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Faba Bean Information Service

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INTERNATIONAL CENTER FOR AGRICULTURAL RESEARCH IN THE DRY AREAS

(ICARDA)

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COVER PHOTO: Faba bean with pendent pods.

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A Summary on Production of Faba Bean in China

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China is by far the world's largest producer of faba bean (*Vicia faba* L.). Cultivation of the crop can be traced to ancient times and now it is widely distributed throughout the country, especially in the Yangtze River Valley. Excluding faba bean crops grown for green manure, the statistics of 20 provinces, municipalities, and autonomous regions in 1985 show that the production area exceeded 1.3 million ha, yielding about 2.3 million metric tonnes, with average yield of 1795 kg/ha (**Fig. 1** and **Table 1**). The major producing provinces are Yunnan, Sichmon, Hubei, Hunan, Jiangsu, Zhejiang, Anhui, Qinghai, and Gansu.

Historically, the largest total area (2.7 million ha) allotted to faba bean was in the 1950's with a total yield of about 3 million metric tonnes and average yield of 1125 kg/ha. Since the 1960's, the area sown to faba bean has been declining mainly because of the changes in farming systems.

Faba bean is an important winter and spring legume in China. The seeds, which are rich in protein (24-32%) and aminoacids, are important in the daily food of the Chinese people. They are used in many kinds of traditional dishes, such as bean-starch vermicelli or sheet jelly, various pastries, faba bean sauce in liquid or paste, and deep-fried faba beans. The green pods, which are also rich in vitamins are consumed as a green vegetable.

The fresh stems and leaves, with 10% protein and 1.5% fat, serve as a nourishing feed for livestock. After seed harvest, the stems, leaves, and pod shells are used as animal feed. An investigation in Sichuan has shown that an area of 0.14 ha under faba bean is sufficient to feed 2-3 pigs.

Faba bean is an excellent green manure crop. In the south, ploughing-in the crop in spring, about mid-March (when 50% of the plants have their first flowers), has increased the organic matter content of the soil. The decay of these green plants releases minerals in the soil, and also helps to improve soil structure.

Faba bean is also produced for export. Cultivars such as Zhejiang Cixi-dabaican, Zhejiang Shangyu-tainjiqing, Gansu-maya, and Qinghai-maya etc. are now important items for export to other countries.

Because of the large differences in climatic conditions between the north and south of China, the area of faba bean production is divided into two main regions according to the sowing and harvest seasons; the region of spring-sowing (March-April) in the north and the region of autumn-sowing (October) in the south (**Fig. 2**). The crops are usually harvested in August in the north and April-May in the south.

In China, faba bean is usually intercropped with cotton, cotton with barley or wheat, corn, cotton with alfalfa, or faba bean with mulberry, etc.

China is rich in the germplasm resources of faba bean. The germplasm collection, which comprises thousands of accessions, can be classified into two ecological types, spring-sown and autumn-sown; three categories of size of seeds (large with 100-seed weight of more than 120 g, medium with 100-seed weight between 70-120 g, and small with 100-seed weight of less than 70 g); five classes of seed shape (thin, thick, medium thin, medium thick, and narrow thick); four classes of flower color (white, light violet, violet, and deep violet); and five classes of color of seed coat (white, light green, green, deep green, and violet red). In dry seed, the protein concentration varies from 22-32%, the fat is 0.9-2.2%, and the lysine is between 1.3 and 3.1%.

The Chinese scientists have evaluated the germplasm accessions, and based on the results of many field experiments, they have selected many good local cultivars. And now there are five famous local

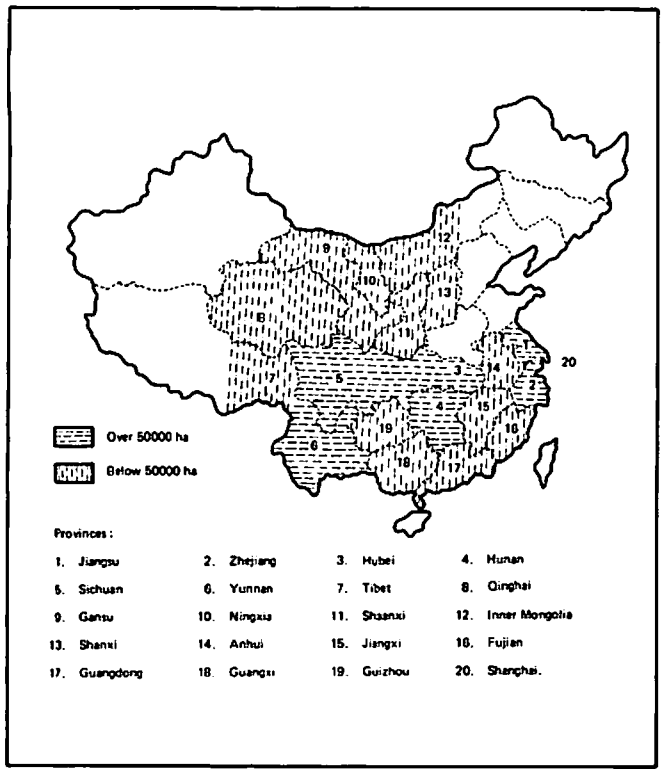

Fig. 1. Distribution of faba bean cultivation in China.

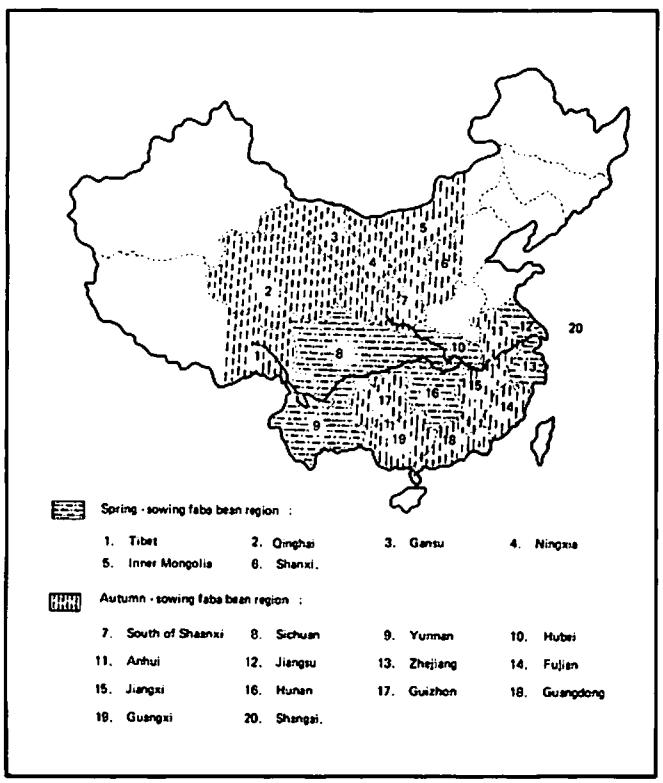

Fig. 2. Two main regions for faba bean cultivation in China.

Table 1. Area, yield, and production of faba bean in China during the 1985 season[1].

Province	Area (ha)	Yield (kg/ha)	Poduction (t)
Jiangsu	220,000	2,820	620,400
Zhejiang	60,000	2,160	129,600
Hubei	132,800	1,750	233,064
Hunan	86,533	1,163	100,638
Sichuan	228,933	1,703	389,873
Yunnan	236,867	1,403	332,324
Tibet	1,867	2,250	4,200
Qinghai	16,000	2,618	41,888
Gansu	48,800	1,710	83,448
Ningxia	933	2,250	2,100
Shaanxi	13,333	1,125	15,000
Inner Mongolia	46,667	3,000	140,001
Shanxi	1,333	3,150	4,200
Anhul	135,506	1,200	162,607
Jiangxi	16,200	728	11,793
Fujian	9,333	1,553	14,494
Guangdong	48,000	810	38,880
Guangxi	8,067	788	6,356
Guizhou	31,867	803	25,589
Shanghai	13,333	2,625	35,000
Total	1,332,372	1,795	2,391,455

[1]Excluding the area sown for green manure.

cultivars of faba bean, Zhejiang Cixi-dabaican, Zhejiang Shangyu-tianjiqing, Zhejiang Fonghua-xiaoqingdou, Zhejiang Pingyany-zhaodozi, and Gansu-maya. The main characteristics of these cultivars are given in **Tables 2, 3, and 4.**

Zhejiang Cixi-dabaican

This cv originated in Cixi county of Zhejiang province. It is mainly intercropped with cotton on about 20,000 ha. It has a medium seed size (100-seed weight is about 120 g) with a white seed coat. The average yield is about 3375 kg/ha. The quality of seeds is good, with 29.5% protein and 2.7% lysine. The shoot dry matter contains 3.05% N, 0.45% P, and 0.89% K. Because of the delicious taste of its seeds, Cixi-dabaican is welcomed in the international market, and is now mainly exported to Japan.

Because Cixi-dabaican needs high fertility level and is sensitive to water logging (it can not stand high humidity thus can not be intercropped with rice), it is considered the best cultivar for dry-land cultivation (**Table 3**).

Table 2. Selected characteristics of the five best faba bean cultivars in China.

Character	Dabaican	Tianjiqing	Xiaoqingdou	Zhaodozi	Maya
Plant height (cm)	131	104	90	61	156
Number of pods/plant	30	25	25	25	17
Number of seeds/plant	48	53	62	50	34
100-seed weight (g)	120	96	80	71	170
Seed yield/plant (g)	54	42	41	34	58
Protein (%)	29.5	31.5	27.8	34.3	26
Lysine (%)	2.7	2.1	NA*	NA	NA

* NA = not tested.

Table 3. Performance of the two faba bean cvs Cixi-dabaican and Shangyu-tianjiqing under two different soil conditions in Hangzhou, China.[1]

Character	Cixi-dabaican		Shangyu-tianjiqing	
	Dry-land	Paddy-field	Dry-land	Paddy-field
Plant height (cm)	130.80	110.00	125.80	93.40
No. of branches with pods/plant	5.80	4.00	4.00	3.80
No. of pods/plant	30.20	22.00	17.00	17.20
Pod length (cm)	8.90	6.48	9.75	9.72
Pod width (cm)	1.96	2.16	1.68	1.77
No. of seeds/plant	48.40	28.20	51.30	49.60
Seed length (cm)	2.01	2.00	1.46	1.44
Seed width (cm)	1.48	1.54	1.09	1.10
Seed thickness (cm)	0.51	0.53	0.58	0.58
100-seed weight (g)	135.00	120.00	67.00	64.30
Seed yield/plant (g)	53.60	34.40	32.60	30.20

[1] Sowing on 28 Oct 1981.

In Zhejiang province, Cixi-dabaican is generally sown in autumn (20-25 Oct) and harvested in early summer (25-30 May). Its total gowth period is 210-215 days, and its average seeding rate is 187.5 kg/ha.

Zhejiang Shangyu-tianjiqing.

Shangyu-tianjiqing originated in Shangyu county in Zhejiang province, where it is sown on about 2,000 ha. This cultivar has a medium seed size (100-seeds weight is about 90 g) with a green seed coat. Its average yield is 3000 kg/ha. The quality of seeds is very good with 31.5% protein, 2.2% fat, and 2.2% lysine. The shoot dry matter contains 3.40% N, 0.522% P, and 1.16% K.

The faba bean cv Shangyu-tianjiqing has a short growing period, and it can stand high humidity, which makes it suitable for intercropping with rice in the rice-growing areas (paddy-fields) in the southern plains of China. **Table 3** shows the performance of the faba bean cv Shangyu-tianjiqing in dry-land and paddy-field under Hangzhou, China conditions.

In Zhejiang province, Shargyu-tianjiqing is usually sown in autumn (24-30 Oct) and harvested in early summer (about 25 May). The total growth period is about 204 days and the average seeding rate is 150 kg/ha.

Zhejiang Fonghua-xiaoqingdou.

The cv Fonghua-xiaoqingdou originated in Fonghua county, in Zhejiang province. The seed size of this cv is medium (100-seed weight is about 80 g) with greenish-white seed coat. The average yield is 2250 kg/ha. Its dry seeds contain 27.8% protein and 1.42% fat, and the dry matter contains 3.11% N, 0.607% P, and 1.29% K.

Table 4. Effect of different sowing dates on different characteristics of faba bean cultivar Xiaogingdon in Hangzhou, China during the 1981/82 season.

Sowing date	Plant height (cm)	No. of branches with pods/ plant	No. of pods/ plant	No. of seeds/ plant	100-seed weight (g)	Seed yield plant (g)	Days to maturity[1]
28 Oct	87.6	4.3	25.3	46.9	76.9	34.4	203
4 Nov	85.6	4.0	19.6	33.3	77.5	29.4	187
11 Nov	92.9	3.8	19.3	39.0	79.3	30.4	193
18 Nov	90.6	3.8	16.3	36.9	76.5	26.8	186
25 Nov	86.4	3.1	15.8	29.9	80.3	24.1	181

[1] Days from sowing to maturity.

The general characteristics are similar to those of Shangyu-tianjiqing. However, one of its special characters is the flexibility in its sowing date (**Table 4**).

In Zhejiang province however, cv Fonghua-xiaoqingdou is usually sown in autumn (25-30 Oct) and harvested in midsummer (late May). The total growth period is 203-207 days and the average seeding rate is 150 kg/ha.

Zhejiang Pingyang-zhaodozi.

This cv originated in Pingyang county, Zhejiang province. The seeds are medium-sized (100-seed weight is about 70 g) with white seed coat. The dry matter is rich in N, P, and K; it contains 4.13% N, 1.65% P, and 1.65% K.

Pingyang-zhaodozi is an early-maturing cultivar. In Zhejiang province, this cv is usually sown in autumn (30 Oct) and harvested in early summer (early May). The total growth period is 195 days. The average yield is about 1875 kg/ha. Also, it can be sown in spring (15 March) and harvested in early June. In this case, the total growth period is about 80 days, and the average yield is about 750 kg/ha.

The Gansu-maya.

This cultivar originated in Gansu Linxia region. It has a large seed size (100-seed weight exceeds 170 g) with a white seed coat. The average yield is between 2250-2625 kg/ha, and the dry seeds contain 25.6% protein. This cv can endure the drought, so it is suited for planting in the dry region of northwest of China.

In Gansu province, this cv is usually sown in early spring (about 15 March) and harvested in early autumn (about 20 August). The total growth period is about 157 days and the average seeding rate is between 300-375 kg/ha.

References

Lang, Li-juan. 1979. Faba bean (*Vicia faba*) production in Zhejiang. Shaoxing Research Notes on Science and Technology no. 4.

Lang, Li-juan. 1982. Faba bean (*Vicia faba*) germplasm resources in Zhejiang: collection and use. Zhejiang Agricultural Sciences 6: 315-319.

Lang, Li-juan. 1985. Four famous varieties of faba bean (*Vicia faba*) of Zhejiang. Crop Germplasm Resources 4: 15-20.

Shen, Xue-yan. (ed.) 1961. Crop cultivation. Agricultural Publishing House, Hangzhou, China, 333-350.

The Problems and Importance of Faba Bean in Guatemala

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Introduction

The western Highlands of Guatemala comprises six districts (Chimaltenango, Totonicapan, Quetzaltenango, San Marcos, Huehuetenango, and El Quiche). In this region, agriculture depends mainly on the small farms (*minifundio*) with limited productivity. The region is however very densely populated (1.09 persons/ha) and accounts for 59.5% of the population of the country. The average diet in this region consists of corn, beans and a limited number of vegetables such as potatoes. Faba bean is one of the major sources of protein in the diets of the people of this region and almost all the domestic production is locally consumed.

Maize dominates the cropping system, which is based round the mixed cropping of several less important crops with corn (*maiz asociado*) such as beans, faba beans, squash, etc. Almost 93% of the total faba bean produced in the country is grown in *maiz asociado*. Recent studies by the rural socio-economic department of the Institute of Agricultural Science and Technology (ICTA) have shown that raising faba bean in "maiz asociado" is not a very profitable proposition because farmers are often unable to recover even the amount of seed that they used for sowing. There is, therefore, an urgent need for improving the production of the crop by developing technological solutions for the problems that confront faba bean production in Guatemala.

Problems Affecting Productivity of Faba Bean

One of the major problems is the degeneration of the existing cultivar 'Criollo' and its increased susceptibility to diseases and pests. This cultivar, of unknown origin, has been in cultivation for a very long period of time and no efforts have been made in the past to improve it. The crop can be completely distroyed by insect pests and diseases in some seasons.

Insect pests

Two root-damaging insects - grubworm (*phyllophaga* sp.) and wireworm (*Agrotis* sp.) are the main insect pests that attack the crop at an early stage of growth when the crop is still at a seedling stage. The damaged roots become susceptible to root-rot and wilt fungi such as *Fusarium* sp.

Aphids (*Aphis* spp.) are also a serious pest attacking the crop when it is still young, but they could come at any stage of growth. The infestation and damage is particularly high when the rainfall is low. They also damage the crop by spreading several viral diseases besides causing direct damage to the plants.

Diseases

The results of research trials, using local and introduced cultivars, show that 47% of the plant population had developed symptoms of *Fusarium sp.* The initial symptoms are clorosis and a general wilting of the plants. Later on, plants die within a few days. The plants can be very easily pulled out of the ground, and roots are partially or totally necrotic. To see the root damage, transversal cuttings can be made in different parts of the root. The vascular system is less affected in the upper parts of the root system. From what we have observed, this disease is the principal problem in the cultivation of faba bean because of the magnitude of the damage. In addition, once the disease is established in an area, it is rather difficult to eliminate.

The most important foliar diseases are listed in the order of their appearance on the plant.
1. Chocolate spot (*Botrytis fabae*)
2. Ascochyta blight (*Ascochyta fabae*)
3. Rust (*Uromyces viciae-fabae*)
4. Alternaria leaf spot *Alternaria alternata* (*A. tenuis*)

The first two diseases appear 15 to 30 days after flowering begins, and they can affect up to 70% of the foliar area. These fungi are characterized by their appearance on leaves on the upper half of the plant. Rust begins to develop at pod formation. It affects the lower leaves, covering as much as 20% of the leaves. However, under certain conditions of humidity and temperature, the disease appears on the stem.

Alternaria leaf spot is the latest disease to appear; nevertheless, because of its reproductive ability, it is considered the most important disease.

This fungus can cover 70 - 100% of the foliar area and may kill the plants. This disease is generally associated with the *Fusarium* sp. attack.

All attempts to identify genotypes resistant to these diseases have failed in the past. Therefore, renewed efforts have been started.

Progress in Research by the Horticultural Program

Since 1982 the Horticultural Program of ICTA has introduced collections of faba beans from Mexico (through the Instituto Nacional de Investigaciones Agropecuarias INIA; now INIFAP); from England; and some accessions as part of an international trial from ICARDA, Syria.

Some of these materials are still being evaluated because of some desirable morphological characteristics. Nevertheless, all the lines and accessions tested have proven susceptible to various diseases.

In seed multiplication plots, using a monoculture system with two Mexican cultivars, yields were found to be twice that of the local 'Criollo'. The Mexican cultivars S-68-8 and C-69-8 yielded 3.2 and 2.95 tone/ha, respectively. The local yielded 1.5 t/ha.

In 1986, in cooperation with other technicians of the discipline of the testing of technology (*"Disciplina de Prueba de Technologia del ICTA"*) a system to prevent foliar diseases through applications of fungicides was developed. This system is presently being evaluated at two locations in the region. The optimum time for fungicidal application, and the rate of increase or decrease of incidence of diseases were also determined.

During 1987, studies were initiated to induce mutations in cultivar S-68-8 using Cobalt 60 source for expanding the variability for local selections.

Projections for Faba Bean Improvement Research during 1988

1. Making a national collection of the genotypes that are of interest to technicians of ICTA.
2. Introducing germplasm lines from INIFAP, Mexico and ICARDA, Syria.
3. Screening germplasm lines under artificial inoculation pressure, a process already underway at ICTA Labor, Ovalle.
4. Making an agromorphological characterization of the national collection including those introductions obtained from Mexico and Syria, and other lines such as those developed in Guatemala.
5. Breeding hybrids by using germplasm with favorable agromorphology.
6. Evaluating promising materials under controlled and field conditions.
7. Multiplying promising lines with the objective of producing seeds.
8. Continuing the mutation breeding work with the Mexican cultivar S-86-8.

Breeding and Genetics

التربية والوراثة

Characteristics and Variation of Cyprus Faba Bean Germplasm

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Abstract

One hundred and one accessions of the local faba bean cultivar were collected in 1980. These were characterized and preliminarily evaluated during the seasons 1980-82 under irrigated and rainfed conditions, respectively. A total of 38 descriptors were studied. The local cultivar was not uniform for a number of characters such as grain size and shape, earliness, grain yield, plant height, protein content, etc. A number of accessions were selected for further testing.

Introduction

The Cyprus local faba bean germplasm was collected during 1980, in a mission organized and conducted by the Cyprus Agricultural Institute (CYPARI) in cooperation with the International Board for Plant Genetic Resources (IBPGR) (Della 1980). The collection, consisting of 101 accessions of the local cultivar is maintained in the CYPARI Genebank (at 4°C and 50% RH) and duplicates were sent to the Germplasm Institute, Bari, Italy and to ICARDA, Aleppo, Syria.

The collection was grown for characterization and preliminary evaluation under both irrigated and rainfed conditions. The passport, characterization and preliminary evaluation information, the summary of statistics, the frequency distribution, as well as the correlation matrices of the quantitative characters were presented by Della (1986). Based upon the results of the above study the characteristics and variation of the local cultivar are briefly described in this paper.

Materials and Methods

During the 1980/81 season, the collection was grown at Athalassa (35°08'N, 33° 24'E and an altitude of 150 m above sea level) under irrigation, and during the 1981/82 season at Laxia (35°06'N, 33°20'E and an altitude of 200 m) under rainfed conditions. The description of plantings for both locations are presented in **Table 1** and the meteorological data in **Table 2**. For the characterization and the preliminary

Table 1. Description of plantings at Athalassa and Laxia during 1980/81 and 1981/82, respectively.

	Athalassa	Laxia
Number of accessions	101	101
Date of planting	18/12/80	19/11/81
Date of first rainfall	25/12/80	16/11/81
Dates and amount of irrigation	19/12/80 (30 mm) 16/4/81 (40 mm) 7/5/81 (30 mm)	
Row length (m)	5	6
Number of rows/plot	1	1
Distance between rows (m)	0.5	0.5
Plant density (plants/m^2)	12	10
N applied (kg/ha)	21	21
P_2O_5 applied (kg/ha)	48	48
Dates of aphid control	6/2/81 & 2/4/81	18/2/82 & 6/4/82
Date of harvesting	4/6/81	19/5/82

Table 2. Meteorological data at locations Athalassa (1980/81) and Laxia (1981/82).

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
Athalassa										
Rainfall (mm)	11.2	7.1	45.6	89.2	94.3	43.8	16.1	17.6	2.0	327
Temp. max (°C)	28.6	23.3	18.0	15.5	16.0	20.2	24.0	26.8	34.4	
Temp. min (°C)	12.2	8.6	4.2	3.8	4.1	5.8	8.0	9.5	16.8	
Laxia*										
Rainfall (mm)	0.2	34.5	21.2	30.4	48.0	96.4	8.9	10.1	16.8	267
Temp. max (°C)	30.9	20.0	19.1	16.8	14.2	17.3	23.7	28.8	33.6	
Temp. min (°C)	16.2	9.2	8.1	6.0	4.9	5.9	11.5	14.7	18.7	

* Rainfall was obtained from the nearest meteorological station at Tseri and temperature from Nicosia Meteorological Station, which is the nearest Meteorological Station keeping such records.

evaluation single replication is sufficient (Erskine and Williams 1980). A random sample of the local cultivar taken from the export load was used as a standard check repeated every 10 rows.

Descriptors studied were decided considering the UPOV Guildelines for the Conduct of Test for Distinctness, Homogeneity and Stability (UPOV 1977) and the Introduction to Breeding Food Legumes (Hawtin 1978). The Faba Bean Descriptors (IBPGR and ICARDA 1985) were adopted for the presentation of some of the characteristics. Descriptors studied and their state were presented earlier by Della (1986).

Quantitative characters were measured on 10 plants from each accession at each environment. Characterization information was mainly collected at the Athalassa nursery in the 1981 season.

Results

All the accessions had indeterminate growth habit (**Table 3**). At flowering stage the size of leaves was medium with the exception of a few plants with small leaf size in accessions ARI00130 and ARI00206 and large leaves in accession ARI00207. The color of foliage (before flowering) was grey green. The ground color of the standard petal in all accessions was white, with moderate or intense presence of brownish streaks. The wing petals in all the accessions were spotted with a dark velvet brown to black color. The stipules were present in all plants and were spotted with black. The ground color of the testa was generally light green in all accessions, surrounded by light brown to a varying degree. The hilum was generally black, with a few seeds with colorless hilums present in some accessions, a considerable number in accession

Table 3. Characterization of Cyprus faba bean.

Growth habit	= Indeterminate
Leaflet size (at flowering)	= Medium
Foliage color (before flowering)	= Grey green
Flower ground color (standard petal)	= White
Intensity of streaks (brownish streaks)	= Moderate or intense
Wing petal color	= Dark velvet brown to black color
Stipules	= Present and black spotted
Max number of ovules/pod	= 3
Ground color of testa	= Light green surrounded by light brown of varying degree
Hilum color	= Black, few exceptions, mainly in ARI00207
Shape of seed	= Elongated, oval, and rectangled
Pod attitude	= Erect
Pod shape	= Mainly curved
Pod breadth	= Broad
Pod length	= Short and medium
Pod apex	= Pointed

ARI00207. Seed shape was a mixture of elongated, oval, and rectangular. Pod at maturity was classified as erect. Pod shape at harvesting was mainly curved in all accessions. Pod breadth was broad in all the accessions while pod length was short or medium. The pod apex at harvesting stage was pointed.

The mean, minimum, and maximum values as well as the variance recorded for 22 characters at the two locations are presented in **Table 4**. The range in time to flower was 7 days at Athalassa and 8 days at Laxia amongst various accessions. Plants were of rather short stature, the height being considerably affected by the environment, with mean values of 83 cm at Athalassa and 52 cm at Laxia. Plant height at lowest pod varied among the accessions and was affected by the environment.

Seed weight/plot, which was also affected by the environment varied considerably among the accessions, ranging between 580-1470 g/plot at Athalassa and 190-830 g/plot at Laxia. The 1000-seed weight was 1722 g and 1775 g, respectively at Athalassa and Laxia. The seed size varied among the accessions with minimum 1000-seed weight of 1285 g at Athalassa and 1420 g at Laxia and maximum values of 2250 g and 2110 g, respectively. The protein content (ICARDA 1986) was medium with a mean value of 29.4% at Athalassa and 29.7% at Laxia with a range of 27.2%-32.6% and 26.5%-32.4%, respectively.

As expected the local cultivar was not uniform for many of the characters under study. Based upon the variation present and particularly in grain yield, seed size and shape, uniformity, earliness, protein content, as well as on visual observation on the presence of ascochyta blight on the seed, a number of accessions were selected for further testing under irrigation and under dryland conditions.

Table 4. Simple statistics for 22 characters observed in 101 accessions of Cyprus local cultivar.

Character	Athalassa 1980/81				Laxia 1981/82			
	Mean	Var.	Min	Max	Mean	Var.	Min	Max
Anthocyanin coloration (%)	25	81.7	6	50	29	35.8	20	40
Time to flowering (days after planting)	79	5.1	75	82	74	2.9	71	79
Plant height (cm)	83	43.2	70	100	52	30.4	39	62
Main stem height (cm)					51	27.4	40	63
Plant height at lowest pod (cm)	21.2	6.2	15.0	28	10.4	2.4	6.3	14.9
Main stem height at lowest pod (cm)					15.2	3.0	11.4	20.6
Plant height at highest pod (cm)					25	8.3	19	31
Main stem height at the highest pod (cm)					23.6	7.9	17.4	30.2
Plant productive height (cm)					28.3	18.5	19.5	39.8
Main stem productive height (cm)					16.3	20.6	6.7	27.4
Number of productive nodes/plant	10.2	2.7	7.0	16.1	7.6	2.6	4.0	12.3
Number of pods/plant	11.2	3.8	7.4	19.6	7.9	2.8	4.1	12.7
Number of seeds/plant	20.6	13.8	13.6	30.6	12.3	9.7	5.9	18.5
Number of seeds/pod	1.8	0.02	1.6	2.5	1.6	0.04	1.1	2.5
Number of productive branches/plant	3.5	0.2	2.5	4.5	3.1	0.2	2.0	4.5
Plant lodging (%)	10.0	27.0	0.0	25	0 in all accessions			
Pod weight/plot (g)	1346	53129	800	1915	673	28598	270	1038
Seed weight/plot (g)	1063	34120	580	1470	518	19030	190	830
Seed weight:pod weight	78.9	4.8	72.5	83.5	76.5	8.2	66.8	81.9
Seed weight/plant (g)	34.0	32.2	20.0	49.0	19.9	22.6	8.3	30.7
1000 - seed weight (g)	1722	40697	1285	2250	1775	26909	1420	2110
Crude protein content (%)	29.4	1.1	27.2	32.6	29.7	1.5	26.5	32.4

Acknowledgments

The author is indebted to Mr. G. Papageorgiou, Mr. Chr. Theodorides and Mrs. A. Hadjinicoli for their assistance in field and laboratory work.

References

Della, Athena. 1980. Broad bean collecting in Cyprus. Plant Genetic Resources Newsletter AGP: PRG/44: 17-19.

Della, Athena. 1986. Collection of local broad beans at the "CYPARI" genebank: passport, characterization and preliminary evaluation information. Agricultural Research Institute, Ministry of Agriculture and Natural Resources. Miscellaneous reports Series No. 27, 47 pp.

Erskine, W. and Williams, J.T. 1980. The principles, problems, and responsibilities of the preliminary evaluation of genetic resources samples of seed-propagated crops. Plant Genetic Resources Newsletter AGP: PGR/41: 19-33.

Hawtin, C.G. 1978. Introduction to breeding food legumes. Technical Manual No. 2. ICARDA, Aleppo, Syria. 109 pp.

IBPGR and ICARDA. 1985. Faba Bean Descriptors. AGPG: IBPGR/85/116, Rome, Italy. 19 pp.

ICARDA. 1986. Third Conspectus of Genetic Variation within *Vicia faba*. FABIS, ICARDA P.O. Box 5466, Aleppo, Syria. 54 pp.

UPOV, 1977. Broad beans (*Vicia faba* L. var *major*). Guidelines for the conduct of tests for distinctness, homogeneity and stability. UPOV/8/1, 21 pp.

خصائص وتنوع اصول وراثية من الفول القبرصي

ملخص

تم جمع 101 مدخل من صنف الفول المحلي في عام 1980 . ثم جرى تحديد خصائصها وتقييمها بشكل مبدئي خلال الموسمين 1980 ـ 1982 تحت الظروف المروية والبعلية على التوالي . وجرت دراسة 38 صفة . ولم يكن الصنف المحلي متجانسا في عدد من الخصائص كحجم وشكل الحبة ، والتبكير في النضج ، والغلة الحبية ، وطول النبات ، ومحتوى البروتين الخ . وتم انتخاب عدد من المدخلات لاجراء مزيد من الاختبارات عليها .

A Protocol for Faba Bean (Vicia faba L.) Micropropagation from Seedlings

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Abstract

A protocol for the micropropagation of faba bean from such explants as apical tips, nodal segments, epicotyls, hypocotyls, roots, cotyledons and epicotyl-hypocotyl junction has been described. Using this protocol high success was achieved in getting the shoots to root to a stage that could be transferred to autotrophic medium.

Introduction

Tissue culture studies have advanced rapidly in the recent past and specialized techniques have been developed to answer questions on the basic biology of crops to address problems difficult to solve by conventional approaches. Tissue culture of legumes for crop improvement has been reviewed recently (*Mroginski* and Kartha 1984). Faba bean has been used extensively in tissue culture studies due to its classical importance as a model system in plant chromosome research. These studies have involved cell suspensions, calli, and protoplasts. However, there are only a few reports of plant regeneration from meristems or meristem-derived callus (Martin *et al.* 1979; Galzy and Hamoui 1981; Chakraborty and Roy 1985). This note describes a protocol for the micropropagation of faba bean from seedlings.

Materials and Methods

Clean, healthy seeds were surface sterilized by rinsing in 12% v/v Domestos solution (9-10% available chlorine) for 15 min and thoroughly washed 3 times in sterile distilled water. Seeds were soaked overnight in sterile distilled water then seed coats were removed and the seeds were sterilized for a second time in 10% v/v Domestos solution for 5 min and washed in sterile distilled water. This procedure eliminated fungal contamination almost completely. Seeds were then germinated on sterile paper bridges in the dark at room temperature for 5-7 days.

Different types of explants were used in the experiments, namely apical tips, nodal segments, epicotyls, hypocotyls, roots, cotyledons, and epicotyl-hypocotyl junctions. These explants came from four breeding lines and one cultivar from the University College Dublin breeding program. A number of different culture media were tested including Murashige and Shoog's medium (MS), Gamborg's medium (B5), Nitsch, and Nitsch and Adam's medium with or without addition of adenine, casein hydrolysate and activated charcoal. For each medium-explant combination a minimum of six cultures were established.

Results and Discussion

The best shoot induction medium was found to be MS inorganic salts and iron (Murashige and Skoog 1962) with 0.1 mg/l each of nicotinic acid, pyridoxine HCl, thiamine HCl and calcium pantothenate, 0.1 mg/l biotin, 3 mg/l glycine, 2 mg/l adenine, 10 mg/l myo-inositol, 30 g/l sucrose, 1 mg/l 6-benzylamino purine (BAP), and 0.1 mg/l indol-3-acetic acid (IAA). The pH was adjusted to 5.6 prior to addition of 8 g/l Difco Bacto-Agar and autoclaving for 20 min at 1.12 kg/cm^2.

Cultures were incubated at 24° ± 4° C with a light intensity of 3000 Lux and 16h photoperiod. Shoots developed after one week from apical tips, nodal segments and epicotyl-hypocotyl junctions. Other explant types did not show any shoot development.

After four weeks, shoots were removed aseptically and subcultured in rooting medium. Although the number of shoots varied between genotypes and explant sources, a minimum of 12 shoots of 5 mm, or more, in length was obtained from each seedling of the five genotypes tested.

The rooting medium consisted of the following macronutrients: 200 mg/l NH_4NO_3, 900 mg/l KNO_3, 600 mg/l $Ca(Na_3)_2.4H_2O$, 180 mg/l Mg $SO_4.7H_2O$ and 135 mg/l KH_2PO_4, with MS micronutrients and iron, 1 mg/l nicotinic acid, 0.5 mg/l each of pyridoxine HCl and thiamine HCl, 100 mg/l myo-inositol, 10 g/l sucrose, 2 mg/l 3-indolebutyric acid (IBA) and 0.1 mg/l BAP. The pH was adjusted to 5.6 prior to addition of 8 g/l Difco Bacto-Agar and 5 g/l activated charcoal and autoclaving. The cultures were incubated under the same light and temperature conditions as in the shoots induction phase.

Fifty-nine shoots of two genotypes were cultured in this rooting medium. Thirty-three shoots (55%) had rooted within three weeks and by the fifth week, a total of 43 (73%) shoots had rooted. Roots were very well developed and plants were successfully transferred to autotrophic media. Plants in Jiffy-7 peat pots were weaned in a fogging unit for two weeks and then transferred to the glasshouse. Plants are now being assessed for genetic stability.

References

Chakraborty, S. and Roy, S.C. 1985. Effect of adenine on regeneration of *V. faba* in tissue culture. Current Science (India) 54: 758-760.

Galzy, R. and Hamoui, M. 1981. Induction de l'organogenese sur les cals de *Vicia faba* minor provenant d'apex. Canadian Journal of Botany 59: 203-207.

Martin, C., Carre, M. and Duc, G. 1979. Note sur les cultures de tissus de feverole *(V. faba* L.): bouturage, culture de cals, culture de meristemes. Annales de l'Amelioration des Plantes 29: 277-287 (cited in Plant Growth Regulator Abstracts 1980: 2391).

Mroginski, L.A. and Kartha, K.K. 1984. Tissue culture of legumes for crop improvement. Plant Breeding Reviews 2: 215-264.

Murashige, T. and Skoog, F. 1962. A revised medium for rapid growth and bioassay with tobacco tissue culture. Physiologia Plantarum 18: 100.

طرق للتكاثر الخضرى Micropropagation للفول بالبادرات (Vicia faba L.)

ملخص

تم وصف طرق التكاثر الخضرى في الفول من خزع explants مأخوذة من قمم طرفية ، وعقد حلقية ، وسويقات جنينية علوية ، وجذور ، وفلقات ، ومن مكان اتصال السويقة الجنينية العلوية بالسفلية . وباستعمال هذه الطرق تم تحقيق نجاح كبير في تجذير هذه النموات ، ووصولها الى مرحلة يمكن معها نقلها الى وسط أو بيئة ذاتية التغذية .

In Vitro Regeneration of Vicia faba L.

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Abstract

Primary explants derived from seedlings and secondary explants derived from regenerated sprouts, mainly shoot tips, nodes and hypocotyl were used to regenerate three *Vicia faba* accessions. Two relatively resistant accessions and one susceptible to *Botrytis fabae* Sard. were regenerated by tissue culture. Regeneration was successful in B5 medium containing 0.1 mg/l of IAA (indole - 3 - acetic acid) and 0.5 mg/l BAP (6-benzylamino purine). None or very few regenerations were achieved in the medium with 0.2 mg/l of IAA and 0.4 mg/l of BAP.

Introduction

There is a considerable potential for crop improvement through tissue culture techniques. In recent years it has attracted the attention of plant pathologists and breeders working on the improvement of disease resistance in cultivated plants. Even if genetic conditions in *in vitro* culture and in primary explants may differ (D'Amato 1975), the method allows to multiply and preserve promising genetic material. Variability arising in tissue culture could also be exploited.

Dale (1983) reported successful plant regenerations from calluses of eight grain legumes, but there are very few experiments conducted on *Vicia faba*. Morphogenesis induction of meristem containing explants and regeneration abilities of explants from different plant parts have however been studied (Martin *et al.* 1979, Cheyne and Dale 1980).

Materials and Methods

The seedlings of three faba bean accessions, obtained from the Plant Genetic Resources Center of Ethiopia (PGRC/E), were raised in the greenhouse and under sterile conditions in test tubes. To raise plants in test tubes, mature seeds were surface sterilized using sodium hypochlorite (NaOCl) for 1-2 min, repeatedly rinsed in distilled water, and then soaked in distilled water for 24 h. The seeds were then planted in sterile growth medium containing 1.9 g of Gamborg's B5 medium (Gamborg and Eveleigh 1968) and vitamines (Medium 1).

Seedlings were grown at 23-25 °C with 16 h light (3000 lux light intensity) and 8 h darkness.

Explants from shoot tips, nodes, and hypocotyl ranging in size from 0.3 to 1.5 cm were taken from 10-12 days old plants from test tubes and 14-day old plants from the greenhouse. Explants were surface sterilized using 1% NaOCl with 13% active chlorine for 1-2 min, thoroughly washed in distilled water, and then transferred into 100 ml Erlenmeyer flasks containing 20 ml of sterile regeneration medium (Medium 2) under aseptic conditions.

The tissue cultures were kept for 14-16 weeks at a constant temperature of 24°C with 16 h light (3000 lux light intensity) and 8 h darkness. During this period cultures were transferred into fresh medium every three weeks.

Directly regenerated shoots and those developed from callus were transferred to a rooting and elongation medium (Medium 3) when they were about 3 to 7 cm tall. In most cases the rooting and elongation of the shoots in the rooting medium was completed within six to seven weeks and plants were transferred into closed transparent plastic boxes containing a mixture of sterilized compost-soil and sand (3:1, v/v). They were kept for about two weeks under the same temperature and light intensity as mentioned earlier. Finally they were moved into a greenhouse for normal cultivation. Callus tissues were recultured on fresh regeneration medium for further sprout production.

Medium 1

The following ingredients were dissolved in 1l demineralized water: 1.9 g Gamborg's B5 medium (Flow laboratories UK), 15.0 g sucrose, 8.0 g agar, 1.0 mg thiamine-HCl, 1.0 mg pyridoxine-HCl, 1.0 mg Calcium pantothenate, 1.0 mg nicotinic acid, 10.0 mg myo-inositol, and 0.1 mg biotin.

In preparing this medium, the first three substances were autoclaved at 120°C and 15 psi for 15 min. The medium was cooled to below 50°C and then the remaining substances were added using 40 ml plastic syringes fitted with a 0.2 µm sterile filter.

Media 2 regeneration medium

The following ingredients were dissolved in 1l demineralized water: 3.8 g Gamborg's B5 medium, 30.0 g sucrose, 8.0 g agar, 0.1 mg IAA (indole-3-acetic acid), 0.5 mg BAP (6-benzylamino purine), 1.0 mg thiamine-HCl, 1.0 mg pyridoxine-HCl, 1.0 mg calcium-pantothenate, 1.0 mg nicotinic acid, 10.0 mg myo-inositol, and 0.1 mg biotin. The substances of this medium were mixed following the same procedure used for Medium 1. This was Medium 2a. Medium 2b contained the same substances, but the amount of IAA was 0.2 mg and that of BAP 0.4 mg.

Medium 3 rooting and elongation medium

Medium 3 had the same amounts of Gamborg's B5 medium, sucroses and vitamines as Medium 2, but contained 2.0 mg of IAA and no BAP was added.

All media were adjusted to a pH of 5.5 using 1 N KOH or 1 N HCl.

Results and Discussion

In this study, two relatively resistant and one susceptible accessions to *Botrytis fabae* were regenerated (**Fig. 1**). Direct regeneration without going throught the callus culture (**Fig. 2**) to insure genetic stability (D'Amato 1975) was only achieved from explants of apical meristem. All other explants produced callus in the regeneration medium and then shoots (**Table 1**).

In our experiments, contrary to the experience of Busse (1986), very small primary explants failed to grow well.

Successful rooting was achieved when shoots were harvested from callus and transferred to rooting medium (**Fig. 3**). However, complications in root production arose when shoots already started rooting in the regeneration medium. Roots blackened and died or grew negatively geotropic.

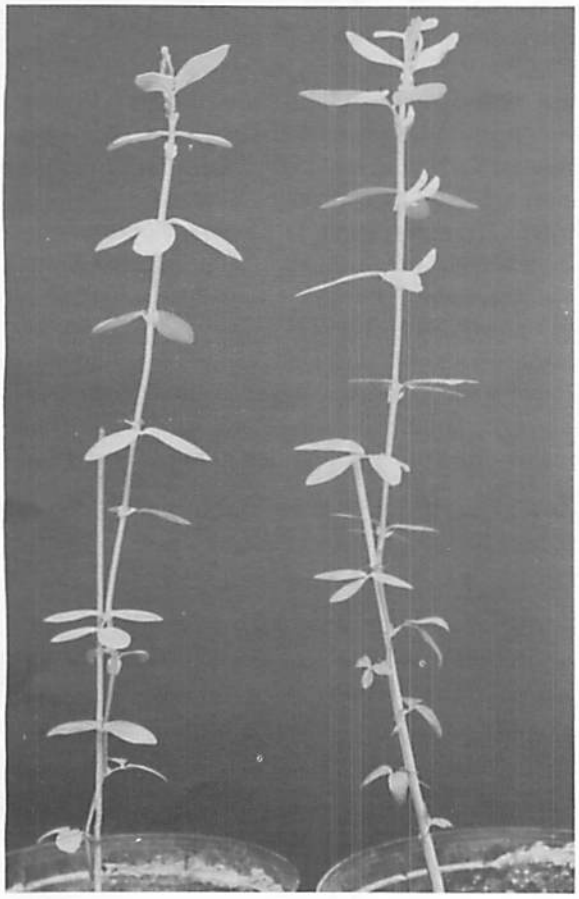

Fig. 1. Regenerated faba bean plants in compost soil. Left, susceptible accession; right, resistant accession.

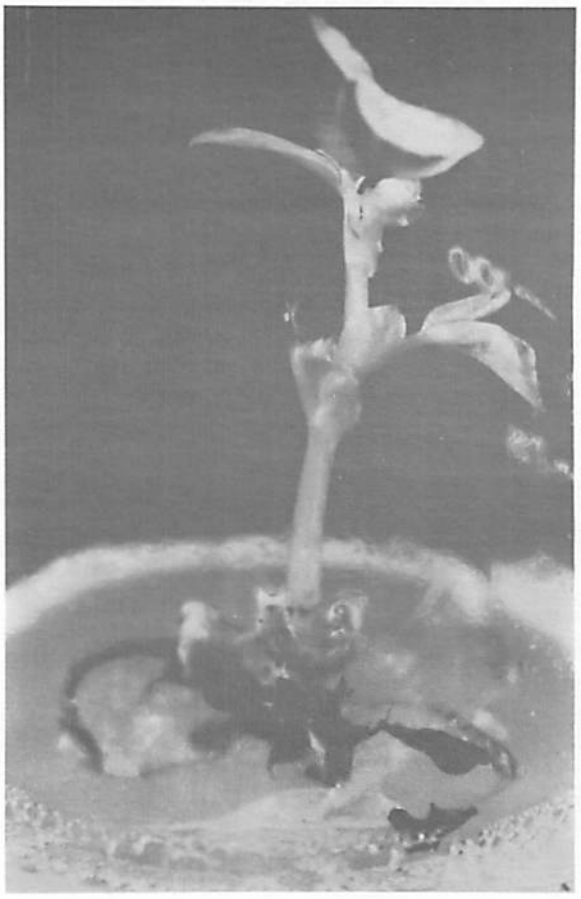

Fig. 2. Directly regenerated shoot at early stage of rooting from apical meristem explant.

Table 1. Number of shoots directly regenerated and harvested from callus in regeneration Medium 2a.

Accession	Number of primary explants	Regeneration		Number of secondary explants	Regeneration	
		from callus	direct		from callus	direct
PGRC/E 25400	8	5(62.5%)	1(12.5%)	5	1(20.0%)	1(20.0%)
PGRC/E 25538	8	4(50.0%)	1(12.5%)	5	1(20.0%)	
PGRC/E 27053	8	7(87.5%)	1(12.5%)	5		1(20.0%)

As the time required for plant regeneration was 7-8 months, it is necessary to try to shorten this period for more effective use in germplasm evaluation. The regeneration from secondary explants to increase the number of plants through cloning was possible (**Table 1**), but needs improvement.

The production of shoots from callus decreased from the first to the second harvest (**Table 2**).

Valuable breeding materials could be preserved for the improvement of disease resistance in *Vicia faba* using *in vitro* techniques. It is also possible to use the developed tissue culture techniques for *V. faba* in advanced breeding programs.

Table 2. Secondary sprout production from callus 21 to 30 days after first harvesting.

Accession	Shoot production
PGRC/E 25400	4(50%)
PGRC/E 25538	2(25%)
PGRC/E 27053	3(37%)

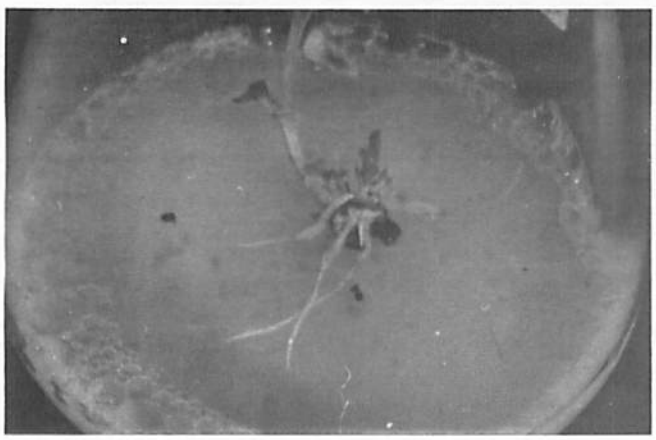

Fig. 3. Shoot harvested from callus developing roots in a rooting medium.

Acknowledgment

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References

Busse, G. 1986. *In vitro* cultivation of *Vicia faba* and induction of morphogenesis. Biologisches Zentralblatt 105: 97-104.

Cheyne, V.A. and Dale, P.J. 1980. Shoot tip culture in forage legumes. Plant Science Letters 19: 303-309.

Dale, P.J. 1983. Protoplast culture and plant regeneration of cereals and other recalcitrant crops. Experientia Supplementum 46: 31-43.

D'Amato, F. 1975. The problem of genetic stability in plant tissue and cell cultures. Pages 333-348 *in* Crop Genetic Resources for Today and Tomorrrow (Frankel, O.H. and Hawakes, J.G., eds.). Cambridge University Press, Cambridge, England.

Gamborg, O.L. and Eveleigh, D.E. 1968. Culture methods and detection of glucanases in suspension cultures of wheat and barley. Canadian Journal of Biochemistry 46: 417-421.

Martin, C., Carre, M. and Duc, G. 1979. Note sur les cultures de tissu de feverole (*Vicia faba*), bouturage, culture de cals, culture de meristems. Annales de l'Amelioration des Plantes 29: 277-287.

تجدد الفول Vicia faba L. في أنابيب الاختبار

ملخص

أخذت خزعات رئيسية من بادرات وأخرى ثانوية من نوابت متجددة النمو ، وبشكل رئيسي من قمم الفروع والعقد والسويقة الجنينية السفلية لاستعمالها في تجديد ثلاثة مدخلات من الفول Vicia faba . وقد تم تجديد مدخلين مقاومين نسبيا ، وآخر حساس لمرض التبقع الشوكولاتي Botrytis fabae Sard . باتباع تقنيات زراعة الانسجة . وقد نجحت عملية التجديد على وسط B5 الحاوى على 0.1 مغ/ل اندول ـ 3 ـ حامض الخليك (IAA) و 0.5 مغ/ل 6 بنزيل أمينو بورين (BAP). أما في 0.2 مغ/ل IAA و 0.4 مغ/ل من BAP فلم يحدث تجدد أو انه حصل ولكن بشكل قليل جدا .

The Rhythm of Flower Opening in Vicia faba L.

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Abstract

The opening and closing rhythms of flowers of two faba bean genotypes, Fiord and TF157, were monitored using time lapse video recording. Flowers opened and closed in several cycles for seven days. The first opening cycle was similar for both genotypes, starting between 1400 h and 1500 h, and closing at 1930 h. On the second day, flowers of Fiord began to open at 1000 h and TF157 at 1030 h, with both closing between 1900 h and 2100 h. There were two major peaks of flower opening in Fiord starting at 0600 h and 0400 h on days three and four, respectively, but most TF157 flowers tended to remain open from 0530 h on the third day to about 1200 h on the fifth. Thereafter, TF157 flowers exhibited two more periods of flower opening.

Introduction

The time when a faba bean flower first opens, that is when the standard petal reflexes, is taken to signal the onset of stigma receptivity and the accessibility of pollen to honey bees. Having opened once, it will then close, and later exhibit several opening-closing cycles. Since honey bees only visit open faba bean flowers (Synge 1947), the periodicity and duration of flower opening are important in cross-pollination and stigma manipulation.

Although the daily appearance of newly opened flowers has been studied by De Pace *et al.* (1985), little information appears to be available about floral rhythm in faba bean. Synge (1947) observed that each flower opened on three successive days, mean times at which this occurred being 1330 h, 1230 h, and 0954 h, respectively on the first, second, and third days. We have extended this approach to observe the time and duration of flower opening in individual flowers using time lapse video recording.

Materials and Methods

Racemes on the sixth to eighth flowering nodes of the genotypes Fiord and TF157 were viewed using a video camera set up for time lapse recording. Plants were raised in 25 cm diameter pots containing a 1:1 mixture of sand and black earth soil in a glasshouse whose day:night temperatures were controlled to 20:10°C. Natural photoperiod was in the range of 12 to 14 h during plant growth.

The development of flowers in racemes was monitored and recorded on video tape. Night exposures were facilitated by the use of a red 25W tungsten filament lamp. Time lapse settings allowed 120 h and 240 h of raceme development to be recorded on a 3 h tape for Fiord and TF157, respectively. Times and durations of flower opening were noted from tape play back at normal speed. Data were summarised by calculating from 10 flowers of Fiord and 11 of TF157 the probability of a flower being open at a particular time after 0000 h of the day of first opening.

Results

The probability that a flower will be open at a given time is shown for the two genotypes in **Fig. 1**. Data for the first opening were similar for both cultivars, with the flower expected to open first about 1400 h and closing at 1930 h. Opening on the second day was also consistent for each genotype, with the flower of Fiord opening from about 1000 h and TF157, from 1030 h. Closing on the second day occurred between 1900 h and 2100 h. Thereafter, the rhythms of flower opening became irregular. There were two major peaks of flower opening in Fiord starting at 0600 h and 0400 h on days three and four, respectively. Flowers of TF157 tended to open from 0530 h on day 3 maintaining a high probability of remaining open until most were closed by 1400 h on day 5. However, flowers tended to reopen from 1700 h on day 5, remaining open throughout the night, and closing at about 0800 h on day 6. There was another small opening after 1900 h on day 6 with closure at 0930 h on day 7.

Discussion

The greatest influence that bee visitation can have on the genetic make up of the next generation will occur during the first flower opening, for it is at this stage that foreign pollen is most competitive. We have unpublished evidence to show that the half time for pollen tubes to reach the first ovule is less than 12 h after self-pollination. Any delay in cross-pollination will reduce the chances of cross-fertilization

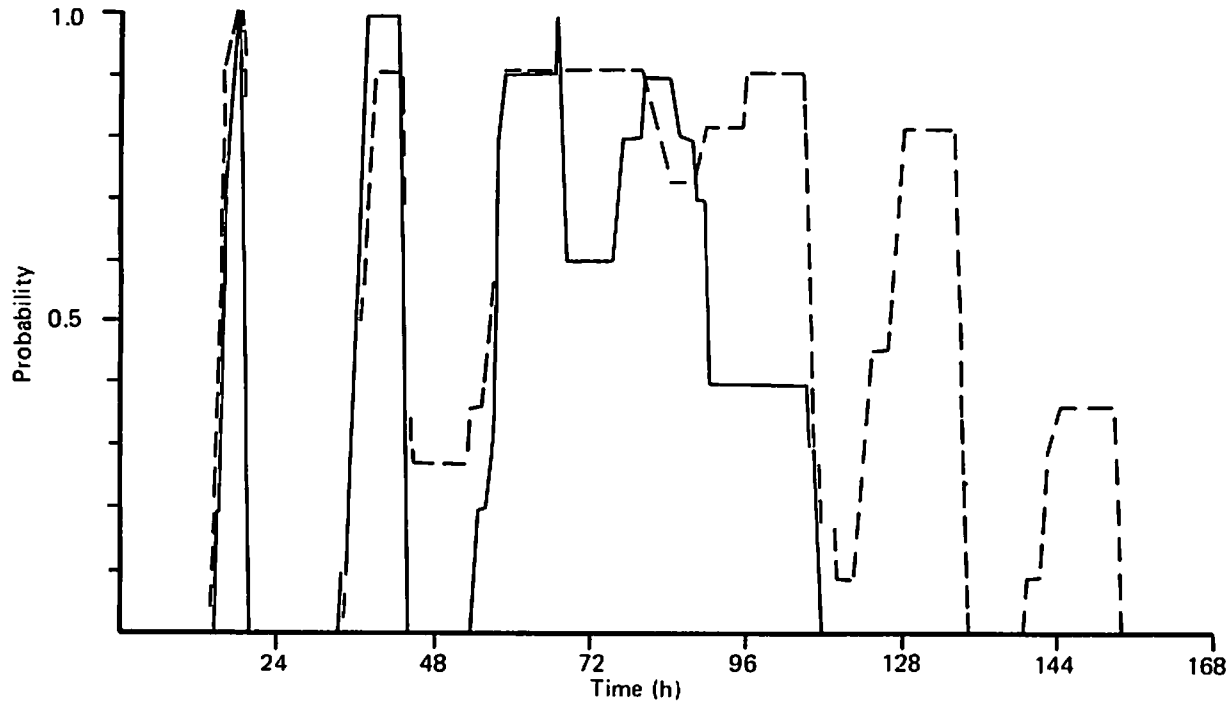

Fig. 1. Probability of flower opening after 0000 h of the first flowering day for the genotypes Fiord (——) and TF157 (— — —).

substantially, particularly in cultivars with early stigma receptivity.

The second flower opening may be an insurance against low fertilization rates in the event of insufficient bee visitation during the first flowering cycle and autosterility.

Later flowering cycles are enigmatic because older flowers were open throughout the night, a useless strategy for the purpose of vector visitation, and were generally devoid of pollen and therefore unattractive to bees.

The wide range of outcrossing rates reported in the literature may be explainable in terms of the interaction between bee visitation, flower opening, and autofertility.

Acknowledgments

We are most grateful to Professor R. Kitching and Mr. S. Jackson from the Land Resource Department, University of New England, for the use of the time lapse video equipment. Also the assistance given by Mr. R. Murison and Mr. A. Doss in the presentation of data, and the technical support of Mr. F. Fensbo is greatly appreciated.

References

De Pace, C., Geng, S., Filippetti, A. and Ricciardi, L. 1985. Optimum time of day for maximum flower opening of faba bean. Agronomy Journal 77: 646-649.

Synge, A.D. 1947. Pollen collection by Honey bees (*Apis mellifera*). Journal of Animal Ecology 16: 122-138.

تواتر انفتاح الزهرة في نبات الفول Vicia faba L.

ملخص

جرى رصد أو تتبع لتواتر انفتاح وانغلاق ازهار طرازين وراثيين من الفول هما Fiord و TF 157 ، وذلك باستخدام تقنية التصوير التزامني بالفيديو • وكان يتم انفتاح وانغلاق الازهار وفق دورات زمنية مختلفة على امتداد سبعة أيام • ولوحظ أن دورة التفتح الاولى كانت متماثلة عند الطرازين مبتدئة بالساعة 14.00 و 15.00 ومنغلقة في الساعة 19.30• وفي اليوم الثاني بدأت ازهار الطراز Fiord بالتفتح عند الساعة 10.00 وعند الطراز TF 157 في الساعة 10.30 ، أما الانغلاق في كل منهما فكان بين الساعة 19.00 و 21.00 • وكان هناك ذروتان رئيسيتان لتفتح الازهار عند الصنف Fiord ابتداء من الساعة 0600 و 0400 في اليومين الثالث والرابع على التوالي ، في حين كانت أزهار الصنف TF157 تميل لان تبقى مفتوحة من الساعة 0530 في اليوم الثالث الى حوالي الساعة 12.00 في اليوم الخامس • بعد ذلك تفتحت أزهار الصنف TF 157 لفترتين زمنيتين أخريين •

Physiology and Microbiology

الفيزيولوجيا والأحياء الدقيقة

Winterhardiness in Mediterranean Populations of Faba Bean

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Abstract

Ten populations of faba bean of Spanish, French, Egyptian, Sudanese, Lebanese and Chinese origin were hardened in a growth chamber at 8/2°C (day/night) after plant emergence. Freezing resistance (FR), and several plant and leaf traits supposed to be associated with winterhardiness, were examined after a saturating hardening treatment. Cote d'Or, an old French landrace displayed the most favorable performance comprising a slow development, a short growth habit, small leaves, a low water/dry matter ratio and a high FR (about -16°C). However, some other populations such as ILB 3187 and 3188, which were not particularly selected for FR, and in part Aquadulce, developed a considerable FR and showed a reasonable performance for most traits examined. Between these traits and FR, phenotypical and genotypical correlations were established and a multiple regression analysis suggested that they might be used as indirect selection criteria for winterhardiness.

Introduction

In general, winter varieties of crop plants build up a higher yield potential than spring varieties. This is because they grow under lower temperatures (particularly during the generative and reproductive phase of development). Most probably this applies also for faba bean (Skjelvag 1981). Superiority of winter sown faba bean is strongly expressed under Mediterranean climate, which is characterised by a rapid increase of temperature and by an early drought in spring (Saxena *et al.* 1981; Salih and Khalafallah 1982; Krarup 1984; Tosun *et al.* 1984) and to a lesser extent in middle Europe (Lawes *et al.* 1983; Herzog 1984). The problems with winter cropping of faba bean arise at locations where lack of adequate winterhardiness becomes a restricting factor as in the intermediate and high altitude areas in the Mediterranean region of West Asia (Saxena *et al.* 1981; Tosun *et al.* 1984) and in northern or continental parts of Europe (Hauser and Boehm 1984; Herzog 1984).

In order to alleviate the risks and to extend the possible area of winter cropping there is an urgent need for improvement of winterhardiness in faba bean. First attempts have been made at ICARDA (Saxena *et al.* 1981). However, the breeding of winterhardy cultivars in Europe during the last decades has produced only limited progress probably due to winters which often do not permit differentiation between the types varying in the winterhardiness (Herzog 1987c). Because freezing resistance (FR) is thought to be the most important component of winterhardiness (Levitt 1980), the present study aimed to get a preliminary insight into the variability of FR among Mediterranean populations of faba bean. Another objective was to examine some simple attributes associated with winterhardiness. Recently, genotypical correlations between these attributes and FR have been established among European varieties leading to a formulation of a winterhardy ideotype with a retarded development, a short growth habit, small leaves, a low water/dry matter ratio, and a high FR when grown under hardening conditions (Herzog 1987c). If these correlations could be verified for Mediterranean populations, they might permit an indirect selection for winterhardiness without examination of winter survival and with a minimum of determinations of FR.

Materials and Methods

Two experiments with 10 populations of faba bean were conducted in a growth chamber (Bioclim 1600 Sp, Weiss GmbH, Germany). Populations and their origin were: Aquadulce (Spain), Cote d'Or (France), Giza 402 (Egypt), Hudeiba 72 (Sudan), ILB 1813 and 1814 (Syria), ILB 1816 and 1817 (Lebanon), ILB 3187 and 3188 (South-East China). Seeds obtained from the

International Legume Bean (ILB) collection at ICARDA in Aleppo, Syria, were imbibed in tap water and pregerminated on quartz sand for 4 days at 20-25°C. Twenty-five seedlings were transferred into a cubic plastic pot (17x17x17 cm) containing a mixture of peat and loam, and were raised at 15°C for 7 days (experiment 1). After this period of adaptation, which was omitted in experiment 2, plants were exposed to 8/2°C (day/night) for hardening for several weeks. Light was provided by fluorescent tubes (Osram, Cool White and Fluora) with a radiant flux of 350 mol/m^2/s at plant level for 10h per day. Six to 10 samplings, each consisting of five plants/population were taken between day 39-59 (Expt. 1) or 66-87 (Expt. 2) of hardening at 8/2°C. Leaf area was measured with an electronic planimeter (Paton, Australia). Freezing resistance (FR) of leaves was determined as R_{50}-values indicating the temperature at which an intermediate level of injury will occur. The degree of injury (I^R) was assessed by visual rating of excised leaves after

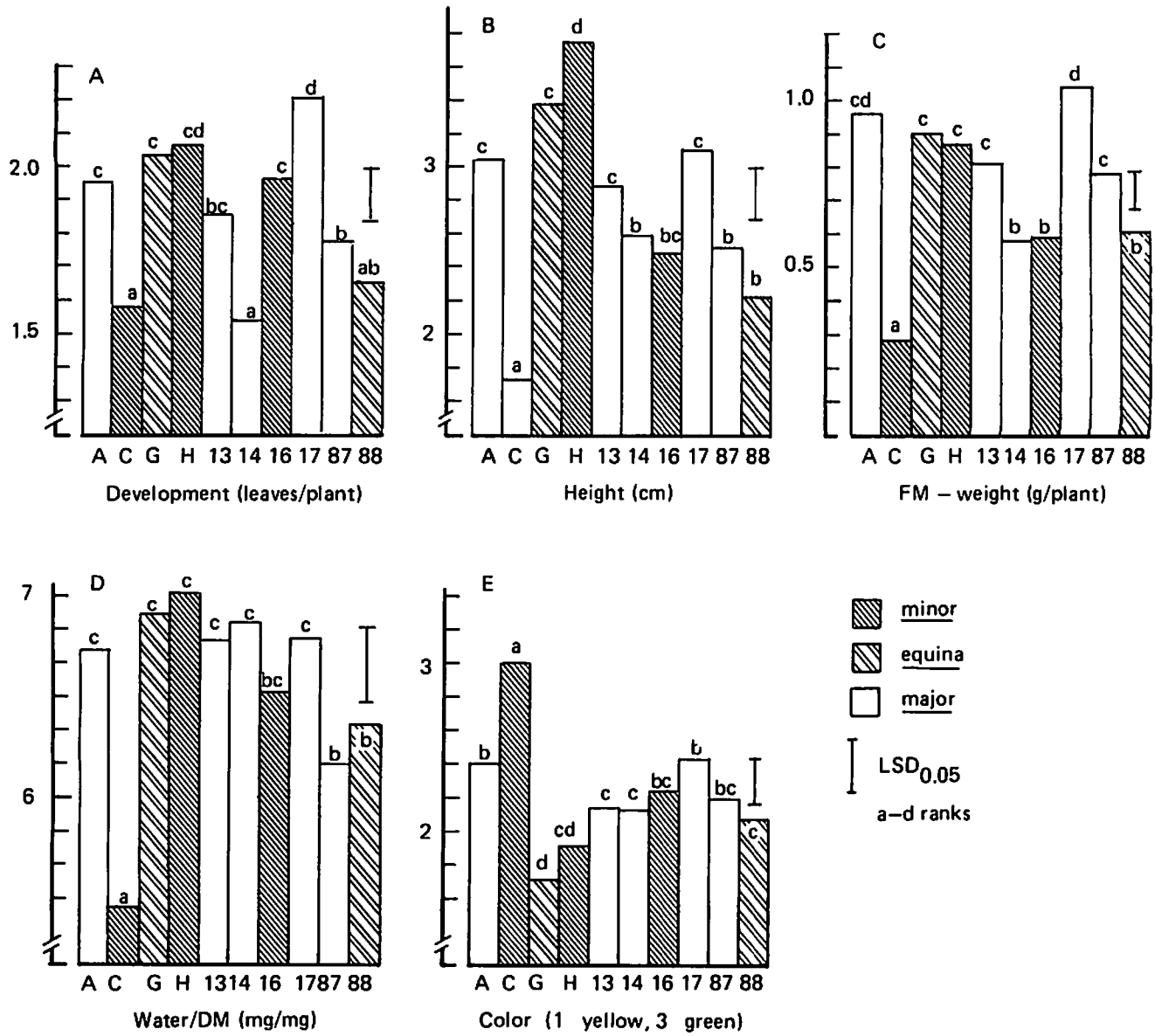

Fig. 1. Mean varietal expression of several plant traits during hardening in experiment 2. Means of 30 plants: A Aquadulce; C=Cote d'Or; G=Giza 402; H= Hudeiba 72; 13=ILB 1813; 14=ILB 1814; 16=ILB 1816; 17=ILB 1817, 87=ILB 3187; and 88=ILB 3188.

exposing to standardised freeze-thaw cycles with different test temperatures (TT). Values of I^R and TT were then transformed to R_{50}-values (Herzog 1987a). Data were subjected to 2-factor-analysis of variance (samplings and genotypes). LSD ($P < 0.05$) was computed with the Student-Newman-Keuls test. For genotypic correlations, means of populations were standardized to the overall mean of each experiment, and then a correlation and regression analysis was performed with the joint data sets of both experiments.

Results and Discussion

Sampling was done during three weeks at an advanced stage of hardening at 8/2°C when growth and development had almost ceased as was expected from previous experiments (Herzog 1987b,c). Because no differences in the rates of growth and development among the populations were observed, we deal only with the mean expression of varietal characters.

The characteristics postulated for a winterhardy faba bean comprise slow rates of development and growth, a short growth habit and a low water/dry matter ratio. These attributes were most perfectly seen in Cote d'Or (rank a; **Fig. 1A-D**), which was consistent with its field performance under hard to severe winters in Europe (Picard *et al.* 1985; Herzog 1987c) and substantiates the validity of the ideotype postulated. A relatively slow development, as in Cote d'Or, was noted in ILB 1814, 3188 and 3187, which, however, had a longer and heavier shoot with a medium high water/dry matter ratio (rank b). A less favorable expression of these four plant characters was observed in ILB 1813 and ILB 1816 (3x rank b and 1x rank c), while it was indeed unfavorable in Aquadulce and Giza 402 (1x rank b and 3x rank c) or Hudeiba 72 and ILB 1817 (3x rank c and 1x rank d). On the whole, the similarity in the rank patterns of the populations indicated some relationships among these four characters which were established by significant phenotypic and genotypic correlations (**Table 1**). The ideotypic performance was apparently not related to the seed size of the populations as shown by the contrasts among the *minor*-types: Cote d'Or and Hudeiba 72 and among the *major*-types: ILB 1817 and ILB 3187. Likewise, this performance obviously did not depend on the ability of the populations to synthesize chlorophyll in the shoot axis and leaves (**Figs. 1E** and **2D**) because there were considerable differences among those with an almost normal color, (i.e., Aquadulce and ILB 1817; rank b) as well as among those with a yellowish green color, (i.e., ILB 1813 and 3188; rank c). Nevertheless, Cote d'Or was the only one with a dark green coloration, a trait postulated for the winterhardy ideotype.

The leaf parameters from experiment 1 should be considered with some caution because of the small sample size (**Fig. 2A-C**; N = 10/population), because there were some deviations in the pattern of fresh matter weight from experiment 2 (**Fig. 2B** and **E**) and also because 25 plants/population have been shown to be necessary for a sufficiently reliable determination of varietal FR in faba bean (Herzog 1987a). Although, the data from experiment 1 suggested that Cote d'Or had the smallest and lightest leaves with the lowest water/dry matter ratio, the latter parameter was also favorably expressed in Hudeiba 72, ILB 1816, 3188, and Aquadulce. Moreover, the leaf area and fresh weight of leaves appeared to have a similar pattern and were indeed phenotypically correlated [$r = 0.58$ (significant at $P < 0.05$)]. Hence, fresh weight of leaves from experiment 2 (**Fig. 2E**), which is based on 35 plants/population is thought to reflect also the differences in leaf area, suggesting that the desired leaf traits for

Table 1. Phenotypic[1] and genotypic[2] correlations among plant traits and with freezing resistance[3] (FR).

Trait	Develop-ment	Plant height	Fresh matter weight/plant	Water/dry matter ratio	FR[3]
Development		0.43	0.50	0.15	-0.30
Plant height	0.62		0.71	0.47	-0.30
FMW/plant	0.71	0.74		0.43	-0.25
W/DM ratio	0.51	0.83	0.65		-0.38
FR	-0.52	-0.76	-0.60	-0.91	

1. Phenotypic correlations are in upper right section. They were determined from data in experiment 1, with N=300, and $r_{0.05} = 0.15$.
2. Genotypic correlations are in lower left section. They were determined from data of both experiments 1 and 2, with N = 20 and $r_{0.05} = 0.44$.
3. Freezing resistance was designated by absolute values of R_{50}.

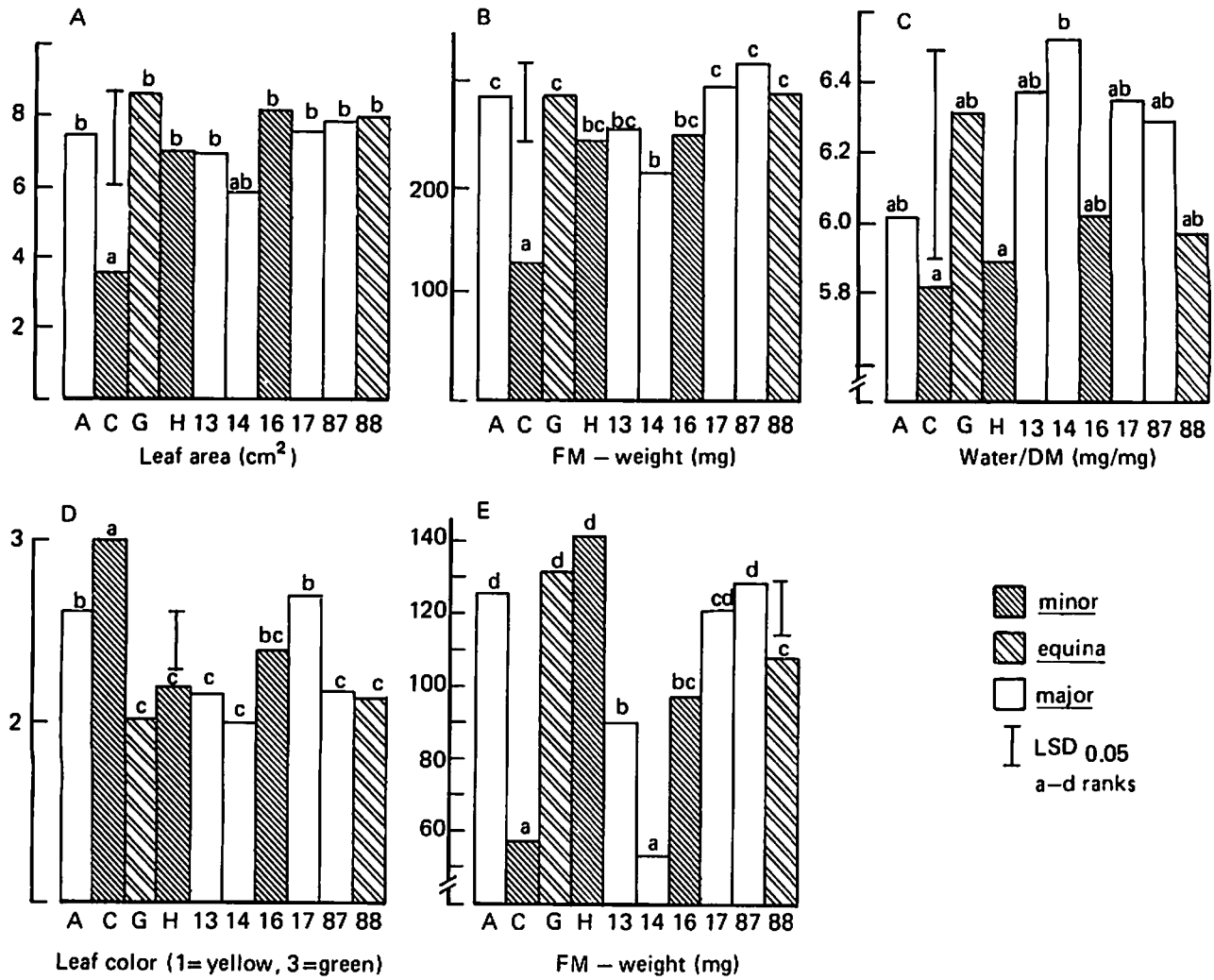

Fig. 2. Mean varietal expression of some leaf traits during hardening in experiments 1 (A – C; means of 10 plants) and 2 (D + E; means of 30 plants). A = Aquadulce; C = Cote d'Or; G = Giza 402; H = Hudeiba 72; 13 = ILB 1813; 14 = ILB 1814; 16 = ILB 1816; 17 = ILB 1817; 87 = ILB 3187; and 88 = ILB 3188.

winterhardiness were good in Cote d'Or and ILB 1814, intermediate in ILB 1813 and ILB 1816, and poor in the remaining genotypes.

With respect to freezing resistance (**Fig. 3**), both experiments gave similar results with Cote d'Or being, by far the most resistant population. Aquadulce, ILB 3187, ILB 3188, and in part ILB 1816 displayed an average FR, while the others, in particular Hudeiba 72 were rather susceptible to freezing. Small differences in the rank patterns between both experiments can most probably be ascribed to the different experimental procedure. In experiment 2 only the first leaf was examined which had developed under hardening conditions from the very beginning, whereas in experiment 1 leaves 1 and 2 were used from plants which had been exposed to 15°C for one week before hardening. The latter procedure led to a difference of 1°C in FR between both leaves and a slight interaction leaves x populations which were in accordance with recent results (Herzog 1988).

The general ranking in FR obtained in this experiment matches well with the field observations made at the Tel Hadya site where temperatures often drop to -9°C during winter. Under this condition, Hudeiba 72 has often been completely killed (**Plate 1**), Giza 402 severely damaged, while the other populations have

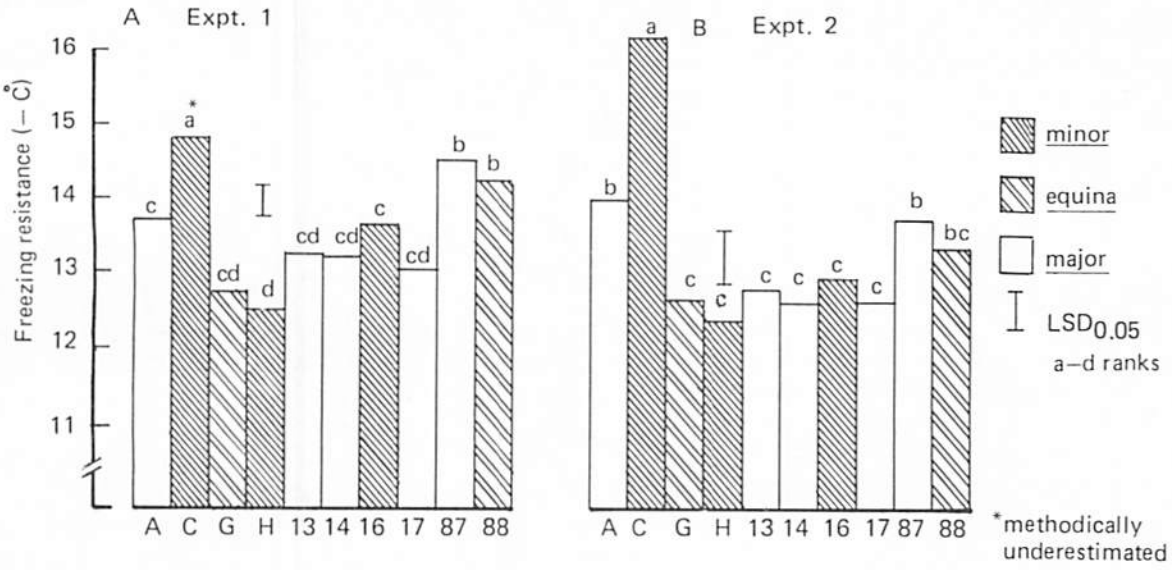

Fig. 3. Mean varietal freezing resistance of hardening plants. Means of 35 plant in experiment 1 and 30 plants in experiment 2: A = Aquadulce; C = Cote d'Or; G = Giza 402; H = Hudeiba 72; 13 = ILB 1813; 14 = ILB 1814; 16 = ILB 1816; 17 = ILB 1817; 87 = ILB 3187; and 88 = ILB 3188.

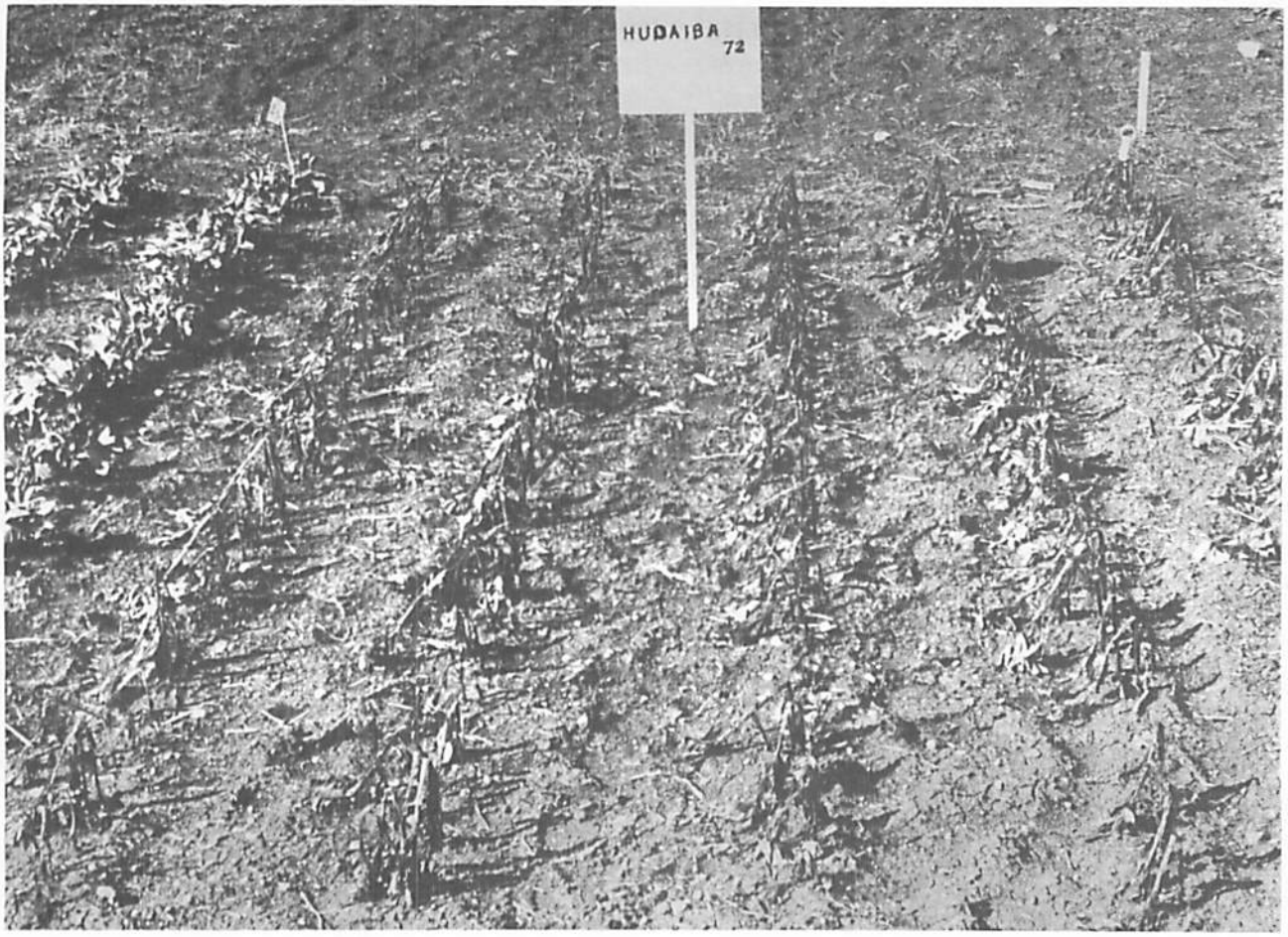

Plate 1. Plants of the Sudanese var Hudeiba 72 as affected by frost at Tel Hadya, Aleppo, Syria.

shown lower level of frost injury. This is indeed the reflection of the growing conditions under which these populations have been developed. The Spanish, Lebanese, Chinese, and Syrian populations have been developed, in general, in much cooler environments than the Sudanese and Egyptian populations.

The rank pattern of populations in FR (**Fig. 3**) more or less resembled those of the plant characters (**Fig. 1**). This inference is confirmed by significant genotypic correlations (**Table 1**) and promises a possibility for an indirect selection for winterhardiness (FR). If, however, only a single plant character was to be used, this could be misleading. For example, development and height would indicate a medium-high FR for ILB 1813, whereas water/dry matter ratio in plants and leaves would not (which is indeed correct as revealed by actual measurement of FR by R_{50}-value).

A multiple regression analysis with a backward elimination of the regressors gave evidence that genotypic variation of FR was mainly contributed by water/dry matter ratio (Bmult = $r^2 = 0.83$) and the coefficient of determination was only slightly improved by the joint use of development, height and leaf area. Nevertheless, with respect to a better discrimination, the joint use of these four traits might be recommended as an appropriate tool for an indirect selection for winterhardiness, since a significant increase in the coefficient of determination of FR had been demonstrated among European populations when compared to the use of water/dry matter alone (Herzog 1987c). It has to be stressed however, that the validity of these selection criteria is strictly limited to measurements made during hardening.

The low chlorophyll content observed in most populations during the hardening period of this study indicated that they were not so well adapted to such conditions. This is not surprising as these populations, except Cote d'Or, Aquadulce, and ILB 1816 and ILB 1817, have not been selected under hardening conditions. Noteworthy is the fact that FR, which ranged between -12.5 and -14.2°C among these populations, is very close to the range reported for European cultivars which have, among other things, been bred for winterhardiness (Lawes *et al.* 1983, Herzog 1987c). Considering the superiority of Cote d'Or it can be concluded that there is certain room for a selection to improve winterhardiness within both the Mediterranean and the European groups of the faba bean. Perhaps a thorough evaluation of the collections of the genebanks might reveal genotypes with equal or even better winterhardiness than the old French landrace Cote d'Or, which up till now seems the most freezing resistant and possesses all traits associated with winterhardy ideotype.

References

Hauser, S. and Boehm, W. 1984. Erfahrungen und Ergebnisse mit dem Anbau von Winterackerbohnen. Kali-Briefe 17: 39-52.

Herzog, H. 1984. Probleme des Ackerbohnenanbaus. Schriftenreihe der Agrarwissenschaftlichen Fakultaet der Universitaet Kiel 66:58-66.

Herzog, H. 1987a. A quantitative method to assess freezing resistance in faba beans. Journal of Agronomy and Crop Science 158: 195-205.

Herzog, H. 1987b. Freezing resistance and development of faba beans as affected by ambient temperature, soil moisture and variety. Journal of Agronomy and Crop Science 159: 90-100.

Herzog, H. 1987c. Frostresistenz und einige fuer die Uberwinterung potentiell bedeutsame Eigenschaften von Fababohnen. Vortraege fuer Pflanzenzuechtung 12: 27-36.

Herzog, H. 1988. Influence of pre-hardening duration and dehardening temperature on freezing resistance in faba beans. Agronomie (in press).

Krarup, A. 1984. Effect of sowing date on yield of faba beans (*Vicia faba major*) at Valdivia, Chile. FABIS Newsletter 8: 9-10.

Lawes, D.A., Bond, D.A. and Poulsen, M.H. 1983. Classification, Origin, Breeding, Methods and Objectives. Pages 23-76 *in* The Faba Bean (*Vicia faba* L.) (Hebblethwaite, P.D., ed.), Butterworths, London, U.K.

Levitt, J. 1980. Responses of plants to environmental stresses. 2nd. Ed. Vol. 1, Academic Press, New York. 497 pp.

Picard, J., Duc, G. and Pelletier, R. 1985. Cote d'Or, a highly frost resistant population of *Vicia faba*. FABIS Newsletter 13: 11-12.

Salih, F.A. and Khalafallah, A. 1982. Influence of sowing date on the performance of four faba bean varieties at different locations in Sudan. FABIS Newsletter 5: 18-19.

Saxena, M.C., Hawtin, G.C. and El-Ibrahim, H. 1981. Aspects of faba bean ideotypes for drier conditions. Pages 210-231 *in Vicia faba*: Physiology and Breeding, World Crops: Production, Utilization, Description.Volume 4 (Thompson, R., ed.), Martinus Nijhoff Publishers, The Hague, The Netherlands.

Skjelvag, A.O. 1981. Effects of climatic factors on the growth and development of the field bean (*Vicia faba* L. var *minor*) 1. Phenology, height, growth and yield in a phytotron experiment. Acta Agriculturae Scandinavica 31: 358-371.

Tosun, O., Eser, D., Gezit, H.H. and Emeklier, H.Y. 1984. The effect of sowing time on seed yield of faba beans. FABIS Newsletter 8: 7-9.

تحمل البرودة عند عشائر الفول المتوسطية

ملخص

تم تقسية عشر عشائر من الفول من اصل اسباني وفرنسي ومصرى وسوداني ولبناني وصيني في حجرة انبات على درجة حرارة 2/8 مئوية (نهار/ليل) بعد ظهور النبات أو التكشف . وتمت دراسة المقاومة للتجمد وعدد من الخصائص المختلفة للنبات والورقة ، المفترض ارتباطها بمدى التحمل للبرودة ، وذلك بعد تعريض المادة النباتية للبرودة لحد الاشباع . وقد اظهر الاصل المحلي الفرنسي (كوت دور) أحسن كفاءة لان نموه بطيء ، وطراز نموه قصير ، واوراقه صغيرة ، ويحتوى على نسبة دنيا من الرطوبة/المادة الجافة ، ومقاوم جدا للتجمد (حوالي ـ 16 مئوية) . ومع ذلك فان بعض العشائر الاخرى مثل ILB 3187 و ILB 3188 ، اللتين لم يتم انتخابهما لصفة مقاومة التجمد ، وبشكل جزئي الصنف Aquadulce ، قد أبدوا مقاومة للتجمد ، واظهروا كفاءة معقولة في معظم الصفات المدروسة . وقد حسبت الارتباطات المظهرية والوراثية فيما بين هذه الصفات والمقاومة للتجمد ، ويوحي تحليل الانحدار المتعدد بأنه يمكن استعمالها كمعايير انتخاب غير مباشرة لمدى التحمل للبرودة .

Agronomy and Mechanization

المعاملات الزراعية والمكننة

Effect of Water Stress on Dry Matter Production, Harvest Index, Seed Yield, and its Components in Faba Bean (Vicia faba L.)

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Abstract

Twenty-five genotypes of faba bean were grown during *rabi* season 1984/85 under water stress (rainfed) and non-stress (irrigated) conditions with the objective to study the effect of water stress on dry matter production, harvest index, and seed yield and its components. Significant differences were observed among the genotypes for seed yield, harvest index, number of seeds/plant, 100-seed weight, and protein content under both environments, whereas dry matter production, days to maturity, and number of branches/plant were significantly different under water stress only. The variation due to environments was significant for seed yield and harvest index. Heritability estimates were observed to be moderate to low for all characters, except for protein content and 100-seed weight.

Introduction

Faba bean (*Vicia faba* L.) has proved to be a good substitute to lathyrus under *utera* and super *utera* conditions in India (Singh 1982). Singh *et al.* (1984) found that under water stress condition faba bean yields better than all other *rabi* legumes.

As a follow-up to the previous work, this study was undertaken to identify genotypes that yield high under water stress and non-stress conditions. The effect of water stress on dry matter production, harvest index, and seed yield and other yield components was also determined.

Materials and Methods

A field experiment was conducted at the Livestock Research Farm of the Jawaharlal Nehru Agricultural University (JNKVY), Jabalpur during the *rabi* season of 1984/85. In this experiment 25 faba bean (*Vicia faba* L.) genotypes obtained from the germplasm collections of the Department of Plant Breeding and Genetics, were planted in single rows 4-8 m long and 40 cm apart, with 10 cm distance between plants within row, in a randomized block design replicated three times. The plants were grown under two different water regimes: rainfed (water stress) and irrigated (non-stress).

For each genotype, 10 comparable plants were taged in each replicate for data recording. The mean values

Table 1. Analysis of variance for yield and its components for faba bean (Vicia faba L.) grown under rainfed and irrigated conditions.

Source of variation	df	Days to 50% flowering	Days to pod formation	Days to maturity	Plant height (cm)	No. of branches/plant	No. of pods/plant	No. of seeds/pod	No. of seeds/plant	Plant weight (g)	Seed yield/plant (g)	100-seed weight (g)	Protein content (%)	Harvest index (%)	Protein yield/plant (g)
Replications															
Rainfed	2	15.05	7.2	12.16*	403.01	7.640*	141.4	0.50	2689.0**	34.19*	12.9*	02.19	0.06	0.032**	1.950*
Irrigated	2	12.64**	232.1**	509.20**	775.20**	0.694	15.2*	0.07*	215.0**	40.45**	32.8	3.41	0.02*	0.006**	0.123
Treatments															
Rainfed	24	8.34	2.6	8.86*	34.43	1.870*	37.7	0.06	261.0**	49.44**	12.7*	21.53**	43.83**	0.005**	0.260**
Irrigated	24	1.54**	14.4*	12.40	49.30	0.417	11.3	0.05	136.0*	13.23	46.9*	38.24**	70.35**	0.014**	0.265
SE +															
Rainfed	48	5.78	1.7	4.32	33.20	0.930	34.7	0.04	61.1	18.89	06.9	04.35	0.03	0.002	0.110
Irrigated	48	0.66	7.8	10.30	36.30	0.427	7.0	0.04	65.6	16.98	22.2	3.40	0.01	0.002	0.156

* Significant at the 5% level of probability.
** Significant at the 1% level of probability.

of different characters were subjected to analysis of variance and pooled analysis adopting the procedure of Panse and Sukhatme (1978). Genetic parameters of variation were calculated by the method proposed by Burton (1952).

Results and Discussion

Table 1 shows the analysis of variance for yield and yield components of faba bean genotypes under stressed and non-stressed conditions. The dry matter production, days to maturity, and number of branches/plant varied significantly among the 25 genotypes grown under water stress condition. Whereas, only seed yield and harvest index differed significantly under both water conditions. **Tables 2 and 3** show the performance of high and low yielding genotypes for yield and yield components under both conditions. Genotypes grown under non-stress condition were superior to those grown under stress. Similar observations were also reported by Ismail *et al.* (1976), Bianco *et al.* (1981), and Frauen (1981).

Table 2. Mean performance of high and low yielding rainfed faba bean genotypes.

Variety	Days to flowering	Days to maturity	Plant height (cm)	Branches/ plant	Pods/ plant	Seeds/ pod	Seeds/ plant	Dry matter production (g)	Seed yield/ plant	100-seed weight	Protein content (%)	Harvest index (%)
High yielding genotypes												
JV37	65	110	39.5	3.56	18.0	3.43	50.0	16.6	5.65	18.00	32.2	33.77
JV-73-81	68	110	39.0	3.32	20.0	3.20	48.0	20.1	5.36	17.67	32.2	26.42
JV-31	60	108	37.8	3.13	13.4	2.86	38.1	15.9	5.27	16.76	28.0	32.49
JV-32	62	108	37.7	3.19	14.3	2.50	39.4	15.5	5.11	14.20	25.0	33.24
JV-5	59	108	38.2	3.10	13.5	2.70	37.1	16.1	5.08	17.00	27.0	31.34
Low yielding genotypes												
JV-70-81	65	109	37.7	3.80	14.3	2.48	45.0	9.7	2.53	14.50	24.0	21.69
JV-23-81	67	110	36.1	3.01	16.0	2.65	39.9	9.1	3.19	14.44	32.0	35.61
JV-82-1	65	110	36.0	2.90	15.0	2.59	40.0	9.9	3.31	14.43	31.9	34.32
JV-1	62	107	38.0	3.46	16.9	3.03	48.7	10.5	3.34	13.83	35.0	31.91
JV-11-80	65	115	41.4	3.46	18.1	3.07	39.9	10.4	3.38	17.05	30.0	31.08

Table 3. Mean performance of high and low yielding irrigated faba bean varieties.

Variety	Days to flowering	Days to maturity	Plant height (cm)	Branches/ plant	Pods/ plant	Seeds/ pod	Seeds/ plant	Dry matter production (g)	Seed yield/ plant (g)	100-seed weight (g)	Protein content (%)	Harvest index (%)	Protein yield
High yielding genotypes													
JV-26-81	57	101	53.1	2.95	16.1	3.01	46.4	15.4	6.59	18.89	32.72	32.46	1.82
JV-9-80	59	105	47.0	2.94	17.8	2.99	46.2	13.7	6.18	15.72	25.98	29.45	1.22
JV-73-81	58	102	52.1	2.70	14.0	2.90	42.4	18.0	6.16	17.89	30.72	26.42	1.70
JV-22	59	103	47.0	2.60	14.7	2.80	44.0	16.1	6.13	14.00	23.00	28.28	1.30
JV-10	70	100	50.2	3.00	18.4	2.98	54.9	15.6	6.08	13.34	29.25	34.77	1.77
Low yielding genotypes													
JV-1	60	105	41.4	3.36	17.2	2.02	42.1	10.6	4.16	10.57	33.70	40.18	1.40
JV-15	57	102	52.0	2.75	13.1	2.01	40.4	11.9	4.32	16.89	31.72	36.99	1.71
JV-70-81	57	105	45.0	2.70	14.1	2.00	40.2	16.0	4.38	13.72	22.90	27.62	1.21
JV-77-82	58	103	52.0	2.43	14.0	2.80	43.1	11.6	4.50	14.00	22.90	39.28	1.15
JV-9	57	104	53.0	2.30	13.5	2.50	45.1	13.6	4.62	15.00	25.9	34.00	1.19

Regarding compared mean performance of varieties (**Tables 2 and 3**) the variety JV-37 under rainfed and JV-26-81 under irrigation were observed to be highest yielders, whereas, JV-70-81 from rainfed and JV1 from irrigated condition were low yielders. The highest seed yield/plant under irrigated condition was coupled with the highest plant height, number of branches/plant, seeds/pod, and seeds/plant suggested that these are the main yield attributing characters under irrigated condition. In rainfed condition pods/plant, seeds/pod, seeds/plant, dry matter, 100-seed weight, and harvest index were the main attributes of faba bean yield.

Table 4. Pooled analysis in dry matter production, seed yield and harvest index in faba bean.

Source of variation	df	Dry matter production MS	Seed yield MS	Harvest index MS
Environment	1	6.687	7.263	217.090
Variety	24	6.420	0.635	23.313
V X E (Interaction)	24	2.819	0.220	6.049
Pooled error	96	13.435	1.628	29.142

Pooled analysis given in **Table 4** shows that the source of variation due to environment was significant for seed yield and harvest index and it was not significant for dry matter. Pooled analysis further suggested that the response of dry matter production was similar under both the environments. But the production was reduced greatly under the water stress. Similar observations were also reported by Sprent (1972), Krogman *et al.* (1980), and Sharma *et al.* (1985).

Tables 5 and 6 show the genetic parameters of variation for yield and yield components in faba bean grown under rainfed and irrigated conditions, respectively. Under both the environments the highest genotypic and phenotypic coefficients of variation were

Table 5. The genetic parameters of variation (phenotypic, genotypic, and environmental variances; phenotypic and genotypic coefficients of variation; and heritability) for yield and its components in faba bean grown under rainfed conditions.

Character	Mean	Range		Pheno-typic variance	Geno-typic variance	Environ-mental variance	Pheno-typic coeffi-cient of variation	Geno-typic coeffi-cient of variation	% Herita-bility (broadsence)	Genetic advance (K=2.06)	Genetic advance as percentage of mean
		Min	Max								
Days to 50% flowering	60.57	58.67	63.33	2.45	0.52	1.93	4.15	1.18	21.20	0.683	1.13
Days to pod formation	75.07	73.33	76.33	8.86	0.30	0.56	1.15	0.73	35.30	0.673	0.90
Days to maturity	108.52	100.00	110.67	1.29	0.14	1.15	1.92	0.03	10.68	0.248	0.23
Plant height (cm)	38.24	26.33	45.67	11.47	1.08	10.40	15.31	0.74	9.41	0.650	1.71
No. of branches/ plant	3.20	2.17	4.50	0.29	0.02	0.31	30.27	0.99	6.87	0.076	2.38
No. of pods/ plant	14.31	8.00	19.47	10.57	0.99	9.58	41.17	0.22	9.37	0.623	4.35
No. of seeds/ pod	2.80	2.19	2.99	0.02	0.01	0.01	7.87	3.18	37.56	0.113	4.03
No. of seeds/ plant	38.36	15.53	62.69	86.96	3.25	53.71	36.34	5.03	38.23	7.334	9.00
Plant weight (g)	13.97	9.10	16.70	16.48	0.18	6.30	38.61	2.85	61.78	5.201	7.23
Seed yield/ plant (g)	4.62	2.54	5.73	4.24	1.97	2.28	71.15	1.15	46.62	1.963	2.47
100-seed weight (g)	14.83	10.76	19.44	5.18	5.73	1.45	21.41	6.13	79.75	4.401	9.67
Protein content (%)	28.87	21.07	35.27	14.61	4.60	0.01	13.25	3.23	99.91	7.867	7.24
Harvest index (%)	0.33	0.22	0.39	0.00	0.00	0.86	17.82	0.21	52.63	0.047	4.43
Protein yield/ plant (g)	1.22	0.56	1.78	0.09	0.04	0.04	35.65	8.08	50.46	0.306	4.95

Table 6. Genetic parameters of variation (phenotypic, genotypic, and environmental variances; phenotypic and genotypic variation, and heritability) for yield and its components in faba bean grown under irrigated conditions.

Character	Mean	Range		Phenotypic variance	Genotypic variance	Environmental variance	Phenotypic coefficient variation	Genotypic coefficient variation	% Heritability (braadsence)	Genetic advance (K=2.06)	Genetic advance as percentage of mean
		Min	Max								
Days to 50% flowering	57.56	56.66	59.66	0.52	0.29	0.22	1.70	0.94	56.8	0.840	1.46
Days to pod formation	74.74	69.66	78.66	4.81	2.21	2.60	4.24	1.99	45.9	2.074	2.77
Days to maturity	101.26	98.30	105.30	4.14	0.63	3.46	3.28	0.82	15.2	0.637	0.63
Plant height (cm)	49.08	41.43	61.00	16.43	4.32	12.10	12.99	4.24	26.2	2.188	4.45
No. of branches/ plant	2.87	2.06	3.36	0.15	0.01	0.14	22.81	1.10	4.60	0.036	1.27
No. pods/ plant	15.27	10.90	18.40	3.78	1.45	2.32	19.82	7.90	38.3	1.534	10.04
No. of seeds/ plant	45.30	29.94	55.31	45.22	23.32	21.89	20.82	10.66	51.5	7.134	15.74
Plant weight (g)	14.97	10.63	20.58	4.41	0.75	3.66	27.52	0.78	18.0	0.779	5.20
Seed yield (g)	5.82	4.16	6.59	8.96	1.21	7.74	84.93	18.96	13.5	0.832	14.30
100-seed weight (g)	15.42	10.57	21.86	12.14	11.60	1.13	25.12	22.09	95.5	6.854	44.45
Protein content (%)	30.34	22.53	38.59	23.45	20.34	0.004	15.96	15.95	86.70	8.649	28.51
Harvest index (%)	0.36	0.27	0.43	0.001	0.0005	0.0009	16.55	6.46	50.0	0.032	9.070
Protein yield/ plant (g)	1.57	1.02	2.21	0.09	0.04	0.053	27.86	12.05	40.9	0.250	15.91

recorded for harvest index, plant height, seed/plant, and protein content. The highest genetic advance expressed as percentage of the mean was obtained for dry matter production, seeds/plant, 100-seed weight, and protein content.

The heritability was recorded to be high for 100-seed weight, and protein content and moderate for days to 50% flowering, seeds/plant, and harvest index under both environments. Non-stressed genotypes exhibited high estimates of genetic advance for 100-seed weight and protein content, whereas, stressed ones exhibited high estimates of genetic advance for seed yield and dry matter production.

An overall observation of genetic parameters revealed that 100-seed weight, protein content, and dry matter production showed moderate to high heritability along with high genetic advance. It suggests the contribution of additive genes in expression of these characters. These observations are in agreement with the findings of Ismail *et al.* (1976), Ondro (1977), Mohamed (1978), and Frauen (1981).

References

Burton, G.M. 1952. Quantitative inheritance in grasses. Pages 277-285 *in* Proceedings of the Sixth International Grassland Congress.

Bianco, V.V., Damato, G. and Miccolis,V. 1981. Correlation coefficients for 51 quantitative and qualitative characters in broad bean. Institute of Agronomy Field Crops, Bari University, Italy. 211-250.

Frauen, M. 1981. Phenotypic and genotypic variances and covariances in population of inbred lines of *V. faba* L. and their significance in breeding. Zeitschrift fuer Pflanzenzuechtung 86: 117-135.

Ismail, M.A., Heakal, M.Y. and Fayed, A. 1976. Improvement of yield through induced mutagenesis in broad bean. Indian Journal of Genetics and Plant Breeding 36: 347-356.

Krogman, K.K., Kenzie, R.G. and Hobbs, E.H. 1980. Response of faba bean yield, protein production and water use to irrigation. Canadian Journal of Plant Science 7: 174-183.

Mohamed, A. and Kadey, E.L. 1978. Induced variability

of yield components in two Egyptian broad bean cultivars by gamma radiation. Research Bulletin No. 820-912.

Ondro, S. 1977. The number of pods per bean plant (*Faba vulgaris* Moench) in complete diallel crossing. Genetika a Slechteni 13(2): 151-159.

Panse, V.G. and Sukhatme, P.V. 1978. Statistical methods for Agricultural workers. ICAR Publication, New Delhi, India.

Sharma, N.K., Singh, C.B. and Khare, D. 1985. Ascorbic acid in relation to drought resistance in *Vicia faba* L. FABIS Newsletter 11: 16-17.

Singh, C.B., Ramgiri, S.R. and Singh (Kur), S.B. 1982. Faba bean a high protein potential pulse crop. Indian Farming.

Sprent, J.I. 1972. The effect of water stress on nitrogen fixing root nodules. IV. Effects on whole plants of *Vicia faba* L. and Glycine max. New phytology 7: 603-611.

تأثير اجهاد المياه على انتاج المادة الجافة ودليل الحصاد والغلة البذرية ومكوناتها في الفول (Vicia faba L.)

ملخص

زرع خمسة وعشرون طرازا وراثيا من الفول خلال ربيع موسم 85/1984 تحت ظروف اجهاد المياه (بعلي) وغياب الاجهاد (مروى) بهدف دراسة تأثير اجهاد المياه على انتاج المادة الجافة ، ودليل الحصاد ، والغلة البذرية ومكوناتها . وقد لوحظ وجود فروق معنوية بين الطرز الوراثية في الغلة البذرية ودليل الحصاد وعدد البذور/النبات ، ووزن المئة حبة ، والمحتوى البروتيني تحت الظرفين البيئيين ، في حين لم يظهر فرق معنوى تحت ظروف الاجهاد الا في كل من انتاج المادة الجافة ، وعدد الايام حتى النضج ، وعدد الفروع/ النبات . وكان التباين العائد الى البيئتين معنويا بالنسبة للغلة البذرية ودليل الحصاد . وقد لوحظ أن تقديرات القابلية للتوريث تتراوح بين المتوسطة الى المنخفضة بالنسبة لجميع الصفات باستثناء المحتوى البروتيني ووزن المائة حبة .

Pests and Diseases

الآفات والأمراض

Performance of some Pesticides in Controlling Orobanche

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Abstract

The effect of preemergence and postemergence applications of the chemicals Basamid (dazomet) at 25 and 50 kg a.i./ha, Furadan (carbofuran) at 2.5 and 5.0 kg a.i./ha, and Fusilade (fluazifop-butyl) at 0.58 and 0.89 kg a.i./ha, was compared with late postemergence foliar spray of Lancer (glyphosate; applied twice at 0.064 kg a.i./ha each) and Scepter (imazaquin) at 0.09 kg a.i./ha in controlling *Orobanche crenata* Forsk. in a naturally infested faba bean field at Giza, Egypt. Lancer proved most effective in significantly controlling the *Orobanche* infestation and increasing the dry weight of faba bean measured 18 weeks after sowing. The effect on *Orobanche* control was maintained till the end of the growing period of faba bean. When compared with Lancer, Scepter was only slightly less effective in controlling *Orobanche*, but it did not cause a commensurate increase in the faba bean dry matter yield because of phytotoxicity. Other chemicals tested proved ineffective in controlling *Orobanche*.

Introduction

Broomrape (*Orobanche crenata* Forsk.) is a highly damaging plant parasite affecting the faba bean production in Egypt. When infestation levels are high, there can be complete collapse of the host plant. In some parts of Egypt when such levels of *Orobanche* infestation have been reached, farmers have stopped growing faba bean to avoid the risk of complete crop failure.

Research on controlling *Orobanche crenata* in faba bean in Egypt has shown that good control of the parasite can be obtained by appropriate use of the herbicide glyphosate (Zahran *et al.* 1980, 1981, 1982). Because of these results and wide testing of the chemical in farmers' fields under the Nile Valley Project, glyphosate was released for commercial use in faba bean in Egypt in 1981. However, the major factor that has limited its widespread use is the problem of crop phytotoxicity when the stage of application and dosage deviate even slightly from the optimum (Borg 1986). For example, in the Menia governorate of Egypt farmers obtained good results with glyphosate when application was supervised by the subject matter specialists and extension agents, while unsupervised use gave variable results (personal communication, A. Nassib). Emphasis is, therefore, being laid in the Nile Valley Project in Egypt to train the key farmers on the appropriate use of the chemical. At the same time, as a part of back-up research, efforts are being made to identify other control measures including new chemicals that may control the parasite without causing phytotoxicity to the crop. Results of one such study are presented in this paper.

Materials and Methods

A field experiment was conducted at Giza Research Station of the Agricultural Research Center, Giza, Egypt during the 1986/87 cropping season to control the broomrape (*Orobanche crenata* Forsk) in faba bean. The experimental site had a high level of natural infestation of the parasite. A set of 15 treatments (**Table 2**), including foliar postemergence applications of glyphosate (Lancer 36% liquid), and imazaquin (Scepter 18% liquid), and pre- and postemergence applications of each dazomet (Basamid 98-100% granules), carbofuran (Furadan 10% granules), and fluazifop-butyl (Fusilade 25% liquid) was tested in a randomized block design with four replications. Seeds of the faba bean cv Giza 2 were sown on 17 Nov 1986 in plots (18 m^2 each). The crop was given recommended agronomic management.

The rates and time of application are given in **Tables 1** and **2**. For chemical application, a knapsack sprayer (CP_3) was used with a spray volume of 500 l/ha.

To assess the treatment effect, a sample of 10 plants from each plot was taken 18 weeks after sowing, when the crop had reached the advanced pod filling stage. The number and dry weight of *Orobanche* spikes/host plant, percentage of plants infested with *Orobanche* and the number of pods, dry weight of pods and total dry weight of shoots of faba bean were recorded from the sampled plants. At maturity, the number and dry weight of *Orobanche* spikes per unit area were also determined. Because of unavoidable reasons the seed yield of faba bean could not be recorded at maturity.

Results and Discussion

The effect of the two herbicides, Lancer (glyphosate) and Scepter (imazaquin or AC 252, 214), on *Orobanche crenata* 18 weeks after sowing is shown in **Table 1**. Two sequential sprays of glyphosate (0.064 g a.i./ha each), during the early reproductive phase of faba bean and one postemergence application of imazaquin (0.09 kg a.i./ha) significantly ($P<0.05$) reduced the *Orobanche* infestation as compared with the untreated check. There was no significant ($P<0.05$) difference between these

Table 1. Effect of two herbicides applied as postemergence treatments on *Orobanche* infestation and on the productivity of faba bean plants harvested 18 weeks after sowing in a field experiment at Giza, during the 1986/87 season.

Herbicide	Rate (kg a.i./ha)	*Orobanche*			Faba bean		
		No. of spikes/host plant	DW of spikes/host plant (g)	*Orobanche* infestation %	No. of pods/plant	Dry weight	
						Pod/plant (g)	Whole shoot/ plant (g)
Lancer	2x0.064	2.3	3.9	16	6.4	12.5	26.4
Scepter	0.09	2.8	6.7	49	3.4	5.6	15.5
Check		7.9	15.6	100	2.2	3.1	14.1
LSD (5%)		4.1	8.5	38	NS	7.5	6.8

Tabel 2. Effect of different chemical treatments on *Orobanche crenata* Forsk. infestation in faba bean at maturity in a field trial at Giza, during the 1986-87 season.

Chemical	Rate (kg a.i./ha)	Time of application	No. of *O.* spikes (1000/ha)	Dry weight of *O.* spikes (t/ha)
Lancer	2x0.064	Foliar postemergence	122.2	0.314
Scepter	0.09	Foliar postemergence	372.9	0.611
Basamid	25.00	Preemergence	531.6	1.194
Basamid	50.00	Preemergence	457.8	1.075
Basamid	25.00	Postemergence	605.5	1.403
Basamid	50.00	Postemergence	413.8	0.968
Furadan	2.50	Preemergence	380.5	0.878
Furadan	5.00	Preemergence	412.5	0.917
Furadan	2.50	Postemergence	397.2	0.956
Furadan	5.00	Postemergence	605.5	1.416
Fusilade	0.58	Preemergence	734.4	1.576
Fusilade	0.89	Preemergence	737.1	1.659
Fusilade	0.58	Foliar postemergence	549.9	1.276
Fusilade	0.89	Foliar postemergence	629.1	1.403
Check			649.9	1.495
LSD (5%)			321.6	0.759

two herbicides in reducing *Orobanche* infestation at this stage. However, at maturity (**Table 2**), the control of *Orobanche* with glyphosate was better than with imazaquin. Glyphosate significantly reduced both the number of *Orobanche* spikes and their dry weight ($P<0.05$), whereas imazaquin only the dry weight of *Orobanche* spikes, as compared with the check.

Other chemicals (carbofuran, dazomet, and fluazifop-butyl) had no significant effect in reducing the *Orobanche* infestation (**Table 2**). However, preemergence or postemergence applications of Furadan (carbofuran), at the rate 2.5 kg a.i./ha tended to reduce the count of *Orobanche* spikes per unit area, but the reduction did not reach the level of significance ($P=0.05$).

Out of the different chemicals tested in this study, glyphosate was the most promising herbicide in controlling *Orobanche*. Imazaquin was second best. However, at the rate and time of application used in this study, imazaquin did not increase the podding and plant dry weight of faba bean to the same extent as did glyphosate (**Table 1**). Perhaps the chemical interfered with the metabolism of the crop plant so that in spite of its effectiveness in reducing the *Orobanche* infestation it did not significantly increase the crop productivity over the check. These results are in agreement with those observed in the field studies at ICARDA in northern Syria (ICARDA 1986).

Imazaquin was included in this study because it was reported to be tolerated well by faba bean (Richardson and West 1984). It was also reported to be a good selective herbicide for soybean (Orwick *et al.* 1983; Chiang *et al.* 1985) in which it was absorbed both by roots and foliage, translocated rapidly through xylem and phloem and rapidly metabolized (Shaner *et al.* 1983). The herbicide affects the meristematic region of the susceptible weeds (Orwick *et al.* 1983). The bioavailable residues of imazaquin were found in the soil after 4 months. But its performance was found to be affected by the soil organic matter content (Lolas 1985). The method of application also affects the performance of this chemical and a combination of pre- and postemergence applications proved the most effective way of using it (Retzinger and Rogers 1985). Considering all these studies with imazaquin and the results of the present study, we suggest that there is a possibility of identifying optimum rate and time of application for this herbicide which may give effective control of *Orobanche* selectively without any deleterious effects on the faba bean crop. More studies are, therefore, recommended with imazaquin to develop an acceptable and safe measure for controlling *Orobanche* in faba bean.

References

Borg, S.J. ter 1986. Present and future of *Orobanche* research; summary and conclusion. Pages 196-203 *in* Proceedings of a Workshop on Biology and Control of *Orobanche*. LH/VPO, Wageningen, The Netherlands.

Chiang, M.Y., Corbin, F.T., Schmitt, D.P., Sheets, T.J. and Worsham, D. 1985. Behaviour of imazaquin in soybeans (*Glycine max*) and sicklepod *Cassia obtusifolia*). *In* Proceedings, Southern Weeds Science Society, 38th Annual Meeting (1985), 77. C.F. Weed Abstract 1987, 36(5), Abstract No. 1467.

International Center for Agricultural Research in the Dry Areas (ICARDA). 1986. Pages 204-206 *in* the Food Legume Improvement Program Annual Report for 1986. ICARDA, Aleppo, Syria.

Lolas, P.C. 1985. Cinmethylin, imazaquin and metazachlor performance for weed control in tobacco. Pages 841-848 *in* Proceedings 1985 British Crop Protection Conference, Weeds. (1985) Vol. 3. C.F. Weed Abstracts 1987 Vol. 36(2), Abstract No. 365.

Orwick, P.L., Marc, P.A., Umeda, K., Shaner, D.L., Los, M., and Ciarlante, D.R. 1983. AC 252, 214 - a new broad spectrum herbicide for soybeans: greenhouse studies. *In* Proceedings, Southern Weeds Science Society, 36*th* Annual Meeting (1983) 90. C.F. Weed Abstracts 1985 Vol. 34(11), Abstract No. 2889.

Retzinger, E.J. JR. and Rogers, R.L. (1985). Effect of method of application on the performance of AC-252, 214. *In* Proceedings, Southern Weed Science Society, 38*th* Annual Meeting (1985) C.F. Weed Abstracts 1987 Vol. 36(5) Abstract No. 1237.

Richardson, W.C. and West, T.M. 1984. The activity and pre-emergence selectivity of some recently developed herbicides: imazaquin, isoxaben, metsulfurm-methyl, aclonifen and orbencarb. Technical Report, AFRC Weed Research Organization (1984), No. 80. 57 pp. C.F. Weed Abstracts 1986 Vol. 35(10), Abstract No. 3263.

Shaner, D.L., Robson, P., Simcox, P.D., and Ciarlante, D.R. (1983). Absorption, translocation and metabolism of AC 252, 214 in soybeans, cocklebur and velvetleaf. *In* Proceedings Southern Weed Science Society, 36*th* Annual Meeting (1983) 92. C.F. Weed Abstracts Vol. 34(1) Abstract No. 2892.

Zahran, M.K., Ibrahim, T.S. El- N., Farag, F.H., and Korollos, M.A. (1980). Chemical control of *Orobanche crenata* in *Vicia faba*. FABIS Newsletter 2: 47-49.

Zahran, M.K., Ibrahim, T.S. El- N., Hassanien, E.S.H., and Farrag, H.M. (1981). Further approach towards adoption of chemical control of *Orobanche crenata* in faba bean. FABIS Newsletter 3: 54-56.

Zahran, M.K. (1982). Control of parasitic plants (broom-rape and dodder) in different crops in Egypt. Final Report EG- ARS- 15 PL 480 Project, Grant No. FG-EG-130, ARC, Ministry of Agriculture, Cairo, Egypt, pp. 53.

كفاءة بعض مبيدات الافات في مكافحة الهالوك Orobanche

ملخص

درس تأثير الرش قبل وبعد الانبات بالمبيدات الكيميائية باساميد (dazomet) بنسبة 25 و 50 كغ مادة فعالة/هكتار ، وفوردان (كاربوفيوران) بنسبة 2.5 و 5.0 كغ مادة فعالة/هـ،وفوسيلاد (Fluazifo P-butyl) بنسبة 0.58 و 0.89 كغ مادة فعالة/هـ ، وقورن بالرش على الاوراق في وقت متأخر بعد الانبات باستعمال المبيدين لانسر (جليفوسات ، رشتان) بنسبة 0.064 كغ مادة فعالة/هـ في كل مرة ، وسبتر (imazaquin) بنسبة 0.09 كغ مادة فعالة/هكتار في مكافحة الهالوك المفرض Orobanche crenata Forsk. وثبت في حقل فول مصاب بشكل طبيعي في الجيزة بمصر أن لانسر هو اكثر المبيدات فعالية في القضاء على الهالوك بدرجة معنوية ، وفي زيادة الوزن الجاف للفول بعد قياسه بفترة 18 اسبوعا من الزراعة . وقد احتفظ المبيد بتأثيره على الهالوك حتى نهاية فترة نمو الفول . وبالمقارنة مع لانسر ، كان سبتر أقل فعالية بقليل في مكافحة الهالوك ، الا انه لم يعط زيادة موازية في غلة المادة الجافة للفول بسبب السمية الورقية . وقد اثبتت المبيدات الكيميائية الاخرى المختبرة عدم فعاليتها في المكافحة .

Comparison between Mechanical and Aphid Inoculation of Bean Yellow Mosaic Virus to Faba Bean

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Abstract

In a comparison between mechanical and aphid inoculation as techniques for screening faba bean for resistance to bean yellow mosaic virus (BYMV), aphid inoculation was found to be better. A higher percentage of infection was obtained with faba bean genotypes inoculated with aphids (*Aphis craccivora* Koch) as compared to mechanical inoculation.

Introduction

Faba bean (*Vicia faba* L.) is a susceptible and highly sensitive crop to a large number of viruses (Bos 1982), of which bean yellow mosaic virus (BYMV) is considered among the most important in Syria (Makkouk *et al.* 1988). BYMV is transmitted from infected to healthy plants mechanically as well as via aphids in the nonpersistent manner (Bos 1970). This study compares mechanical and aphid inoculation techniques to determine which is more useful for screening faba bean genotypes for resistance to BYMV.

Materials and Methods

Aphis craccivora Koch culture used in this study was collected from a faba bean field near Lattakia (northwestern Syria), and raised as a pure colony inside insect-proof polyvenylchloride (PVC) or wooden cages placed either in a glasshouse or in a growth chamber. The temperature was adjusted at 19 ± 1C. Identification of this species was confirmed by Dr. V.F. Eastop, Department of Entomology, British Museum (Natural History).

A BYMV isolate (SV205-85) was collected from Tel Hadya (30 km south of Aleppo), identified in the Virology laboratory by serology and electron microscopy, and maintained on faba bean (cultivar

Syrian Local Large) in a glasshouse by serial mechanical inoculation.

Thirteen faba bean genotypes representing different reactions to mechanical BYMV-inoculation were selected and planted in a plastic-house, where temperature varied between 5 and 25°C, and relative humidity between 60 and 80%. Two batches of 30 plants each were BYMV-inoculated, mechanically and through viruliferous aphids. Mechanical inoculation was done by grinding infected tissue with 0.01 M potassium-phosphate (pH = 7.2). After adding Carborandum (1%), the extract was gently rubbed on the leaves of faba bean at 2-3 leaf stage. One minute after inoculation, seedlings were rinsed with distilled water.

A. craccivora adults were used for aphid BYMV-inoculation. Insects were fasted for 1 h, after which they were allowed to feed on infected faba bean leaves for an acquisition period of 3-5 min. Three viruliferous aphids per plant were used to inoculate the different faba bean genotypes. Twelve hours after inoculation, plants were sprayed with 0.5 g/l Pirimor (Pirimicarb-50%). Five plants of each genotype were not inoculated and kept as healthy controls.

In both experiments, visual readings based on the characteristic symptoms of BYMV were taken three weeks after inoculation. Disease index (DI) for each genotype was calculated by applying the following formula (L. Bos, Personal communication):

$$DI = \frac{(n0x0) + (n1x1) + (n2x2) + (n3x3) + (n4x4)}{N(n-1)} \times 100$$

where DI stands for Disease index; n0, n1, n2, n3 and n4, the number of plants with symptom index of 0, 1, 2, 3 and 4, respectively; N, the total number of plants used; and n, the total number of symptom classes. Symptom index of infected plants was measured based on BYMV symptoms severity (foliar symptoms, stunting) using a 0-4 scale (0, no symptoms and 4, severe symptoms).

Results and Discussion

Unlike the results of previous work (Atiri and Thottapilly 1984), where both techniques proved to be of equal efficiency in screening cowpeas for resistance against cowpea aphid-borne mosaic virus (CAMV), our study showed that aphid inoculation was more effective than mechanical inoculation (**Table 1**). A higher infection rate and disease index (DI) was obtained with aphid rather than with mechanical inoculation for all genotypes inoculated, except for SM6-4 (1) and S82145-7 (1) where values were slightly lower. Moreover, the genotype SE17-8 (1), seemed nonhost when mechanically inoculated, but all aphid inoculated plants were infected. This may be due to the ability of aphids to introduce BYMV into susceptible sites during probing which could not be reached by mechanical inoculation.

Table 1. Disease Index (DI) and percentage of bean yellow mosaic virus infection obtained by inoculating 13 faba bean genotypes mechanically and through viruliferous aphids.

Genotype	Mechanical inoculation		Aphid inoculation	
	Infection (%)	DI	Infection (%)	DI
SE17-8(1)	00.0	00.0	100.0	57.0
SP23-1	60.0	47.0	100.0	70.0
SP10-4	36.0	20.0	100.0	68.8
SNA5-2(1)	44.0	33.0	100.0	76.7
SE1-1(2)	84.0	33.0	96.4	74.1
SE1-4	59.1	35.2	100.0	75.0
SE7-8(2)	44.0	36.0	100.0	79.2
SE1-4(1)	100.0	50.0	100.0	83.0
SE7-9	84.0	57.0	100.0	84.8
SM6-4(1)	100.0	75.0	93.3	73.3
SNA9-2(1)	100.0	75.0	100.0	82.1
S82145-7(1)	100.0	00.0	96.4	74.1
FB (S820832)	54.2	39.6	70.0	93.3

Even though using aphids requires more effort than mechanical inoculation, the results of this study are strongly in favour of using the former. BYMV spread in nature occurs mainly through aphid transmission, thus screening faba bean genotypes by using aphid inoculation leads to more reliable results.

References

Atiri, G.I. and Thottapilly, G. 1984. Relative usefulness of mechanical and aphid inoculation as modes of screening for resistance against cowpea aphid-borne mosaic virus. Tropical Agriculture (Trinidad) 61 (4): 289-292.

Bos, L. 1970. Bean yellow mosaic virus. Commonwealth Mycological Institute and Association of Applied Biologists. Description of Plant Viruses. No. 40 Kew, Surrey, England.

Bos, L. 1982. Virus diseases of faba beans. Pages 233-242 *in* Faba Bean Improvement: Proceedings of the Faba Bean Conference (Hawtin, G. and Weeb, C. eds.), ICARDA/IFAD, Nile Valley Project, 7-11 Mar 1981, Cairo, Egypt, Martinus Nijhoff Publishers, The Hague, The Netherlands.

Makkouk, K.M., Bos, L., Azzam, O.I., Koumari, S. and Rizkallah, A. 1988. Survey of viruses affecting faba bean in six Arab countries. Arab Journal of Plant Protection 6: (In press).

مقارنة بين التلقيح الميكانيكي والتلقيح بالمن لفيروس الموزاييك الاصفر للفاصولياء على نبات الفول

ملخص

بعد اجراء مقارنة بين التلقيح الميكانيكي والتلقيح بالمن كتقنيات لغربلة نباتات الفول لمدى مقاومتها لفيروس الموزاييك الاصفر للفاصولياء (BYMV) على الفول ، ثبت ان التلقيح بالمن كان الافضل . قد حصلت اعلى نسبة من الاصابة على طرز وراثية من الفول قام بتلقيح الفيروس فيها المن (Aphis craccivora Kock) مقارنة بالتلقيح الميكانيكي .

A Study of the Performance of Certain Faba Bean Genotypes in Relation to Botrytis fabae and Ascochyta fabae in France

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Abstract

The reaction of two different sets of 20 genotypes of faba bean to *Botrytis fabae* and *Ascochyta fabae* was studied using detached leaf technique and artificial infection in a polythene tunnel and in the field. Genotypes varied considerably in their reaction to the diseases, and based on their performance they can be classified to genotypes with good, intermediate, and weak performance. The resistance of ILB 938 and BPL 710 to *B. fabae* and Asco 16 and 17 to *A. fabae* was confirmed under the French conditions.

Introduction

Research on genotypic differences reaction to faba bean diseases such as *Botrytis fabae* and *Ascochyta fabae* is becoming important throughout the world (Gaunt 1983). Some major studies on this aspect were initiated by the International Center for Agricultural Research in the Dry Areas (ICARDA) which has a wide range of varieties and lines collected from all over the world and in particular the Mediterranean basin. Hanounik (1983) and Hanounik and Maliha (1983) reported certain faba bean lines with high resistance to *B. fabae* as well as certain genotypes resistant to *A. fabae*. This was complemented by the works of Egyptian researchers (Mansour *et al.* 1976; El-Sherbeeny and Mohamed 1980; Khalil and Harrison 1981; Abou-Zeid 1985) who compared the response of several ICARDA genotypes to *B. fabae* with certain varieties of faba bean currently cultivated in Egypt.

Various studies in Europe have made it possible to screen genotypes adapted to the local conditions of cultivation there, and lines that display good resistance to *A. fabae* have been identified (Bond and Pope 1980; Tivoli *et al.* 1986). However, their resistance to *B. fabae* appears mediocre (Tivoli *et al.* 1986). There was, therefore some interest in studying the reaction of certain ICARDA genotypes to *B. fabae* and *A. fabae* under the French environmental conditions.

Materials and Methods

Several trials were conducted in the field and under polythene tunnel conditions to study the reaction of certain faba bean genotypes to *Botrytis fabae* and *Ascochyta fabae* during 1985.

The genotypes tested against *B. fabae* were 20: 15 genotypes (noted as Bot 1 - Bot 15) provided by ICARDA, Syria, and 5 genotypes (BPL 938, 249/804/80, BPL 261, Giza 3, and Giza 402) provided by Dr. N. Abou-Zeid under the Cooperation Scientifique Franco-Egyptienne. The French variety Alto was added as control. It was chosen for its vigorous early growth.

The genotypes tested against *A. fabae* were also 20 (Asco 1 - Asco 20), but all were provided by ICARDA, Syria. Two French genotypes 48B and 29H were added as controls, the first being susceptible to ascochyta blight and the other highly tolerant.

Planting was made following the instructions recommended by ICARDA. Ten seeds of each genotype

were planted in 1 m rows in duplicates. A French genotype or variety was also planted after each entry to facilitate comparisons.

Each nursery was infested by using grains of barley colonised with *A. fabae* or *B. fabae* following the method described by Tivoli *et al.* (1986a and 1986b). Inoculation with *B. fabae* was carried out on 6 Feb 1985, and with *A. fabae* on 25 April 1985. Irrigation was given on 4 June 1985 for genotypes used for *B. fabae* study.

A second trial was carried out with *B. fabae* under a polythene tunnel to check more specifically the performance of the cultivars Giza 3 and Giza 402, and the genotypes 249/804/80, BPL 938, and BPL 261. Vernalised plants were artificially inoculated with *B. fabae* at the flowering stage by spraying a spore suspension of 50,000 spores/ml. Leaves were detached from healthy plants developed under the same conditions. These were then inoculated by a 20 l droplet of spore suspension containing 5000 spores/ml (Tivoli *et al.* 1986).

In the field, plants were scored for their disease reaction to *B. fabae* on 26 June 1985. Scores of the disease were taken at the left side of each plant (pods and remaining flowers) according to the 1 to 9 scale recommended by Gondran (1977).

In the polythene tunnel, three separate scores were taken following the same scale. However, for the detached leaves, another scale (0 to 9) was used (Abou-Zeid 1985).

For *A. fabae*, plants were scored twice, on 22 April 1985 and on 26 June 1985, thus permitting an evaluation of the respective percentages of diseased leaves and diseased pods.

Results and Discussion

Botrytis fabae nurseries

In the field, the development of the disease was low until the summer due to the abnormally low temperatures during the months of May and June 1985. Then, serious symptoms started to appear about 18 June; that is, a long time after pods had formed on all the experimental material. The mean disease scores for the variety Alto was 2.9.

Considerable differences in the performance of the 18 genotypes and the two Egyptian cultivars were observed, i.e., certain genotypes displayed only a few chocolate spot lesions whereas others lost almost all the leaves, with BPL 938 being the most resistant and Giza 402 the most susceptible (**Table 1**). The mean disease scores varied between 1.3 on BPL 938 and 5.8 on Giza 402.

Table 1. Average disease reaction of ICARDA genotypes of V. *faba* to *Botrytis fabae* under the field conditions in France, during the 1985/86 season.

Genotype	Disease reaction[1]
BPL 938	1.3[a]
Bot 4	1.8
Bot 7	2.1
Bot 2	2.2
BPL 261	2.3
Bot 10	2.3
Bot 9	2.5
Bot 3	2.5
Bot 6	2.6
Bot 11	2.6
Bot 8	2.8
Bot 12	3.1
Bot 15	3.5
Bot 5	3.5
Bot 1	3.6
249/804/80	4.1
Bot 13	4.1
Bot 14	4.6
Giza 3	5.3
Giza 402	5.8
ALTO	2.9
F test	Sig.
LSD (5%)	0.9

1. Disease reaction was made on 1-9 scale (Gondran 1977).
a. Figures are means of two replicates.

Based on the disease reaction, three groups of genotypes can be distinguished (i) those which display good performance: i.e., BPL 938, Bot 4 (BPL 710), Bot 7, and Bot 2; (ii) those which display very weak performance i.e., Giza 3, Giza 402, and Bot 13, and (iii) those which display intermediate performance and do not fit into either of the above categories (all the remaining genotypes).

The trials carried out on detached leaves and on plants in pot culture confirmed the above observations. Furthermore, the good performance of BPL 938 and BPL 261, and the high susceptibility of Giza 402 to *B. fabae* were reconfirmed (**Table 2**).

Ascochyta fabae nurseries

The low temperatures greatly favoured the development of the disease in the inoculated plots. The first serious symptoms appeared around 30 Mar 1985 and continued to develop throughout growth, also attacking the pods. The two scorings indicate the wide variability in the performance of the different genotypes under study.

On 22 April 1985, each plant had more or less the same amount of vegetation (2 to 3 tillers, 5 to 7 leaf levels, and certain lines had formed fewer buds). **Table 3** shows that the French genotype 48 B was most sensitive (on average 59% of the leaf displayed diseased symptoms). Whereas, line 29 H confirmed its excellent performance in relation to *A. fabae*.

Based on this study, the ICARDA lines could be classified as follows: (i) Asco 17 and Asco 18; lines performed well with less than 7% diseased leaf surface, and (ii) Asco 1, Asco 7, and Asco 11 proved highly susceptible with more than 50% diseased leaf surface.

The second scoring in which the percentage of diseased pods was assessed clearly distinguished the tested lines (**Table 4**). The genotypes Asco 16, Asco 17, and 29 H showed excellent performance and their pods were nearly disease free. The most susceptible genotypes were Asco 1, Asco 7, Asco 11, Asco 14, and Asco 15.

Table 3. Average disease reaction of certain ICARDA genotypes to *Ascochyta fabae* under the field conditions in France, during the 1985/86 season.

Genotype	Disease reaction[1]
Asco 18	5.5[a]
Asco 17	6.8
Asco 16	18.1
Asco 9	19.1
Asco 2	23.9
Asco 3	24.3
Asco 19	24.9
Asco 20	26.4
Asco 8	26.7
Asco 15	27.1
Asco 5	28.1
Asco 12	31.3
Asco 6	34.9
Asco 14	36.9
Asco 10	37.2
Asco 4	38.8
Asco 13	38.9
Asco 7	49.2
Asco 11	50.5
Asco 1	53.5
29 H	4.3
48 B	59.5
F test	Sig.
LSD (5%)	23.7

1. Expressed as percent of damaged leaves.
a. Figures are means of two replicates.

A comparison of the two scorings (percentage of diseased leaves and percentage of diseased pods) indicated that an early scoring to evaluate the rate of diseased leaves in the plant is a reliable sign of the risk of disease on the pods.

Table 2. Reaction of five genotypes of *V. faba* to *Botrytis fabae* under artificial inoculation on detached leaves and on whole plants in the greenhouse.

Genotype	Detached leaves				Plants in greenhouse		
	Days after inoculation				Days after inoculation		
	1	2	3	4	9	22	40
Giza 402	2.7	4.7	5.7	6.7	5.1	6.0	7.3
Giza 3	2.5	4.5	5.0	5.7	2.5	3.1	4.5
249/804/80	2.3	3.3	4.8	5.7	2.8	3.9	4.4
BPL 938	1.5	2.3	3.0	3.2	1.3	1.5	2.8
BPL 261	2.4	2.8	3.6	4.2	1.9	2.0	3.5

Table 4. Average disease reaction of certain ICARDA genotypes to *Ascochyta fabae* under the field conditions in France, during the 1985/86 season.

Genotype	Disease reaction[1]
Asco 17	0.0[a]
Asco 16	0.3
Asco 9	9.8
Asco 2	10.0
Asco 19	10.1
Asco 13	10.3
Asco 6	12.2
Asco 12	14.1
Asco 18	16.3
Asco 4	19.2
Asco 5	19.7
Asco 8	20.4
Asco 3	22.1
Asco 10	24.9
Asco 7	26.0
Asco 1	26.6
Asco 20	30.9
Asco 11	32.7
Asco 15	38.3
Asco 14	44.5
48 B	25.0
29 H	0.6

1. Expressed as percent of damaged pods.
a. Figures are means of two replicates.

Conclusions

The results obtained from this study underline once again the wide genetic variability in faba bean in relation to *A. fabae*. Lines Asco 16 and Asco 17 seem to have a high degree of resistance. A comparison of their performance with that of the French line 29 H indicates that they have the same level of tolerance to *A. fabae*. On the other hand, some of the ICARDA lines were more susceptible than the local control 48 B.

With respect to *B. fabae*, the excellent performance of BPL 938 was confirmed in the field under the French conditions of cultivation using strains of fungus which are doubtless different from those existing in Syria or Egypt. Its high degree of tolerance was maintained even when the inoculum used was highly concentrated and the test was made either in the plastic tunnel or on detached leaves .The good performance of Bot 4 (BPL 710) was also confirmed in the field. On the other hand, the high degree of susceptibility observed in Giza 3 was also noted by Khalil and Nassib (1984), but in contrast to their results, line 249/804/80 did not perform well under the French environment.

References

Abou-Zeid, N. 1985. Contribution a l'amelioration de la resistance de la *Vicia faba* L. au *Botrytis fabae* Sard. These de Doctorat es Sciences, Universite de Rennes I, 105 pp.

Bond, D.A. and Pope, M. 1980. *Ascochyta fabae* on winter beans (*Vicia faba*): pathogen spread and variation in host resistance. Plant Pathology 29: 59-65.

El-Sherbeeny, M.H. and Mohamed, H.A. 1980. Detached leaf technique for infection of faba bean plants (*Vicia faba* L.) with *Botrytis fabae*. FABIS Newsletter 2: 44-45.

Gaunt, R.E. 1983. Shoot diseases caused by fungal pathogens. Pages 463-487 *in* The Faba Bean (Hebblethwaite, P.D., ed.) Butterworths, London, England.

Hanounik, S.B. 1983. Resistance in faba bean to chocolate spot. FABIS Newsletter 5: 24-25.

Hanounik, S.B. and Maliha, N.F. 1983. Screening for resistance to, and chemical control of major diseases in faba beans. Pages 107-118 *in* Proceedings of the International Workshop on Faba Beans, Kabuli Chickpeas, and Lentils in the 1980s, (Saxena, M.C. and Varma, S., eds.) 16-20 May 1983, ICARDA, Aleppo, Syria.

Khalil, S.A. and Harrisson, J.G. 1981. Methods of evaluating faba bean materials for chocolate spot. FABIS Newsletter 3: 51-52.

Khalil, S.A. and Nassib, A.M. 1984. Identification of some sources of resistance to diseases in faba bean I - Chocolate spot (*Botrytis fabae* Sard.) FABIS Newsletter 10: 18-21.

Mansour, K., Kamel, B. and Amer, S. 1976. Severity of chocolate spot disease of horse beans and search for resistance. Agricultural Research Review (Cairo) 54: 101-109.

Tivoli, B., Berthelem, P., Leguen, J. and Onfroy, C. 1986. Comparison of some methods for evaluation of reaction of different winter faba bean genotypes to *Botrytis fabae*. FABIS Newsletter 16: 46-50.

Tivoli, B., Reynaud, B., Maurin, N., Berthelem, P. and Leguen, J. 1986. Comparison of some methods for evaluation of reaction of different faba bean genotypes to *Ascochyta fabae*. FABIS Newsletter 17: 35-38.

دراسة كفاءة بعض الطرز الوراثية للفول فيما يتعلق باصابتها بالتبقع الشوكولاتي Botrytis fabae والتبقع الاسكوكيتي Ascochyta fabae في فرنسا

ملخص

تمت دراسة تفاعل مجموعتين مختلفتين موءلفتين من 20 طرازا وراثيا من الفول ازاء التبقع الشوكولاتي والتبقع الاسكوكيتي باستخدام طريقة الورقة المنفصلة Detached والعدوى الاصطناعية في دفيئة من البوليثين وفي الحقل. وقد تباينت الطرز الوراثية بشكل كبير في تفاعلها مع الاصابة، ويمكن تصنيفها بحسب كفاءتها الى طرز وراثية ذات كفاءة جيدة ومتوسطة ومنخفضة. وثبتت مقاومة الصنفين ILB 938 و BPL 710 لمرض التبقع الشوكولاتي، والصنفين Asco 16 وAsco 17 لمرض التبقع الاسكوكيتي تحت الاجواء الفرنسية.

Reaction of Faba Bean Genotypes to Various Diseases in Pakistan

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Abstract

The disease reactions of 23 accessions of faba bean (*Vicia faba* L.) provided by ICARDA, Syria and one local cultivar were studied under field conditions at the National Agricultural Research Center (NARC), Islamabad. Of these 23 accessions, one proved resistant to aschochyta blight (*Ascochyta fabae*), 12 to rust (*Uromyces viciae-fabae*), 15 to powdery mildew (*Erysiphe polygoni*), and 1 to chocolate spot (*Botrytis fabae*). The local check was rated tolerant to *A. fabae*, resistant to *U. fabae*, and susceptible to *E. polygoni* and *B. fabae*. As the infection with various diseases occurred late in the season, the effect of the diseases on yield was minor.

Introduction

In Pakistan, faba bean (*Vicia faba* L.), which earlier used to be grown in only certain parts of the country, is now becoming more popular among the people. However, in the past, little attention was given to the improvement of this crop. It is most likely that faba bean may substitute other conventional pulses of Pakistan if breeding is directed to improve the quality of the crop to suit the taste of the consumers. However, the productivity of the crop is affected by several fungal diseases. Among these, most important are ascochyta blight (*Ascochyta fabae*) as reported by Khan *et al.* (1983), and chocolate spot, (*Botrytis fabae*), powdery mildew (*Erysiphe polygoni*), and rust (*Uromyces viciae-fabae*) as reported by Ahmad (1956).

The present work was undertaken to study the reaction of 23 faba bean accessions provided by the International Center for Agricultural Research in the Dry Areas (ICARDA), Syria and one local cultivar to various fungal diseases in Pakistan.

Materials and Methods

The experimental material was received from ICARDA, Syria and planted during the *Rabi* season of 1986/87 at the National Agricultural Research Centre (NARC), Islamabad. Seeds of each of the 24 entries were sown on 10 Nov 1986 in 4-row plots each 4 m long, with 50 cm between rows and 10 cm between seeds within rows. The experimental material was arranged in a randomized complete block design with three replicates. Disease severity was recorded under natural infection conditions according to the scale used by Anthoni and Prasad (1975). For each disease, several readings were made, the last being recorded 15 days before harvest. The data were statistically analyzed according to Fisher (1958) and Steel and Torrie (1960).

Results and Discussion

Table 1 shows the reactions of the 24 faba bean accessions against different diseases.

Ascochyta blight

The 23 accessions and the local check showed different reactions to *Ascochyta fabae*. However, only one accession (FLIP 82-28 FB) was rated resistant with disease reading of 3, 14 were tolerant, and the remaining 8 accessions were susceptible with disease readings more than 5. The local check, which was scored tolerant (4.33), behaved better than most of the other accessions.

Table 1. Disease reactions of 23 faba bean accessions and one local cultivar to ascochyta blight, rust, powdery mildew, and chocolate spot under the field conditions at the National Agricultural Research Center, Islamabad during the 1986/87 season.

Accession	Disease readings[1]			
	Ascochyta blight	Rust	Powdery mildew	Chocolate spot
FLIP 82-25 FB	4.33[a]	1.67	1.67	6.33
FLIP 82-27 FB	3.67	1.67	1.00	6.33
FLIP 82-28 FB	3.00	5.00	1.67	4.33
FLIP 82-29 FB	5.67	4.33	3.00	4.33
FLIP 82-30 FB	4.33	5.67	2.33	5.00
FLIP 82-45 FB	5.67	5.00	5.00	5.67
FLIP 82-53 FB	3.67	3.00	2.33	6.33
FLIP 82-54 FB	6.33	5.00	5.00	5.67
FLIP 83-5 FB	3.67	5.67	1.00	5.67
FLIP 83-6 FB	5.67	3.00	4.33	4.33
FLIP 83-17 FB	3.67	3.67	6.33	5.00
FLIP 83-43 FB	5.00	5.67	1.67	5.67
74TA 22	5.67	3.00	3.67	5.00
76TA 56246	5.67	3.00	4.33	5.67
79S 4	5.67	7.00	2.33	5.00
79S 653	6.33	6.33	3.00	4.33
80S 44027	5.67	3.00	3.67	4.33
80S 80135	4.33	5.67	6.33	5.00
Lattakia local	4.33	4.33	2.33	3.67
Reina Blanca	5.00	3.00	2.33	7.00
Turkish local	3.67	3.00	2.33	3.67
ILB 3187	3.67	2.33	2.33	3.00
ILB 1814	5.00	2.33	2.33	3.67
Local check	4.33	3.00	6.33	6.33
LSD (5%)	1.34	1.55	1.62	1.47

1. Disease readings were made on 1-9 scoring scale where 1-3 = resistant, 4-5 = tolerant, and 6-9 = susceptible.

a. The figures are averages of three replications.

However, only seven of ICARDA accessions performed better than the local check. The prevalence of the disease may be attributed to the high relative humidity at the pod filling stage, which is conducive to the disease spread (Blotnika 1979).

Rust

Of the 23 accessions tested, 11 were rated similar or better than the local check. However, the highest disease severity was scored on 79S 653 and 79S 4 with disease readings of 6.33 and 7.00 respectively. As the rust disease appeared late in the season (at maturity stage), it caused negligible loss in yield. This is in agreement with the findings of Blotnika (1979).

Powdery mildew

From the data presented in **Table 1**, it is evident that most of the accessions tested were either resistant or tolerant to the disease: only two accessions (FLIP 83-17 FB and 80S 80135) and the local check were susceptible. Similar to rust, powdery mildew also appeared late in the season, and was more common on older leaves than new ones. Similar observations were also reported by Bernier *et al.* (1984).

Chocolate leaf spot

It is clear from the **Table 1** that none of the entries was free of the disease. However, of the 23 accessions

included in this test. 1 (ILB 3187) was rated resistant (3). 13 tolerant, and 10 including the local check were rated susceptible to the disease. Among the four diseases, chocolate spot was more common during the growing season. This may be due to the favourable weather conditions and the high humidity (Harrison 1980). We also observed that the disease severity had increased with plant age, and it was more serious on older than on younger plants. This is in accordance with the findings of Hanounik (1980).

References

Ahmad, S. 1956. Fungi of West Pakistan. Monograph No. 1:126.

Anthoni, R. and Prasad, N.N. 1975. Reaction of groundnut to *Rhizoctonia bataticola.* Indian Phytopathology 28: 440-441.

Bernier, C.C., Hanounik, S.B., Hussein, M.M. and Mohamed, H.A. 1984. Field manual of common faba bean diseases in the Nile Valley. Information Bulletin No. 3, ICARDA, 40 pp.

Blotnika, K. 1979. The most important fungus diseases of broad bean (*Vicia faba minor*) and their occurrence in Poland. Biuletyn Instytutu Hodowli i Aklimatyzacji Roslin 137: 23-28.

Fisher, R.A. 1958. Statistical methods for research workers. 13th ed. Oliver and Boyd, London, UK.

Hanounik, S. 1980. Susceptibility of faba beans of different ages to infection by *Botrytis fabae* and *Ascochyta fabae.* FABIS Newsletter 2: 46.

Harrison, J.G. 1980. Effect of environmental factors on growth of lesions on field bean leaves infected by *Botrytis fabae.* Annals of Applied Biology 95(1): 53-61.

Khan, B.A., Khan, I.U., Rehman, F.U. and Aslam, M. 1983. *Ascochyta fabae* of broad beans - A new disease record in Pakistan. Pakistan Journal of Botany 15 (2): 121.

Steel, R.G.D. and Torrie, J.H. 1960. Principles and Procedures of Statistics. McGraw Hill Book Inc., New York, USA.

تفاعل طرز وراثية من الفول مع مختلف الامراض في باكستان

ملخص

تمت دراسة تفاعل 23 مدخلا من الفول Vicia faba L، مرسلة من ايكاردا بسورية،وصنف محلي واحد مع الامراض تحت الظروف الحقلية في المركز الوطني للبحوث الزراعية (NARC) في اسلام اباد . ومن بين المدخلات الـ 23 ثبت ان واحدا منها مقاوم للفحة الاسكوكيتا (Ascochyta fabae) و 12 مقاوم للصدأ (Uromyces viciae-fabae) و 15 مقاوم للبياض الدقيقي (Erysiphe polygoni)، ومدخلا واحدا مقاوم للتبقع الشوكولاتي (Botrytis fabae) . اما الشاهد المحلي فقد تبين انه متحمل للفحة الاسكوكيتا ، ومقاوم للصدأ ، وحساس للبياض الدقيقي والتبقع الشوكولاتي . ونظرا لحدوث الاصابة بمختلف الامراض في اواخر الموسم فقد كان تاثيرها على الغلة طفيفا .

Contributors' Style Guide

Policy

The aim of FABIS Newsletter is to publish quickly the results of recent research on faba beans. 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. Authors should refer to recent issues of FABIS for guidance on format. 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.

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 8.5 cm or 17.4 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 ug; 5°C; 1980/81 season; 1980-82 seasons; 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 difference = 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..s 1;*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, ICARDA, P.O. Box 5466, Aleppo, Syria.

NEWS

أخبار

Book Reviews

مطالعات في الكتب

Principles and Practice of Nematode Control in Crops
Edited by R.H. Brown and B.K. Kerry
Published by Harcourt Brace Jovanovich, Publishers (AP), Sydney, Australia, 1987.
ISBN 0 12 137640 0
Price: 38.75
447 pp.

The withdrawal of some nematicides for health and environmental reasons has forced nematologists to review control strategies based solely on chemicals and to develop integrated management programs based on several control measures. This multi-author book is a valuable reference to those nematologists developing such programs and will be of interest to students, research scientists, and extension workers.

The book is not intended to provide solutions to particular pest problems on specific crops. But, whenever possible, practical details have been highlighted and each chapter was followed by a comprehensive reference list which should allow the reader to locate more detailed information in the nematology literature.

Contents: Introduction - Extraction of Nematodes and Sampling Methods - Analysis and Prediction as a Basis for Management Decisions - Principles of Nematode Control - Chemical Control of Nematodes - Resistance and Tolerance - Biological Control - Physical Methods and Quarantine - Interaction with other Organisms - Control Strategies in High-value Crops - Control Strategies in Low-value Crops - and Control Strategies in Subsistence Agriculture.

Plant Diseases: Infection, Damage and Loss
Edited by R.K.S. Wood *FRS* and G.J. Jellis
Published by Blackwell Scientific Publications, UK
ISBN 0 632 01126 2
Price: 29.50
327 pp.

This book arose from a symposium held under the auspices of the British Society for Plant Pathology at the University of Surrey in December 1982. The four sections of the book are on substances from pathogens that damage plants and on how they do so, the effects of pathogens on the main physiological processes of plants, the damage to substance and structure that result in different types of diseases, and the damage and loss of various types of economically important crops.

Cropping Strategies for Efficient Use of Water and Nitrogen
Edited by W.L. Hargrove
Published by ASA, CSSA, and SSSA, Madison, USA, 1988.
ISBN 0 89118 097 4
Price 16.50 USD
218 pp.

Water and nitrogen are two factors that play major a role in crop production. The book examines the management of these resources from several perspectives including crop species, crop sequences, cultural practices, inputs, and environmental quality.

Forthcoming Events

أحداث مرتقبة

Symposium on Laboratory and Field Pesticide Performance

The Symposium, organized by the Pesticides Group of the Society of Chemical Industry, the Association of Applied Biologists and the British Crop Protection Council, will be held 4-6 April 1989 at the University of Kent, Canterbury. The aim of the symposium will be to discuss the causes of differences in pesticide performance between laboratory/glasshouse testing and field evaluation. These differences arise from biological factors such as growth and habits of plants, insects and fungal pathogens between laboratory and field situations, physicochemical stresses placed on the applied pesticides in the two situations, and methods of application and the test protocols between the two environments. There will be invited speakers and half day of contributed short papers and posters.

For further information write to:

Dr. C.R. Merritt
International Centre for the Application of Pesticides,
Cranfield Institute of Technology,
Cranfield, Bedford MK 43 OAL,
England

Second International Symposium on Bruchids and Legumes

The symposium, organized by the Japanese Society of Applied Entomology and Zoology and the Foundation for Advancement of International Science, will be held 6-9 September 1989 at Okayama, Japan. The program will cover all aspects of bruchids and legumes. Special emphasis will be given to legume biology, bruchid biology, legume-bruchid interactions, and preventive techniques against bruchid attack. Within each topic area, there will be special papers by outstanding workers. To complement these reports, contributed papers are also invited.

Further information may be obtained from:
Secretariat, 2nd ISBL
c/o Laboratory of Applied Entomology,
Faculty of Agriculture,
Okayama University,
Tsushima, Okayama 700
Japan

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Request your list of all currently available publications from the Scientific and Technical Information Program (STIP).

ICARDA Information Brochure
ICARDA's historical background and research objectives are outlined in English and Arabic. For your copy, contact STIP.

LENS (Lentil Newsletter)
This newsletter is produced twice a year at ICARDA. Short research articles are published and comprehensive reviews are invited regularly on specific areas of lentil research. The newsletter also includes book reviews, key abstracts on lentils, and recent lentil references. For further information write LENS.

RACHIS (Barley, and Wheat Newsletter)
This ICARDA service is aimed at cereals researchers in the Near East and North Africa region and Mediterranean-type environments. It publishes up-to-the-minute short scientific papers on the latest research results and news items. RACHIS seeks to contribute to improved barley and durum wheat, production in the region; to report results, achievements, and new ideas; and to discuss research problems. For further information, write RACHIS.

Field Guide to Major Insect Pests of Faba Bean in the Nile Valley (English and Arabic)
This pocket field guide for research and extension workers explains how to identify and control the main insect pests of faba bean in Egypt and Sudan. The distribution, description, and biological characteristics are given for each insect, along with the type of injury, assessment of damage, and recommended control measures. A key to injuries is included. Insects and the damage they cause on faba beans are illustrated with 41 color photos. For your copy, write FLIP.

Field Manual of Common Faba Bean Diseases in the Nile Valley (English and Arabic)
This pocket field manual is a tool for field workers to diagnose and control diseases of faba beans in Egypt and Sudan. Symptoms, development, and control of various diseases are discussed, and symptoms are illustrated with 38 color photos. Also included are rating scales for disease resistance in faba bean lines and a glossary of basic phyto-pathological terms. For your copy, write FLIP.

Field Guide to Major Insect Pests of Wheat and Barley (Arabic)
This field guide in Arabic covers fungal, bacterial, viral, and physiological diseases, as well as insects and nematodes, that attack wheat and barley crops in the Middle East and North Africa. Forty-four insects and diseases are discussed and illustrated with 72 color photos. For your copy, write Cereals Improvement Program.

Introduction to Food Legume Physiology
This comprehensive 105-page technical manual is designed for food legume scientists and their support staff. It covers several areas of food legume physiology in a practical way, with examples whenever possible. The book contains four chapters covering the following: plant structure and physiological functions; mineral nutrition; photoperiodism, vernalization, crop canopy and radiation, and growth analysis; and physiology and crop improvement. For your copy, write Training Coordination Unit.

ICARDA's Food Legume Improvement Program
In English and Arabic, the 24-page illustrated information brochure briefly describes research projects on lentil, faba bean, and chickpea treated either as single crops or as a group. For your copy, write FLIP.

Screening Chickpeas for Resistance to Ascochyta Blight A Slide-tape Audio-tutorial Module
This slide-tape audio-tutorial module is the first in the food legume training series. It is designed for the use of legume trainees during the training courses at ICARDA as well as for scientists and their support

staff in the various national programs. This module is also useful educational material for universities and training departments in national research systems. For your copy of this publication or package, write Training Coordination Unit.

Checklist of Journal Articles from ICARDA 1978 - 1987
This checklist, compiled to bring information to the attention of the scientific community, consists of references of articles by ICARDA research scientists submitted to refereed scientific journals as of 1978. Each reference includes within year of publication: author, primary title, volume number, issue number, pagination, language code of the article and/or summary when necessary, and AGRIS reference number. For your copy write STIP.

Opportunities for Field Research at ICARDA
This brochure is intended primarily to assist Master of Science candidates, who are enrolled at national universities within ICARDA region and selected for the Graduate Research Training Program. It explains to them the opportunity they have to conduct their thesis research work at ICARDA research sites under the supervision of distinguished international scientists. For your copy, write GRI Program, Training Coordination Unit.

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, write Training Coordination Unit.

TO OBTAIN PUBLICATIONS:
Address requests for publications to the specific department or service cited above, at: ICARDA, P.O. Box 5466, Aleppo, Syria.

DOCUMENT COLLECTION

With the financial support of the International Development Research Centre (IDRC), ICARDA is building up its document collection on faba bean. The collection will be used to supply needed documents to scientists in developing countries.

We would be grateful if readers who have any relevant documents would send them to:

FABIS
ICARDA
Box 5466
Aleppo, Syria

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If you have any

* faba bean news
* announcements of meetings
* book reviews
* new research interests
* suggestions

Please send them to:

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ICARDA, Box 5466
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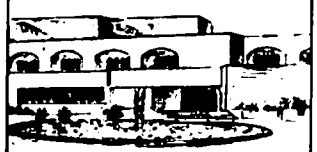

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اعلان الى العلماء والباحثين العرب الكرام

يسر المركز الدولي للبحوث الزراعية في المناطق الجافة (ايكاردا) ، اعلامكم بان مركز بحوث التنمية الدولية (IDRC) في أوتاوا بكندا ، قد وافق على تقديم دعم مالي لمشروع فابس FABIS مدته ثلاث سنوات اعتبارا من بداية عام 1987 ولغاية 1989 ، علما بان ادراج اللغة العربية ضمن النشرة الاخبارية للفول يشكل أحد أهم أهداف هذا المشروع .

وبمزيد من السرور تعلن اسرة تحرير " FABIS " للباحثين العرب العاملين في مجال تحسين محصول الفول أنها تصدر نشرتها العلمية باللغتين العربية والانكليزية . لذا فيرجى من الاخوة العلماء الراغبين في نشر بحوثهم باللغة العربية التفضل بارسالها الى العنوان التالي : نشرة " فابس " ، ايكاردا ــ قسم التوثيق ، ص.ب. 5466 حلب ــ سورية .

ملاحظة :

تتم كتابة البحث بلغة عربية واضحة ، وفق الترتيب التالي :

1) الملخص ويكتب باللغتين العربية والانكليزية .
2) المقدمة .
3) المواد والطرق .
4) النتائج .
5) المناقشة ويمكن دمجها مع النتائج وتصبح (نتائج البحث والمناقشة) .
6) المراجع .

المعاملات الزراعية والمكننة

الفيزيولوجيا والأحياء الدقيقة

التربية والوراثة

مقالة عامة

فابِس

مشروع المعلومات المتخصصة عن الفول

فابس ، نشرة علمية 21 ، آب/اغسطس 1988

المحتويات

ايكاردا والمجموعة الاستشارية للبحوث الزراعية الدولية

يتمثل الهدف العام للمركز الدولي للبحوث الزراعية في المناطق الجافة (ايكاردا) في زياده الانتاجيه الزراعية والموارد الغذائية المتاحة في المناطق الريفية والحضرية بهدف تحسين الوضع الاجتماعي والاقتصادي لسكان البلدان الناميه وخاصة في شمال افريقيا وغرب آسيا . وتركز ايكاردا اهتماماتها بصورة رئيسيه على المناطق التي تعتمد في زراعتها على الامطار الشتويه التي تتراوح من 200-600 مم سنويا ، وعندما تستدعي الضرورة ستمتد دائره بحوثها لتغطي مناطق بيئية مروية او ذات امطار موسمية .

ويضطلع المركز بمسؤولية عالمية في تحسين الشعير والعدس والفول ، وبمسؤولية اقليمية في تحسين القمح والحمص والنظم الزراعية والثروة الحيوانية والمراعي والمحاصيل العلفية . كما ويعتبر تدريب وتاهيل الباحثين الزراعيين في البلدان النامية ، وتبادل نتائج البحوث معهم احد اهم الانشطة التي تقوم بها ايكاردا .

وقد ساهمت المجموعة الاستشارية للبحوث الزراعيه الدولية (CGIAR) بتاسيس ايكاردا في سوريه عام 1977 كمركز للبحوث لا يتوخى الربح . أما المجموعة الاستشارية للبحوث الزراعية الدولية فهي هيئة غير رسمية من المتبرعين تضم حكومات ومنظمات ومؤسسات خاصة ، وتدعم البحوث الزراعية في جميع انحاء العالم بهدف تحسين الانتاج الغذائي في البلدان النامية ، وذلك من خلال شبكة مؤلفة من ثلاثة عشر مركزا دوليا للبحوث من بينها ايكاردا . وتغطي اعمال الشبكة بحوثا على انظمة المحاصيل والثروة الحيوانية التي تسهم في تامين ثلاثة ارباع الغذاء في البلدان النامية .

فابس

تصدر ايكاردا نشرة " فابس FABIS " العلمية ثلاث مرات في السنه بدعم مالي من مركز بحوث التنمية الدولية (IDRC) في اوتاوا بكندا . وهي نشرة علمية متخصصة بالفول . وتعتبر وسيله اتصال لتبادل نتائج البحوث حول هذا النبات . وتضم النشرة بحوثا مختصرة تهدف الى ايصال المعلومات بسرعة . اضافة الى بعض المقالات العامه التي تدعو اليها اسرة التحرير بشكل منتظم وتتناول مجالات معينة من بحوث الفول . كما تضم النشرة بعض الاعلانات . وهذه النشرة تقدم المعلومات حول بحوث الفول دون مقابل من خلال قسائم الاستجواب والتصوير النسخي (الفوتوكوبي) وجمع الوثائق العلمية المتعلقة بالفول .

الاشتراكات

توزع نشرة " فابس " العلمية دون مقابل للباحثين المعنيين بنبات الفول . وللاشتراك فيها نرجى الكتابه الى :

FABIS/Documentation Unit/ICARDA, P.O.Box 5466
Aleppo, Syria

هيئة التنسيق

كندا : الدكتور س. برنييه ، قسم علوم النبات ، جامعة مانيتوبا ، وينبج ، مانيتوبا R3T 2N2
مصر : الدكتور عبد الله نصيب ، معهد المحاصيل الحقلية ، مركز البحوث الزراعيه ، الجيزه 12619
اليابان : الدكتور ك . كوجر ، كلية الزراعه ، جامعه كاجاوا 2393 Ikenobe. Miki-tyo. Kagawa-Ken
السودان : الدكتور ف . آ . صالح ، هيئة البحوث الزراعيه ، محطه بحوث شمباط ، ص.ب. 30 خرطوم بحري .
سورية : الدكتور م . ساكسينا ، برنامج تحسين البقوليات الغذائية ، ايكاردا ، ص.ب. 5466 ، حلب .
البرازيل : الدكتور هـ. ايدار ، المركز الوطني لبحوث الرز والفاصولياء BR-153. km 4-Gionia/Anapolis
Caixa Postal 179. 74.000-Goiania. Goias
فرنسا : الدكتور ج. بيكارد 4 Rue du 8 Mai. 36. 100 Neuvy-Pailloux.
ايطاليا : البروفسور سي دو باتشه ، معهد البيولوجيا الزراعية ، جامعه توشيا ، فيتربو .
اسبانيا : الدكتور ج.ى. كوبيرو ، المدرسة الفنيه العليا للهندسة الزراعيه ، قسم الوراثة ، ص.ب. 3048 ، قرطبة .
المملكة المتحدة : الدكتور د . آ . بوند ، معهد تربية النبات ، ماريس لين ، نورفولك ، كامبريدج .

هيئة التحرير

الدكتور موهان ساكسينا/محرر علمي
الدكتور حبيب ابراهيم/مساعد محرر علمي
السيد نهاد مليحه/محرر
السيدة مليكه عبد العالي مارتيني/مساعدة
الدكتور وليد سراج والسيد خالد الحبيلي/الملخصات العربية

صورة الغلاف : سلالة من الفول ذات قرون متدلية .

فابِس

نشـرة علميـة متخصصة بالفول

العدد 21

آب/اغسطس 1988

المركز الدولي للبحوث الزراعية في المناطق الجافة
ايكاردا
ص. ب. 5466 ، حلب، سورية