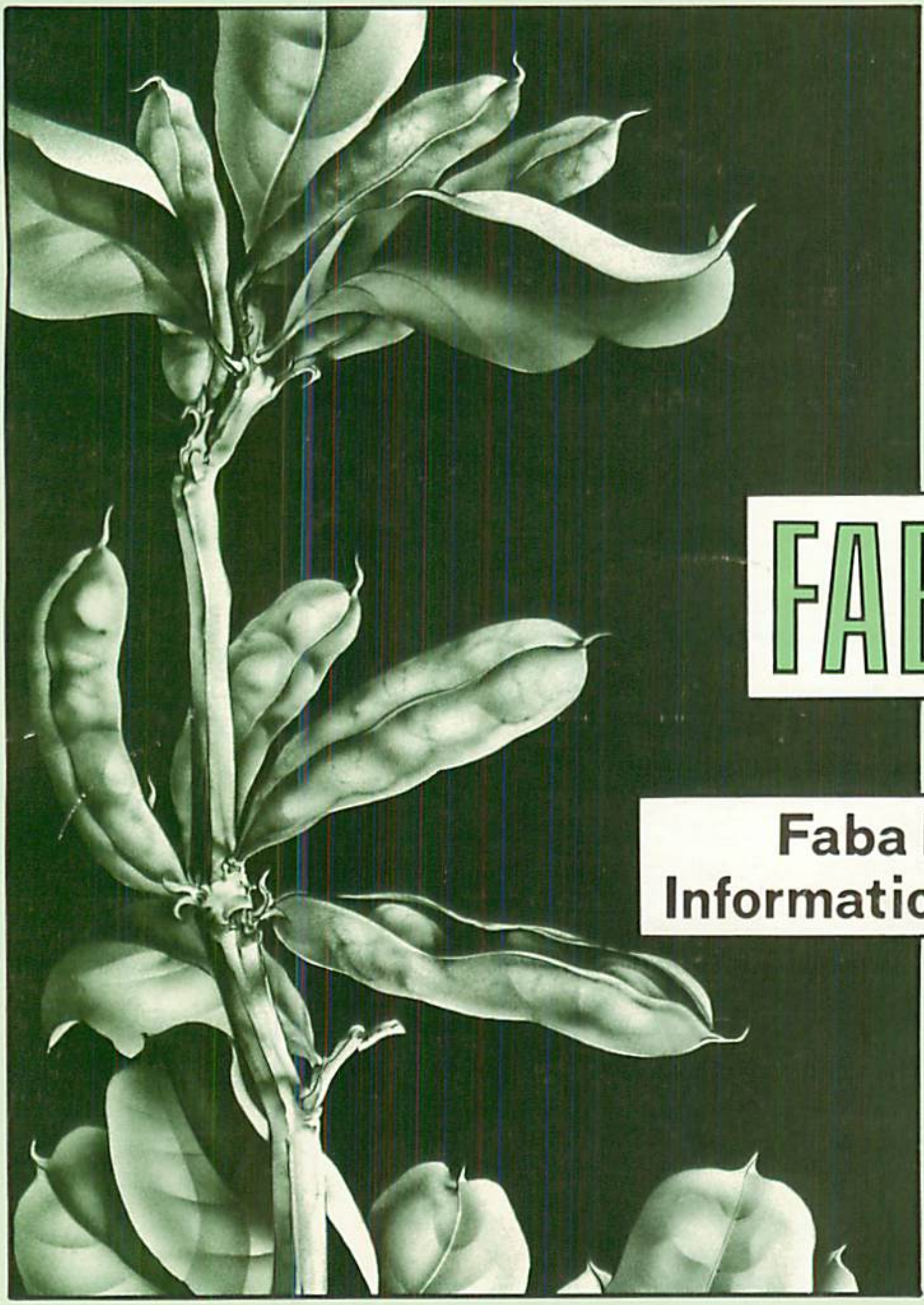

FABIS

Faba Bean Information Service

NEWSLETTER No. 33
July—December 1993

INTERNATIONAL CENTER FOR AGRICULTURAL RESEARCH IN THE DRY AREAS

(ICARDA)

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FABIS

FABIS Newsletter is produced twice a year by ICARDA for the Faba Bean Information Service. It is a forum for communicating research results on faba bean and other Viceae legumes in the genera *Vicia* and *Lathyrus*. Short research articles provide rapid information exchange and comprehensive reviews are invited regularly on specific areas. The newsletter occasionally publishes reviews of relevant books. Recent references are published in an annual supplement.

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Research Articles

Breeding and Genetics

Performance of Faba Bean Genotypes in the Jebel Marra Area

Farouk A. Salih[1], Asim Abu Sarra[2] and Salih H. Salih[3]

[1] *Shambat Research Station, Khartoum North, SUDAN*
[2] *Jebel Marra Agricultural Research Unit, Darfur State, SUDAN*
[3] *Hudeiba Research Station, Ed-Damer, SUDAN*

Abstract

Two yield trials were conducted over three years to assess the adaptation of new lines of faba bean (*Vicia faba* L.) to the Jebel Marra area of Sudan. Fifteen and 17 genotypes were grown on the sides of ridges and received irrigation every 10–12 days. The trials were arranged in randomized complete blocks with four replications. Significant differences were observed in seed yield and best yielders were: 00310, SM-L, 317/99/81, Super L 85, F402-7 and Super small. Seed yield was significantly affected by seasonal variation, but the trials demonstrated that faba bean can be grown sucessfully in the Jebel Marra area. The best genotypes from this trial will be included in verification trials.

Key words: *Vicia faba*; faba beans; genotypes; adaptation; yields; seasonal variation; Sudan.

كفاءة طرز وراثية من الفول في منطقة جبل مرة

الملخص

أجريت تجربتان لمقارنة الغلة على مدى ثلاث سنوات لتقييم مدى تأقلم سلالات جديدة من الفول (Vicia faba L.) في منطقة جبل مرة في السودان. زُرع 15 و17 طرازاً وراثياً على أطراف الأثلام وتم ريها كل 10 – 12 يوماً. وقد نُفذت التجربتان في قطاعات عشوائية كاملة بأربعة مكررات. لوحظت فروقات كبيرة في الغلة البذرية، وكانت أفضل السلالات غلة : 00310، SM - L، 317/99/81، Super L 85، F 402 -7 و Super small . ولقد تأثرت الغلة البذرية إلى حد كبير بالتباين الموسمي، إلا أن التجربتين أظهرتا أنه يمكن زراعة الفول بنجاح في منطقة جبل مرة. وستخضع أفضل الطرز الوراثية في هاتين التجربتين لتجارب اختبارية .

Introduction

The Jebel Marra area, located in the south-west part of Darfur State, Sudan, consists of volcanic mountains (the highlands) and floodplains (the lowlands). The area gradually increases in altitude to reach more than 3000 m.

On the Jebel Marra Massif, gravity feed irrigation from perennial streams is mainly used to irrigate citrus trees.

The lowlands have four main wadi systems: from north to south, Wadi Azum, Wadi Debarei, Wadi Salih and Wadi Sirgilong. The wadi systems are bounded by floodplains of alluvial soils and high water-tables (at 3–4 m depth) below the floodplains. Irrigated agriculture is practised in these floodplains using diesel-operated pumps and shallow hand-dug wells alongside traditional types of irrigation using *shadoof* and buckets (*ramboyia*). An estimate of land suitable for irrigation is about 85,000 hectares (FAO 1968). Currently only a small fraction of this potential area is being utilized.

On average, rainfall varies between 450 and 600 mm per year, being highest at the mountain Massif, which strongly modifies the regional climate and increases rainfall. Most of the rain falls during July and August.

Monthly mean temperature varies between 30°C in March–June, before the start of the rains, 25°C in the rainy season and 20°C in the winter (November–February). The relative humidity varies between 80% in the rainy season and 20–30% in the dry season.

All these factors, coupled with the fertile volcanic soils on the Jebel and alluvial soil along the wadis, make Jebel Marra a unique area for horticultural production in Sudan. Cool-season crops are grown almost throughout the year. However, autumn (fall) is considered the main production season. Crops produced in autumn include: potato, cherry, tomato, wheat, chickpea, faba bean and spices. Winter crops include wheat, faba bean, chickpea, potato, onion and other vegetables.

The aim of the present work was to study the adaptability and yield performance of a new group of faba bean genotypes grown under Jebel Marra conditions and to introduce the crop as a new cash crop to the area.

Materials and Methods

For three consecutive seasons (1990/91–1992/93), two faba bean yield trials were carried out at Jebel Marra. Fifteen and 17 genotypes were used in the trials, respectively, and the genotypes of each trial were evaluated and compared for seed yield with Kabkabyia (the standard check). The design used was a randomized complete block with four replicates, a plot size of 3.6 × 6.0 m and a net harvested area of 12.5 m^2. Planting dates of both trials were: 11 November 1990, 13 November 1991 and 23 November 1992. The seeds of the different genotypes were planted on both sides of ridges 60 cm wide, at plant spacing of 20 cm with 2 seeds per hole. Irrigation was at intervals of 10–12 days. Pests and diseases were kept to a minimum.

Results and Discussion

The seed yields (t/ha) for both trials are shown *in Tables* 1 and 2, for the seasons 1990/91 to 1992/93. Differences in seed yield in both trials were significant in all seasons.

Table 1. Seed yield (t/ha) of 15 genotypes of faba bean grown at Jebel Marra for three consecutive seasons (1990/91–1992/93).

Genotype	Season			Mean
	1990/91	1991/92	1992/93	
00310	3.21 (2)*	3.11 (2)	5.77 (1)	4.03
SM-L	2.85 (7)	3.67 (1)	5.24 (2)	3.92
317/99/81	3.52 (1)	3.04 (3)	5.12 (3)	3.89
00633/H	3.21 (3)	2.71 (8)	5.08 (4)	3.67
00616	3.10 (4)	2.80 (5)	4.80 (8)	3.57
0094	2.59 (9)	2.74 (7)	5.04 (5)	3.46
Giza 2	3.00 (6)	3.03 (4)	3.84 (14)	3.29
557/81	2.70 (8)	2.14 (13)	4.85 (6)	3.23
00605	2.52 (11)	2.30 (12)	4.63 (9)	3.15
00340	2.24 (13)	2.74 (6)	3.99 (11)	2.99
00648	1.91 (14)	2.01 (14)	4.84 (7)	2.92
El Selaim L/1/1	1.79 (15)	2.35 (11)	4.39 (10)	2.84
00482	2.53 (10)	2.00 (15)	3.95 (12)	2.83
A-0-70	3.08 (5)	2.52 (10)	2.70 (16)	2.76
Kabkabyia	1.26 (16)	2.62 (9)	3.87 (13)	2.58
M00639	2.46 (12)	1.82 (16)	3.38 (15)	2.55
S.E.	0.30	0.17	0.47	
Mean	2.62	2.60	4.47	3.23

* Figures in parentheses are the ranking position of the genotypes in seed yield.

Table 2. Seed yield (t/ha) performance of 17 genotypes of faba bean grown at Jebel Marra for three consecutive seasons (1990/91 –1992/93).

Genotype	Season			Mean
	1990/91	1991/92	1992/93	
Super L 85	3.38 (1)*	3.71 (1)	5.79 (2)	4.29
F 402-7	2.53 (5)	3.21 (6)	6.26 (1)	4.00
Super small	3.00 (2)	3.60 (3)	5.31 (6)	3.97
00310	2.86 (3)	3.44 (4)	5.52 (4)	3.94
0094	2.40 (7)	3.66 (2)	5.33 (5)	3.80
El Selaim L/1	2.59 (4)	3.19 (7)	4.84 (14)	3.54
BS 4/1	1.96 (10)	3.11 (8)	5.56 (3)	3.54
Giza 2	2.51 (6)	3.01 (10)	4.77 (15)	3.43
El Selaim L/1/1	1.79 (14)	3.07 (9)	5.19 (9)	3.35
00616	1.46 (16)	3.33 (5)	5.01 (10)	3.27
SML	1.88 (13)	2.69 (16)	5.25 (7)	3.27
Bulk 2/3	2.27 (8)	2.92 (13)	4.63 (16)	3.27
SML-4	1.93 (11)	2.84 (14)	4.86 (13)	3.21
SML 85/2/1	1.89 (12)	2.94 (11)	4.61 (16)	3.15
BB 25	2.16 (9)	2.75 (15)	4.50 (18)	3.14
Kabkabyia	1.48 (15)	2.94 (12)	4.91 (12)	3.11
Cross 1/2/1	1.36 (17)	2.54 (17)	4.97 (11)	2.96
Cross 27/1	1.35 (18)	2.24 (18)	5.22 (8)	2.94
S.E.	0.11	0.16	0.47	
Mean	2.15	3.07	5.14	3.45

* Figures in parentheses are the ranking position of the genotypes in seed yield.

First yield trial

In 1990/91, the highest seed yields were obtained from 317/99/81, 00310, 00633/H and 00616 and their yields surpassed the yield of Kabkabyia by 179%, 155%, 155% and 146%, respectively. Line SM-L, which ranked the second in seed yield over the three seasons, ranked seventh in this season and its yield exceeded that of Kabkabyia by 126%.

In 1991/92, the highest seed yields were produced by line SM-L, 00310 and 317/99/81, and their yields exceeded the yield of the local check Kabkabyia by 40%, 19% and 16%, respectively.

In 1992/93, line 00310 was the top seed yielder, followed by SM-L and 317/99/81; their yields exceeded the yield of Kabkabyia by 49%, 35% and 32%, respectively.The highest seed yields in the overall average of the three seasons were obtained from line 00310 followed by SM-L and 317/99/81, surpassing Kabkabyia by 56%, 52% and 51%, respectively (Table 1).

Differences among the tested lines in 100-seed weight were significant only in the 1991/92 and 1992/93 seasons (Table 3). Lines 00310, SM-L and 317/99/81, which had the highest seed yields in this trial, had 100-seed weights of 47.2, 47.1 and 44.7 g, respectively. Thus, their seeds were smaller than those of the local check Kabkabyia by 9.7%, 10.0% and 15.9%, respectively.

Table 3. 100-seed weights (g) of 15 genotypes of faba bean grown at Jebel Marra for three seasons.

Genotype	Season			Mean
	1990/91	1991/92	1992/93	
00310	55.5	46.8	39.3	47.2
SM-L	51.5	47.2	42.7	47.1
317/99/81	45.5	45.5	43.2	44.7
00633/H	49.3	43.9	40.7	44.6
00616	48.5	47.4	47.8	44.4
0094	46.8	47.5	45.1	46.5
Giza 2	54.3	59.5	45.6	53.1
557/81	48.8	43.9	42.9	45.2
00605	53.8	42.4	35.2	43.8
00340	52.3	39.5	37.2	43.0
00648	48.3	44.2	40.0	44.2
El Selaim L/1/1	44.0	63.5	47.5	51.7
00482	46.5	46.5	40.0	44.3
A-0-70	45.3	46.0	38.8	43.4
Kabkabyia	55.5	55.2	44.6	51.8
M00639	51.3	43.6	36.8	43.9
S.E.	3.53	3.37	3.16	
Mean	49.8	47.6	41.6	46.2

Number of pods per plant for the three seasons are summarized in Table 4. Significant differences were found among the genotypes in this character for all three seasons. Lines 00310 and SM-L ranked sixth and seventh for pods per plant and exceeded that of Kabkabyia by 8.7% and 8.3%, respectively. Lines 317/99/81, Giza 2 and El Selaim L/1/1 had the fewest pods per plant among the tested genotypes.

Second yield trial

This trial included 17 genotypes plus Kabkabyia as a local check. Four of these genotypes – 00310, 00616, 0094 and El Selaim L/1/1 – were common to both trials. Table 2 gives the average seed yields for the three seasons.

In 1990/91, Super L 85, Super small and 00310 outyielded Kabkabyia by 128%, 103% and 93%, respectively. The lowest yields were given by crosses 1/2/1 and 27/1; their yields were inferior to Kabkabyia by 8.8% and 9.6%, respectively.

In 1991/92, Super L 85 produced the highest seed yield, as in the previous season. It out-yielded the control by 26%. Super small and 00310 were the third and fourth top seed yielders in this season, and their yields exceeded the yield of Kabkabyia by 22% and 17%, respectively.

In 1992/93, the top seed yield was produced by line F 402-7 and Super L 85 ranked second. Line 00310 had the fourth rank in the last two seasons and in the overall mean of the three seasons. The yields of Super L 85, Super small and 00310 exceeded the yield of Kabkabyia by 18%, 14% and 12%, respectively.

Table 4. Number of pods per plant for 15 genotypes of faba bean grown at Jebel Marra for three seasons.

Genotype	Season			Mean
	1990/91	1991/92	1992/93	
00310	32.0	25.6	36.3	31.3
SM-L	29.0	29.6	35.1	31.2
317/99/81	26.8	14.5	39.3	26.9
00633/H	32.6	27.5	40.8	33.6
00616	32.8	23.8	36.2	30.9
0094	32.8	28.5	35.7	32.3
Giza 2	21.6	19.5	35.1	25.4
557/1	31.5	25.4	42.4	33.3
00605	31.4	19.6	39.4	30.1
00340	35.3	21.8	39.8	32.3
00648	28.6	26.5	42.4	32.5
El Selaim L/1/1	22.5	23.1	30.8	25.5
00482	30.8	19.1	39.3	29.7
A-0-70	29.7	26.4	29.1	28.4
Kabkabyia	26.8	23.6	35.9	28.8
M00639	31.0	14.9	39.2	28.4
S.E.	1.85	1.44	3.09	
Mean	29.7	23.1	37.3	30.0

Over the three seasons, line Super L 85 was the top yielder, F402-7 was second, followed by Super small and 00310; their yields exceeded the yield of Kabkabyia by 39%, 29%, 28% and 27%, respectively.

Differences among the tested lines in 100-seed weight were significant, except in 1990/91 (Table 5). SML-4 had the highest 100-seed weight, but that did not compensate for its low seed yield. Super L 85, the top-yielding genotype in the three seasons, had the second highest 100-seed weight. Most of the lines were large seeded.

Table 5. 100-seed weights (g) of 15 genotypes of faba bean grown at Jebel Marra for three seasons.

Genotype	Season			Mean
	1990/91	1991/92	1992/93	
Super L 85	52.0	60.3	56.6	56.3
F 402-7	46.5	52.5	47.9	49.0
Super small	49.5	50.9	56.0	52.1
00310	56.3	43.5	41.3	47.0
0094	56.3	45.0	43.0	48.1
El Selaim L/1	49.3	64.2	56.8	56.8
BS 4/1	51.5	57.8	54.0	54.4
Giza 2	46.5	57.7	54.3	52.8
El Selaim L/1/1	44.0	59.7	61.2	55.0
00616	51.0	50.7	50.1	50.6
SML	55.3	48.8	51.1	51.7
Bulk 2/3	43.0	60.7	56.3	53.3
SML-4	55.3	62.6	55.4	57.8
SML 85/2/1	48.5	60.0	44.9	51.1
BB 25	46.5	57.8	46.8	50.4
Kabkabyia	49.3	56.9	55.2	53.8
Cross 1/2/1	53.3	48.2	52.6	51.4
Cross 27/1	50.0	53.9	50.1	51.3
S.E.	12.4	10.8	12.8	
Mean	50.2	55.0	51.8	52.3

Table 6 gives the numbers of pods per plant, where significant differences were encountered among the lines. Over the three seasons, Super L 85, 0094, 00616 and cross 1/2/1 had the most pods per plant.

Table 6. Number of pods per plant for 15 genotypes grown in Jebel Marra for three seasons.

Genotype	Season			Mean
	1990/91	1991/92	1992/93	
Super L 85	34.2	23.3	33.1	30.2
F 402-7	25.5	9.8	29.4	21.6
Super small	30.1	22.6	33.0	28.6
00310	29.0	15.6	35.3	26.6
0094	40.6	17.1	36.0	31.2
El Selaim L/1	20.0	17.2	30.4	22.5
BS 4/1	25.7	13.6	32.9	24.1
Giza 2	27.9	17.4	33.4	26.2
El Selaim L/1/1	22.5	20.3	32.6	25.1
00616	38.0	18.3	37.5	31.3
SML	32.7	13.9	38.3	28.3
Bulk 2/3	34.2	20.2	32.7	29.0
SML-4	21.4	15.0	29.9	22.1
SML 85/2/1	26.1	10.0	27.2	21.1
BB 25	23.7	18.2	35.1	25.7
Kabkabyia	28.0	21.8	31.7	27.2
Cross 1/2/1	32.6	19.9	39.9	30.8
Cross 27/1	28.5	16.2	37.6	27.4
S.E.	8.83	5.25	10.3	
Mean	28.9	17.2	33.7	26.6

The results from the two trials showed that 00310, SM-L, 317/99/81, Super L 85 and Super small produced the highest seed yields and were better adapted to the Jebel Marra area.

In conclusion, the results indicate that seed yield of the different genotypes were affected by seasonal variation. However, faba bean could be produced economically under Jebel Marra conditions if suitable lines are used. Moreover, screening of varieties and breeding lines should be expanded. The promising genotypes from the two trials reported here will be included in a verification trial in the near future.

Reference

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Metroglyph and Index Score Analysis in Induced Mutants of Faba Bean

Vandana and D.K. Dubey
Department of Botany
Janata Mahavidyalaya
Ajitmal, Etawah 206 121, INDIA

Abstract

Index scoring and a metroglyph scatter diagram for yield and eight yield components in 11 induced mutants of *Vicia faba* L. are presented. The study revealed a wide genetic diversity for different traits among the genotypes. Mutant AV8 was found to be the best performer for all the characters and thus fell in a distinct class by itself. Mutants AV6, AV7 and AV10 were also outstanding performers for most of the traits. The parent variety along with the mutants AV3 and AV11 were found to be the poorest performers.

Key words: *Vicia faba*; faba beans; yield components; induced mutation; genetic variation; genotypes.

الـ Metroglyph وتحليل دليل درجة الترتيب في طافرات مستحدثة من الفول

الملخص

يُعرض في هذا البحث دليل درجة الترتيب ومخطط تبعثر metroglyph المتعلقان بالغلة وثمانية مكونات للغلة في 11 طافرة مستحدثة من الفول *Vicia faba* L. وقد كشفت الدراسة عن تنوع وراثي واسع في صفات عديدة بين الطرز الوراثية . وقد وجد أن الطافرة AV8 كانت الأفضل من حيث جميع الخصائص، مما يضعها في مرتبة مميزة . كما كانت *الطافرات* AV6 ، AV7 ، AV 10 متفوقة بالنسبة لمعظم الصفات . وقد تبين أن الصنف الأبوي بالإضافة إلى الطافرتين AV 3 و AV 11 أسوأ الطافرات كفاءة في هذا المجال .

Introduction

The metroglyph and index score analysis proposed by Anderson (1957) was applied to 11 induced mutants of faba bean (*Vicia faba*) to determine the range of variation for yield and its component characters. This analysis has been used by a number of workers on different crops (Ramanujam and Kumar 1964; Mukherjee et al. 1971; Venkat Rao et al. 1973; Singh and Choudhary 1977).

Materials and Methods

In a study on induced mutagenesis in a local cultivar of *V. faba* using two chemical mutagens, dimethyl sulfate (DES) and ethyl methane sulfonate (EMS), a number of macromutants were isolated (Vandana 1990) of which 11 elite mutants were selected for the present study. The M_3 populations of these mutants were grown in a randomized block design with five replications. Each replicate contained 15 plants in rows 2 m long. Observations on yield and eight component characters – plant height, number of branches, number of leaves, days to flowering, pods/plant, seeds/plant, seeds/pod and test (100-seed) weight – were recorded. Index scores for yield and its components were determined according to the procedure described by Singh and Choudhary (1977) and the pattern of morphological variations in these mutants has been depicted in a scatter diagram in metroglyph analysis as proposed by Anderson (1957).

For index scoring, the range of variability for each character was classified into three groups: 1, 2 and 3, indicating low, medium and high values for the character, respectively. Table 1 summarizes the class intervals on the basis of which the genotypes were assigned to these groups for each character.

Results and Discussion

The mean data of nine characters for the 11 mutants and the control are presented in Table 2 with index scores in parentheses. The total index scores for a particular genotype are summed in the last column. The higher the total index score, the better the performance of the genotype for the character under study. The maximum score possible for any genotype in the present analysis was 27 and the minimum possible score was 9.

The index scores of the 11 genotypes varied from 13 to 26 (Table 2). Mutant AV8, with a total score of 26, was the best performer, closely followed by mutants AV10, AV6 and AV7.

Mutants AV1, AV2, AV4, AV5 and AV9, with total scores ranging from 16 to 20, may be considered to be intermediate in overall performance. Mutants AV3 and AV11, along with the parent strain (control), had the lowest total scores. Thus, these genotypes were comparatively poor performers.

Table 1. Index scores for yield and its components in 11 mutants and the control variety of faba bean.

Character	Range of means	Score 1 Mean <	Score 2 Mean range	Score 3 Mean >
Plant height (cm)	15.40 – 38.40	19.00	19.00 – 30.00	30.00
No. branches	1.50 – 5.88	2.00	2.00 – 3.00	3.00
No. leaves	18.52 – 57.80	25.00	25.00 – 35.00	35.00
Days to flowering†	78.42 – 86.05	82.00	79.00 – 82.00	79.00
No. pods/plant	3.55 – 25.48	5.00	5.00 – 12.00	12.00
No. seeds/plant	8.55 – 63.30	15.00	13.00 – 25.00	25.00
No. seeds/pod	2.13 – 2.65	2.40	2.40 – 2.60	2.60
Seed yield (g/plant)	0.05 – 7.00	1.25	1.25 – 2.25	2.25
Test weight (g)	9.06 – 11.86	10.00	10.00 – 11.00	11.00

† Early types were given score = 3; late types score = 1.

A metroglyph diagram with mean values of grain yield plotted on the X axis and those of plant height on the Y axis is presented in Figure 1. Specific positions on the glyphs and symbols for scores 1, 2 and 3 are shown in Table 1. The figure reveals that mutant AV8 was the most outstanding with the best performance for most of the traits. Mutants AV6, AV7 and AV10 were the other good performers; the remaining mutants and the control variety fell into the same group on the basis of overall performance. However, within these groups there was considerable variation for different traits.

Thus, index scoring and metroglyph analysis of the mutants and control variety has indicated clearly the wide genetic diversity among these genotypes. Dixit (1985) also demonstrates the pattern of morphological variation in 40 elite mutants of lentil using the index scoring method.

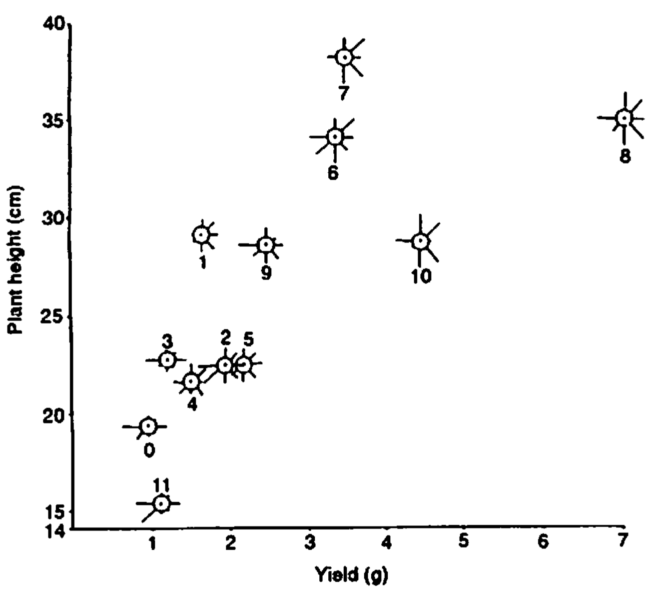

Fig. 1. Metroglyph diagram of induced mutants in *Vicia faba* L.

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Table 2. Mean values† and index scores (in brackets) for various polygenic traits in M_3 generation of 11 elite mutants and the control variety of faba bean.

Genotype	Plant height	Branching	Leaves	Flowering	No. pods/ plant	No. seeds/ plant	No. seeds/ pod	Yield	100-seed weight	Total score
Control	19.04(2)	1.82(1)	18.52(1)	80.07(2)	3.55(1)	8.55(1)	2.42(2)	0.95(1)	11.11(3)	14
AV1	29.26(2)	2.62(2)	32.55(2)	80.07(2)	7.95(2)	17.80(2)	2.13(1)	1.95(2)	9.05(1)	16
AV2	22.42(2)	2.80(2)	32.50(2)	80.50(2)	6.30(2)	16.55(2)	2.73(3)	1.95(2)	11.48(3)	20
AV3	22.74(2)	1.90(1)	23.13(1)	80.52(2)	4.90(1)	11.42(1)	2.28(1)	1.24(1)	11.01(3)	13
AV4	21.68(2)	2.05(2)	26.30(2)	86.05(1)	5.70(2)	14.20(1)	2.51(2)	1.54(2)	10.69(2)	16
AV5	32.50(2)	2.87(2)	34.17(2)	82.72(1)	8.70(2)	21.20(2)	2.45(2)	2.19(2)	9.98(1)	16
AV6	34.30(3)	2.50(2)	35.50(3)	80.25(2)	10.00(2)	28.26(3)	2.40(2)	3.37(3)	11.86(3)	23
AV7	38.40(3)	2.32(2)	35.65(3)	80.32(2)	14.32(3)	32.65(3)	2.27(1)	3.46(3)	10.65(2)	22
AV8	35.42(3)	5.87(3)	77.95(3)	78.42(3)	25.47(3)	63.30(3)	2.45(2)	7.00(3)	11.03(3)	26
AV9	28.78(2)	2.85(2)	22.05(1)	80.05(2)	8.62(2)	21.08(2)	2.40(2)	2.48(3)	11.77(3)	19
AV10	29.08(2)	4.65(3)	57.80(3)	83.60(1)	15.85(3)	37.85(3)	2.34(1)	4.43(3)	11.70(3)	24
AV11	15.40(1)	1.50(1)	22.25(1)	81.50(2)	4.00(1)	10.50(1)	2.65(3)	1.18(1)	11.15(3)	14

† Mean of 25 values, 5 from each of the 5 replicates.

Agronomy and Mechanization

Adoption of Recommended Practices by Faba Bean Farmers in Shendi Area, Sudan

Abdelmoneim T. Ahmed
Agricultural Research Corporation
P.O. Box 126, Wad Medani, SUDAN

Abstract

On-farm research in the northern region of Sudan has shown a potential for improvement in faba bean (*Vicia faba* L.) yield. A package of new technologies and improved practices has been developed and recommended for faba bean farmers of the region. Agronomic data and partial budgeting suggest that the package is potentially a profitable alternative for faba bean farmers. This study examines the behavior and rate of adoption of the package by farmers in the Shendi area of Sudan. The results show that farmers are adopting the recommendations with varying degrees, depending on the components of the package as well as farmers' circumstances.

Key words: *Vicia faba*; faba beans; cultural methods; Sudan.

Introduction

Faba bean is an important food crop in Sudan and is consumed in almost all parts of the country as a main dish in two meals – breakfast and supper (Yousif 1988). Faba bean is also the main cash crop for farmers in the northern region of the country where 98% of the crop is produced. Demand for the crop has been increasing faster than supply and, as a result, real prices have been increasing.

The Nile Valley Regional Program (NVRP), a joint project between the Agricultural Research Corporation (ARC) of Sudan and the International Center for Agricultural Research in the Dry Areas (ICARDA), is working toward improving faba bean yield. A package of improved practices has been developed by the project and recommended for faba bean farmers in the region. The package includes three components: sowing during the first week of November (early sowing); frequent irrigation at intervals of 10–12 days; and pest control. Agronomic data and partial budgeting suggest that the package is potentially a profitable alternative for faba bean farmers in the region (Table 1).

اعتماد مزارعي الفول في منطقة شندي بالسودان للمعاملات الموصى بها

الملخص

كشف بحث أجرى في حقول المزارعين في الإقليم الشمالي من السودان عن إمكانية تحسين غلة الفول (Vicia faba L.) . فلقد تم استنباط مجموعة من التقنيات الجديدة والمعاملات المحسنة وأوصي بها لمزارعي الفول في ذلك الإقليم. وتوحي البيانات الزراعية وخطة الانفاق الجزئية بأن تلك المجموعة تشكل بديلاً مربحاً لمزارعي الفول. ويدرس هذا البحث اسلوب ومعدل اعتماد المجموعة من قبل مزارعي منطقة شندي بالسودان، وتبين النتائج أن المزارعين قد اعتمدوا التوصيات بدرجات متباينة اعتماداً على مكونات المجموعة وظروف المزارعين.

Table 1. Profitability of the faba bean package in the Nile Province, Sudan, 1982/83–1988/89.

Season	Site	Net benefit (LS/ha)†	Marginal rate of return (%)
1983/84	Zeidab	119	159
1984/85	Zeidab	339	390
1984/85	Aliab	661	918
1985/86	Sayal	2445	1825
1986/87	Shendi	2165	1099
1988/89	Wad Hamid	2391	131

† In 1989, US$ 1 = LS 12.1.
Source: ICARDA (1990).

The package has been demonstrated in farmers' fields for several years in the Shendi area, one of the main faba bean producing areas in Sudan. The demonstration was done for verification and as a means of extension to expose the package to farmers.

Objective and Method

The objective of this study was to test the acceptability of the package to farmers and to examine factors that affect adoption rates and behavior. A farm survey was conducted in 1990/91 in the Sayal scheme and private pump schemes around Shendi. A sample of 36 farmers was randomly drawn from two groups of farmers, former participants in on-farm trials or demonstration plots (54% of the sample), and non-participants (46%). The stratification was made to demonstrate the effectiveness of the demonstration program. Farmers were asked if they had adopted the package or any of its individual components that season or previously.

Adoption of Recommendations

The survey showed a moderate rate of adoption of the whole package and higher adoption rates for individual components. These results are summarized in Table 2.

Table 2. Adoption of the recommended practices, 1990/91.

Practice	Used in 1990/91 (%)	Ever used (%)
Whole package	41	–
Sowing date	69	>69
Frequent irrigation	50	84
Pest control	92	85

About 41% of the sample adopted the whole package. For the sowing time, over 68% of the farmers in the sample planted their crop during the recommended period. This was a high rate for the 1990/91 season because of warm temperatures around sowing time. A number of farmers who have not sown during the recommended time indicated that this was not the optimal time. For the recommended irrigation regime, two levels were defined. These are, 7 or 8 irrigations to represent the recommended level, and 6 or fewer irrigations for traditional practices. The level of 7 and 8 irrigations is lower than the recommended level of 10 to 12, but it is the highest level given by farmers. It is regarded as a medium level of the recommended regime. Only 50% of the farmers adopted the recommended level; however, 85% indicated that they have used or adopted the optimal level before. This is an indication that the adoption rate of this component is relatively high and cannot be judged by the results of one season. Only one farmer indicated that frequent irrigation is harmful for the crop around flowering *time*. There was a widely held belief among farmers that subjecting the crop to water stress at flowering has a positive response on yield (Salkini et al. 1983). Pest control was adopted by 72% of the farmers in this season. However, a higher percentage of farmers are actually using this technology when needed since 85% of the sample have adopted it before.

Explaining Adoption

Although the adoption rates of the recommendations were relatively high, there are still some farmers who do not adopt one or more components of the recommended package. The rates and behavior of adoption can be attributed to factors such as the degree of the farmer–extension contact and farmers' characteristics and circumstances which affect their receptiveness to that extension program.

Extension

Effectiveness of the demonstration program and its success in exposing the recommendation to a widespread group of farmers is an important issue that this study attempted to address. To do so the sample was taken from two groups of farmers, former participants in on-farm trials and demonstration plots, and non-participants.

The results show that, except for the pest control, participants' adoption rates were substantially higher than those of the non-participants. The whole package was adopted by 71% of the participants and only 7% of the non-participants. The adoption rates of the sowing date recommendation were 89 and 43% for the participants and non-participants, respectively. For the irrigation regime, 77% of the participants adopted the recommendation compared with 20% of the non-participants. Pest control was highly adopted by both groups with a 100% adoption by non-participants. Except for the pest control recommendation, it is evident that there is a difference in the two groups' acceptance of the recommendations. This difference was tested using Chi-square statistics and was significant for all components except pest control.

Characteristics of Farmers

Another factor that could affect adoption behavior is the characteristics and circumstances of farmers, which can affect the degree of their receptiveness of the extension program. This factor was addressed by drawing the sample from two different farming systems, a public scheme and a private scheme. The adoption rates of the two types of farmers are given in Table 3.

Table 3. Adoption of recommendations by farming system, 1990/91.

Item	Public scheme (%)	Private scheme (%)
Whole package	57	0
Sowing date	74	56
Irrigation regime	57	33
Pest control	100	75

The results show that the adoption rates for tenants of the public scheme were relatively higher than those of the private farmers. No private farmer adopted the whole package whereas 57% of tenants did. More tenant farmers than private farmers adopted the pest control. More tenant farmers adopted sowing date and irrigation, but the differences were not as great as for the whole package. The difference in the adoption behavior between the two systems was tested using a Chi-square test, and was found to be significant for the whole package and for pest control, but not statistically significant for the acceptability of irrigation and sowing date recommendations by the two types of producers.

Conclusions

This study examined the adoption of recommended faba bean practices in the Shendi area by two groups of farmers in two farming systems. The results reveal that farmers are adopting the package, not completely but gradually, either by testing the practices one at a time or by modifying them to fit their circumstances. The least adopted component of the package is the frequent irrigation regime and adopters are giving no more than eight irrigations, which is below the recommended *level.*

The results also show significant differences in the adoption rates of former participants and non-participants. This may suggest the need for improvement of our demonstration program so that the recommendations reach more farmers. Also, more adoption of the components took place in public schemes than in private ones. This was probably because private schemes are widely dispersed and have weak contacts with the extension and other agricultural service departments. Therefore, more extension effort is needed for that system. This can be done by using demonstration plots and organizing field days and visits for farmers so that a large number of farmers can be exposed to these plots.

In conclusion it must be recognized that the research and extension efforts of the Nile Valley Regional Program are paying off. The indications are that farmers are adopting the recommendations in increasing numbers. However, further research and investigation should continue in some existing components and new factors so that stable, higher yields can be achieved.

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Growth and yield of faba bean at different plant densities

P.R. Gurung and T.B. Katwal
Agriculture Research Centre
Department of Agriculture
Yusipang, BHUTAN

Abstract

An experiment was conducted to evaluate the effect of different plant densities (19, 33, 41, 60 and 110 plants/m²) on the growth, pod yield and dry matter production of a local faba bean (*Vicia faba* L.) variety. The experiment was conducted at Yusipang (2700 m), Bhutan in the 1992 growing season. Fresh weight and dry matter production increased with an increase in plant population. Closer spacing also increased lodging.

Key words: *Vicia faba*; faba beans; plant population; yields; plant habit; Bhutan.

نمو وغلة الفول في كثافات نباتية مختلفة

الملخص

أجريت تجربة لتقييم تأثير كثافات نباتية متعددة (19، 33، 41، 60 و 110 نبتات/م2) على نمو صنف محلي من الفول وغلة من القرون وإنتاجه من المادة الجافة. وقد نفذت التجربة في يوسيبانغ (2700 م)، بهوتان، في الموسم الزراعي 1992. وقد تزايد الوزن الطازج وإنتاج المادة الجافة مع تزايد الكثافة النباتية، كما أنه كلما ضاقت المسافة بين السطور زاد الرقاد.

Introduction

The kingdom of Bhutan, with a surface area of 46,500 km², lies between latitudes 26°45' and 28°10' N and longitudes 88°45' and 92°10' E. This land-locked country shares its northern border with the Tibetan autonomous state of China and its southern border with the Indian sub-continent. Bhutan is an agrarian country with almost 95% of the population engaged in agriculture or related activities.

Inherent low soil fertility is a major problem in most of the areas and a continuous input of organic matter, nitrogen and phosphorus is essential to sustain yield. A possible low-cost input to maintain soil fertility would be to exploit the use of green-manure crops. The choice of suitable green-manure crops for the highlands of Bhutan, however, remains limited. Potential crops identified are white clover (*Trifolium repens* L.), vetch (*Vicia villosa* Roth) and big trefoil (*Lotus uliginosus* Schkuhr). The seed potato multiplication farm at Phubjikha (2900 m) grows pearl lupin (*Lupinus mutabilis* Sweet) in rotation with potato mainly as a green-manure crop. Of the many lupin species tested, pearl lupin excelled in biomass production. However, owing to the problems in oil extraction and its high alkaloid content, the crop has not been accepted by farmers. Moreover, the solid lupin stems decompose very slowly and it is, therefore, difficult to incorporate the plant parts into the soil.

Faba bean is another green-manure crop that is well adapted to climatic conditions in the temperate regions of Bhutan. Though confined to kitchen gardens, it is an important source of protein for both people and livestock. Since it is a legume, it can be grown in rotation with potato to maintain or enhance soil fertility. This crop would be more acceptable to farmers than lupin since its grains are edible and the plant parts could be used as livestock feed or as green manure.

The biomass production of faba bean is lower than pearl lupin (Annual Report, ARC, 1991). However, if planted at an optimum plant density, the grain yield and biomass production could be increased substantially. Therefore, a trial was conducted to establish the optimum plant density required to increase pod yield, fresh weight and dry matter production.

Materials and Methods

The trial was planted on 17 March 1992 at the Agriculture Research Centre, Yusipang. The experiment had a randomized complete block design with six replications. A local variety of faba bean was planted at five different plant densities. The plot size was 10.8 m², with 12 rows (3 m long) spaced 0.3 m apart. The intra-row spacings varied according to the plant density. Fertilizer was applied in the rows at the rate of 0–80–20 N–P–K kg/ha. Fresh weight and pods/plant were recorded from ten plants randomly selected from the ten center rows. These plants were then oven-dried to record their dry matter content. Total pod yield was recorded from the ten center rows. Observations on plant height and degree of lodging were also taken. The treatments consisted of the following plant densities:

Within-row spacing (cm)	Plants/m²
17	19
10	33
8	41
5	60
3	110

Results and Discussion

Significant differences in dry matter production were observed, with the closer spacing recording the highest weight (Table 1). The trend in dry matter production was similar to that for pod yield; however, the differences in pod yield were not significant. The yield of fresh weight of the plants increased significantly with the densely planted plots giving the highest yield.

Table 1. Fresh weight yield, dry matter content and pod yield for the different treatments of faba bean.

Treatment	Fresh weight (t/ha)	DM content (t/ha)	Pod yield (t/ha)
19 plants/m²	29.05	5.62	17.16
33 plants/m²	41.65	10.97	20.33
41 plants/m²	67.63	13.48	20.57
60 plants/m²	72.50	12.78	21.16
110 plants/m²	109.98	19.00	23.04
CV(%)	24	18	21
LSD (0.05)	-	3.325	6.52

Observations on lodging indicated that closer spacing favored lodging (Table 2). The data on lodging may not be reliable, however, since a very high variance was observed. The data on pods/ten plants were not consistent, although the highest number was recorded in the plots where the plants were spaced furthest. Plant height was greatest for the larger spacings, although not significantly.

Table 2. Observations on plant height, lodging and number of pods per ten plants of faba bean.

Treatment	Plant height (cm)	Lodging score†	Pods/ten plants
19 plants/m²	155.65	1.26	246.75
33 plants/m²	146.23	1.51	165.50
41 plants/m²	155.58	1.76	199.00
60 plants/m²	152.83	2.76	127.00
110 plants/m²	145.45	4.51	148.25
CV(%)	10	54	14
LSD (0.05)	-	1.974	-

† 1 = No lodging, 10 = Whole plot lodged.

Conclusions

The trial indicates that to maximize pod yield, fresh weight and dry matter production, faba bean should be planted at closer spacings (110 plants/m²) for conditions similar to those at Yusipang. Too close spacing may, however, induce lodging and therefore a reduction in the final yield.

Pests and Diseases

Effect of Fusarium spp. on Faba Bean Seeds During Germination

Endre I. Simay[1]
Agrobotanikai Központ
[Research Centre for Agricultural Botany]
H-2766 Tápiószele, HUNGARY

Summary

Several *Fusarium* species are known to infect the seeds of faba bean (*Vicia faba* L.). These may inhibit germination or cause seedling rot. Twenty-nine isolates of 11 species were tested on germinating faba bean seeds with rates of seedling emergence, seedling rot before emergence and rotted seeds recorded. Although fusaria originated from both homologous and heterologous hosts, emergence from infected seeds remained under 70%. Among isolates from *Vicia faba*, germination was affected least by *F. pallidoroseum* and most by *F. oxysporum*, but reactions varied greatly.

Key words: *Vicia faba*; faba beans; *Fusarium*; germination; seed pathology.

Introduction

Fusaria are well-known saprophytic plant pathogens on different hosts, including faba bean (Salt 1983; Bao and Wang 1991; Zakrzewska and Oleksiak 1992). Some of them are also known from seeds of this host (Simay 1992a) or from plant residues (debris) (Simay 1992b). Because fungi can infect seedlings from both seed and soil, we tested pure isolates of *Fusarium* spp. from different hosts on germinating seeds of faba bean.

Material and Methods

Twenty-nine isolates of 11 *Fusarium* species were investigated. These were obtained from different hosts from the collection of the Phytopathological Laboratory of Research Centre for Agricultural Botany, Tápiószele

[1] Present address: Gyümölcs és Dísznövénytermesztési Kutató Fejlesztő Vállalat [Enterprise for Extension and Research in Fruit Growing and Ornamentals], H-1775 Budapest, P.O. Box 108, HUNGARY.

تأثير *Fusarium spp.* على بذور الفول خلال الإنبات

من المعروف أن عدة أنواع من الفيوزاريوم تصيب بذور الفول (Vicia faba L.)، وقد تكبح هذه الإصابة الإنبات أو تسبب تعفن البادرات. تم اختبار 29 عزلة من 11 نوعاً على بذور فول نابتة ذات معدلات مختلفة في تكشف البادرات، وتم تسجيل تعفن البادرات قبل ظهورها، والبذور المتعفنة. ورغم أن أنواع الفيوزاريوم تتحدر من عوائل متماثلة أو متغايرة التركيب، بقي تكشف البادرات في البذور المصابة دون 70٪. ومن بين العزلات على نباتات الفول كانت *F.Pallidoraseum* أقلها تأثيراً على الإنبات في حين كانت *F.oxysporum* أكثرها تأثيراً، إلا أن التفاعلات كانت شديدة التباين.

(Table 1). Effects of fusaria were studied on germinating seeds of faba bean harvested in 1986 with endogenous *Fusarium* infection less than 1%.

Three-week-old cultures of fungi grown on a mixture of perlite (volcanic mineral) and coarse meal (1:1) were combined with heat-sterilized perlite to accomplish infection of potting media. Seeds of faba bean cv. 'Bakony I' were surface sterilized by NaOCl (10%) and rinsed with sterilized distilled water. After that 25-25 seeds were sown in 4 replicates in the infected perlite.

Emergence of seedlings was recorded after two weeks. Data of pre-emergence seedling rot and number of rotted seeds without developed germlings were also recorded. Seed samples were also sown in uninfected perlite as a control. The investigations were carried out at the Research Centre for Agricultural Botany.

Results and Discussion

Emergence of seedlings from the infected substrate varied between isolates, as did rates for rotted seedlings and rotted seeds (Table 2). The tested fusaria are common in

Table 1. Isolates of *Fusarium* species tested on faba bean seeds.

Species	Isolate no.	Original host/substrate
Fusarium avenaceum (Corda ex Fr.) Sacc.	AI271	*Vicia faba* L./seed
F. avenaceum	AI60	*Zea mays* L./–†
F. culmorum (W.G.Sm.) Sacc.	AI414	*Basella alba* L./stem base
F. culmorum	AI413	*Vicia faba*/seed
F. culmorum	AI65	*Zea mays*/–
F. equiseti (Corda) Sacc.	AI164	*Cicer arietinum* L./–
F. equiseti	AI184	*Helianthus tuberosus* L./tuber
F. equiseti	AI302	*Hordeum vulgare* L./seed
F. equiseti	AI289	*Vicia faba*/phylloplane
F. graminearum Schw.	AI303	*Hordeum vulgare*/seed
F. graminearum	AI232	*Triticum aestivum* L./seed
F. oxysporum Schlecht. em. Snyd. & Hasn. f.sp. *callistephi* (Beach) Snyd. & Hasn.	AI140	*Callistephus chinensis* (L.) Nees/–
F. oxysporum	AI257	*Capsicum annuum* L./seed
F. oxysporum	AI308	*Helianthus tuberosus*/tuber
F. oxysporum	AI300	*Hordeum vulgare*/seed
F. oxysporum	AI222	*Vicia faba*/seed
F. oxysporum	AI291	*V. faba*/phylloplane
F. oxysporum	AI292	*V. faba*/phylloplane
F. oxysporum	AI294	*V. faba*/stem base
F. oxysporum	AI295	*V. faba*/stem base
F. pallidoroseum (Cooke) Sacc.	AI290	*V. faba*/phylloplane
F. sacchari var. *subglutinans* Wollenw. & Reink.) Nirenb.	AI270	*Chamacereus silvestri* (Speg.) Br. & R./phyllopane
F. solani (Mart.) Sacc. em. Snyd. & Hans. *p.p.*	AI307	*Capsicum annuum*/seed
F. solani	AI286	*Helianthus annuus* L./stem base
F. tricinctum (Corda) Sacc.	AI301	*Hordeum vulgare*/seed
F. ventricosum Appel & Wollenweber	AI280	*Foeniculum vulgare* Mill./phylloplane
F. verticillioides (Sacc.) Nirenberg	AI305	*Capsicum annuum*/seed
F. verticillioides	AI306	*C. annuum*/seed
F. verticillioides	AI67	*Zea mays*/–

† Data about source substrate for some older isolates not available.

Table 2. Rates of emergence of seedlings, pre-emergence rot and seed rot caused by fusaria.

Isolate		Emergence (%)	Pre-emergence rot (%)	Seed rot (%)
AI271	*F. avenaceum*	42	45	13
AI60		37	38	25
AI414	*F. culmorum*	42	40	18
AI413		44	35	21
AI65		48	31	21
AI164	*F. equiseti*	52	18	30
AI184		62	24	14
AI302		55	35	10
AI289		31	36	33
AI303	*F. graminearum*	58	18	24
AI232		40	45	15
AI140	*F. oxysporum*	46	44	10
AI257		33	48	19
AI308		30	51	19
AI300		35	46	19
AI222		11	38	51
AI291		26	36	38
AI292		31	45	24
AI294		27	35	38
AI295		31	36	33
AI290	*F. pallidoroseum*	64	21	15
AI270	*F. sacchari* var. *subglutinans*	57	38	5
AI307	*F. solani*	48	44	8
AI286		40	43	17
AI301	*F. tricinctum*	27	24	49
AI280	*F. ventricosum*	50	35	15
AI305	*F. verticillioides*	25	37	38
AI306		28	35	37
AI67		20	59	21
Control	(mean of 3 replicates)	92.3	3	2.7†

† Some seeds remained hard and symptomless, while rots were caused by *Alternaria*, *Phoma*, *Stemphylium* and *Trichotecium*.

soils (Domsch et al. 1980), and several of them are known to occur on faba bean seeds (Simay 1992a). An isolate of *Fusarium oxysporum* (A1222) was most effective against emergence and 51 seeds of 100 tested were inhibited in germination when sown with this fungus. The other isolates of this fungus, including those isolated from rotted stem bases of wilted plants, caused similar effects to other *Fusarium* species. *F. oxysporum* f. sp. *fabae* is possibly seed transmitted endogenously in seeds of *Vicia faba*. This suggests that the seed-transmissible *F. oxysporum* f.sp. *fabae* might be adapted to seed infection, since the A1222 isolate caused disease on plants, too (Simay 1986). This disease was wilt and root rot developed on seedlings.

F. tricinctum and *F. verticillioides* (=*F. moniliforme* p.p.) also inhibited emergence, but the rate of rotted seeds was higher with *F. tricinctum*, which significantly retarded germination. All isolates of these fungi originated from heterologous hosts, both from dicotyledons and monocotyledons.

Some fungi moderately inhibited the germination process, but germlings were rotted before emergence. Rates of pre-emergence rot were similar to emerged seedlings for most isolates. However, roots of emerged seedlings were also affected in some cases. This effect on roots was non-specific for fungal species. Least effective fungi were the rather saprophytic *F. pallidoroseum* (=*F. semitectum*) from the phylloplane of *V. faba*, *F. equiseti* from the tuber of *Helianthus tuberosus* and *F. graminearum* from the seed of *Hordeum vulgare*. The number of ungerminated, rotted seeds was also low in perlite infected with *F. sacchari* var. *subglutinans* (=*F. moniliforme* var. *subglutinans*) and an isolate of *F. solani*, but the pre-emergence rot was relatively high.

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Efficacy of Fungicides Against *Ascochyta fabae*

كفاءة المبيدات الفطرية في مقاومة لفحة الأسكوكيتا

S. Rahat[1], S.M. Iqbal[2], C.A. Rauf[1] and S. Hussain[2]

[1] *Barani Agricultural College, Rawalpindi, PAKISTAN*
[2] *National Agricultural Research Centre, Islamabad, PAKISTAN*

Abstract

The efficacy of nine fungicides (benomyl, captan, copper oxychloride, chlorothalonil, maneb + zineb, metalaxyl, thiabendazole, sulfur and thiophanate-methyl) was tested *in vitro* against *Ascochyta fabae* Speg. by the poisoned-food technique. Captan, chlorothalonil and metalaxyl were the most effective and significantly suppressed the mycelial growth of the fungus at all the concentrations, i.e. 50, 100 and 150 p.p.m. Maneb + zineb, thiabendazole and thiophanate-methyl exhibited intermediate effectiveness against the pathogen.

Key words: *Vicia faba*; faba beans; disease control; ascochyta; fungicides.

الملخص

اختبرت كفاءة 9 مبيدات فطرية، هي: (benomyl, captan, copper oxychloride, chlorothalonil, maneb + zineb, metalaxyl, thiabendazole, sulfur, thiophanate - methyl) في المختبر إزاء *Ascochyta fabae* speg. بطريقة الغذاء المسموم. وقد تبين أن الـ Chlorothalonil ، captan و metalaxyl كانت أكثر المبيدات فعالية، وكبحت إلى حد كبير نمو الغصينات الفطرية تحت جميع التراكيز، أي 50 ، 100 و 150 جزء بالمليون، في حين أظهرت Maneb + zineb ، thiabendazole و Thiophanate - methyl فعالية متوسطة ضد المسبب المرضي.

Introduction

Ascochyta fabae causes leaf spot disease of faba bean (*Vicia faba* L.) described by Carruthers (1899) and Spegazzini (1899). The disease has been reported in almost all faba bean growing areas of the world (Moore 1943; Hewett 1966; Gaunt et al. 1978); it has been reported in Pakistan by Khan et al. (1983). Its endemic outbreak may cause heavy or even a total loss of yield.

Some degree of resistance in faba bean genotypes has been reported from Russia and neighboring countries (Trychenko 1963; Papoyan 1970; Sestiperova and Timofeev 1970; Yartiev and Kashmanova 1975). Bond and Pope (1980) in Britain also observed a degree of resistance in some genotypes, although the results were variable and could be explained by other influences. In Canada, Kharbanda and Bernier (1979) observed that some varieties were less susceptible than others in untreated plots of fungicide evaluation trials. Some commercial cultivars have been found particularly resistant to some isolates of the pathogens (Kharbanda and Bernier 1980). Fungicides have been tested over a number of years both as seed treatments and foliar sprays as a means of controlling *A. fabae*. In the present study some fungicides were evaluated against *A. fabae*.

Materials and Methods

The fungus was isolated from infected stems of faba bean on potato dextrose agar (PDA) medium, then purified and multiplied on chickpea seed meal agar (CSMA) medium. The efficacy of nine fungicides – Benlate (benomyl), captan, Cobox (copper oxychloride), Daconil (chlorothalonil), Liro Manzeb (maneb + zineb), Ridomil (metalaxyl), Thiovit (micronized wettable sulfur powder), Tecto-60 (thiabendazole) and Topsin-M (thiophanate-methyl) – were tested by the poisoned-food technique (Nene and Thapliyal 1979). Each fungicide was mixed separately at 50, 100 and 150 p.p.m. in autoclaved melted CSMA medium to obtain the required concentration. Poisoned melted medium (20 ml) was then poured into each sterilized plate and allowed to solidify. The CSMA medium without fungicide served as the control. After solidification, 4-mm agar plugs were placed in the center of the plates. Five plates were used per treatment and incubated at 20 ± 2°C. Growth inhibition rate was recorded after incubation for seven days. Percentage inhibition was calculated according to Vincent (1947).

Results and Discussion

The tested fungicides showed different fungitoxicities against *A. fabae* at all concentrations (Table 1). There was a significant decrease in mycelial growth of the fungus with increased concentration for each fungicide. This fungus was most sensitive to captan, Daconil and Ridomil, and least sensitive to Thiovit and Cobox, while it showed

Table 1. Effect of different fungicides on the mycelial growth of *Ascochyta fabae*.

Treatment	50 p.p.m.		100 p.p.m.		150 p.p.m.	
	Radial growth (mm)	Decrease over control (%)	Radial growth (mm)	Decrease over control (%)	Radial growth (mm)	Decrease over control (%)
Liro Manzeb	21.2 de	76.4	16.8 d	81.3	11.8 de	86.9
Tecto-60	28.2 cd	68.7	23.4 d	74.0	21.8 d	75.8
Topsin-M	34.8 c	61.3	26.0 d	71.1	19.4 d	78.4
Ridomil	18.8 de	79.1	14.2 d	84.2	11.6 de	87.1
Thiovit	84.0 ab	6.7	72.4 b	19.6	64.2 b	28.7
Benlate	26.4 cde	70.7	26.0 d	71.1	24.2 d	73.1
Captan	0.00 f	100.0	00.0 e	100.0	00.0 e	100.0
Cobox	78.6 b	12.7	60.8 c	32.4	45.0 c	50.0
Daconil	16.2 e	82.0	18.2 d	79.8	00.0 e	100.0
Control	90.0 a	–	90.0 a	–	90.0 a	–

Figures within columns and rows having the same letters are not significantly different at the 5% level.

intermediate sensitivity to Liro Manzeb, Benlate, Tecto-60 and Topsin-M. Complete inhibition of mycelial growth was observed with captan at all concentrations. Daconil completely inhibited fungal growth only at the highest concentration.

Several reports have been published about the effectiveness of fungicides. Kharbanda and Bernier (1979) report that the systemic fungicides benomyl and thiabendazole effectively controlled seed-borne *A. fabae*. Similarly, Liew and Gaunt (1980) report that disease incidence in the field was reduced by seed treatment with benomyl and H-2161, with some evidence for control by captan and thiram when assessed 28 and 56 days after emergence. Maude and Kyle (1971) note a similar result. Captan reduced levels of disease and significantly increased yield with an initial infection level of 8% (Gaunt and Liew 1981; Liew 1981). When captan and Daconil were used, mycelial growth was completely reduced. Results with Daconil coincide with those for ascochyta blight of lentil (Iqbal et al. 1989) and anthracnose of mungbean (Bashir et al. 1985).

In the present study, all the fungicides were effective against *A. fabae in vitro*. Its possible use for reducing transmission and establishment of disease from infected seed needs further investigation.

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Pathogenicity of *Myrothecium roridum* Tode ex Tr. on Faba Bean

Endre I. Simay

Agrobotanikai Központ
[Research Centre for Agricultural Botany]
H-2766 Tápiószele, HUNGARY

Abstract

Myrothecium roridum **was isolated from different substrates and pathogenicity of isolates was studied on faba bean (*Vicia faba* L.). The isolates originated from both healthy and diseased leaves of *Vicia faba*, and diseased leaves of *Vigna unguiculata* Walp.; their pathogenicity was investigated on artificially infected leaves of faba bean. All the isolates could infect faba bean leaves in the greenhouse; occurrence of the fungus on symptomless leaves was also detectable by incubating them in moisture chambers.**

القدرة الإمراضية للفطر *Myrothecium roridum* Tode ex Tr. على الفول

الملخص

عزل الفطر *Myrothecium roridum* من مواد خاضعة مختلفة، ودرست القدرة الإمراضية للعزلات على الفول. نشأت العزلات على أوراق سليمة ومريضة لنباتات الفول وعلى أوراق مريضة من *Vigna unguiculata* Walp. وقد تمت دراسة القدرة الإمراضية لتلك العزلات على أوراق مصابة اصطناعياً. واستطاعت جميع العزلات أن تعدي أوراق الفول في الدفينة، كما تم اكتشاف وجود الفطر على أوراق الخالية من الاعراض وذلك بعد وضعها في حاضنات غرف التبريد.

Key words: *Vicia faba*; *Vigna unguiculata*; faba beans; myrothecium; pathogenicity; Hungary.

[1] Present address: Gyümölcs és Dísznövénytermesztési Kutató Fejlesztő Vállalat [Enterprise for Extension and Research in Fruit Growing and Ornamentals], H-1775 Budapest, P.O. Box 108, HUNGARY.

Introduction

Myrothecium roridum is a rather common fungus species found on different substrates (Domsch et al. 1980). It occurs on several different species, too, invading leaves, seeds and other parts. On leaves it causes leaf spots (Brooks 1945; Cunfer et al. 1969; Nguyen et al. 1973; Nyvall 1979). It is also often observed in the phylloplane of plants, and Dickinson (1976) suggests a possible pre-incubating phase in the phylloplane before pathogenesis. On seeds, *M. roridum* has a pathogenic role (Neergaard 1979), and its toxins (the roridines) might be toxic to animals (Ueno 1985, 1986). The fungus was isolated from leaf spots and also from the phylloplane of *V. faba* in Hungary (Simay 1988, 1991). The aim of this paper is to present the results of pathogenicity tests of isolates from different sources, including *Vicia faba*.

Material and Methods

Myrothecium roridum was isolated from plant materials collected from experimental fields of the Research Centre for Agricultural Botany (formerly the I.A.Q. Research Centre). Sources were diseased, spotted leaves of cowpea (*Vigna unguiculata*) and both spotted and symptomless leaves of *Vicia faba*. The pathogen was isolated from symptomless faba bean during an earlier investigation of fungi in the phylloplane (Simay 1988). Conidia for pathological tests were harvested from pure cultures maintained on Leonian's agar medium. Five-leaved faba bean plants were sprayed with conidial suspensions of 5×10^5 conidia/ml.

The infected plants of faba bean cv. 'Bakony 1' were covered with polyethylene tents for 72 hours. Leaves with and without symptoms were collected from inoculated plants after one week, and were incubated in moisture chambers until sporulation. The occurrence of the fungus was detected by developing sporodochia on leaves.

Results and Discussion

All isolates tested caused disease on faba bean leaves in the greenhouse. However the symptoms and their development were slightly different. Symptoms were reddish spots on leaves similar to earlier observations (Simay 1991). These spots were larger with isolates from diseased faba bean leaves. These isolates caused the development of white, non-sporulating sporodochia on leaves in the greenhouse. The sporodochia developed after a week in the spots which had become large and blackish. These symptoms were similar to the field symptoms of the same isolates.

Isolates from symptomless faba bean leaves and from diseased cowpea leaves caused red pin-spots only, or larger reddish spots with a blackening center, although some leaves remained symptomless. However, *M. roridum* was re-isolated from these apparently uninfected leaves. Both pin-spotted and unspotted leaves collected and incubated in a moisture chamber became black-spotted, and white sporodochia covered with a green conidial mass developed in black rotting lesions after some days. The incubation of leaves infected with isolates from diseased faba bean had a similar effect. All isolates sporulated more abundantly on senescent leaves collected from the lower parts of the plants.

The pathogenicity of *M. roridum* is well known on several hosts, but Gaunt (1983) does not list it among leaf pathogens of faba bean. It is also common in the phylloplane of plants, but there is little information about the pathogenicity of phylloplane-inhabiting forms of the fungus, or host specialization which is known in other fungi.

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Yield Loss of Faba Bean Caused by Foot Rot (*Fusarium avenaceum*)

Dereje Gorfu
Holetta Agricultural Research Center
P.O. Box 2003, Addis Abeba, ETHIOPIA

Abstract

Yield loss of faba bean (*Vicia faba* L.) due to foot rot disease caused by *Fusarium avenaceum* (Corda ex Fr.) Sacc. was assessed from a faba bean field grown with improved cultivar CS 20DK in the 1993 crop season at Holetta, Ethiopia. The single-tiller technique was used to generate this information. Seed yield per tiller decreased from 15.9 to 1.3 g when foot rot increased from 0 to 5, on a 0–5 rating scale. A mean yield loss of 48.7% was obtained ranging from 34.6 to 91.7% depending on foot rot severity. Among yield components, pods/tiller, seeds/tiller and 100-seed weight similarly decreased with the increase in foot rot severity. However, seeds/pod was not affected. Hence root rot mainly affected pod set and seed size. Regression of seed yield (dependent variable) on foot rot score (independent variable) gave a significant linear relationship, i.e. yield = 14.8 – {2.631 × (foot rot score)}, with R^2 = 96% and r = –0.980. Similarly, percentage yield loss (dependent variable) was regressed on foot rot severity score (independent variable) producing a linear relationship: Percentage yield loss = 9.8 + {16.5 × (foot rot score)}, with R^2 = 96% and r = 0.98**, which are highly significant, suggesting that foot rot can cause considerable yield loss to faba bean.**

Key words: *Vicia faba*; faba beans; root rots; *Fusarium*; yields; Ethiopia.

خسارة غلة الفول التي يسببها تعفن القدم
(Fusarium avenaceum)

الملخص

قُيمت خسارة غلة الفول الناجمة عن الإصابة بمرض تعفن القدم الذي يسببه *Fusarium avenaceum* (Fr.) sacc. ، في حقل مزروع بصنف فول محسن CS-20-DK وذلك في الموسم الزراعي 1993 في هوليتا بإثيوبيا. واستخدمت تقنية الشطء الوحيد لجمع هذه المعلومات. انخفضت الغلة البذرية لكل شطء من 15.9 إلى 1.3 غ بعد أن ازداد تعفن القدم من 0 إلى 5 على مقياس مدرج من 0 إلى 5. بلغ متوسط الخسارة في الغلة 48.7٪، إذ تراوحت بين 34.6 إلى 91.7٪ تبعاً لشدة المرض. كما تناقصت بعض مكونات الغلة: القرون/الشطء، البذور/الشطء، ووزن المئة بذرة، بازدياد شدة تعفن القدم، غير أن البذور/القرن لم تتأثر بها. لذلك أثر تعفن القدم بشكل رئيسي على تشكل القرون وحجم البذور. أعطى انحدار الغلة البذرية (وهو متغير تابع) على درجة الإصابة بتعفن القدم (وهي متغير متبوع) علاقة خطية معنوية، أي: الغلة 14.8–{ (درجة الإصابة بتعفن القدم) x 2.631 } مع 96٪ = R2 و **0.980 – = r. وعلى غرار ذلك، تراجعت النسبة المئوية للخسارة في الغلة (وهي متغير تابع) على درجة شدة الإصابة بتعفن القدم مما أعطى هذه العلاقة الخطية: النسبة المئوية لخسارة الغلة = 9.8 + { (درجة الإصابة بتعفن القدم) x 16.5} مع 96٪ = R2 و **0.98 = r، وهي معنوية للغاية مما يوحي بقدرة مرض تعفن القدم على إلحاق خسارة كبيرة بغلة الفول.

Introduction

Foot rot of faba bean in Ethiopia is caused by *Fusarium avenaceum* (Yitbarek 1983; Dereje 1994). This disease affects faba bean plants at the stem base, from the ground level to about one-third of the plant height (Dereje 1994). Obvious symptoms are wilting, premature death, lodging and stem breakage, and seriously diseased plants are mostly podless. Despite these obvious symptoms on faba bean, there was no information on the yield losses caused by the disease.

Yield loss assessment was done in the 1993 cropping season taking advantage of the serious foot rot infection of faba bean at Holetta Agricultural Research Centre. The assessment was done using the single-tiller technique. Many workers have used this technique to assess yield-loss relationships. Richardson et al. (1975), King (1976) and Richardson (1981) used it for several foliar and foot or root diseases. Also, FAO (1971) and Scott et al. (1978) used this technique to assess the yield loss of wheat due to eyespot. This disease (eyespot) causes similar damage to wheat as that caused by foot rot on faba bean.

The present work presents and discusses yield loss of faba bean caused by foot rot using the single-tiller technique.

Materials and Methods

An improved faba bean cultivar, CS 20DK, that was planted for increase, was used for this loss-assessment study. The crop was sown on 18 June 1993. Recommended agronomic practices were followed to raise the crop (Beniwal 1988). As this season had higher rainfall than usual, severe foot rot developed in all trial and production fields at Holetta Agricultural Research Centre. This was taken advantage of to assess the yield loss caused by disease, which is increasing at the Centre.

On 25 September, plants having a typical foot rot infection score were tagged using threads of different colors. The growth stage of the crop plants on that day was G-7 (FAO 1971). The foot rot scoring scale used was based on that of Clarkson (1978) with slight modifications (Table 1).

In addition to the tagged plants, each of the remaining plants was categorized into one of the rating scores and all the necessary data were collected, assessed and determined. From those tagged and grouped plants, assessment of number of pods, number of seeds and seeds per pod was done at maturity. One hundred and sixty plants in each category were used to generate the data. These plants were hand-threshed and weighed to determine seed yield per plant and 100-seed weight after sun-drying for one week.

The data were subjected to analysis of variance where means were separated using Duncan's Multiple Range Test. Furthermore, seed yield per plant and percentage yield loss were regressed on foot rot severity score.

Percentage yield loss was determined on the basis of yield of healthy plants using the following formula:

$$\text{Yield loss, YL (\%)} = \frac{Y^H - Y^D}{Y^H} * 100$$

where Y^H = yield of healthy plants, Y^D = yield of diseased plants for each foot rot severity score, and YL = yield loss (%).

The results were interpreted in accordance with the behavior of the disease and statistical parameters obtained by analysis.

Table 1. Foot rot scoring scale used in this study.

Disease rating	Severity	Disease symptoms
0	Healthy	None
1	Trace	One, small, dark lesion about 3 cm long on the stem base (foot)
2	Slight	Two to three large lesions on the foot of the plant
3	Moderate	About half of the foot part (*c.*10 cm) with large lesions, lower leaves with dark necrosis or starting to dry, orange color fructification started at the lesion center
4	Severe	Most of the foot infected, lesions with abundant sporulation, 5 lower leaves fully necrotic
5	Dead	One-third of the lower part of the stems totally infected, complete collapse of the plant and wilting

Results and Discussion

The incidence of foot rot was fairly uniform throughout the field; only a few portions of the field were without infection. When each tiller was assessed and grouped into the six severity scores, there were plants in each of the severity score groups. Score 3 (moderate) was the most frequent value. The mean infection for the field was 2.63, slightly more than the average score in the scale.

A summary of the yield and yield-component data is given in Table 2. Seed yield/tiller decreased from 15.9 to 1.3 g when foot rot increased from 0 to 5 (Table 2). Similarly, pods/tiller, seeds/tiller and, to some extent, 100-seed weight decreased with the increase in foot rot severity. However, number of seeds/pod was not affected (Table 2). Healthy plants (score 0) had significantly higher seed yield, 100-seed weight, pods/tiller and seeds/tiller, but there was no difference in number of seeds/pod.

When seed yield/tiller (dependent variable) was regressed on foot rot score (independent variable), a highly significant negative linear relationship was found ($P \leq 0.001$). The relationship was: Yield = 14.8 – {2.631 × (foot rot score)} with correlation a coefficient of –0.980, which is again highly significant. Ninety-six per cent of the variation in seed yield was explained in this linear equation. Therefore, this linear equation seems adequate to explain the relationship between seed yield and foot rot severity in faba bean.

Data collected from each tiller were used to determine the percentage loss in tiller yield. Loss was calculated on the basis of tiller yield of disease-free stems. The yield loss for each foot rot score is given in Table 3.

Mean yield loss ranged from 34.6% (for score 1) to 91.7% (for score 5). When yield loss (dependent variable) was regressed on disease score (independent variable), a linear equation, Yield loss (%) = 9.6 + {16.5 × (foot rot score)}, was obtained.

Table 3. Mean yield loss (%) of faba bean due to foot rot disease in each rating score.

Foot rot score†	Mean percentage yield loss
0	0.0
1	34.6
2	39.6
3	53.9
4	69.9
5	91.7

† Foot rot score indicating that 0 = disease-free tillers and 5 = dead, very severe infection leading to plant death.

This linear equation significantly explained the yield-loss relationship. It was highly significant ($P<0.001$) in which R^2 and r were 96% and 0.98, respectively. This indicates that percentage yield loss was strongly influenced by foot rot severity. Hence the loss was primarily caused by foot rot and as the severity of foot rot increased (to score 5), the yield of faba bean decreased by about 92%. Therefore, this linear equation seems adequate to explain the yield-loss relationship of foot rot in faba bean.

Furthermore, many trial and production fields were severely affected by foot rot in 1993 at Holleta Agricultural Research Centre where cultivar Holetta local failed to yield any seed during the epidemic year. The disease is severe under some specific environmental conditions especially when August rainfall is above average.

Table 2. Mean seed yield and yield component values for each rating score of foot rot.

Severity score	Yield/tiller (g)	100-seed wt (g)	Pods/ tiller	Seeds/tiller	Seeds/pod
0	15.9 a	51.8 ab	11.6 a	31.3 a	2.7 a
1	10.4 b	62.3 a	7.5 b	18.1 b	2.7 a
2	9.6 b	50.9 ab	7.1 b	18.3 b	2.5 a
3	7.3 bc	46.5 b	5.9 bc	15.6 bc	2.6 a
4	4.8 c	44.9 b	4.2 c	10.7 c	2.5 a
5	1.3 d	29.7 c	1.2 c	4.7 d	2.3 a

Means followed by the same letter are not significantly different using Duncan's Multiple Range Test at P=0.05.

This investigation has shown that foot rot of faba bean could cause large yield loss if it continues to spread. Therefore, *precautions* must be taken to limit this disease from spreading to other areas (soils).

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Occurrence and Serology of a Mosaic Disease of Faba Bean in Himachal Pradesh, India

S.V. Bhardwaj, Anil Handa and M.K. Vaid[1]
Dr Y.S. Parmar University of Horticulture and Forestry
Solan 173 230 (H.P.), INDIA

Abstract

On the basis of host range and behavior in sap and serology, a mosaic disease of faba bean (*Vicia faba* L.) was found to be caused by a potyvirus in Himachal Pradesh, India. The virus was transmitted by *Myzus persicae* Sulz., *Brevicoryne brassicae* L. and *Aphis fabae* Scop. through sap to some members of families Leguminosae, Chenopodiaceae, Solanaceae, Compositae and Iridiaceae. The virus had a thermal inactivation point between 60 and 65°C, dilution end point between 10^{-4} and 10^{-5}, and longevity in faba bean sap of 3 and 5 days at room and refrigeration temperatures, respectively. Electron microscopic studies conducted previously indicated that the virus was a member of the potyvirus group. This has been confirmed serologically.

[1] Present address: Department of Agriculture, Government of Himachal Pradesh, Nichar, District Kinnaur, H.P., INDIA.

الإصابة بمرض تبرقش الفول في هيماجال براسيش بالهند ودراسته مصلياً

الملخص

استناداً إلى مجموعة من العوائل والسلوك في النسغ والمصل، تبين أن مرض تبرقش الفول في هيماجال براسيش بالهند يسببه أحد فيروسات مجموعة البوتي (potyvirus group). وقد نقل هذا الفيروس بواسطة *Myzus Persicae* Sulz. ، *Brevicoryne Brassicae* L. و *Aphis Fabae* Scop.، و عبر النسغ إلى بعض الفصائل البقولية و .Chenopodiaceae, Solanaceae, Compositae, Iridiaceae. وقد توقف نشاط هذا الفيروس عند درجة حرارة ما بين 60 و65 م°. وكانت أقصى نقطة لتخفيف محلوله تقع مابين 10^{-4} و 10^{-5} وأن بقاءه حياً في نسغ الفول استمر ما بين 3-5 أيام على درجة حرارة الغرفة ودرجة التبريد على التوالي. وأشارت الدراسات المجهرية الالكترونية التي اجريت سابقاً إلى أن هذا الفيروس كان واحداً من مجموعة فيروسات البوتي، وقد تم التثبت من ذلك مصلياً.

Key words: *Vicia faba*; faba beans; potyviruses; immunology; India.

Introduction

Faba bean, the only winter bean widely grown in many parts of India, often suffers from mosaic disease in Himachal Pradesh. The disease was common and severe in terms of symptoms and yield loss. The causal agent was diagnosed as a flexuous virus measuring 790 × 12 nm and capable of producing pin-wheel, lamellae, tube- and scroll-type inclusion bodies (Bhardwaj et al. 1990) and was tentatively assigned to the potyvirus group. A detailed serology is presented in this communication.

Materials and Methods

Inoculum was prepared from young leaves of infected plants showing pronounced symptoms and maintained by mechanical sap inoculations on its original host by repeated passage through a local lesion host (*Chenopodium amaranticolor* L.) each time using a single lesion for inoculation on faba bean. The pots containing test plants were maintained under insect-free glasshouse conditions.

Biophysical properties of the virus were studied following Noordam (1973), the aphid transmission test following Bhardwaj and Dubey (1984) and serology using direct antigen coating (DAC) form of indirect enzyme-linked immunosorbent assay (ELISA) suggested by Hobbs et al. (1987).

Different weed species growing in and around faba bean fields were examined for their possible role as reservoirs of the causal virus by biological and serological methods.

The alkaline phosphatase (ALP) and penicillinase (PNC) based DAC-ELISA systems described by Handa and Bhardwaj (1991) were followed. As substrates, *p*-Nitrohenyl phosphate (PNPP) and bromothymol blue (BTB) were used for the ALP and PNC systems, respectively. Antiserum against peanut mottle virus (PMV), a potyvirus obtained from ICRISAT, India, was used. Rabbit Fc-specific antibodies produced in goats were conjugated to ALP and highly purified PNC by the single-step glutaraldehyde method (Clark and Adams 1977). All incubations were done for 60, 90 and 120 min. at 27°C for antigen, antiserum, enzyme-labelled immunoglobins and substrate.

Results

Symptoms and host range

The first symptom on inoculated plants was systemic diffused chlorotic spots near veins of emerging leaves, 10–14 days after inoculation. This was followed by mild mosaic mottling leading to clearing of the veins. Leaves then developed various abnormalities in shape and size; inward and outward curling and irregular rolling were the most prominent. The younger leaves had narrow leaf laminae and there was an overall reduction in leaf area.

The virus had a rather narrow host range restricted to the families Leguminosae, Chenopodiaceae, Solanaceae, Compositae and Iridiaceae. Within the family Leguminosae the virus could infect *Medicago sativum*, *Trigonella foenum-graceum* and *Lathyrus odoratus* L. In the Solanaceae the virus could infect only *Solanum laciniatum* and *Nicotiana tabacum* L. var. White Burley. In the Chenopodiaceae, *Chenopodium album*, *C. quinoa* and *C. amaranticolor* were infected. In the Iridiaceae family the virus could infect *Gladiolus* sp. In the Compositae the virus could infect *Zinnia elegans* Jacq.

Transmission

The causal virus was transmissible through sap but was not seed borne. Of five aphid species tested *Myzus persicae*, *Brevicoryne brassicae* and *Aphis fabae* could transmit the virus effectively (Table 1).

Biophysical properties

The virus isolate under study had a thermal inactivation point between 60 and 65°C, dilution endpoint between 1:10,000 and 1:100,000, and longevities *in vitro* of 3 and 5 days at room and refrigeration temperatures, respectively.

Weeds as potential reservoirs

Eight weed species most commonly encountered in and around faba bean fields (Table 2) were evaluated for their possible role in harboring the virus causing mosaic disease of faba bean. Only one weed species, *Medicago denticulata* L., was found to be a carrier of the virus. All inoculated plants were examined serologically for possible presence of virus.

Serology

The ALP and PNC based DAC-ELISA systems were able to detect the present virus and were comparable for their suitability for assaying it. The virus was detectable at a

Table 1. Transmission of the virus by aphid species.

Aphid species	Number of aphids/plant	Mean no. of plants infected	Transmission (%)
Myzus parsicae Sulz.	10	10 (3.32)†	100 (3.32)†
Aphis fabae Scop.	10	6 (2.65)	60 (3.32)†
Brevicoryne brassicae Linn.	10	4 (2.23)	40 (2.23)
Aphis craccivora Koch.	10	0 (1.00)	0 (2.23)
Acyrthosiphon sp.	10	0 (1.00)	0 (1.00)
S.E.M.		0.45	–
C.D. (0.05)		1.24	(1.00)

† Figures in parentheses represent $\sqrt{(n+1)}$ transformed values.

Table 2. Indexing of potential weed reservoirs on *Vicia faba*.

Weed	Family	Reaction on *Vicia faba*†
Medicago denticulata L.	Leguminosae	+
M. sativum L.	Leguminosae	–
Trifolium pratense L.	Leguminosae	–
T. repens L.	Leguminosae	–
Trigonella foenum-graceum L.	Leguminosae	–
Solanum laciniatum L.	Solanaceae	–
S. nigrum L.	Solanaceae	–
Chenopodium album L.	Chenopodiaceae	–

† + = transmission, – = no transmission.

concentration of 1:10,000 for antigen and antiserum. Both systems produced an ELISA color reaction when the enzyme-labelled immunoglobins were used at a concentration of 1:5000. An incubation period of 90 min. at 27°C for all the reactants except for substrate (60 min. at room temperature) was required to get detectable results.

Discussion

Based on biological and serological evaluation of different weed species most commonly encountered in and around the faba bean fields, only *Medicago denticulata* was found to act as a potential reservoir of the causal virus. Wide host ranges are widely known for potyviruses (Schmidt et al. 1977; Eid 1984; Eid et al. 1986), therefore the observation that only a single weed host could carry this virus is encouraging. Keeping the field and vicinity free from *M. denticulata* might help to control the spread of virus in the crop.

The present virus isolate differed strikingly in particle morphology and cytopathology from many viruses reported on faba bean. Bean common mosaic virus (Omar et al. 1978) has similar symptoms, biophysical properties and mode of transmission; however, the present virus does not infect bean (*Phaseolus vulgaris*), the original host of bean common mosaic and bean yellow mosaic viruses.

The provisional identification of the present virus as a potyvirus, established on the basis of particle morphology and the induction of cytoplasmic inclusions typical of potyviruses (Bhardwaj et al. 1990), has been confirmed serologically by DAC-ELISA. The present virus is serologically related to peanut mottle virus, a member of the potyvirus group. Hence, the virus under investigation is distinct from all other viruses commonly recorded on faba bean.

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Imazethapyr can Control Dodder (*Cuscuta* spp.) Infestation in Faba Bean

Rajae Khallida[1], S.P.S. Beniwal[2], Z. Fatemi[1] and M.C. Saxena[3]

[1] *Douyet Research Station, INRA/ICARDA, B.P. 2335, Fes, MOROCCO*

[2] *ICARDA, P.O. Box 39 Emek, 06511 Ankara, TURKEY*

[3] *ICARDA, P.O. Box 5466, Aleppo, SYRIA*

Abstract

Pre-emergence application of the herbicide imazethapyr at 75 g a.i./ha was found highly effective in controlling *Cuscuta* spp. on faba bean (*Vicia faba* L.). Also, a post-emergence application of imazethapyr at 20 g a.i./ha at the pre-flowering stage of faba bean provided good control of *Cuscuta* infestation without exhibiting any phytotoxicity. This is the first report on the effectiveness of imazethapyr to control *Cuscuta* in faba bean.

قدرة Imazethapyr على مكافحة الحامول (Cuscuta sp.) في الفول

الملخص

تبين أن رش الفول بالمبيد العشبي imazethapyr قبل طور تكشف البادرات بمعدل 75 غ مادة فعالة/هـ إجراء فعال للغاية في مكافحة *Cuscuta* sp. على الفول. كما أن القيام برش imazethapyr بعد تكشف البادرات بمعدل 20 غ مادة فعالة/هـ في طور ما قبل الإزهار قد أعطى مكافحة جيدة لـ Cuscuta دون إبداء أية تأثيرات سمية. وهذا التقرير هو الأول حول فعالية imazethapyr في مكافحة الحامول على الفول.

Key words: *Vicia faba*; faba beans; herbicides; weed control; *Cuscuta*.

Introduction

Dodder (*Cuscuta* spp.) is an important parasitic weed in many crop plants (Dawson et al. 1984). It has lately become a major parasite on faba bean and chickpea in the fields of Douyet Experiment Station of INRA (Institut National de la Recherche Agronomique), Morocco. This is in addition to the holoparasite *Orobanche crenata* Forsk. which is already well established in the experimental fields at Douyet and is a major retardant to high yield of faba bean in Morocco (Schmitt 1979). Past studies showed that two post-emergence sprays of glyphosate at 80 g a.i./ha at 15-day intervals at the tubercle/bud stage of *Orobanche* development were effective in the control of *O. crenata* in faba bean (El Antri and Mokhless 1990; Fadli 1989). However, the field performance of glyphosate has been variable, depending on weather and soil conditions. Because of the difficulty in identifying the time when application of glyphosate would cause least phytotoxicity to the crop, herbicide damage to faba bean is common in farmers' fields. The search for safer pre-emergence herbicides to control *O. crenata* has, therefore, been a priority area of research (Garcia-Torres et al. 1989). Of the several herbicides of the imidazole group tested at ICARDA (Sauerborn et al. 1989; ICARDA 1990), imazethapyr (Pursuit) was found to be effective in controlling *O. crenata.* Since no information on the efficacy of imazethapyr in controlling *O. crenata* in faba bean was available in Morocco, a field experiment was conducted in the 1991/92 crop season at Douyet station to test this herbicide. The weather conditions that season were not, however, conducive for the development of *O. crenata*, but infestation with *Cuscuta* occurred. Therefore, the experiment was opportunistically used to gain information on *Cuscuta* control. In the following season (1992/93), the efficacy of a post-emergence application of imazethapyr in controlling *Cuscuta* was tested.

Materials and Methods

Field experiments were conducted at Douyet, Morocco. The experiment in 1991/92 was laid out in a randomized block design with four replications to compare the efficacy of a new pre-emergence herbicide, imazethaypyr, with the standard treatment of post-emergence glyphosate sprays, in controlling *O. crenata* in faba bean. The treatments planned were: pre-emergence application of imazethapyr (75 g a.i./ha) (IMZ); pre-emergence application of imazethapyr plus one post-emergence spray of glyphosate (80 g a.i./ha) at tubercle/bud stage (IMZ + G); two post-emergence applications of glyphosate (75 g a.i./ha) 15 days apart starting at tubercule/bud stage of *Orobanche* development (GLY 2); *Orobanche*-free treatment by hand pulling of above-ground *Orobanche* shoots as they emerged (POR); and an untreated control (COR). 'Aquadulce', an *Orobanche*-susceptible faba bean cultivar, was sown on 26 November 1991. Application of imazethapyr was done just after sowing. Planned post-emergence application of glyphosphate and hand-pulling of *Orobanche* shoots were not done as drought made the *Orobanche* infestation in the crop negligible.

In the 1992/93 season, the efficacy of post-emergence spray of imazethapyr in controlling *Cuscuta* spp. on faba bean was tested. A single spray of imazethapyr (25 g a.i./ha) was given to non-*Cuscuta* infested faba bean plants in the pre-flowering stage grown in 3 m × 2 m plots in two replications. The untreated plots served as controls. Observations on infestation of faba bean by *Cuscuta* spp. were recorded three weeks after spraying. In a second trial in the same season, a single spray of imazethapyr (25 g a.i./ha) was given on *Cuscuta*-infested faba bean plants, in 4 m × 2 m plots with two replications. Observations on the toxicity of imazethapyr on *Cuscuta* were recorded three weeks after spraying.

Results and Discussion

The severe drought due to very little or no rainfall from November to January in the 1991/92 season resulted in late emergence of faba bean plants and very heterogeneous crop establishment. Accordingly, *Orobanche* development was also very limited. However, a heavy infestation of weeds occurred during March and April because of high rainfall (210 mm) received during these months. The main species of weeds were *Cuscuta* spp., *Convolvulus* sp., *Amaranthus* sp. and *Phalaris brachystachys*. Pre-emergence application of imazethapyr provided efficient control of weeds in faba bean (giving a rating of 2.6 against a rating 9 for non-treated plots on a 1–9 scale, where 1 = weed-free, 3 = low, 5 = medium, 7 = high, and 9 = very heavy infestation of weeds) (Table 1). The effect was spectacular on *Cuscuta* spp. which was completely controlled in imazethapyr-treated plots.

A post-emergence application of imazethapyr (25 g a.i./ha) during 1992/93 at the pre-flowering stage of faba bean also provided effective protection from *Cuscuta* infestation, as the parasite did not develop on sprayed plants, whereas plants in unsprayed plots developed heavy infestation. Similarly, a single spray of imazethapyr (25 g a.i./ha) on *Cuscuta* parasitizing faba bean plants at flowering and podding resulted in complete destruction of the parasite with no phytoxicity to faba bean plants.

Table 1. Infestation of weeds and *Cuscuta* spp. in different treatments in a faba bean *Orobanche* control trial at Douyet, 1991/92.

Treatment†		Infestation score‡	
Planned	Executed	Weeds	*Cuscuta* spp.
IMZ	IMZ	2.3	1.0
IMZ + G	IMZ	3.0	1.0
GLY	COR	9.0	9.0
POR	COR	9.0	9.0
COR	COR	9.0	9.0

† Refer to text for explanation of abbreviations.
‡ Based on ICARDA's 1-9 rating scale, where 1 = no weeds, and 9 = very heavy weed infestation.

This is the first report on the effectiveness of imazethapyr in controlling *Cuscuta* spp. in faba bean. Although these results suggest that imazethapyr could be used both as a preventive and as a curative measure in managing *Cuscuta* in faba bean, there is a need for further verification.

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Seed Quality and Nutrition

Effect of Soaking in Alkali on Tannin Content and *in vitro* Protein Digestibility of Faba Bean Cultivars

El Fadil E. Babiker and
Abdullahi H. El Tinay
Department of Biochemistry, Faculty of Agriculture
University of Khartoum, Shambat, SUDAN

Abstract

Investigation of two faba bean (*Vicia faba* L.) cultivars showed that the tannin content of untreated seeds was 0.08 and 0.07% for 317/99/98 and Giza 402, respectively. Their *in vitro* protein digestibilities (IVPD) were similar (80.7 and 81.5%, respectively). Extractable tannin content was markedly reduced by incubating whole seeds in NaOH or KOH solutions for up to 24 hours at 30°C or for up to 20 min. at 100°C. With both cultivars, the percentage of tannin extracted increased with time, temperature and alkali concentration, and this was coupled with an increase in the percentage of IVPD. The degree of change in tannin extractability and IVPD for both cultivars was similar. Conditions have been established which combine a low energy input, short time treatment with a high protein digestibility of the treated grain.

Key words: *Vicia faba*; faba beans; soaking; tannins; proteins; digestibility; seeds; alkali treatment; temperature; time; Sudan.

تأثير النقع في *القِلى* على محتوى التانين وقابلية هضم البروتين مخبرياً في بعض أصناف الفول

الملخص

أظهرت دراسة أجريت على صنفين من الفول (Vicia faba L.) أن محتوى التانين في البذور غير المعاملة بلغ 0.08٪ وذلك في الصنف 98 /317/99 و 0.07٪ في الصنف جيزة 402 . وكانت قابلية هضم البروتين مخبرياً (IVPD) في كلا الصنفين متماثلة (80.7٪ و 81.5٪ على التوالي). انخفض محتوى التانين المستخلص بشكل ملحوظ بنقع كامل البذور في محاليل Na OH أو KOH لفترة تصل حتى 24 ساعة على حرارة 30 م° أو لفترة 20 دقيقة على حرارة 100 م° . وفي كلا الصنفين، ازدادت نسبة التانين المستخلص مع زيادة الوقت ودرجات الحرارة وتركيز القِلى، وقد ترافق ذلك مع زيادة في نسبة IVPD . وكانت درجة التغير في مدى القدرة على استخلاص التانين و IVPD في كلا الصنفين متماثلة جداً. وقد جمعت الظروف بين نسبة منخفضة من الطاقة ومعالجة قصيرة الزمن مع قدرة عالية على هضم بروتين الحبوب المعالجة.

Introduction

In different parts of the world, vigorous efforts are directed toward coupling the beneficial effects of tannins in sorghum and faba bean as field crops with methods for overcoming the antinutritional property of tannins in seeds, by direct removal of seed testa, inactivation or extraction. In feeding trials with rats (Reichert et al. 1980; Yasaman et al. 1990) and chicks (Teeter et al. 1986), tannins reduced weight gain and feed conversion.

Extractable tannin content was markedly reduced when grains were soaked in water and stored in a carbon dioxide atmosphere (Reichert et al. 1980). Chavan et al. (1979) report that soaking sorghum seeds at high temperature for different time intervals reduced tannin content and improved *in vitro* protein digestibility (IVPD). They also report that high-tannin grains treated with sodium carbonate exhibited a significant increase in IVPD compared with untreated grains.

The study reported here was undertaken to investigate whether the nutritional value of faba bean could be improved when seeds are soaked in sodium hydroxide (NaOH) or potassium hydroxide (KOH) solutions of different concentrations, at different temperatures and for different time intervals.

Materials and Methods

Seeds of two faba bean cultivars (317/99/81 and Giza 402) obtained from the Shambat Research Station, Sudan, were used in this study. All samples were carefully cleaned and freed from dirt, stones and other grains. For determination of protein digestibility, both treated and untreated seeds were ground to pass a 0.16-mm screen. For tannin analysis, cultivars were ground to pass a 0.4-mm screen.

Moisture, protein and tannin analysis

To express results on a 105°C dry-matter basis, moisture was determined according to the AOAC (1965) method. Protein (N × 6.25) was determined by the method of AOAC (1965). Tannins were estimated by the modified procedure of Maxon and Rooney, as described by Price et al. (1978). A 200-mg sample was extracted with 10 ml of HCl:methanol (1:100 concentration) for 20 minutes in capped rotating test tubes. To 1-ml aliquots, 5 ml vanillin reagent (0.5%) was added and the absorbance of the color developed after 20 min. at 30°C was read at 500 nm. A standard curve was prepared expressing the results as catechin equivalents, i.e. amount of catechin (mg/ml) which gives a color intensity equivalent to that given by tannins after correcting for a blank run using 1 ml HCl:methanol (1:100).

Determination of tannin extracted from treated seeds

Faba bean seeds (8 g) were soaked in NaOH or KOH solution (200 ml) at either 30°C for 1, 3, 6, 12 or 24 hours or at 100°C for 5, 10 or 20 min. Treated seeds were washed thoroughly with distilled water several times. All washings were collected and the volume was made up to 250 ml. Tannin extracted was then determined according to the modified vanillin-HCl method as described above.

In vitro protein digestibility (IVPD)

IVPD was determined according to the method of Saunder et al. (1973). Treated seeds (8 g) were washed thoroughly to remove any traces of alkali, air-dried for 24 hours, oven-dried at 65°C for 24 hours and then ground. A 0.2-g sample was placed in a 50-ml centrifuge tube, 15 ml of 0.1*M* HCl containing 1.5 mg of pepsin was added, and the tube was incubated at 37°C for three hours. The suspension was then neutralized with 0.5*M* NaOH and treated with pancreatin (4 mg) in 7.5 ml of 0.2*M* phosphate buffer (pH = 8.0) containing 0.005*M* sodium azide; the mixture was then gently shaken and incubated at 37°C for 24 hours. After incubation, the sample was treated with 10% trichloroacetic acid (10 ml) and centrifuged at 5000 × g for 20 min. at room temperature. Nitrogen in the supernatant was estimated using the Kjeldahl method. Protein digestibility was calculated using the formula:

$$\text{Digestibility (\%)} = \frac{\text{(N in supernatant)} - \text{(Enzyme N)}}{\text{N in sample}} * 100$$

Each sample was analyzed in triplicate and the mean determined.

Results

Effect of soaking in NaOH or KOH on tannin content

Figures 1 and 2 illustrate the percentage of total tannin extracted by NaOH at 30°C and 100°C in relation to time and concentration for cultivar Giza 402. Tannin extraction was very slow at 30°C (Fig. 1) and very fast at 100°C (Fig. 2). Similar results were obtained for cultivar 317/99/81. In 0.05*M* NaOH for both cultivars, the percentage of tannin extracted increased steadily up to 20 min. at 100°C and 24 h at 30°C, while at lower concentrations it increased at about *half of this rate. KOH* gave similar results to those obtained with NaOH. For both cultivars and for a given time, higher alkali concentrations resulted in higher extractable tannin.

Effect of tannin extracted on IVPD

Figures 3 and 4 illustrate the relationships between IVPD and tannin extracted with NaOH for Giza 402 at 30°C and 100°C, respectively. There was a progressive increase in IVPD with tannin extracted, which in turn increased with alkali concentration and time. Similar results were obtained for cultivar 317/99/81. KOH was found to give results similar to those obtained with NaOH for both cultivars and at both temperatures, with a high positive correlation (r=0.90 to 0.99).

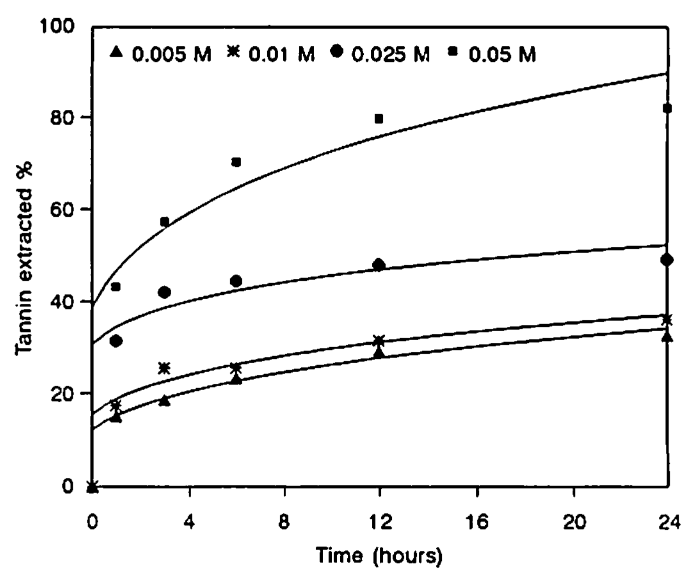

Fig. 1. Percentage tannin extracted with NaOH at 30°C in relation to time for faba bean cultivar Giza 402.

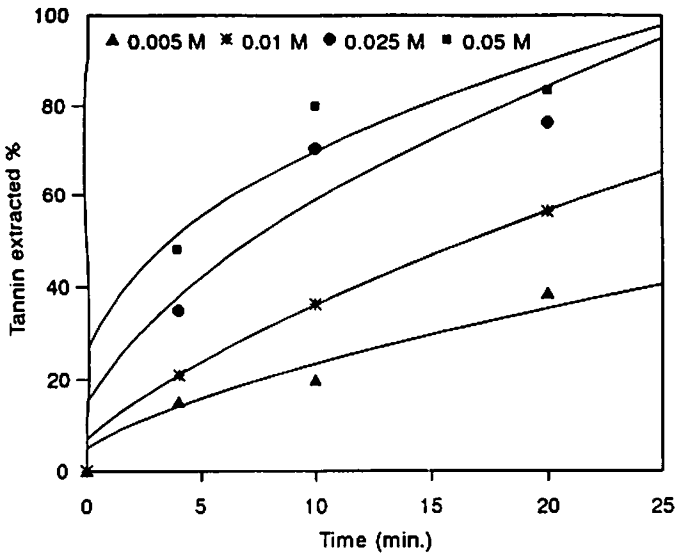

Fig. 2. Percentage tannin extracted with NaOH at 100°C in relation to time for faba bean cultivar Giza 402.

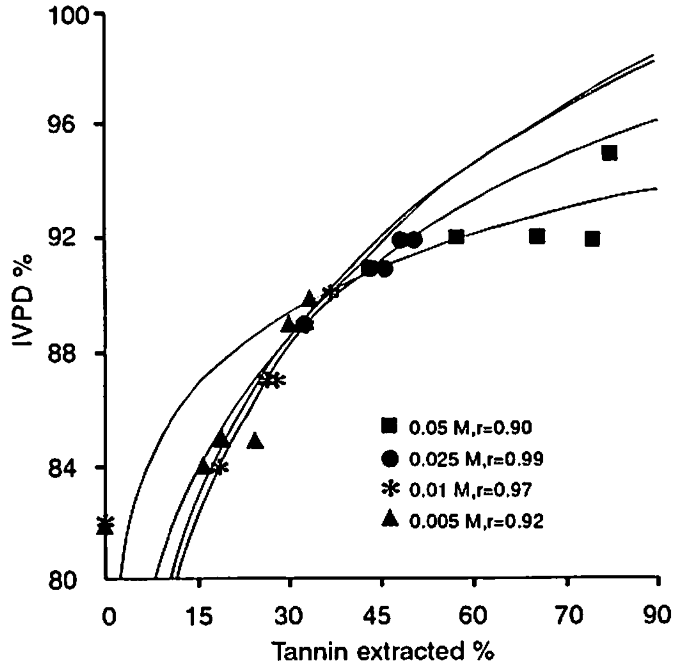

Fig. 3. Percentage tannin extracted with NaOH at 30°C in relation to IVPD for faba bean cultivar Giza 402.

Discussion

For both cultivars and at both 30 and 100°C, results revealed that tannin extractability and IVPD increased with time when faba bean seeds were soaked in NaOH or KOH solutions of different concentrations. The rate of increase varied among concentrations, but there was no significant difference between NaOH and KOH. For both cultivars and at both temperatures, lower concentrations of alkali slightly increased IVPD relative to tannin extraction for a short period after which it was not significantly affected (r = 0.92). These effects may be due to the hardness of the seed coat which is rich in tannin. The two cultivars showed closely similar responses in terms of the effects of time, temperature and NaOH or KOH concentrations on tannin extractability. They were also qualitatively similar in terms of the effects of these parameters on IVPD. For both cultivars and at both temperatures when seeds were treated with NaOH or KOH of different concentrations, a good correlation (r = 0.90 to 0.99) between tannin extractability and IVPD was observed. However, there is a notable exception, i.e. when tannin extraction exceeded 40–50%, IVPD remained constant despite an increase in tannin extractability (Figs 3 and 4). The explanation for this exception is that a little tannin migrates toward the endosperm owing to alkali and heat treatment and inhibits the activities of proteolytic enzymes. Some workers (Sternberg et al. 1975; Aymard et al. 1978) report that alkali treatment at high temperature or high temperature treatment alone may lower the protein quality of treated grain because treatments may form lysinoanaline and lanthionine cross-links which render the protein insoluble. In contrast, Schaffert et al. (1974) found that there were no differences in the distribution patterns of proteins among the treatments for dehulled and alkali-treated seeds.

In general, results revealed that alkali and heat treatments have no significant effect on protein quality as indicated by IVPD at given percentages of tannin extraction. It is by no means certain, therefore, that the effect of tannins on IVPD in the present study can be explained only by the strong positive correlation (r=0.90 to 0.99) between tannin extractability and IVPD in all treatments.

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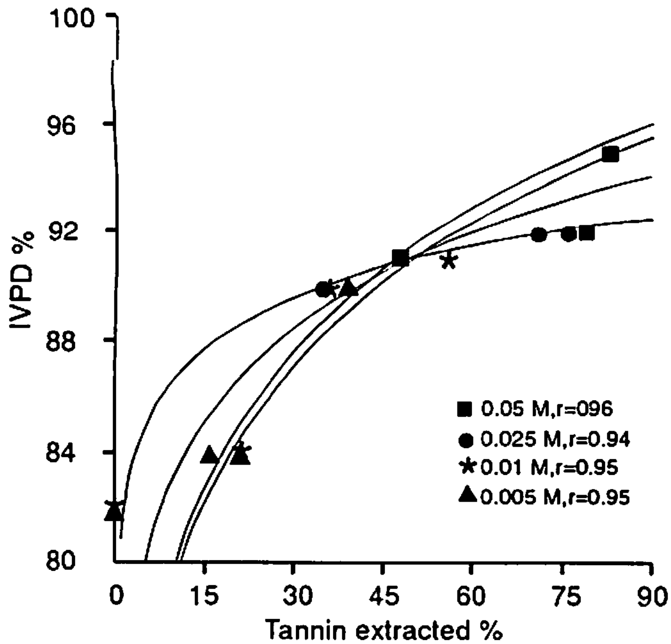

Fig. 4. Percentage tannin extracted with NaOH at 100°C in relation to IVPD for faba bean cultivar Giza 402.

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Milk Yield and its Composition in Goats Fed Faba Bean

غلة ومكونات حليب ماعز تتغذى على الفول

B.S. Tewatia, A.S. Virk, P.C. Gupta, Z.S. Rana, V.K. Khatta and V. Sagar
CCS Haryana Agricultural University
Hisar 125 004, INDIA

الملخص

قسمت عشوائياً 15 عنزة في بداية الإرضاع إلى ثلاث مجموعات، وكان متوسط وزن العنزة الواحدة 20 كغ. وقد قدم لجميع عنزات المجموعات الثلاث علائق مكونة من تبن حمص ad Lib وحصيد برسيم مع كمية متساوية من خلائط أعلاف مركزة تحتوي على 20٪ من البروتين الخام. وكانت المعاملات ذات علائق متماثلة الآزوت، وقد حوت المعاملة الثانية على 60٪ من الفول والمعاملة الأولى على 30٪ منه ومعاملة الشاهد خالية من الفول. وكان تناول المادة الجافة مختلف احصائياً (P < 0.05) في مجموعات عديدة، إذ بلغ أعلاها في المعاملة الثانية وأدناها في معاملة الشاهد، إلا أن تناول المادة الجافة/100 كغ من وزن الجسم لم يختلف معنوياً بين المجموعات، كما لم يختلف إجمالي غلة الحليب ودسم الحليب ومحتويات البروتين بين المجموعات. وكانت الزيادة الإجمالية في وزن الجسم على مدى 100 يوم أكبر معنوياً في المجموعة الثانية (0.56 ± 3.58 كغ) وفي المجموعة الأولى (0.57 ± 3.20 كغ) بالمقارنة مع معاملة الشاهد (0.17 ± 2.06 كغ). وقد بينت النتائج أنه يمكن اقتصادياً وبطريقة مأمونة إحلال الفول حتى نسبة 60٪ من علائق العنزات في مرحلة الإرضاع محل كسبة الفول السوداني دون أن يؤثر ذلك على غلة الحليب ومكوناته.

Abstract

Fifteen goats in early lactation were randomly divided into three groups having 20 kg average body weight. All animals were fed *ad lib.* chickpea straw and berseem hay with equal amounts of concentrate mixtures having 20% crude protein. Treatments were iso-nitrogenous diets containing 60% (T_2), 30% (T_1) and no (C) faba bean (*Vicia faba* L.). Dry-matter intake was statistically ($P<0.05$) different in various groups with the highest in T_2 and lowest in the control (C); however, dry-matter intake/100 kg body weight did not differ significantly among groups. Total milk yield and milk fat and protein contents did not differ among groups. Total body weight gain over 100 days was significantly greater for T_2 (3.58 ± 0.56 kg) and T_1 (3.20 ± 0.57 kg) compared with the control (2.06 ± 0.17 kg). The findings revealed that up to 60% faba bean could safely and economically replace groundnut cake in the diet of lactating goats without affecting milk yield and its composition.

Key words: *Vicia faba*; *Cicer arietinum*; *Trifolium alexandrinum*; faba beans; diet; goats; milk yield; straw; India.

Introduction

In order to minimize the gap between availability and requirement of protein for the booming livestock population in India, continuous efforts are being made to explore the possibilities of alternate protein sources. Faba bean, a rich source of protein, has been identified for livestock feeding. It has been widely used as a protein supplement in growing animals (Akbar and Gupta 1990; Virk et al. 1991, 1993). In the present study, the effects of faba bean on milk yield and its composition and nutrient utilization were studied in lactating goats.

Materials and Methods

Fifteen goats in early lactation were randomly divided into three groups, having 20 kg average body weight. In all the groups, animals were fed chickpea (*Cicer arietinum* L.) straw and berseem (*Trifolium alexandrinum*) hay in the ratio of 7:3 *ad lib.* Concentrate mixture was fed to meet the protein requirements as per NRC (1981). Table 1 gives the composition of the concentrate feeds (treatments) and Table 2 gives the chemical composition of the diets involved. The concentrate mixtures were iso-nitrogenous having about 20% crude protein.

During the feeding trial of 100 days, milk yield and body weight changes were recorded weekly. A metabolism trial lasting 5 days was conducted toward the end of the experiment. Proximate components of feeds, faeces and milk protein were estimated as per AOAC (1980) and cell wall constituents were determined as per Goering and Van Soest (1970). Milk fat was estimated by the method of Gupta et al. (1992).

Table 1. Composition of concentrate feeds (%).

Ingredient	Concentrate		
	Control (C)	Treatment 1 (T_1)	Treatment 2 (T_2)
Maize	30	30	30
Rice polish	27	17	7
Groundnut cake	40	20	0
Faba bean seed	0	30	60
Mineral mixture	2	2	2
Salt	1	1	1

Result and Discussion

Dry matter intake (Table 3) was significantly higher ($P<0.05$) in animals given faba bean seed. However, dry matter intake/100 kg body weight did not differ significantly among the groups. No effect on feed intake was observed by Ingallis and Mckirdy (1974) by adding 17 or 35% faba beans in the diets of dairy cows. Virk et al. (1991) also found no significant differences in dry matter intake of crossbred goats fed faba bean seed concentrate mixture in which 20, 40 and 60% of groundnut cake protein was replaced by faba beans.

Table 2. Chemical composition (% on dry matter basis) of dietary constituents.

Feed	Chickpea straw	Berseem hay	C	T_1	T_2
Crude protein	5.6	12.4	19.5	19.5	19.7
Ether extract	2.2	4.3	8.5	9.0	9.1
Crude fiber	32.0	30.2	6.6	5.9	9.1
Ash	12.5	12.0	18.3	19.9	17.0
Nitrogen-free extract	47.6	41.1	47.1	45.7	45.0
Neutral detergent fiber	55.7	53.2	15.0	12.0	16.0
Acid-detergent fiber	44.8	43.3	9.9	8.0	12.3
Cellulose	25.6	24.0	5.3	6.1	7.3

Table 3. Dry matter intake, body weight gain and digestibility coefficients in lactating goats.

Attribute	C	T_1	T_2
Total dry matter intake (g/day)	857.9 ± 24.9^b	1019.1 ± 55.6^a	1026.0 ± 43.2^a
Average dry matter intake (kg/100 kg body wt)	3.8 ± 0.1	4.3 ± 0.2	4.1 ± 0.1
Average initial body wt (kg)	20.5 ± 1.0	20.4 ± 1.9	21.6 ± 1.8
Average final body wt (kg)	22.6 ± 1.0	23.6 ± 1.5	25.2 ± 1.8
Body weight gain (g/day)	20.6 ± 1.7^b	32.0 ± 5.7^a	35.8 ± 5.6^a
Digestibility coefficients			
Dry matter	62.1 ± 1.5	61.5 ± 2.3	62.0 ± 1.7
Crude protein	84.3 ± 1.4	83.8 ± 1.1	83.7 ± 0.8
Crude fiber	51.3 ± 1.1	47.3 ± 3.3	52.4 ± 2.2
Ether extract	72.5 ± 1.7	70.5 ± 1.6	72.0 ± 1.2
Nitrogen-free extract	67.1 ± 1.1	66.5 ± 2.3	66.1 ± 1.8
Neutral detergent fiber	43.3 ± 2.4	47.0 ± 1.8	47.4 ± 2.4
Acid-detergent fiber	37.1 ± 1.6	40.2 ± 2.5	43.4 ± 2.8

Values within rows bearing different superscripts differ significantly at $P<0.05$.

Body weight gains were statistically higher (P<0.05) in the treatment groups, i.e. 35.8 g/day (T_2) and 32.0 g/day (T_1) compared with 20.6 g/day in the control group (Table 3). Digestibility coefficients for various nutrients remained unaffected in the different groups; however, apparently higher values were observed in group T_2. Digestible crude protein intake was significantly higher (P<0.05) in T_1 (103.7 g/day) and T_2 (103.9 g/day) compared with the control (97.2 g/day), and intake of crude protein and total digestible nutrients was also apparently higher in treatments T_1 and T_2, which may be attributed to higher dry matter intake in these groups (Table 4).

Variations in net energetic efficiency for milk production values were non-significant among the groups, although apparently higher in treatments T_1 and T_2. All animals showed a positive nitrogen balance (Table 4).

Total milk yield did not differ significantly (Table 5) and ranged between 273.5 g in the control and 352.2 g in

Table 4. Nutrient intake, nutritive value, N-balance and energy efficiency in lactating goats.

Parameter	C	T_1	T_2
Nutrient intake (g/day)			
Crude protein	115.3 ±	1.2 123.9	± 4.7124.2±3.1
Digestible crude protein	97.2 ±	1.4 103.7	± 3.3103.9±2.5
Total digestible nutrients	514.9 ±	12.1 591.4	± 22.8614.1±21.1
Nutritive value (%)			
Digestible crude protein	9.4 ±	0.1 9.2	± 0.29.4±0.1
Total digestible nutrients	60.1 ±	1.0 58.3	± 1.860.0±1.3
Energy efficiency (%)			
Gross	10.9 ±	2.8 11.8	± 0.610.4±1.0
Net	33.3 ±	3.2 37.7	± 4.137.0±3.3
N-balance (g/day)			
Nitrogen intake	18.4 ±	0.2 19.8	± 0.319.9±0.4
Excretion in faeces	2.9 ±	0.2 3.2	± 0.43.2±0.2
Excretion in urine	6.7 ±	0.3 6.7	± 0.96.1±0.7
Excretion in milk	1.7 ±	0.1 2.4	± 0.12.2±0.1
Nitrogen balance	7.2 ±	0.2 7.4	± 0.68.3±0.4
Retention of N absorbed (%)	46.4 ±	1.4 44.7	± 4.249.7±3.3

Table 5. Total milk yield and milk composition in lactating goats.

Parameters	C	T_1	T_2
Total milk yield (g/day)	273.5 ±64.4	352.2 ±40.7	335.2 ±35.4
Fat corrected milk yield (g/day)	301.2 ±76.9	378.5 ±39.0	352.7 ±34.6
Milk fat (%)	5.1 ± 0.4	4.5 ± 0.2	4.4 ± 0.1
Milk protein (%)	3.9 ± 0.2	4.4 ± 0.6	4.2 ± 0.2

T_1. Milk fat content also remained unaffected in the three groups, although apparently higher milk protein content was observed in animals receiving faba bean, which might be due to higher digestible crude protein intake in these groups. No significant differences in average milk yield and milk composition of goats fed 0.5 kg faba bean daily were observed by Rubino et al. (1988).

These findings suggest that up to 60% faba bean seed can be incorporated in the rations of lactating goats without any deleterious effect on health and production.

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News

Recent faba bean publications from ICARDA

Faba bean in China: state-of-the-art review, by Lang Li-juan, Yu Zhao-hai, Zheng Zhao-jie, Xu Ming-shi and Ying Han-qing. Special Study Report. 1993, 144 pp.

This book looks systematically at the development history of faba bean in China, as well as the production technology, theoretical research, germplasm resources, genetics and breeding, cultivation, diseases, insect pests and utilization. The English edition of this book is the first specialized work that introduces foreign readers to the production, technical and scientific research of faba bean in China.

Legume cookbook, by Lorna Hawtin and Linda J. Sears. 1993, 119 pp.

A collection of recipes for chickpeas, faba beans and lentils, ICARDA's mandate crops. It is conveniently spiral bound to lay flat when open.

Lentil and faba beans in Latin America: their importance, limiting factors and research, by Gabriel Bascur B. Special Report. 1993, 156 pp.
La lenteja y el haba en América Latina: su importancia, factores limitantes e investigación. Rapporte de Estudio Especial. 1993, 154 pp.

This state-of-the-art review is the result of a consultancy cotracted by ICARDA. The current state of lentil and faba bean production and marketing is reviewed for each country. Research in individual countries is reviewed, followed by proposals for the direction of future research. There is also a complete literature review.

Faba bean production and research in China. Proceedings of an international symposium, 24–26 May 1989, Hangzhou, China, Ed. Mohan C. Saxena, Susanne Weigand and Lang Li-juan. 1993, 179 pp.

As part of the collaboration between ICARDA and the Chinese Academy of Agricultural Sciences, this meeting was held to discuss faba bean production. The objectives of the meeting were: (1) to review the (a) importance of faba bean in legume production, general agriculture and rural economy of China, (b) current status of genetic resources work on faba bean in China and the future needs, (c) major constraints to faba bean production and research in different agro-ecological situations of different provinces of China, (d) status of research on the different aspects of faba bean improvement at ICARDA and overview of ICARDA's research mandate and achievements, and (2) to develop a strategic plan for future research on faba bean in China. Participants in the meeting came from different organizations and provinces of China, as well as from Japan and ICARDA.

Seed-borne diseases in seed production, by Marlene Diekmann. 1993, 81 pp.

This publication is based on material used in numerous seed technology and seed health training courses. In addition to general background information on the importance of seed-borne diseases in seed production, it contains methods relevant for seed health testing in the context of seed certification, on seed treatment and on other pertinent topics. A list of relevant literature is also given.

All these books are currently available free to faba bean researchers and libraries from:
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Book review

Insect pests of pulses. Identification and control manual, by K.S. Chhabra, S. Lal, B.S. Kooner and M.M. Verma. Copublished by Dr K.S. Chhabra and Dr S. Lal on behalf of Punjab Agricultural University, Ludhiana and Directorate of Pulses Research, Kanpur, India. 1993.

This manual covers the major insect pests of the main pulse crops in India: greengram (mung bean), blackgram (urd bean), pigeon pea, chickpea, lentil and field peas. Excellent color photographs show the identification characteristics of each insect as well as symptoms on plant parts or seeds. Since the photographs have been taken under natural conditions, they are of practical diagnostic value. The illustrations are complemented by information on distribution and host range, damage caused, description of pest, its biology and appropriate control measures. This publication provides good information for research workers, extension personnel, farmers and students. As many of the pests are not restricted to India, the manual should receive broad attention and be widely used.

S. Weigand

Conferences

1995

American Phytopathological Society Annual Meeting, **Pittsburgh, PA, USA.** Contact: APS Headquarters, 3340 Pilot Knob Road, St Paul, MN 55121, USA.

1st Maghrebian Seminar on Faba Bean Research: Rehabilitation of Faba Bean, **Rabat, Morocco, 23-26 January 1995.** Contact: Coordination du Réseau Maghrébin de Recherche sur Fève, Station Expérimentale de l'INRA/Douyet, B.P. 111, 30007 Fès Dokkarat, Marocco [Tel. & Fax +212-5-65-55-74].

24th International Seed Testing Association (ISTA) Congress, **Copenhagen, Denmark, 7-16 June 1995.** Contact: Dr Hans Arne Jensen, ISTA Congress Coordinator, Plante Directorate, Skovbrynet 20, DK-2800 Lyngby, Denmark [Tel. 45-42-88-33-66; Fax 45-45-93-33-66].

13th International Plant Protection Congress, **The Hague, The Netherlands, 2-7 July 1995.** Contact: J. Zadoks, Department of Phytopathology, P.O. Box 8025, 6700 EE Wageningen, The Netherlands.

Improving Production and Utilisation of Grain Legumes - 2nd AEP Conference, **Copenhagen, Denmark, 10-12 July 1995.** Contact: KVL (1995 AEP Conference), 40 Thorvaldsensvej, DK-1871 Frederiksberg C, Copenhagen, Denmark [Tel. 45-35-28-24-32; Fax 45-35-28-20-89]; or AEP, 1995 Conference, 12 avenue George V, 75 008 Paris, France [Tel. 33-1-40-69-49-09; Fax 33-1-47-23-58-72].

10th biennial Australasian Plant Pathology Society Conference, **Lincoln University, Christchurch, New Zealand, 28-30 August 1995.** Contact: Secretariat, 10th Biennial APPS Conference, Centre for Continuing Education, P.O. Box 84, Lincoln University, New Zealand [Tel. 64-3-325-3819; Fax 64-3-325-3840; E-mail crabbd@lincoln.ac.nz].

1996

6th International Parasitic Weed Symposium, **Cordoba, Spain, tentative.** Contact: Dr Maria Teresa Moreno, Centro de Investigacion y Desarrollo Agrario, Apartado 4240, 14080 Cordoba, Spain [Fax +34-57-202721; Telex 76686].

1997

International Food Legume Research Conference III, **Adelaide Australia, 22-26 September 1997.** Contact: Dr F.J. Muehlbauer, Chair: IFLRC-III, 303W Johnson Hall, Washington State University, Pulman, WA 99164-6434, USA [Tel. +1-509-335-9521; Fax +1-509-335-8674]; or, Prof. R.J. Summerfield, Program Chairman IFLRC-III, Department of Agriculture, University of Reading, Early Gate, Reading, Berkshire RG6 2AT, UK [Tel. +44-734-318482; Fax +44-734-352421; Telex 847813].

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STOP PRESS: The following are already out of print.
FABIS Newsletter Nos. 1, 2, 4-7, 9-13, 19, 23-26.
Faba bean in Agris Vols. 2-5.

ICARDA Publications and Services

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This publication is aimed at cereal researchers in the Near East and North Africa region and other Mediterranean-type environments. It publishes short scientific papers on the latest research results and news items. *Rachis* seeks to contribute to improved barley and wheat production in the region; to report results, achievements and new ideas; and to discuss research problems. For further information or to subscribe, write to: RACHIS/CODIS.

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Contributions should be sent to FABIS/CODIS, ICARDA, P.O. Box 5466, Aleppo, Syria. The name, address, and telex or fax number of the corresponding author should be included in the covering letter. One good-quality original of the text should be submitted, typed double-spaced on one side of the paper only. Figures should be original drawings, good-quality computer prints, or black and white photographs of good quality. Photographs and figures should be suitable for reduction to a printed size of 8.5 or 17.4 cm wide. Photocopies are not acceptable for publication in FABIS. Authors may submit color photographs to be considered for the cover.

All articles must have an abstract (maximum 250 words) and usually the following sections: Introduction, Materials and Methods, Results, Discussion, Conclusions and References. Articles will be edited to maintain uniform style, but substantial editing will be referred to author(s) for approval. Papers requiring extensive revision will be returned to the author(s) for correction. Authors can refer to a recent issue of FABIS for format. The following guidelines should be followed:

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Define in footnotes or legends any unusual abbreviations or symbols used in the text or figures.

Provide the full name of journals and book titles. Use the following formats for references.

Journal article: Schubert, I. and R. Rieger. 1990. Alteration by centric fission of the diploid chromosome number in *Vicia faba* L. *Genetica* 81:67-69.

Article in book: Bos, L. 1982. Virus diseases of faba beans. Pages 233-242 *in* Faba Bean Improvement (G. Hawtin and C. Webb, eds.). Martinus Nijhoff Publ., The Hague.

Article in proceedings: Montoya, J.L. 1988. The production of seed of leguminous crops in Spain. Pages 136-142 *in* Seed Production in and for Mediterranean Countries. Proceedings of the ICARDA/EC Workshop, 16-18 Dec 1988, Cairo, Egypt (A.J.G. van Gastel and J.D. Hopkins, eds.). ICARDA, Aleppo, Syria.

Book: Agarwal, V.K. and J.B. Sinclair. 1987. Principles of Seed Pathology. CRC Press, Boca Raton, Florida, USA.

Thesis: El-Hosary, A.A. 1981. Genetic studies of some strains of field beans (*Vicia faba* L.). Ph.D. Thesis. Menoufia University, Egypt.

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