasan, T.E. 1981. Genetic divergence among some brown plant hopper resistant rice varieties. Indian Journal of Genetics and Plant Breeding 41: 179-185.

SELECTION INDICES IN FABA BEAN (*VICIA FABA* L.)

J. S. Sindhu, O. P. Singh, and R. P. Singh
C.S.A. University of Agriculture and Technology, Department of Genetics and Plant Breeding, Kanpur-208 002, INDIA

Abstract

In order to develop suitable selection indices for faba bean, 24 different genotypes from nine countries were examined for six characters viz. primary branches/plant (X_1), plant height (X_2), flowers/plant (X_3), days to maturity (X_4), pods/plant (X_5), and grain yield/plant (X_6). Selection index combining X_3 and X_4 gave 138% selection efficiency compared to selection based on seed yield alone. However, the highest gain in selection efficiency (192%) was obtained when all the five characters, X_1 to X_5, were used as a selection index compared to the selection criterion of seed yield/plant alone.

Introduction

The inheritance of grain yield in faba bean is quite complex. Studies suggest that it is polygenic because the yield is affected by a number of yield attributes, which may be under different genetic control. This study of selection indices in faba bean was undertaken to assess the relative contributions of some growth and morphological attributes toward grain yield.

Materials and Methods

Twenty-four strains were selected from nine countries: Cyprus, Egypt, Ethiopia, India, Iraq, Lebanon, Spain, Syria, and Uruguay. The experiment was replicated three times in a randomized complete block design during the 1983/84 season. Observations were recorded on 10 randomly-selected plants for six characters: primary branches (X_1), plant height (X_2), flowers/plant (X_3), days to maturity (X_4), pods/plant (X_5), and grain yield/plant (X_6). The selection indices were constructed as suggested by Smith (1936).

Results and Discussion

The selection indices and their relative efficiencies (by percent) are presented in Table 1. Various combinations of the yield-contributing traits offered varying magnitudes of genetic gain over straight selection for grain yield. Of indices with two characters, the index combining flowers/plant and days to maturity offered 138.38% efficiency compared to straight selection. Four component characters —primary branches, flowers/plant, days to maturity, and pods/plant—combined in an index produced 181.41% efficiency compared to selection for grain yield alone.

Table 1. Selection indices and their relative efficiencies in faba bean.

	Discriminant function	Relative efficiency (%)
1.	$11.220\ X_1$	75.93
2.	$-\ 0.008\ X_2$	0.28
3.	$-\ 0.418\ X_3$	3.32
4.	$-\ 0.618\ X_4$	121.21
5.	$0.411\ X_5$	65.22
6.	$0.996\ X_6$	100.00
7.	$10.75\ X_1 + 0.58\ X_2$	74.02
8.	$12.01\ X_1 + 0.13\ X_3$	76.33
9.	$7.65\ X_1 + 1.01\ X_4$	35.93
10.	$3.14\ X_1 + 0.52\ X_5$	83.85
11.	$-\ 1.96\ X_2 + 2.32\ X_3$	77.78
12.	$0.21\ X_2 + 0.81\ X_4$	47.33
13.	$0.13\ X_2 + 0.45\ X_5$	68.25
14.	$0.64\ X_3 - 0.75\ X_4$	138.38
15.	$0.66\ X_3 + 0.65\ X_5$	71.75
16.	$0.93\ X_4 + 0.77\ X_5$	75.90
17.	$15.96\ X_1 + 0.64\ X_2 - 12.53\ X_3$	80.52
18.	$8.48\ X_1 + 0.47\ X_2 + 0.22\ X_4$	61.32
19.	$48.01\ X_1 + 0.95\ X_2 - 2.32\ X_5$	23.23
20.	$7.47\ X_1 + 0.26\ X_3 + 4.82\ X_4$	95.95
21.	$8.48\ X_1 + 0.93\ X_3 + 0.55\ X_5$	87.44
22.	$0.03\ X_1 + 4.25\ X_4 + 1.68\ X_5$	79.50
23.	$1.90\ X_2 + 0.12\ X_3 + 2.97\ X_4$	65.02
24.	$7.15\ X_2 + 3.12\ X_3 + 2.38\ X_5$	125.54
25.	$35.97\ X_2 + 0.16\ X_4 + 2.66\ X_5$	157.72
26.	$1.17\ X_3 + 0.85\ X_4 + 0.45\ X_5$	23.66
27.	$4.80\ X_1 - 0.09\ X_2 + 0.07\ X_3 + 1.95\ X_4$	150.07
28.	$8.27\ X_1 + 0.04\ X_2 + 1.01\ X_3 + 0.76\ X_5$	97.40
29.	$9.26\ X_1 + 0.48\ X_2 - 2.04\ X_4 + 0.88\ X_5$	91.63
30.	$0.32\ X_1 + 2.28\ X_3 + 2.05\ X_4 + 2.09\ X_5$	181.41
31.	$0.01\ X_2 + 2.80\ X_3\ \ 9.87\ X_4 + 4.10\ X_5$	99.42
32.	$0.16\ X_1 + 0.27\ X_2 + 33.42\ X_3 + 30.80\ X_4 + 19.6\ X_5$	192.35

Selection efficiency may be further improved in faba bean using an index of five component characters: primary branches, plant height, flowers/plant, days to maturity, and pods/plant. This index would offer efficiency of 192.35% compared to straight selection for grain yield.

Reference

Smith, H.F. 1936. A discriminant function for plant selection. Annals of Eugenics 7: 240-250.

PROPOSED USE FOR A NEWLY–DISCOVERED DOMINANT MALE STERILE ALLELE FOR BREEDING PURPOSES IN *VICIA FABA*

G. Duc[1], *J. Le Guen*[2], *J. Picard*[1], *and P. Berthelem*[2] *
1. INRA- Station d'Amelioration des Plantes, 17, Rue Sully-BV 1540, 21034 Dijon, FRANCE
2. INRA-Station d'Amelioration des Plantes–Domain de la Motte au Vicomte, B.P. No. 29-35650 Le Rheu, FRANCE

Abstract

Since the mating system in faba bean is intermediate between autogamy and allogamy, recurrent selection as a means of population improvement is of limited value. Efforts have therefore been made to use genetic male sterility. A dominant gene for male sterility, 'D6', has been discovered in M_2 plants obtained from EMS treatment of seeds of cultivar DIANA. A scheme has been proposed for using this gene in varietal improvement of faba bean. Also discussed are the advantages of using a dominant gene for male sterility over a recessive gene in a faba bean breeding strategy.

Introduction

Improvement of populations of cross pollinated species by recurrent selection has proved to be an adequate breeding method (Gallais 1977). Yet, the use of this method for *Vicia faba* may be limited by the low level of outcrossing in this species which ranges between 30-60% in France.

Several researchers have tested the usefulness of genetic male sterility to modify the mating system, using either a recessive gene (Brim and Stuber 1973) or a dominant one (Sorrells and Fritz 1982). This paper reports the discovery of a dominant male sterile gene in *Vicia faba* and proposes a scheme for its utilization.

Identification of dominant male sterile gene after mutagenic treatment

The spontaneous occurrence of a dominant male sterile gene has been reported in cotton (Bowman and Weaver 1979). In mutagenesis programs using EMS (ethyl methane sulfonate), the appearance of a dominant male sterile gene has been seen in wheat (Sasakuma *et al.* 1978) and petunia (Singh 1976). In wheat, the mutated gene was differentially transmitted to progenies through cytoplasmic influence. For petunia, the genetic nuclear background appeared to act on the expression of the mutated gene.

A mutagenic treatment was applied to the German synthetic spring cultivar DIANA obtained from OTTO-BREUSTEDT . Seeds were soaked for 24 hours in a 1.5% EMS solution. Treated seeds were sown in an isolated plot at Dijon in the spring of 1974.

From 1400 M_1 plants, a total of 24,000 seeds were harvested. M_2 plants were screened by eye observation of the anthers in the field at different ACVF member stations. A microscopic confirmation of male sterility was done of flowers from the plants that appeared to be male sterile in the field examination. Ten male sterile plants were crossed by the original cultivar DIANA as pollen parent. Only three progenies from these crosses contained male sterile plants and were backcrossed with the original cultivar.

Our interest was to discover a new type of cytoplasmic male sterility different from the '447' and '350' ones. The fertile F_1 progenies were discarded, which also would have automatically removed plants with recessive genes for male sterility. Of the three remaining progenies, only one exhibited a perfect male sterile phenotype when examined microscopically (100% male sterile pollen grains in the anthers). We named this the D6 character.

The inheritance of the D6 character was studied (Fig. 1). Backcrosses with DIANA resulted in segregating progenies fitting a 1:1 ratio which can be explained by dominant gene action in this type of male sterility.

DIANA M_1
↓ *Open pollination*
DIANA M_2
Male sterile plant D_6
↓ *Crossed by DIANA*
10:9
↓ *Backcrossed by DIANA* BC_1
17:19
16:13
24:25
10:13
26:15
↓ *Backcrossed by DIANA* BC_2
15:17
24:25
33:24
9:13
↓ *Backcrossed by DIANA* BC_3
7:6
16:11
16:14
15:14
5:7

Fig. 8. Male fertile - male sterile segregations observed in the course of backcrossing DIANA D_6 male sterility.

* On behalf of ACVF: No. 1, 59235 Bersee, France; and Estallissements CLAUSE, 91220 Bretigny sur ORGE, France.

Four other spring lines –Ad23, G58, HG115, and 123– tested as pollen parents against the sterile plants, gave F1 with the same 1:1 ratio in F1 progenies. However, in backcross four, 40 of 180 progenies did not fit this ratio; 30 of these showed a 1:3 pattern and 10 others showed a 3:1 ratio. Out of 210 progenies arising from selfing fertile plants, 55 exhibited male sterile plants, of which 25 fit a 1:3 ratio, 27 fit a 1:15 ratio, and 3 fit a 3:1 ratio.

These results clearly show that the main cause of this male sterility is a dominant acting gene. Nevertheless, the particular disjunctions exhibited in some progenies show that the expression of this gene can be affected by other alleles, by the genetic background in which it acts, and perhaps also by environmental conditions. Singh (1976) has drawn a similar conclusion in the case of an EMS induced sterile mutant in petunia.

Proposed use of this gene in a breeding scheme (Fig. 2)

One of the main problems raised by the introduction of recurrent schemes in faba bean breeding is the poor rate of inter-mating. Because of the species' special floral biology and a mating system which is intermediate between allogamy and autogamy, crosses between individual faba bean plants are relatively infrequent, with few expected recombinations. The proposed scheme, modified from the one proposed for self pollinated crops (Sorrells and Fritz 1982), allows maximum intercrossing in the course of formation of a source population. Moreover, this scheme allows continous screening and test input of the material under selection during population improvement.

This scheme can be considered as recurrent, since each cycle leads to a population issued from the previous one by

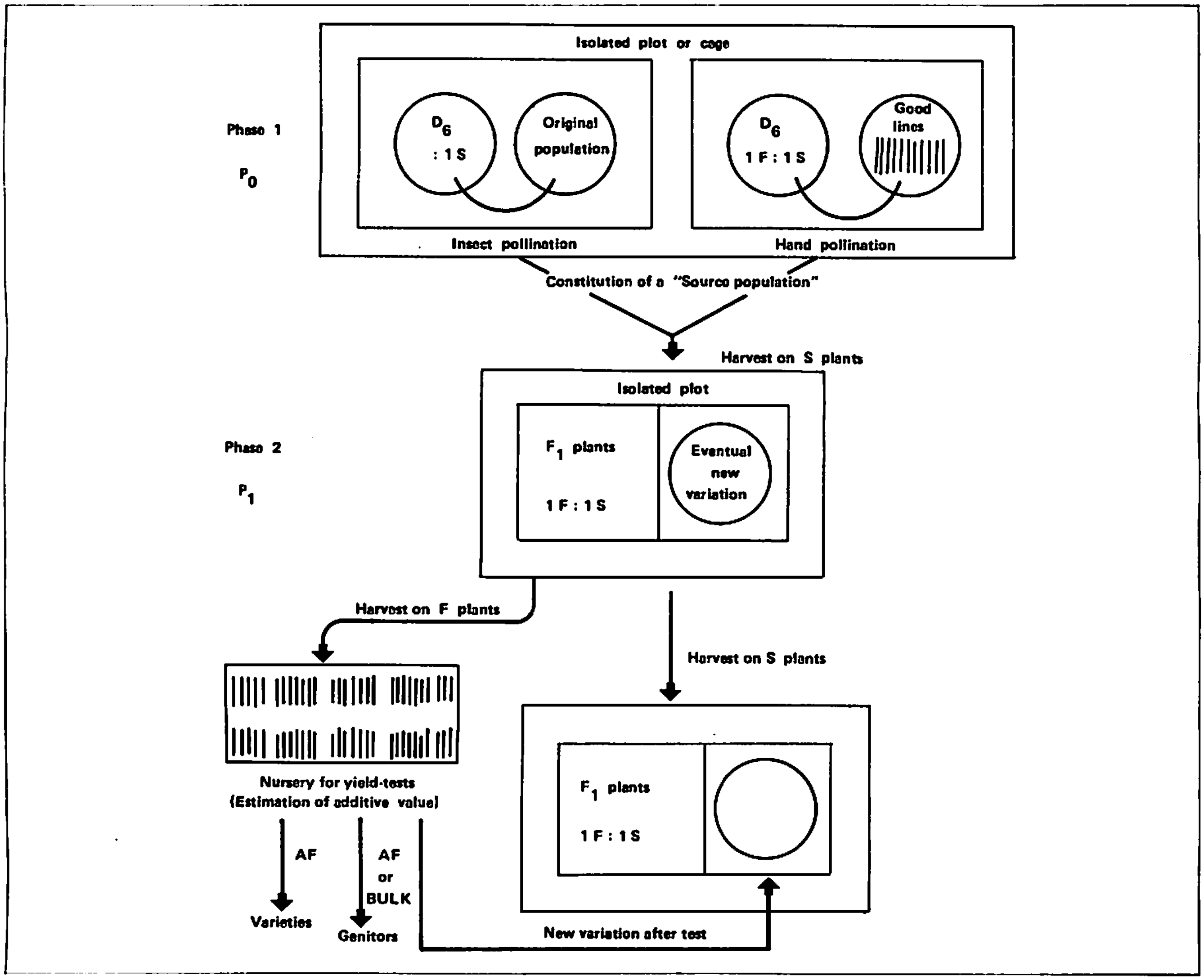

Fig. 2. Proposed scheme for the use of D_6 male sterility in a breeding program.

intercrossing and/or by eventually adding new variation. The source population can be achieved, as proposed in Fig. 2, both by bee pollination of the male sterile (S) plants after elimination of the half male fertile (F) ones in an original population, and also by hand pollination with selected genitors on the male sterile plants in the D6 population (Phase 1).

Seeds of male sterile (S) plants are sown as mixtures in isolated plots or under insect proof cages, and segregation into F and S plants is noted at the beginning of flowering stage. The harvested S plants constitute the next generation of intercrossing for another time, with new variation eventually added.

Fertile F_1 plants are collected individually and their progenies are tested in field micro-trials for yield and other characters on the basis of the estimation of their additive value in the families. From the yield results of micro-trials, a maternal selection can be done within the best families, with the potential to obtain improved lines by selfing, or to bulk them for one or more years to promote new intercrosses. The new lines or improved bulks can be subsequently used as commercial varieties or genitors, or put back in the population under selection as a new source of variation (Phase 2).

In short, it appears that the dominant gene for male sterility 'D6' in *V. faba* offers better breeding opportunities than does a recessive one, because there is a chance to make an effective breeding choice at each generation ensuing from the constant 1:1 disjunction in the progenies of the male sterile parents. Furthermore, phase 2 of the scheme can be maintained for several years or cycles to ensure more intercrossing between individuals before testing. Finally, when good material is selected, it is possible to make an improved synthetic commercial variety from a mixture of fertile and sterile lines intercrossed for a few years, hopefully employing an important residual heterosis.

References

Bowman, D.T. and Weaver, J.R. 1979. Analysis of a dominant male sterile character in upland cotton. II Genetic studies. Crop Science 19: 628-630.

Brim, C.A. and Stuber, C.W. 1973. Application of genetic male sterility to recurrent selection schemes in soybean. Crop Science 13: 528-530.

Gallais, A. 1977. Amelioration des populations, methodes de selection et creation de varietes. I. Synthese sur les problemes generaux et sur les bases theoriques pour la selection recurrente intrapopulation. *Annales de l'Amelioration des Plantes* (Paris) 27: 281-329.

Sasakuma, T., Maan, S.S. and William, N.D. 1978. EMS induced male sterile mutants in euplasmic and alloplasmic common wheat. Crop Science 18: 850-885.

Singh, I.S. 1976. Une mutation dominante pour la sterilite pollinique induite par le MSE chez le petunia. C.R. Academie Science Paris 282 D: 859-862.

Sorrells, M.E. and Fritz, S.E. 1982. Application of a dominant male sterile allele to the improvement of self pollinated crops. Crop Science 22: 1033-1035.

AGRONOMY AND MECHANIZATION

EFFECT OF SOWING DATE, RIDGE DIRECTION, PLANT ORIENTATION, AND POPULATION ON FABA BEAN GRAIN YIELD

Ali Khalafalla Mohamed
Shendi Research Station, P.O. Box 33, Shendi, SUDAN

Abstract

The effect of two sowing dates, two ridge directions, two seed rates, and three plant orientations was studied on the plant stand, yield attributes, and yields of faba bean cultivar BF 2/2 at Shendi Research Station in Sudan. October sowing resulted in a poorer plant stand than November sowing. Sowing on the top of the ridge was better than on the sides. High seeding rate (33.3 plants/m^2) was better than the lower one (16.6 plants/m^2). Sowing on the left side of the ridge, particularly in October, resulted in a poor stand and, therefore, reduced yield compared to sowing either on the top or the right side of the ridge. These differences are attributed to differences in soil temperature.

Introduction

Manipulation of cultural practices is a well-known way to maximize crop yields. Sowing on the optimum date can minimize crop losses due to insects and diseases and maximize yield (Fereigon 1981; Salih and Khalafalla 1983). Shadbolt *et al.* (1961) found that bed shape, size, and direction often markedly affect the crop plant's microclimate. This study investigates the effect of sowing date, ridge direction, plant orientation, and population on faba bean yield.

Materials and Methods

This study, using faba bean variety BF 2/2, tested two sowing dates (D_1 = 10 Oct and D_2 = 1 Nov); two ridge directions (NS, north-south and EW, east-west); two plant populations (P_1 = 16.6 and P_2 = 33.3 plants/m^2); and three plant orientations (right, center, and left sides of the ridge). Right side refers to the east side of the NS directed ridge and the north side of the east-west ridge, while left side refers to the west side of NS ridges and south side of EW ridges. The treatments were arranged in a single split plot design, combining ridge direction and planting date in main plots, and orientation and plant population in subplots. There were four replications. Irrigation and weeding were done when necessary. Insects were controlled effectively by spraying twice with 57% malathion.

Results and Discussion

Data on yield response to sowing date, ridge direction, plant orientation, and population are shown in Table 1. The effect of sowing date on grain yield and its components (number of plants/m^2 and number of pods/plant) was highly significant. Plants sown in both ridge directions on 1 Nov outyielded these sown on 10 Oct by 54%. The lower yield from sowing on 10 Oct was mainly due to the reduced plant stand, and the high number of pods/plant with early sowing did not compensate for the low number of plants/ unit area (Table 1). Plant stand at harvest was 12% of theoretical population with October sowing, and 34% with November sowing. The smaller plant stand from October sowing was probably due to the higher temperature (both air and soil) during October at the time of seed germination and seedling development. (Mean maximum and minimum temperatures for these two stages were 39.5 and 25.5°C in October, and 33.9 and 19°C in November). The higher October temperature not only made the plants more susceptible to wilt and root rot (Fereigon 1981), but also might have affected germination, emergence, and growth.

Plant orientation significantly affected grain yield, number of plants/m^2, and number of pods/plant (Table 1). Sowing at the center of the ridge produced a higher yield than sowing on the sides of the NS or EW directed ridges. The lowest grain yield was obtained with early sowing on the western side of the NS ridge and the southern side of the EW ridge. Late sowing on the southern side also yielded less than sowing on the northern side. Ridge direction, however, did not significantly affect grain yield.

The number of plants/unit area at harvest followed a pattern similar to that of grain yield (Table 1). A plant population of 33.3 plants/m^2 outyielded 16.6 m^2 by 12%. A low plant population gave a significantly smaller number of plants/m^2 (4.7 for a low population and 6.6 for a high population) and more pods/plant (39.9 for low and 33.5 for high) than the high plant population.

These results show that the low grain yields obtained on the western side of the NS ridge and the southern side of the EW ridge, especially at early sowing, resulted from a reduced plant stand which was due, in turn, to the failure of seeds to germinate and /or emerge because of the high temperature during germination and seedling development. High temperature might reduce seed vigor by disturbing biochemical reactions, during the process of germination and seedling emergence.

Table 1. The effect of sowing date, ridge direction, plant orientation, and population on yield and some yield components of faba bean at Shendi, 1981 season.

Ridge direction and sowing date	Plant orientation and population*						
	Right		Center		Left		
	P_1	P_2	P_1	P_2	P_1	P_2	
			Seed yield (kg/ha)				Mean ± 85.5
NS D_1	700	748	1328	1126	76	249	704
NS D_2	1628	1472	1706	1784	1298	1628	1585
EW D_1	738	964	977	1185	64	225	692
EW D_2	1524	1823	1771	1849	668	1068	1450
Mean ± 114.7	1147	1251	1445	1486	527	792	
			No. of plants/m^2				Mean ± 0.72
NS D_1	2.2	4.2	3.5	6.6	0.3	0.8	2.9
NS D_2	8.8	11.1	9.1	10.2	6.6	8.1	9.0
EW D_1	3.2	4.0	3.3	5.0	0.3	0.9	2.8
EW D_2	8.1	10.9	9.6	10.9	1.2	7.2	8.0
Mean ± 0.81	5.6	7.5	6.4	8.1	2.1	4.2	
			No. of pods/plant				Mean ± 3.89
NS D_1	41.7	38.7	61.4	34.9	35.7	52.4	44.1
NS D_2	29.5	22.9	34.0	27.5	31.9	29.8	29.2
EW D_1	46.5	43.7	51.0	38.8	19.5	33.1	38.8
EW D_2	38.6	22.7	36.7	20.9	52.5	36.2	34.6
Mean ± 4.23	39.1	32.0	45.8	30.5	34.9	37.9	

* P_1 = 16.6 plants/m^2; P_2 = 33.3 plants/m^2

References

Fereigon, S.O. 1981. Effect of sowing date and watering interval on the incidence of wilt and root rot diseases in faba bean. FABIS No. 2: 41.

Salih, F.A. and Khalafalla, A. 1983. Influence of sowing date on performance of four faba bean varieties at different locations in Sudan. Paper presented at the Fourth Annual Coordination Meeting of ICARDA/IFAD Nile Valley Project, ICARDA/IFAD, 10-14 Sept 1983, Khartoum, Sudan.

Shadbolt, C.A., Mecoy, O.D. and Little, T.M. 1961. Soil temperature as influenced by bed direction. American Society for Horticultural Science Journal 78: 488-495.

COMPARATIVE PERFORMANCE OF FABA BEAN AND SOME OTHER GRAIN LEGUMES IN THE NORTH OF SCOTLAND

J. M. Sutherland,[1] A. Fyson,[2] and J. I. Sprent[1]

1. The University, Department of Biological Sciences, Dundee, UK.

2. Rothamsted Experimental Station, Harpenden, Herts, UK (Present address: McMaster University, Department of Biology, Hamilton, Ontario, Canada).

Abstract

In order to explore the possibility of introducing non-traditional grain legumes to the north of Scotland, the comparative performance of three cultivars of faba beans and one each of dry peas and lupins was evaluated. Of the species evaluated, dry peas showed the greatest potential. Yields of faba bean were sufficiently high to warrant further evaluation with emphasis on early-maturing types for spring sowing and winter types for winter sowing.

Table 1. Stem fresh weight (FW) and dry weight (DW) and seed yields (g) of three grain legumes from two trials carried out in Caithness in 1983.

	Trial A			Trial B		
Species/cultivar	FW/m^2	DW/m^2	Seed DW/ m^2 (SE)	FW/m^2	DW/m^2	Seed DW/ m^2 (SE)
Faba Bean						
Banner Winter	3150	730	160 (10)			
Maris Bead	2190	510	110			
Minden	3090	710	210	1140	170	14 (4)
Lupin						
Vladimir	2760	390	26 (4)	1550	270	12 (2)
Pea						
Poreka	2130	920	430 (40)	1030	510	196 (4)

Introduction

In recent years, two crops previously considered unsuited to growing conditions in the north of Scotland–winter barley and oilseed rape– have been gradually extended northwards to near the north coast in Caithness. There are obvious advantages of growing grain legumes in an area where both feed and fertilizer costs are high. Yields of both faba bean *(Vicia faba)* and combining pea *(Pisum sativum)* in the south of Scotland are as high or higher than those in England, so a small scale investigation of the growth of these crops in the north promised interesting results.

Materials and Methods

Three cultivars of *V. faba* and one each of *Pisum sativum* and *Lupinus albus* were grown on two trial sites in eastern Caithness in 1983. Site A was 500 m from the sea at an altitude of 50 m above sea level, with a slightly south-easterly aspect. The soil, a fairly rich loam which had grown two previous potatoe crops, was prepared by several passes of a spring-tine cultivator. Site B, situated in a valley at an elevation of about 85 m above sea level with a north-easterly aspect, had poorer soil than site A. The previous crop was also potatoes and the soil was prepared by plowing and harrowing.

Weather conditions were worse than average, with the spring particularly wet and late.

Experimental design

Trial A was carried out in a randomized block design with two replicates each of the peas and lupins and one replicate each of the faba bean cultivars. One of the faba bean cultivars (Banner Winter) is normally sown in autumn, while the other two (Maris Bead and Minden) are spring cultivars. Each plot consisted of three rows, each 8 m long, with a spacing of 25-30 cm between rows and 3·5 cm between seeds.

Trial B was carried out in a randomized block design with three replications, each containing one plot of lupin, pea, and faba bean. Each plot consisted of four rows, 6 m long, with 25 cm between rows and 3·5 cm between seeds.

Results and Discussion

The results of trials A and B are shown in Table 1. The peas matured much earlier than other species (late August in trial A and early September in trial B). The field beans matured in mid-Oct in trial A and failed to mature in trial B. The lupines failed to mature at either site. The pea yield of 430 g/m^2 was higher than expected, since the test variety Poreka is usually grown for forage. On site B, yield was reduced by a greater infestation of weeds resulting from wetter conditions at planting.

Of the species investigated, pea shows the greatest potential for cultivation in northern Scotland. Yields of faba bean were sufficiently high to warrant further investigation with earlier cultivars and with Banner Winter grown as a winter cultivar. It is unlikely that any of the currently available *L. albus* cultivars are sufficiently early to warrant further immediate investigation, but other lupin species such as *L. luteus* and *L. angustifolius* should be considered.

Acknowledgement

We are grateful to Grainfax Ltd., 3a High St., Kinross KY13 7AW, UK for donating pea seed for the 1984 trial.

PESTS AND DISEASES

FIELD BIOLOGY OF THE FABA BEAN STEM BORER, *LIXUS ALGIRUS* L. (COLEOPTERA: CURCULIONIDAE) IN SYRIA

C. Cardona, A. Joubi, and O. Tahhan
ICARDA, P.O. Box 5466, Aleppo, SYRIA

Abstract

Stem borer is a widespread pest of faba beans in the Mediterranean region with variable economic importance. Its biology has not been well-studied. This paper describes the field biology of the insect based on studies carried out in the Beka'a valley in Lebanon and at a coastal site in Lattakia in western Syria. The adult female beetles bore holes into and lay eggs in the stem mostly between February and March. All immature stages occur in the stems. The larval cycle takes an average of 55 days and larvae are found in the hollow part of the stem (where they have nibbled the walls). Pupation usually occurs in the lower third of the stems, and the pupal stage lasts for about 17 days. Adults emerge from the stem in May. The insect seems to overwinter in the adult stage and its biology and habits seem to be timed well to the phenology of the faba bean crop. Delayed sowing reduces infestation.

Introduction

The faba bean stem borer, *Lixus algirus* L., is a widespread insect pest of faba beans in the Mediterranean region (Bardner 1983). Its occurence in Europe has been noted in Spain and Portugal (Isart 1967) and Italy (Fullaway 1958). In the Middle East the stem borer has been found in Cyprus, Turkey, Syria, Lebanon, Palestine, and Jordan (Gentry 1965; ICARDA unpublished work). Diekmann (1982) registered *L. algirus* as a pest of faba beans in Tunisia and Morocco, but not in Egypt. The insect has not been recorded in Algeria and Libya. In Syria, the insect is largely confined to the coastal region, and less common in drier inland areas (Hariri and Tahhan 1983).

The economic importance of the faba bean stem borer seems to vary. In North Africa, Gentry (1965) and Coers *et al.* (1983) regard it as an important pest in Tunisia, while Diekmann (1982) regarded the stem borer as the most destructive pest of faba beans in Morocco. In the Middle East, it is considered a minor pest in Palestine (Gentry 1965), and in Turkey (Lodos 1985, Ege University, Turkey, personal communication).

Isart (1967) and Coers *et al.* (1983) specifically discuss the biology of *L. algirus*. This paper reports the main results of a three-year study on the field biology of the stem borer.

Materials and Methods

Some observations in this paper were made in the Beka'a Valley of Lebanon, but most of the studies were conducted at ICARDA's Lattakia station, 35 km from Lattakia, a coastal city in Syria located at 35°30'N, 35°47'E, 7 m above sea level. This area of Syria has a typical Mediterranean climate with mild, rainy winters alternating with hot, dry, summers. Average relative humidity is 70% and mean precipitation is 800 mm/year. Mean temperatures in winter and spring, the two periods most relevant to this study, are 12 and 18°C, respectively.

To follow the biology of the stem borer, large (1000 m^2) plots of the commercial Syrian Local Medium variety were planted for three seasons (1981-84). No fertilizer or irrigation was used, and the crop was planted on the usual date (early November) and grown with the typical cultural practices. Every two weeks after germination, samples of 20-30 plants or, later, 100 stems were taken at random to assess insect damage and record the presence of different insect developmental stages. On each occasion, data were recorded on number of perforations/stem, percentage of plants and stem infested, and number of adults/m^2. All immature stages were collected, placed in 40% alcohol, and examined in the laboratory. Representative samples of each stage and larval instars were measured with a calibrated ocular micrometer. The effect of planting dates on *L. algirus* populations and damage levels was studied by planting 50 m^2 plots on three planting dates, replicated four times in a randomized complete block design. Damage and infestation levels were assessed as above.

Results and Discussion

L. algirus adults are large (15-21 mm long) beetles with a slender body slightly constricted between the pronotum and elytra and tapered towards the end. Both sexes bear a pronounced rostrum which is longer in the female. The body is solid brown, often covered with a yellow or reddish powder; the elytra are finely striate.

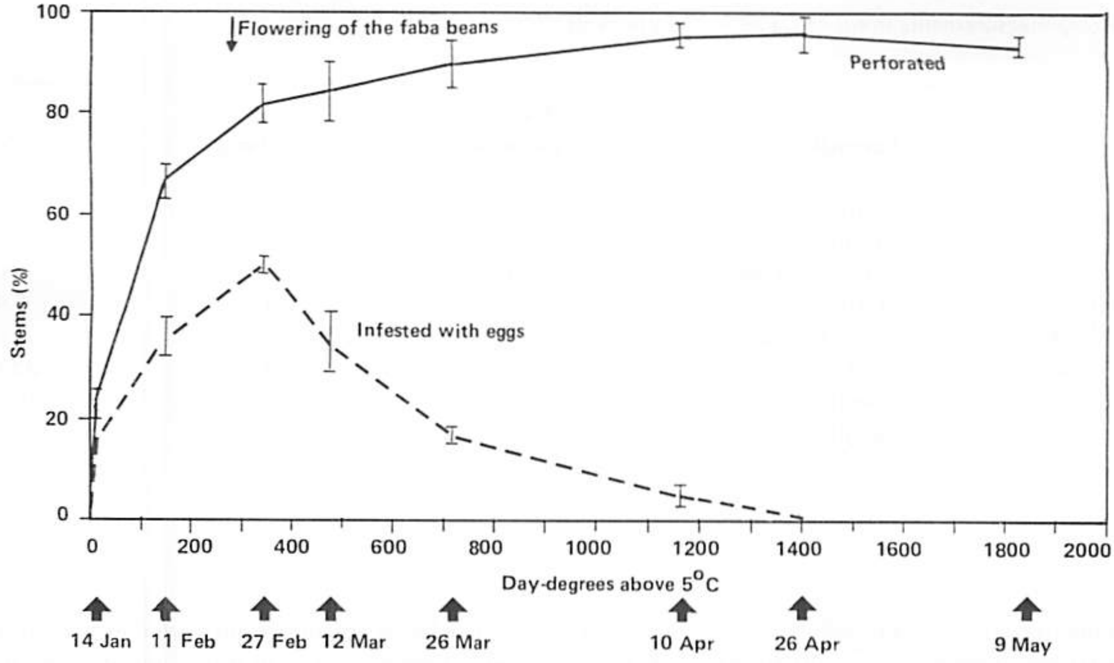

Fig. 1. Seasonal *Lixus algirus* adult activity as reflected by the percentage of stems perforated and the percentage of stems infested with eggs (Lattakia, Syria; means of three seasons).

Upon becoming active the adults feed on the foliage, but this damage is not important. Characteristically, the females bore holes into and lay eggs in the stalks and tender branches of the faba bean plant. This habit of boring holes into the stalks can be used as an indicator of adult activity. In the Lattakia area, adults leave diapause by mid-January when minimum daily temperatures can be as low as 5°C, a temperature used as a threshold to calculate day-degrees (Fig. 1). The percentage of stems perforated increases sharply between mid-January and late February; as more adults become active, it plateaus at about 95%. At this time, average adult populations are 1.5 females/m^2 and the sex ratio tends to be 1:1.

Mating occurs soon after emergence from diapause and there does not seem to be a preoviposition period, with eggs laid soon after mating. A typical oviposition curve is shown in Fig. 1, with the oviposition peaking in late February. Under controlled conditions (cages), the mean number of eggs laid/female was calculated as 50.5 ± 6.4, a figure similar to that obtained by Isart (1967). It should be noted that many perforated stems do not bear eggs and that most of the time only one egg/stem was recorded, even though the mean number of perforations/stem was 4.4 (range: 1-7). As most eggs are laid between February and March (Fig. 2), control measures would have to be initiated in January and directed towards preventing oviposition. However, an effective adult trapping system would be needed which is now under study.

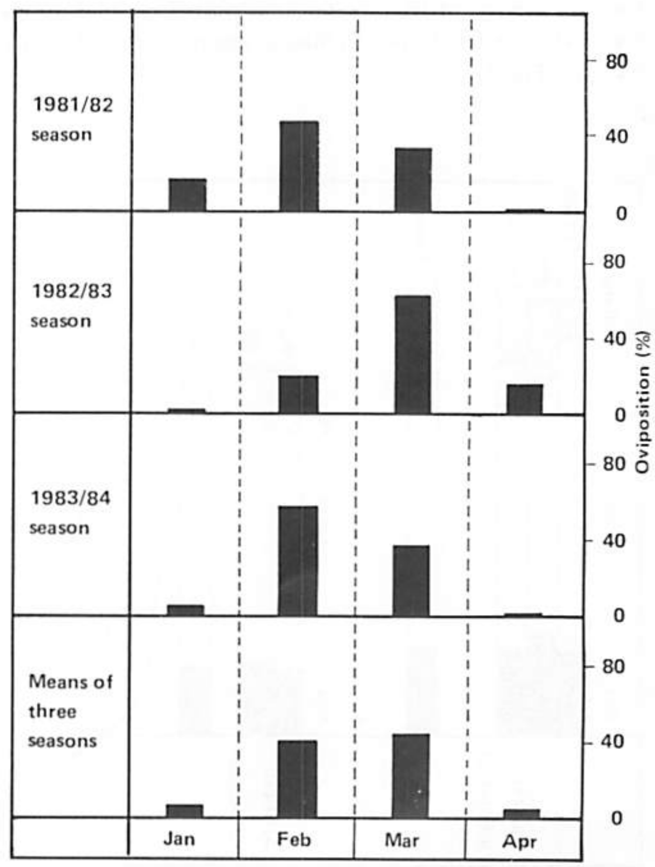

Fig. 2. Seasonal frequency distribution of eggs laid by female *Lixus algirus* at Lattakia, Syria.

Table 1. Body measurements (mm) of stages in the life cycle of *Lixus algirus.*

Stage	Parameter	Number measured	Range	Mean ± S.D.
Egg	Width	27	1.0 – 1.5	1.25 ±0.15
Egg	Length	27	1.6 – 2.1	1.91 ±0.14
Larva 1st instar	Width head capsule	117	0.8 – 1.2	1.04 ±0.06
Larva 2nd instar	Width head capsule	73	1.3 – 1.6	1.46 ±0.07
Larva 3rd instar	Width head capsule	182	1.7 – 2.1	1.94 ±0.07
Larva 3rd instar	Length	20	21.8 –26.7	23.4 ±1.53
Pupa	Length	55	12.5 –18.7	16.0 ±1.18
Adult	Length	29	15.0 –21.0	16.9 ±1.60

All immature stages occur within the stems. Body measurements for these and for adults are shown in Table 1. The eggs—oval and yellow, with a smooth, tough chorion—are laid in the stems near the perforations made by the females. Under natural conditions, egg hatching takes an average of 18 days, but under artificial infestations under warmer conditions in March, egg hatching took only 14 days (Fig. 3).

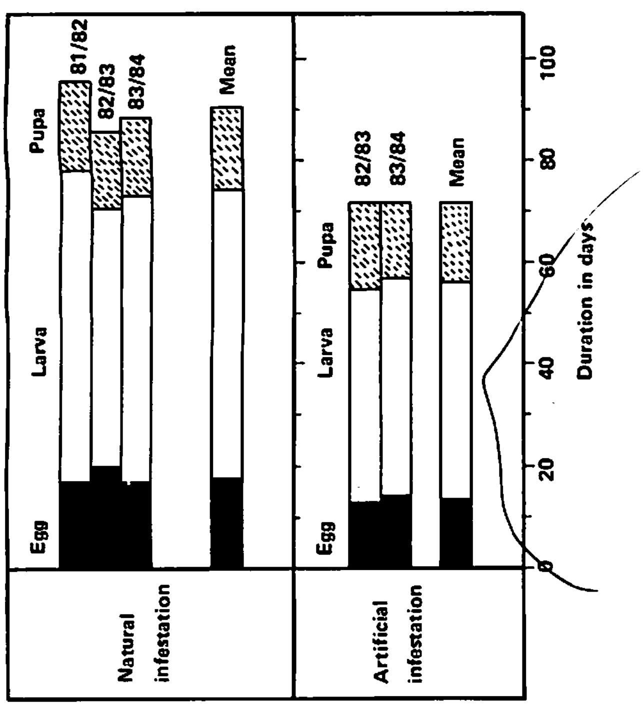

Fig. 3. Duration of immature stages of *Lixus algirus* at Lattakia, Syria.

The larvae are dirty white, cylindrical, slightly crescent-shaped legless grubs with a light brown head, dark mouth parts, and a few short setae on most segments. All segments are subequal in length and diameter except for the smaller prothorax and ninth and tenth abdominal segments. The spiracles are pronounced. Three definite instars were detected by measuring the width of the head capsule (Table 1). The duration of each larval instar was not measured; the total larval cycle takes an average of 55 days in the Lattakia region. Larvae are found in the hollow part of the stems where they tunnel up and down nibbling the walls. Frass and excreta are found but in general, at least under Syrian conditions, the larvae cannot be characterized as voracious.

Pupation usually takes place in the lower third of the stems. The pupae are cream-white, exarate type. The pupal stage lasts an average of 17 days. Thus, under natural conditions, the mean length of the complete cycle from egg to adult was 90.5 days.

The neonate adults remain in the stems for 10-12 days and then emerge in May through a round hole 5-6 mm in diameter. There is only one generation on faba beans each season. The univoltine nature of *L. algirus* has also been reported by Isart (1967) and Coers *et al.* (1983), but Bardner (1983) cites a 1963 paper by Hoffman *et al.* which states that there can be up to three generations a year. According to Isart (1976), adults can live up to 10-12 months feeding sporadically on beet and artichoke during summer and autumn but remaining hidden when temperatures are high. The species overwinters in the adult stage. We have not followed the fate of adults during and after summer, but we believe that a similar phenomenon could occur in

Syria where summers are hot and dry and where, to the best of our knowledge, this species has not been recorded as a pest of summer crops.

The biology and habits of *L. algirus* seem to be well timed to the phenology of the crop (Fig. 4): adults become active again in mid-January, mate, and then lay most of the eggs during the early flowering period; the larvae develop in March and April; and new adults emerge in May just before crop harvest. Changes in planting dates have a remarkable effect on oviposition patterns, with later crops significantly less infested (Table 2). Unfortunately, changing the planting date from early November to late December or early January is not always practical in this area, because of other factors including disease and weed incidence and rainfall patterns.

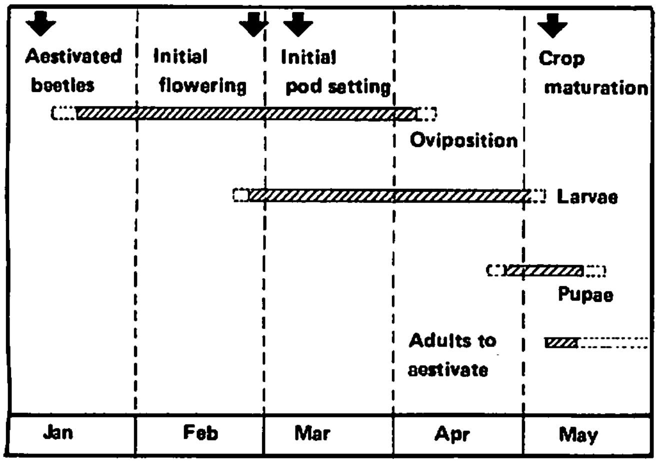

Fig. 4. Phenology of *Lixus algirus* in Lattakia, Syria related to crop phenology (normal planting date: early November).

Table 2. Effect of planting dates on ihfestation levels of the faba bean stem borer in Terbol (Lebanon) and Lattakia (Syria) (means of four replicates).

Planting date	Stems infested (%) Terbol (1981/82)	Lattakia (1982/83)
Early Oct	35.0	–
Late Oct - early Nov	26.3	51.2
Late Nov - early Dec	10.6	21.8
Early Jan	–	4.1
LSD 5%	5.1	4.2

Infestation levels in coastal Syria and in Lebanon have been consistently high: an average of 97% plants with one or two infested stems and up to 60% of the stems in a field showing infestation (Fig. 5). However, most plants seem to tolerate larval damage, and lodging and dead stems (Coers *et al.* 1983) are uncommon. An evaluation of actual yield losses due to different levels of infestation is now in progress.

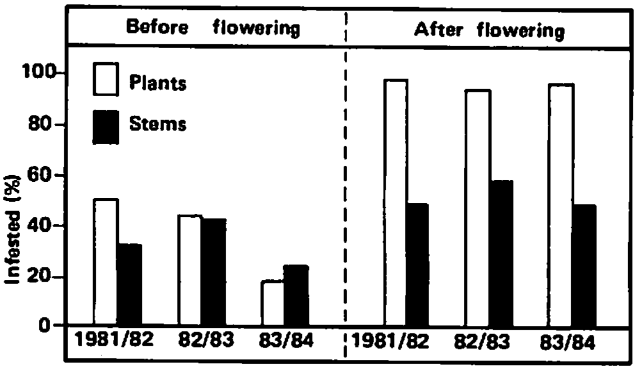

Fig. 5. Percentages of infestation by the faba bean stem borer at Lattakia, Syria.

References

Bardner, R. 1983. Pests of *Vicia faba* L. other than aphids and nematodes. Pages 371-390 *in* The Faba Bean (*Vicia faba* L.) (Hebblethwaite, P.D., ed.). Butterworths, London, UK.

Coers, P., Traia, M. and Zouaghi, N. 1983. Rapport de suivi de l'evolution et des taux d'infestation de *Lixus algirus* L. sur feves et feveroles, Campagne 82-83. Ministere de l'agriculture. Station de la defense des cultures du Nord-Beja. Project Tuniso-Belge. 7pp. (unpublished work).

Diekmann, M. 1982. Survey on pests and diseases of faba beans *(Vicia faba)* in Egypt, Morocco and Tunisia. FABIS No. 4: 44-45.

Fullaway, D.T. 1958. Importation of the natural enemies of the weed *Emex spinosa* Campd. Hawaii Entomol. Soc. Proc. 16: 359-360.

Gentry, J.W. 1965. Crop insects of Northeast Africa-Southwest Asia. Handbook No. 273. USDA, U.S. Government Printing Office, Washington, DC. 210 pp.

Hariri, G. and Tahhan, O. 1983. Updating results on evaluation of the major insects which infest faba bean, lentil and chickpea in Syria. Arab Journal of Plant Protection 1: 12-21 (English summary).

Isart, J. 1967. El *Lixus* de las habas *Lixus algirus* (L.) (Coleoptera: Curculionidae). Graellsia 23: 117-204. (English summary).

A COMPARISON OF TIMING OF INSECTICIDE APPLICATIONS FOR BLACK BEAN APHID CONTROL IN FABA BEAN

K. Ali
Institute of Agricultural Research, P.O. Box 2003, Addis Ababa, ETHIOPIA

Abstract

A field experiment was conducted at the main research station of the International Center for Agricultural Research in the Dry Areas (ICARDA) at Tel Hadya, Syria in the 1983/84 season. Application of pirimicarb (Pirimor) 50% wp at a rate of 0.5% (10 g/20 l water) at early pod setting stage of faba beans decreased the black bean aphid population and increased seed yield. Aphid infestation had a significant effect on plant height, number of pods/plant, and number of seeds/pod. No significant differences in yield were found between plots sprayed early and late, but the yield of sprayed plots was significantly higher than that of the unsprayed check.

Introduction

Aphids are long-established pests of bean species in many parts of the world. In the tropics and sub-tropics, the most important pest of faba beans is the black bean aphid or "blackfly," *Aphis fabae* Scop., which causes severe crop losses principally by direct feeding damage. In Ethiopia, the pea aphid *Acyrthosiphon pisum* (Harris) and the groundnut aphid, *Aphis craccivora* Koch., are occasional pests which seldom cause economic damage either by direct feeding or by transmission of virus diseases (Crowe *et al.* 1977).

A. fabae occurs in most of Europe and the Middle East, and in parts of Asia, Africa, and North and South America, but not in Australia (Cammell and Way 1983). Aphids such as *A. fabae* are ideally adapted to exploit short-lived, ephemerally nutritious arable crops such as *Vicia faba.* They feed by tapping the phloem and in this way are able to ingest large quantities of soluble nutrients. For a complete discussion on the mechanisms of feeding, refer to Pollard (1973).

Over 380 thousand hectares are cultivated with faba beans in Ethiopia; yield, however, is very low (350-500 kg/ha). There are many reasons for this, one being the serious damage caused by *A. fabae* which even at low infestation levels may greatly reduce yield under dry weather conditions. Control using systemic insecticides has been suggested, but there are no quantitative data on their efficiency, and the economic returns of insecticidal control have not been estimated.

Little information was available on the efficacy of post-flowering treatments for aphid control as compared with pre-flowering ones, although Gould and Graham (1969a, 1969b) obtained good results with menazon applied at the late flowering stage.

The aims of this experiment were to improve control of *A. fabae* on faba bean while minimizing the risk to bees pollinating the crop; to assess the effect of aphid populations on yield; and to evaluate the economics of control measures.

Materials and Methods

This field experiment was carried out at ICARDA's main site, at Tel Hadya, Syria. Syrian Local Medium variety was planted on 16 Dec 1983 at a rate of 222,000 plants/ha in plots of 16 rows of 6 m in length. The experiment was laid out in randomized complete blocks, replicated four times. The faba beans were drilled in rows 45 cm apart with 10 cm between plants.

Colonies of *A. fabae* on faba bean plants were brought from farmers' fields near Hama and Homs in northwest Syria to infest all plots other than the clean check. Pieces of infested faba beans were distributed as uniformly as possible within the plots and the transferred aphids were allowed to feed. The crop was 60 days old (mid-vegetative stage) at the time of infestation with *A. fabae.* Ten plants were tagged in each plot to record levels of infestation and damage scores every week. The degree of damage was estimated on the basis of the following scale: 1 = no apparent aphid damage; 2 = slight damage, some curling of the leaves; 3 = heavy damage, more curling, and slight honeydew production; and 4 = very heavy damage, extreme curling of the leaves, and heavy honeydew production. Infestation by *A. fabae* was evaluated according to the following scale: 1 = no aphids; 2 = a few alate aphids; 3 = a few scattered colonies of nymphs; 4 = many scattered colonies of nymphs; and 5 = many large merged colonies of nymphs.

The effect of aphids was evaluated with and without insecticidal protection. The protected plots were kept as insect-free as possible. The early treatment was applied as soon as the colony was established and damage done. Late application was made at full flowering and early pod setting stages. The insecticide used was pirimicarb (Pirimor) 50% wp at a rate of 0.5% (10 g/20 l water). The insecticide was applied manually by knapsack sprayer. Finally, number of pods, number of seeds/pod, and seed weight in the 10 previously marked plants/plot were recorded. Biological and grain yields in 12 central rows were also recorded in each plot. All data were submitted to analysis of variance. An economic analysis of the cost/benefit ratios for each treatment was also performed.

Results and Discussion

The mean degree of infestation and damage after several scorings showed significant differences (at the 1% level of probability) among treatments (Table 1). The spray at flowering (18 days after the initial infestation, when a high aphid population had developed) gave good initial control of aphids. However, a single spray at flowering could not prevent *A. fabae* reinfestation and damage during the rest of the growing season. This was due mainly to recolonization by alate secondary migrants from the untreated plots and from the surrounding beans. These migrants were very important for they were produced when the crop was in the stages of full flowering and early pod setting; furthermore, the crop was suffering from drought.

As a result of this process of reinfestation, the plots sprayed at flowering showed a higher level of damage at the critical stage of mid-pod setting than those sprayed at early pod setting. This is called the critical stage in Table 1.

In this trial, aphid infestation had a significant effect on plant height, number of pods/plant, and number of seeds/pod (Table 2). Very few pods were recorded in untreated control plots, whereas the greatest number of pods/plant were found in aphid-free plots. The severe effect of reinfestation in early-sprayed plots also affected height, and yields were lower than in late-sprayed plots.

Biological yield was also highly affected by *A. fabae* attack, indicating that vegetative development was severely affected (Table 2). All spray treatments gave significant increases in biological yield over the check, but no significant differences were found between plots sprayed early and late.

In this trial, severe aphid damage resulted in 96% yield loss in the check aphid-free plots (Table 2). Plots sprayed at flowering yielded significantly less than those sprayed at early pod setting, mainly because of the high level of reinfestation in early-sprayed plots which coincided with the critical stage of mid-pod setting and pod filling period. Also, when the crop was irrigated on 2 Apr, the late-sprayed plots were free of aphids, whereas the early sprayed plots were suffering from a severe attack. The irrigation could not compensate for aphid damage.

The economic analysis indicated that the maximum increase in net benefits was obtained with two sprays. It also suggested that the best alternative for a farmer, not willing to take a risk, could be one spray at mid-pod setting.

The regressions of infestation and damage scores on seed yields (kg/ha) were as follows:

Infestation scores (X): $Y = 1960.4 - 384.2X$;
$r = -0.581^{*}$
Overall damage scores (X): $Y = 2209.9 - 480.1X$;
$r = -0.643^{**}$
Damage at peak of infestation (X):
$Y = 2347.4 - 486.3X$; $r = -0.816^{**}$

Table 1. Effect of different aphid management levels on infestation and degrees of damage to faba bean plants.

Treatment	Mean degree of infestation[1]	Mean damage scores[2]	Damage scores at critical stage[3]
Never infested	1.0	1.0	1.0
Sprayed at flowering	2.2	2.7	3.8
Sprayed at early pod setting	3.3	3.2	2.6
Check	3.8	3.5	4.0
LSD 1%	0.5	0.4	0.7
CV (%)	7.8	5.9	11.2

[1] On a 1-5 visual scale (see text); means of eight scorings throughout the season.

[2] On a 1-5 visual scale (see text); means of 10 scorings.

[3] On a 1-4 visual scale; means of two scorings on 18/4 and 29/4 at peak of infestation.

Table 2. Plant height, yield components, and final yields of faba bean plots as affected by different levels of management of black bean aphids.

Treatment	Plant height (cm)	Pods/ plant	Seeds/ pod	Biological yield[1]	Seed yield (kg/ha)[2]	Yield loss (%)
Never infested	69.9	37.5	2.4	4185.5	1676.0	–
Sprayed at flowering	52.9	10.7	1.6	2415.2	733.2	56.2
Sprayed at early pod setting	55.0	27.7	2.2	3317.9	1370.5	18.2
Check	44.1	1.7	0.5	1716.7	66.5	96.0
LSD 5%	7.9	16.4	1.0	1086.2	635.2	–

[1] CV (%) for biological yield = 22.4

[2] CV (%) for seed yield = 41.3

These regression analyses suggest that both infestation and damage scores are reliable variables to assess the extent of damage and its effect on yields. The most reliable parameter seems to be damage scores at peak of infestation ($r = -0.816$).

In conclusion, the results indicate that single insecticidal treatments were more beneficial when applied at the early pod setting stage of the crop. The observations also indicated that aphid attack lowered both yield and seed quality.

References

Cammell, M.E. and Way, M.J. 1983. Aphid pests. Pages 315-346 *in* The Faba Bean (*Vicia faba* L.). (Hebblethwaite, P.D., ed.). Butterworths, London, UK.

Crowe, T.J., Tadesse, G.M. and Tsedeke, A. 1977. An annotated list of pests of field crops in Ethiopia. Institute of Agricultural Research, Addis Ababa, Ethiopia. 41 pp.

Gould, H.J. and Graham, C.W. 1969a. The control of *Aphis fabae* Scop. on spring-sown field beans (*Vicia faba* L.). Annals of Applied Biology 64: 1-10.

Gould, H.J. and Graham, C.W. 1969b. Damage assessment aspects of *Aphis fabae* on spring-sown field beans. Pages 505-510 *in* Proceedings of the 5th British Insecticide and Fungicide Conferences.

Pollard, D.G. 1973. Plant penetration by feeding aphids (Hemiptera: Aphidoidea), a review. Bulletin of Entomological Research 62: 631-714.

Acknowledgements

I am grateful to Dr. Cesar Cardona and the other Food Legume Entomology staff of ICARDA for all the technical support offered. Financial and material assistance provided by ICARDA during my stay in Syria is also gratefully acknowledged. Thanks also are given to Sossie Ayanian and Beteha Degefe for patiently typing the report.

A GREENHOUSE TECHNIQUE FOR SCREENING FABA BEANS (*VICIA FABA* L.) FOR RESISTANCE TO *OROBANCHE* SPP.

S. T. Kukula and H. Masri
ICARDA, P.O. Box 5466, Aleppo, SYRIA

Abstract

Field screening of faba bean genotypes for resistance to *Orobanche* is often unreliable because of uneven distribution of *Orobanche* seeds in the soil and the interference of environmental factors in the development of the parasite. For a rapid screening of a large number of faba bean genotypes, a greenhouse technique was developed. The technique consists of growing test genotypes in a greenhouse (20-21°C), in polyethylene bags, using attapulgus clay as the growth medium, artificially infested with *Orobanche* seeds. The root system of the plants is examined at flowering (about 65 days after planting) for haustoria attachment after removing the clay. The number of germinated seeds of *Orobanche* is also counted to get a picture of host genotype differences. Using this technique, differences in resistance of 15 genotypes of faba bean to *Orobanche* have been described.

Introduction

Orobanche crenata Forsk and *O. aegyptiaca* are very destructive parasitic weeds of faba bean and lentils in the Middle East and North Africa.

Control of *Orobanche* is very difficult and no successful control practice has yet been found. Chemical control has been studied by many researchers (Kasasian 1973; Schmitt *et al.* 1979; ICARDA 1982, 1983; Zahran 1982; Kukula and Masri 1984) with promising results, but the problem of phytotoxicity continues. Cultural practices for *Orobanche* control are very limited and not always effective (Kukula and Masri 1984).

The most promising and long-term way to prevent parasitism is to grow resistant cultivars. The selection and breeding of *Orobanche* resistant varieties has already shown some promise (Cubero 1973; Basler and Haddad 1979; Nassib *et al.* 1978). The successful development of resistant varieties necessitates screening a large number of genotypes with a simple, quick, and reliable screening technique. An attempt has been made at ICARDA to develop such a technique using a greenhouse, which eliminates the problem of escape common to field screening. This paper briefly describes this technique as well as the results of some initial screening for resistant sources in ICARDA's collection of pure faba bean lines (BPL's).

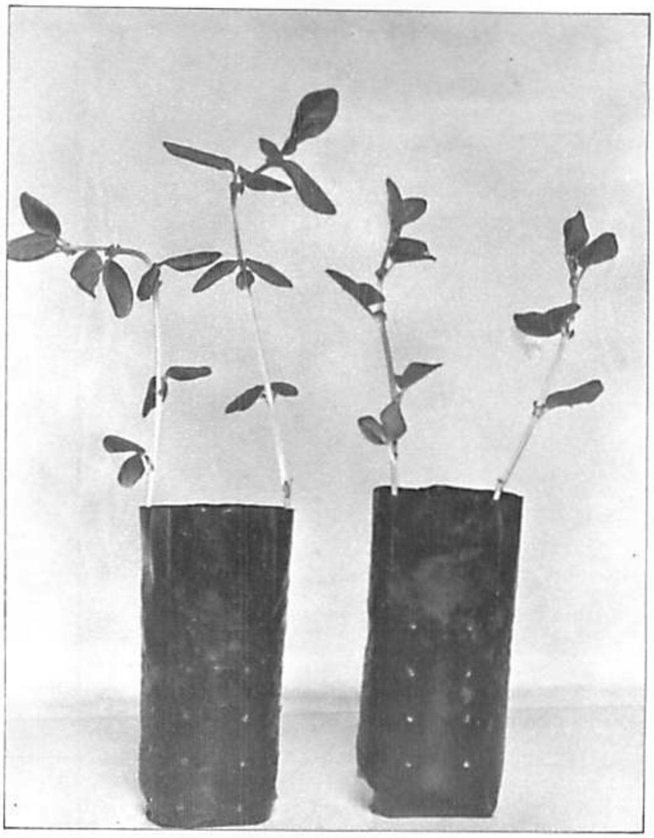

Fig. 1. Faba bean plant growing in black polythene bags filled with attapulgus clay. Holes are punched in the bag to permit free drainage.

Materials and Methods

Fifteen faba bean lines were tested in black polyethylene bags (26 x 8 x 8 cm) filled with attapulgus clay artificially infested with *O. crenata* seeds (0.5 g seeds/800 g of medium). The *Orobanche* seeds mixed with the medium were preconditioned (kept moist) for 15 days. Three seeds of each faba bean genotype, with two replications, were planted in the bags (Fig. 1), grown in the greenhouse for 65 days with a mean temperature of 20-21°C, and watered as required.

At full flowering stage, the faba bean plants were examined for *Orobanche* spp. infestation by uprooting the plants and washing the attapulgus clay from the roots (Figs. 2 and 3). Since the attapulgus clay separates easily and does not leave stains on the root, the haustoria developed on the root system could be counted easily.

Fig. 2. Attapulgus clay is gently removed from roots when plants reach full flowering.

Results and Discussion

The *Orobanche* germination and haustoria attachment to the roots of faba bean could be observed very clearly after

Fig. 3. Roots are gently washed to remove any adhering clay by dipping them in water.

Fig. 4. Washed roots show clearly the attachments of haustoria of *Orobanche*.

washing off the attapulgus clay (Fig. 4). An examination of the host planted roots revealed that the growth and development of the haustoria was quite variable, ranging in size from 0.5 mm to 20 mm, apparently because seeds germinated on different dates. Those *Orobanche* seeds that germinated but had not yet attached to the root of the host plant were counted through a microscope. About 90% of *Orobanche* haustoria attachment occurred on the root nodules (Fig. 5), much of it restricted to the upper part of the root system. The number of *Orobanche* spp. seeds germinating and/or attaching to faba bean roots varied in different genotypes. The results of differential response of genotypes to *Orobanche* infestation are presented in Table 1.

This newly developed screening technique is easy to use. It is more reliable and should give more consistent results than the field technique in common use, due to the more uniform distribution of *Orobanche* spp. seeds on each faba bean plant, and the elimination of environmental variables that may affect a genotype's reaction under field screening. Because diverse genotypes are not adapted to a single environment, field screening is of limited use and any uncontrollable environmental stress can seriously affect results. For example, 20 days of continuous frost in January and February 1985 at Tel Hadya killed many faba bean lines planted in an *Orobanche* infested field well

Table 1. Number of *Orobanche* attachments/plant on root systems of different faba bean genotypes.

Entry	Mean number of *Orobanche* attachments/plant
S 83001-1	0.66
-2	3.16
-3	6.00
-4	1.00
S 83002-3	5.16
-4	8.66
-6	1.66
S 83003-4	0.00
S 83004-1	2.33
-3	4.17
-5	2.33
S 83007-1	1.83
-2	0.00
-3	0.33
F - 402	0.66
LSD 5%	1.209
CV (%)	22.26

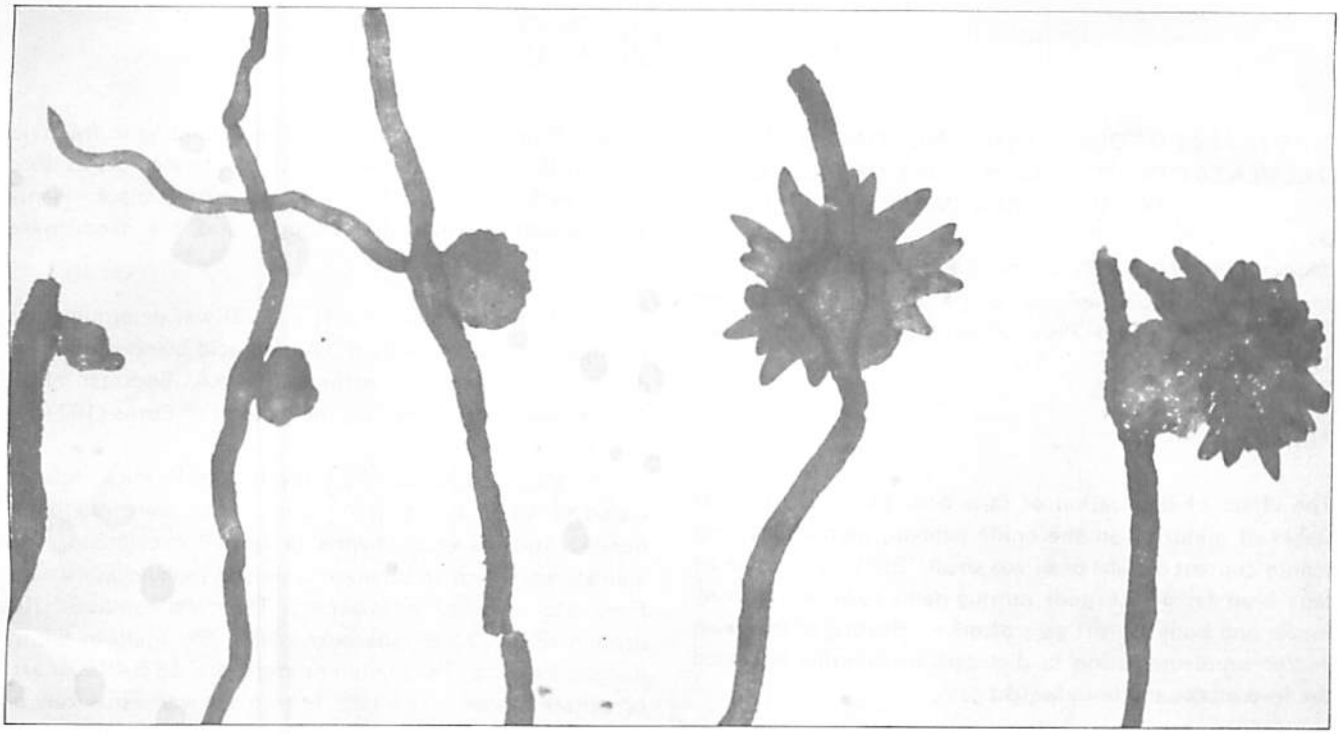

Fig. 5. Various stages of development of haustoria on the nodules of faba bean roots.

before the *Orobanche* seeds could germinate and parasitize the plants. Another limitation of field testing is that experiments can be conducted only during the growing season. The greenhouse technique described here lacks these limitations, and it permits clear examination of germinated *Orobanche* spp. seeds and haustoria establishment on the roots. Selected faba bean plants can also be reported after examination to produce pure seeds.

Acknowledgement

The authors wish to express their deep appreciation to Dr. M.C. Saxena for the suggestions during this study and for reviewing the manuscript.

References

Basler, F. and Haddad, A. 1979. Selection of *Orobanche* resistant cultivars of broad bean and lentil. Pages 254-259 *in* Proceedings, Second International Symposium on Parasitic Weeds. Raleigh.

Cubero, J.I. 1973. Resistance to *Orobanche crenata* Forsk., in *Vicia faba* L. Pages 205-217 *in* Proceedings, European Weed Research Council Symposium on parasitic Weeds, Malta.

ICARDA (International Center for Agricultural Research in the Dry Areas). 1982. Annual Report 1981. Aleppo, Syria. 164 pp.

ICARDA (International Center for Agricultural Research in the Dry Areas). 1983. Research Highlights 1982. Aleppo, Syria. 64 pp.

Kasasian, L. 1973. The chemical control of *Orobanche crenata* in *Vicia faba* and the susceptibility of 53 cultivars of *Vicia faba* to *O. crenata.* Pages 224-230 *in* Proceedings, European Weed Research Council Symposium on Parasitic Weeds, Malta.

Kukula, S.T. and Masri, H. 1984. Integrated cultural practices and chemical control of *Orobanche crenata* in faba bean. Pages 256-261 *in* Proceedings, Third International Symposium on Parasitic Weeds, ICARDA, 7-9 May 1984, Aleppo, Syria.

Nassib, A.M., Ibrahim, A.A. and Saber, H.A. 1978. Broomrape *(Orobanche crenata)* resistance in broad beans: breeding work in Egypt. Pages 133-135 *in* Food Legume Improvement and Development: Proceedings of a Workshop Held at the University of Aleppo. ICARDA/Aleppo University, 2-7 May 1978, Aleppo, Syria. IDRC, Ottawa, Canada.

Schmitt, U., Schluter, K. and Broosma, P.A. 1979. Chemical control of *Orobanche crenata* in broad beans. FAO Plant Protection Bulletin No. 27: 88-91.

Zahran, M.K. 1982. Weed and *Orobanche* control in Egypt. Pages 191-198 *in* Faba Bean Improvement: Proceedings of the Faba Bean Conference (Hawtin, G. and Webb, C., eds.), ICARDA/IFAD Nile Valley Project, 7-11 Mar 1981, Cairo, Egypt. Martinus Nijhoff Publishers, The Hague, The Netherlands.

THE EFFECT OF DESICCATION, HEATING, AND SUPPLEMENTATION WITH METHIONINE OF FABA BEAN ON MICE PERFORMANCE

Janusz Zurek, Michal Ploszynski, and Piotr M. Gorski
Institute of Soil Science and Plant Cultivation, Department of Biochemistry and Plant Physiology, 24-100 Pulawy, POLAND

Abstract

The effect of desiccation of faba bean plants at different stages of maturity on the crude protein, methionine, and tannin content of faba bean was small. Early desiccation of faba bean (at 40-50%pods turning dark) reduced the feed intake and body weight gain of mice. Heating of this meal and/or supplementation of diet with methionine increased the feed intake and body weight gain.

Introduction

Faba bean is an important human and animal food in some areas because of the high protein and carbohydrate content. However, faba bean contains thermolabile antinutritional factors which decrease its feeding value (Griffiths 1983; Marquardt 1983). Faba bean seeds are also poor in the sulphur amino acids, methionine and cysteine (Boulter 1980). Faba bean seeds are often heated and supplemented with methionine to increase their nutritional value (Liener and Kakade 1969; Lawes 1980).

In Europe and Canada chemical desiccants are used to shorten the time to maturity and to dry-down faba bean and weed plants. Desiccation permits mechanical harvesting of early-maturing crops in wet years, and of late-maturing crops in normal years (Betts and Morrison 1980).

This study examined the dietary effect of desiccation of faba bean at different stages of maturity. The effect of heating and supplementing faba bean meal with methionine on mice performance was also assessed.

Materials and Methods

Faba bean (*Vicia faba* minor) var Nadwislanski was grown on alluvial soil at Kepa Agricultural Experiment Station in 1982. The crop was desiccated with Reglone (diquat), at 0.6 kg/ha in 500 l of water, using a portable sprayer. Plants were sprayed when 45-50% or 85% of the pods had turned black. Plants were then cut and left standing in the field until all the pods had become black. Untreated plants were cut when 85 or 100% of the pods had turned black. Plants were threshed when dry enough, and the seeds were ground.

Crude protein content (N x 6.25) was determined by the macro Kjeldahl method. Amino acid composition was determined using an automatic AAA Beckman 119. Tannins were determined by the method of Burns (1971).

In the feeding trial, 21-day old male mice initially weighing 13 ± 0.2 g were used. Mice were randomly divided into 16 experimental groups, 6 mice/group. The animals were kept in separate cages and weighed every day. Feed was provided *ad libitum*. The diets contained 10% protein (36.3-37.5% faba bean meal), 8% soybean oil, 5% mineral mixture, 1% vitamin mixture, and 48.5-49.7% heated potato starch. The faba bean meal was either raw or autoclaved for 1 h at 1520 hPa, 30% H_2O. Diets were either supplemented with methionine (0.3% of diet) or not supplemented.

Results and Discussion

The concentration of crude protein, tannins, and amino acids in desiccated and untreated faba bean seeds was similar (Table 1; of the amino acids, only methionine is shown). Small differences in proteins, tannins, and

Table 1. The concentrations of crude proteins, methionine, and tannins in faba bean seeds.

	Concentrations		
	Crude protein (% dry weight)	**Methionine (g/16 g N)**	**Tannins (% dry weight)**
Desiccated when 40-50% pods black	26.7	0.66	0.61
Desiccated when 85% pods black	27.6	0.79	0.48
Harvested when 85% pods black	28.0	0.70	0.41
Harvested when 100% pods black	27.5	0.84	0.46

methionine concentrations were observed only when faba bean was desiccated very early (45-50% black pods).

The lowest feed intake was observed with the diet containing faba bean seeds from plants which had been desiccated very early, without methionine supplementation (Table 2). Heat treatment of the faba meal, with or without methionine supplementation, significantly increased feed intake, except for the diet containing faba bean seeds harvested at full maturity (100% black pods), with which feed intake was reduced (Table 2). Methionine supplementation had the greatest effect on feed intake, followed by heating and desiccation treatment. The interaction between methionine and heating was also significant.

Mice fed the diet containing raw seeds from plants desiccated when 45-50% of pods were black, without methionine supplementation, lost weight during the trial period. With diets containing these seeds, heating and methionine supplementation gave similar, highly significant increases in weight gain.

In the non-methionine-supplemented diets, heating the faba bean meal produced similar, significant increases in weight gain compared with raw faba bean meal.

Methionine-supplemented diets containing raw faba bean meal gave significantly higher mice weight gains than the unsupplemented diets, raw or heated, except for the diet containing seeds from plants desiccated early (45-50% black pods).

Weight gains of mice fed the diet containing faba bean seeds from plants desiccated when 85% of the pods were black generally were higher than those fed faba bean meal from plants harvested at the same stage without desiccation.

Heating and methionine supplementation combined gave the highest weight gains, except with seeds from plants harvested when fully mature. In the latter case, weight gain was lower than with heating or methionine supplementation singly. This may have been due to overdosage of methionine in this diet. Mice eating raw faba bean seeds need more methionine because of its role in trypsin synthesis (Liener and Kakade 1969). Trypsin is deactivated by thermolabile inhibitors (Liener and Kakade 1969) as well as by thermostable tannins (Griffiths and Mosely 1980). The methionine content was highest and the tannin content lowest in faba bean seeds from fully mature plants (Table 1). Thus, heating and methionine supplementation of these seeds may have made the methionine content too high for the mice. Depressed feed intake is characteristic of a deficit or surfeit of methionine in the diet (Rakowska *et al.* 1978).

Significant desiccation x methionine, methionine x heating, and desiccation x heating interactions were also observed. The desiccation x methionine x heating interaction was not significant.

In conclusion, only the seeds from very early desiccated (with 40-50% black pods) faba bean plants reduced body weight gain. Heating and supplementing with

Table 2. The effect of faba bean desiccation, heating and methionine supplement on feed intake by mice.

	Feed intake (g/14 days/mouse)			
	No methionine		Methionine-supplemented	
Faba bean	**Raw**	**Heated**	**Raw**	**Heated**
Desiccated when 40-50% pods black	54.75 $^{A}_{a}$	62.00 $^{B}_{a}$	77.00 $^{C}_{a}$	84.00 $^{D}_{a}$
Desiccated when 80% pods black	69.00 $^{A}_{b}$	74.25 $^{B}_{b}$	78.50 $^{B}_{a}$	85.50 $^{C}_{a}$
Harvested when 85% pods black	52.25 $^{A}_{a}$	65.00 $^{B}_{a}$	80.25 $^{C}_{a}$	82.25 $^{C}_{a}$
Harvested when 100% pods black	65.75 $^{A}_{b}$	71.50 $^{B}_{b}$	74.50 $^{B}_{a}$	69.25 $^{AB}_{b}$

a-b: Values followed by the same letter (a and b) within a column, and same letter (A to D) in a line are not significantly different according to Tukey's procedure at P = 0.05.

Table 3. The effect of faba bean desiccation, heating and methionine supplement on body weight gain of mice.

Faba bean	Body weight gain (g/14 days/mice): No methionine, Raw	No methionine, Heated	Methionine-supplemented, Raw	Methionine-supplemented, Heated
Desiccated when 40-50% pods black	– 0.60 A a	4.52 B a	4.37 B a	8.82 C a
Desiccated when 85% pods black	2.45 A b	4.20 B a	8.90 C b	8.77 C a
Harvested when 85% pods black	0.67 A c	3.75 B a	5.20 C a	8.00 D a
Harvested when 100% pods black	1.97 A b	4.10 B a	8.17 C b	5.80 D b

a-c: Values followed by the same letter (a to c) within a column, and same letter (A to D) within a line are not significantly different according to Tukey's procedure at P = 0.05.

methionine of faba bean seeds restored the body weight gain. Heat treatment and addition of methionine significantly increased mice body weight gains; the only exception was seeds from undesiccated plants, harvested at the 100% black pods stage, with which heating reduced the advantage of methionine supplementation on body gain significantly.

References

Betts, M.F. and Morrison, J.N. 1980. Effect of chemical desiccation versus swathing on seed yield quality of faba bean *(Vicia faba)*. Canadian Journal of Plant Science 60: 1115-1121.

Boulter, D. 1980. Ontogeny and development of biochemical and nutritional attributes in legume seeds. Pages 127-134 *in* Advances in Legume Science: Proceedings of the International Legume Conference (Summerfield, R.J. and Bunting, A.H., eds.). Royal Botanic Gardens/Missouri Botanical Garden/University of Reading, 31 July-4 Aug 1978, Kew, England. Royal Botanic Gardens, Kew, England.

Burns, R.E. 1971. Method for estimation of tannin in grain sorghum. Agronomy Journal 63: 511-512.

Griffiths, D.W. 1983. Some anti-nutritive factors in *Vicia faba*. FABIS No. 6: 18.

Griffiths, D.W. and Mosely, G. 1980. The effects of diets containing field beans of high or low polyphenolic content on the activity of digestive enzymes in the intestines of rats. Journal of the Science of Food and Agriculture, UK 31: 255-259.

Lawes, D.A. 1980. Recent developments in understanding, improvement, and use of *Vicia faba*. Pages 625-636 *in* Advances in Legume Science: Proceedings of the International Legume Conference (Summerfield, R.J. and Bunting, A.H., eds.), Royal Botanic Gardens/Missouri Botanical Garden/University of Reading, 31 July-4 Aug 1978, Kew, England. Royal Botanic Gardens, Kew, England.

Liener, I.E. and Kakade, M.E. 1969. Protease inhibitors. Pages 8-53 *in* Toxic Constituents of Plant Foodstuffs (Liener, I.E., ed.). Academic Press, New York, USA.

Marquardt, R.R. 1983. Antimetabolites in faba beans and their metabolic significance. FABIS No. 7: 1-4.

Rakowska, M., Szkilladziowa, W. and Kunachowicz, H. 1978. Biologiczna wartosc bialka zywnosci. Wydawnictwo Naukowo-Techniczne, Warszawa, Poland. 234 pp.

ANNOUNCEMENTS

Reprints

ICARDA has been designated as the world center for information on faba beans, and as such we are trying to assemble a complete collection of papers relevant to this subject.

We would be most grateful if readers who have published papers relating to faba beans would send reprints to:

FABIS
Documentation Unit, ICARDA,
P.O. Box 5466, Aleppo, SYRIA

Mailing List

We are having many items of correspondence returned, due to those on our mailing list having changed their addresses or left their place of employment without notifying us. Obviously this represents a considerable waste of money to the FABIS service.

We request that those who currently receive FABIS should inform us of any change in their address or position in good time to allow us to maintain an efficient service.

Need More Information ?

Opportunities for Training and Post-Graduate Research at ICARDA

ICARDA has active training courses on the development and improvement of food legumes, cereals, and forages with ICARDA's research scientists, trained instructors, and proven programs. For a complete brochure of the training opportunities at ICARDA, please write to Training Department.

Lentil Experimental News Service (LENS)

LENS, a scientific newsletter published jointly by the University of Saskatchewan and ICARDA with financial support from IDRC, is designed to improve communication among world lentil researchers.

For your free copy write to:

LENS
ICARDA, Documentation Unit,
P.O. Box 5466, Aleppo, SYRIA

FORTHCOMING CONFERENCES 1985/86

1985

Arid Lands Conference
Arizona, USA, 21-25 Oct

Contact: Dr. G. P. Nabham, Office of Arid Land Studies, University of Arizona, Tucson, Arizona 85721, USA

1986

XI Congress of EUCARPIA
Warsaw, Poland, 22-29 June
"Quality in plant breeding"

Topics covered:

1. Genetic control of quality
2. Achievements and goals in quality improvement in seeds, roots, bulbs and tubers, vegetative green matter, fruits, and flowers.
3. Methods and techniques of quality determinations.
4. Physiological costs of quality.

Each topic to be introduced through a main invited lecture followed by plenary discussion. Other contributions are welcome in the form of posters.

In addition, there is a general assembly of EUCARPIA and two post-congress tours.

Language: English. For further details contact:

IHAR–ZK, RADZIKOW
The Organizing Committee of EUCARPIA
P.O. Box 1019. PL-00-950 Warsaw,
POLAND

II International Legume Conference
St. Louis, USA, 23-27 June

The Second International Conference on the Biology of the *Leguminosae* is to be held at St. Louis, Missouri jointly by the Missouri Botanical Garden and the Royal Botanical Gardens, Kew, UK. The conference will address the biology, ecology, evolution, and taxonomic classification of the legume family.

Contact: Dr. James L. Zarucchi, Legume Conference Co-ordinator, Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166, USA

IV Latin American Botanical Congress
Medellin, Colombia, 29 June-5 July

Contact: Dr. Enrique Ferero, Presidente, Comite Organizador, IV Congreso Latin Americano de Botanica, Apartado 54546, Bogota 2, Colombia

International Food Legume Research Conference
Spokane, Washington, 6-11 July

Selected topics include: Germplasm; Breeding; Biotechnology; N_2 Fixation; Nitrogen and Carbon Economy; Physiology; Environmental Stress; Tillage and Systems Management; Weeds, Pests, and Diseases; Integrated Pest Management; Harvesting and Storage; Commodity Utilization and Nutrition; Economics; Marketing, Trade, and Policies.

Complementary workshops and open discussion sessions will address topics such as N_2 Fixation Research Methods; Rhizosphere Ecology; Seed Quality; Innoculant Production Technology; Small Farm Technology; Systems Production Alternatives; Human Nutrition; and Knowledge Assessment, Integration, and Retrieval Systems.

The Conference program has been carefully formulated to interface all aspects of both applied and basic research involving pea, lentil, faba bean, and chickpea. Seventy-nine plenary and invited papers co-authored by more than 250 contributors from 46 countries have been identified in a program planned by an International Advisory Board in collaboration with the Local Organizing Committee.

International Advisory Board

Dr. R. J. Summerfield	University of Reading, United Kingdom; Conference Editor
Dr. G. C. Hawtin	International Development Research Centre (IDRC)
Dr. Y. L. Nene	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
Dr. M. C. Saxena	International Center for Agricultural Research in the Dry Areas (ICARDA)

International Observer

Dr. H. A. Al-Jibouri	Food and Agriculture Organization of the United Nations

Local Organizing Committee

Dr. R. H. Lockerman	Conference Chairman, Montana State University, USA
Dr. D. F. Bezdicek	Program Chairman, Washington State University, USA
Dr. F. J. Muehlbauer	United States Department of Agriculture/Agricultural Research Service, Pullman, Washington, USA
Dr. J. M. Kraft	United States Department of Agriculture/Agricultural Research Service, Prosser, Washington, USA
Dr. G. A. Lee	University of Idaho, USA
Dr. L. E. O'Keeffe	University of Idaho, USA
Mr. H. L. Blain	American Dry Pea and Lentil Association (ADPLA); Washington and Idaho Associations of Dry Pea and Lentil Producers

Information concerning the International Food Legume Research Conference on pea, lentil, faba bean, and chickpea can be obtained from:

Dr. R. H. Lockerman, Chairman
International Food Legume Research Conference
Plant and Soil Science Department
Montana State University
Bozeman, Montana 59717 USA

Telephone: 406-994-5064
Telex: 910-963-2066

IV International Lupin Conference
Geraldton, W. Australia, 15-22 Aug

Contact: The Secretary, 4th International Lupin Conference, Conventions Department, P.O. Box 489, G.P.O., Sydney, N.S.W. 2001, Australia

BOOK REVIEWS

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

PROCEEDINGS: FABA BEANS, KABULI CHICKPEAS, AND LENTILS IN THE 1980s
AN INTERNATIONAL WORKSHOP 16-20 MAY 1983

Edited by M.C. Saxena and S. Varma

ICARDA presents a 395 page book designed for all food legume researchers. This volume reflects the contributions of participants from 24 countries, including those from institutions with which ICARDA collaborates on more basic research.

UDC 582.736.001.5
395 pages, Paperback

This book is the proceedings of an international workshop on food legumes–faba beans, kabuli chickpeas, and lentils–held at ICARDA, Aleppo in 1983. The workshop aimed to assess the progress made in collaborative work on the improvement of these legumes in the last five years. The meeting also examined the research and training plans of the Food Legume Improvement Program at ICARDA and then formulated recommendations for future research directions.

The papers cover many aspects of food legume research, including germplasm, breeding, disease control by host-plant resistance, insect pests, weed and nematode control, and the physiology, agronomy, and nitrogen fixing capacity of food legumes. Other subjects include food legume quality and anti-nutritional factors, seed production, mechanization, on-farm trials on food legumes, training and communications, and ICARDA's cooperative food legume testing program. The papers also review recent food legume research in the Nile Valley, North Africa, the Americas, and India.

The proceedings reflect the contributions of participants from 24 countries, including those from advanced institutions and from developing countries. Included also is the discussion which followed the conference presentations and the recommendations.

Copies of the proceedings are available from ICARDA, FLIP, P.O. Box 5466, Aleppo, Syria.

FIELD MANUAL OF COMMON FABA BEAN DISEASES IN THE NILE VALLEY

By C. C. Bernier, S. B. Hanounik, M. M. Hussein, and H. A. Mohamed

This comprehensive 40-page reference field manual is designed to help scientific workers, trainees, and extension workers identify common faba bean diseases in the field. It describes the causal agents, their survival, and life cycles to explain the factors that influence disease development; covers the symptoms, development and control measures of each disease; and includes an appendix on rating scales for disease resistance, a glossary of basic phytopathological terms, and references for further reading. Color photographs of 38 important diseases are included.

FIELD GUIDE TO MAJOR INSECT PESTS OF FABA BEAN IN THE NILE VALLEY

By C. Cardona, E. Z. Fam, S. I. Bishara, and A. C. Bushara

This comprehensive 60-page reference field guide is designed for research and extension workers. It covers the practical considerations necessary in the identification of the insects attacking faba bean, assessment of damage or population levels, and proper insect control practices. It includes a glossary of basic entomological terms, a key to injuries, official and some commercial names of chemicals, an index of common and scientific names of insects, and references for further reading. Color photographs of 41 important insects are included.

For your copy of these publications, write FABIS/ICARDA/P.O. Box 5466/Aleppo/Syria.

ICARDA (The International Center for Agricultural Research in the Dry Areas). 1985. **Harvest of research, Highlights of the IFAD/ICARDA Nile Valley Project 1979-1985.** ICARDA, Aleppo, Syria. 48 pp.

In English and Arabic, this illustrated brochure from FLIP narrates the story of the Nile Valley Project that is reaping success as the years unfold, with tangible benefits to the poor farmers of Egypt and Sudan. It includes list of Nile Valley Project collaborating scientists and list of references for further reading. For your copy of this publication, write FABIS/ICARDA/Documentation Unit/ P.O. Box 5466/Aleppo/Syria.

Contributors' Style Guide

Policy
The aim of FABIS Newsletter is to publish quickly the results of recent research on faba bean. Articles should normally be brief, confined to a single subject, good quality, and of primary interest to research, extension, and production workers, and administrators and policy makers.

Style
Articles should have an abstract (maximum 250 words) and whenever possible the following sections: introduction, materials and methods, and results and discussion. Articles will be edited to maintain uniform style but substantial editing will be referred to the author for his/her approval; occasionally, papers may be returned for revision.

Disclaimers
The views expressed and the results presented in the newsletter are those of the author(s) and not the responsibility of ICARDA. Similarly, the use of trade names does not constitute endorsement of or discrimination against any product by ICARDA.

Language
FABIS Newsletter is published in English but ICARDA will endeavor to translate articles submitted in Arabic and French.

Manuscript
Articles should be typed double-spaced on one side of the page only. The original and two other legible copies should be submitted. The contributor should include his name and initials, title, program or department, institute, postal address, and telex number if available. Figures should be drawn in India ink; send original artwork, not photocopies. Define in footnotes or legends any unusual abbreviations or symbols used in a figure or table. Good quality black and white photographs are acceptable for publication. Photographs and figures should preferably be 8.4 cm or 17.7 cm wide.

Units of measurement are to be in the metric system; e.g. t/ha, kg, g, m, km, ml (= milliliter), m^2.

The numbers one to nine should be written as words except in combination with units of measure; all other numbers should be written as numerals; e.g., nine plants, 10 leaves, 9 g, ninth, 10th, 0700 hr.

Examples of common expressions and abbreviations
3 g; 18 mm; 300 m^2; 4 Mar 1983; 27%; 50 five-day old plants; 1.6 million; 23 μg; 5^{o}C; 1980/81 season; 1980-82; Fig.; No.; FAO; USA. Fertilizers: 1 kg N or P_2O_5 or K_2O/ha.
Mon, Tues, Wed, Thurs, Fri, Sat, Sun; Jan, Feb, Mar, Apr, May, June, July, Aug, Sept, Oct, Nov, Dec. versus = vs, least significant differences = LSD, standard error = SE ±, coefficient(s) of variation = CV(s). Probability: Use asterisks to denote probability * = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$.

Botanical: Include the authority name at the first mention of scientific names. Cultivar(s) = cv(s), variety = var(s), species = sp./spp., subspecies = subsp., subgenus = subg., forma = f., forma specialis = f.sp.

References
Journal articles: Khalil, S. A. and Harrison, J. G. 1981. Methods of evaluating faba bean materials for chocolate spot. FABIS No. 3: 51-52.

Books: Witcombe, J. R. and Erskine, W. (eds.). 1984. Genetic resources and their exploitation – chickpea, faba beans, and lentils. Advances in Agricultural Biotechnology. Martinus Nijhoff/Dr. W. Junk Publishers, The Hague, The Netherlands. 256 pp.

Articles from books: Hawtin, G. C. and Hebblethwaite, P. D. 1983. Background and history of faba bean production. Pages 3-22 *in* The Faba Bean (*Vicia faba* L.) (Hebblethwaite, P. D., ed.). Butterworths, London, England.

Papers in Proceedings: Hawtin, G. C. 1982. The genetic improvement of faba bean. Pages 15-32 *in* Faba Bean Improvement: Proceedings of the Faba Bean Conference (Hawtin, G. and Webb, C., eds.), ICARDA/IFAD Nile Valley Project, 7-11 Mar 1981, Cairo, Egypt.

Submission of articles
Contributions should be sent to FABIS/Documentation Unit/ICARDA/P.O. Box 5466/Aleppo, Syria.

FABIS 12/1200/August 1985