



# FABIS

## Faba Bean Information Service

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INTERNATIONAL CENTER FOR AGRICULTURAL RESEARCH IN THE DRY AREAS

(ICARDA)

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## FABIS

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COVER PHOTO: Faba bean seeds infested with *Callosobruchus chinensis*



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## SHORT COMMUNICATIONS

### بحوث مختصرة

#### Breeding and Genetics

#### التربية والوراثة

### Path Coefficient Studies for Yield and Yield Components in Faba Bean (*Vicia faba* L.)

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#### Abstract

In 40 indigenous and exotic strains of faba bean (*Vicia faba* L.), there was a positive and significant association between grain yield and number of pods/plant and harvest index. Pods/plant in turn was positively correlated with seeds/pod and harvest index. There was negative association between seeds/pod and seed weight. Based on path coefficient analysis, number of pods/plant, harvest index, seeds/pod, and seed weight appeared to be the principal yield attributes for which selection can be effective.

#### Introduction

In India, faba bean (*Vicia faba* L.) is gaining some importance due to its high protein content and high input responsiveness, particularly under irrigated conditions. However, small seeded and low yielding cultivars are currently used. Thus, the genetic improvement of such cultivars is an important aspect. For the genetic improvement of yield, which is the product of several contributing traits, informa-

tion on the direct and indirect influences of these traits is a basic requirement. The present work was undertaken to study the nature of the association and furnish additional information as path coefficient analysis to determine the components of yield using 40 indigenous and exotic faba bean strains.

#### Materials and Methods

The experimental material comprised 40 strains of indigenous and exotic (Afganistan, Holland, West Germany, England, Syria, Egypt, Canada, Ethiopia, Jordan, Lebanon, and Turkey) faba beans arranged in a randomized complete block design with three replications. Each plot consisted of a single row 5 m long, with inter and intra row spacings of 40 and 10 cm, respectively. Observations were recorded on 10 competitive plants taken at random for days to flowering, plant height, total number of branches, number of pods/plant, pod length, number of seeds/pod, seed yield/plant, 100-seed weight, harvest index, and protein content.

Following the analysis of variance, the data were subjected to phenotypic and genotypic correlations as suggested by Al-Jibouri *et al.* (1958). Path coefficient analysis was done as described by Dewey and Lu (1958).

#### Results and Discussion

The analysis of variance revealed highly significant differences among all the treatments for all the characters studied, indicating the existence of sufficient genetic variability among the examined traits. In general, correlation coefficients at the genotypic level were greater than the corresponding phenotypic ones.

Data presented in Table 1 indicated that only 11 out of the 40 possible correlations were significant. Grain yield associated significantly and positively with the number of pods/plant and harvest index --a plant type with more number of pods and better harvest index would lead to high yield.

Path coefficient analysis provided a better understanding of the cause and effect relationship between different pairs of characters (Table 2). Number of pods/plant had the highest direct effect on grain yield followed by harvest index, number of seeds/pod, 100-seed weight, and pod length. Naidu *et al.* (1985) observed that number of seeds/pod is the most important yield component in faba

bean. Among the indirect effects, through different variables, number of pods/plant and harvest index were the highest contributors to grain yield. These were followed by number of seeds/pod and seed weight.

It appears from the results of this study that number of pods/plant, harvest index, number of seeds/pod, and seed weight are the principal yield attributes for which selection can be effective. Thus, different selection indexes based on these characters need to be constructed. It is desirable to insure, while selecting high yielding genotypes, that advance in one component is not nullified by deterioration in another.

Table 1 Genotypic and phenotypic correlations among 10 metric traits in faba bean.

Character	Days to flowering	Plant height	Number of branches	Number pods/plant	Pod length	Seeds/pod	Grain yield/plant	100-seed weight	Harvest index	Protein content
Days to flowering		-0.035	0.148	0.224	-0.237	0.231	0.086	-0.242	0.046	0.088
Plant height	-0.039		0.352	-0.323	0.469	-0.784	-0.361	0.693	-0.490	-0.025
No.of branches	-0.079	0.024		0.156	0.082	-0.009	0.383	0.041	0.072	-0.037
No.of pods/plant	0.201	-0.129	0.199		-0.651	0.889	0.501	-0.764	0.864	0.105
Pod length	-0.077	0.216	-0.040	-0.543**		-0.924	-0.256	0.972	-0.920	-0.115
Seeds/pod	0.196	-0.310	-0.106	0.439**	-0.159		0.177	-0.818	0.931	0.331
Grain yield/plant	0.216	-0.082	0.055	0.468**	0.003	0.205		-0.288	0.468	0.072
100-seed weight	-0.144	0.288	0.037	-0.664**	0.702**	-0.475**	-0.151		0.928	-0.128
Harvest index	0.083	-0.350	0.100	0.540**	-0.491**	0.462**	0.517**	-0.599**		0.193
Protein content	0.083	0.004	-0.036	0.096	-0.064	0.169	0.005	-0.129	0.076	

\* Significant at  $P < 0.05$

\*\* Significant at  $P < 0.01$

Table 2 Path coefficient analysis for 10 metric traits in faba bean

Character	Days to flowering	Plant height	Number of branches	Number pods/plant	Pod length	Seeds/pod	100-seed weight	Harvest index	Protein content	Correlation coefficient
Days to flower	<u>2.178</u>	-5.2 22	0.825	2.967	0.025	0.003	0.876	1.671	-3.237	0.086
Plant height	-2.961	<u>2.104</u>	-0.424	6.474	2.901	-5.256	7.318	-10.593	0.076	-0.361
No.of branches	-2.415	0.740	<u>2.622</u>	1.700	-2.429	-2.056	0.435	1.551	0.235	0.383*
No.of pods/plant	1.001	-6.679	-4.188	<u>7.800</u>	-4.819	3.960	4.062	4.691	-5.327	0.501**
Pod length	-10.090	0.989	-8.998	4.169	<u>3.174</u>	5.167	4.321	5.400	-4.388	-0.256
Seeds/pod	-1.366	-3.650	-6.010	4.628	-5.707	<u>6.168</u>	5.996	4.139	-4.020	0.178
100-seed weight	-0.656	-6.059	-6.047	3.306	-3.633	3.481	<u>4.557</u>	3.967	0.796	-0.288
Harvest index	2.153	-6.030	-4.100	5.394	-8.183	4.385	<u>4.787</u>	<u>6.656</u>	-4.594	0.468**
Protein content	-0.560	0.052	0.602	-1.143	-0.717	2.217	-1.355	4.164	<u>-3.086</u>	0.072

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## دراسات حول مُعاملِ المسار للغة ومكوناتها في الفول (*Vicia faba* L.)

### الملخص

ظهر ارتباط موجب ومعنوي بين اللغة الحبيبة وعدد القرون/النبات ودليل الحصاد لأربعين سلالة فول متوطنة ومُدخلة. كما ارتبط عدد القرون/النبات بشكل موجب بعدد البذور/القرون ودليل الحصاد. وكان ثمة ارتباط سالب بين عدد البذور/القرون ووزن الحبة. واستناداً إلى تحليل معامل المسار، فقد بدا أن عدد القرون/النبات ودليل الحصاد وعدد البذور/القرون ووزن الحبة هي المكونات الرئيسية للغة، والتي يمكن للانتخاب لها أن يكون فعالاً.

## Physiology and Microbiology

## الفيزيولوجيا والأحياء الدقيقة

### Effect of Desiccation and Storage on the Viability of *Vicia faba* Pollen

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#### Abstract

*In vitro* viability (as assessed by the fluorochromatic-reaction, FRC), was studied in pollen of seven lines of *Vicia faba* after desiccating at 20 or 30°C and drying at room temperature (20.5°C) for 24h. A study on storage of fresh pollen and pollen predried at room temperature was also conducted over a period of one month. Storage was at -20 and -80°C or in liquid nitrogen (-196°C). Pollen grains desiccated at 30°C were least viable in desiccation experiments with significant variability among the lines. Line STW was affected least by such desiccation. In storage experiments pollen grains, whether predried or fresh, were least viable when stored at -20°C and those stored in LN2 were the most viable. The results indicate that, with some significant variability among *Vicia faba* genotypes, desiccation at 30°C for even 6h has a detrimental effect on pollen viability. Pollen dried at room temperature for 24h is best stored in LN2. Reduction of pollen moisture prior to storage proved valuable in increasing pollen longevity in storage.

#### Introduction

The storage of pollen has been a subject of prime interest for various uses. Storage can provide flexibility for field crop breeders and horticulturists involved in fruit improvement (Hanna *et al.* 1983; Haunold and Stanwood 1985; Bajaj 1987; Luza and Polito 1988) and permit circumvention of

some of the practical problems encountered during hybridization program such as seasonal, geographical, and physiological limitations. Other reasons for pollen storage includes: i) provision of constant supplies of short-lived pollen (Roberts 1975), ii) material for the production of haploids from isolated pollen and pollen banks (Bajaj 1987), and iii) medical studies such as pollen allergy (Luza and Polito 1987).

*Vicia faba*, as a crop with three sub species, has a wide range of flowering periods although the selection pressure which breeders exert has narrowed the genetic base of the crop. For breeding purposes, genotypes with similar flowering periods are sought to facilitate crossing. Planting dates may also be staggered so that the flowering period is synchronized. Such practices, however, have drawbacks in terms of climatological and entomological dynamics and other abiotic and biotic factors. Thus in certain years rainfall might be unreliable, insect prevalence might occur at unexpected times and the whole crop might be lost. However, if a practical method of pollen storage can be developed many breeding programs would be able to continue over one or more seasons. *Vicia faba* pollen storage strategy may also have potential as a method for conserving genetic resources as an alternative to storing bulky seeds. In the present study storage of faba bean in three low temperature regimes and prior reduction of moisture by high temperature treatments is reported.

#### Materials and Methods

**Pollen collection:** This study was conducted on seven genetically diverse faba beans: STW, 288, NDP, 247, 248, 4/7, and TA95-2. Except for TA95-2, all these are lines inbred for nine generations. TA95-2 has been inbred for six generations. STW had its origin in Sudan, whereas TA95-2 came from ICARDA but was selected in Ethiopia. The remaining five lines were all of European origin.

Pollen collection was from even-aged flowers, at stages 6-7 as described by Smith (1982), i.e., at anther dehiscence. On collection, the flowers were immediately enclosed in Petridishes. Flowers were harvested from glasshouse-grown plants at Durham University Botanic Gardens and the pollen plugs immediately dusted on to aluminum foil for the various drying processes.



**Drying Process:** Three methods of drying before storage were used. Pollen collected on aluminum foil was divided into three samples. One sample was spread on the aluminum foil for 24h. The second sample was put in a desiccator containing silica gel which was pre-dehydrated at 105°C for 24h. This was sealed with wax and placed immediately in the incubator at either 20 or 30°C for 6h. The third sample was stored without dehydration. Using the initial weight of pollen and the weight after drying, the moisture loss was determined. The value obtained was converted to a percentage of the fresh pollen weight.

**Storage:** Three temperature regimes were used for storage. These were -20°C, -80°C, and liquid nitrogen (-196°C). At -20 and -80°C, pollen was stored in gelatin capsules (volume 0.21 ml). In LN2 the gelatin capsules would have burst on return to room temperature and so were not suitable; 2.0 ml cryotubes with screw lids proved convenient both for storage in LN2 and for subsequent withdrawal of sub-samples for viability studies (Luza and Polito 1988; Bajaj 1987). Each cryotube containing a pollen sample was fixed to an aluminum canister and immediately plunged into LN2 (rapid cooling) (Weatherhead *et al.* 1987).

**Viability studies:** Evaluation of pollen viability was carried out by measuring the fluorochromatic reaction (FCR) of pollen treated with a dilution of 2 mg/l fluorescein diacetate in acetone (Heslop-Harrison and Heslop-Harrison 1970). The reagent was prepared from this stock by adding 20% sucrose until the solution just appeared milky. Sucrose prevents pollen bursting due to osmotic effects.

All sub-samples of variously dried or fresh pollen to be stored were assessed visually for their viability using the method described above. A pollen grain may be considered viable if it fluoresces bright green under the fluorescence microscope using the blue-violet (BV) excitation filter. In each study 22 samples were taken, with three replicates for each sample. Between 200-1900 pollen grains were counted in each of the three replicates.

After one month storage, sub-samples were taken from each temperature regime and rehydrated to at least 96% relative humidity in a chamber at 4°C for 30-45 min to avoid pollen bursting (Hecker *et al.* 1986; Gay *et al.* 1987). 96% relative humidity was maintained in the Petridish containing pollen sub-samples by including a supersaturated solution of potassium nitrate (Winston and Bates 1960).

**Statistical analysis:** All data were transformed into percentages and analyzed for variance and F ratios. Means were

compared by calculating least significance differences (LSD) at both 5% and 1% levels of probability. To gain a better understanding of the influence of each method of drying, and the three storage temperatures on pollen viability, combined analysis of all the data was done using the method described by Gomez and Gomez (1984).

## Results

**Pollen Desiccation:** The effect of various methods of drying on pollen viability as tested by the fluorochromatic reaction (FCR) are shown in Fig. 1. There was a large difference in fertility among the cultivars at the 1% level of probability. Drying pollen for 24h at room temperature (20.5°C) and desiccating it at 20°C for 6h had similar effects on pollen viability (Fig. 1-II and Fig. 1-III). However, desiccating pollen at 30°C for 6h dramatically reduced the mean percentage of viable pollen (Fig. 1-IV). In this treatment the cultivar STW responded best, showing some degree of resistance to the higher temperature treatment.

**Pollen viability after one month storage:** The results of the study are shown in Fig. 2. Only two pretreatments, drying for 24h at room temperature (RT) and storage of fresh pollen, are reported in this case. Cultivars showed large differences under each method of storage. At -80 and -20°C, cultivar 247 was worst affected by storage while in LN2 the cultivar TA95-2 manifested the greatest intolerance. Of the three temperatures used for storage, all cultivars responded worst to storage at -20°C and best in LN2.

## Discussion

Variability in pollen viability has been demonstrated as shown in Fig. 1 and Fig. 2. This variability could be either intrinsic, i.e., attributable to genetic factors, or due to environmental conditions such as pollen starvation due to competition for nutrients (Heslop-Harrison 1972).

Under natural conditions, pollen grains are usually desiccated to some extent at the time of release or dispersal from the anthers. This natural desiccation appears to be an important and necessary step in the maturation of pollen (Lin and Dickinson 1984). Further, variability of pollen is a common feature of most plant species (Farmer and Barnett 1974). In the present study, drying for 24h or desiccating for 6h at 20°C has a similar effect on all cultivars. Fresh pollen of cultivar STW, for example, has a mean potential fertility of about 90%. On drying for 24h at room temperature or desiccating fresh pollen at 20°C for 6h, the mean percentage loss in viability is about 5% in each case.

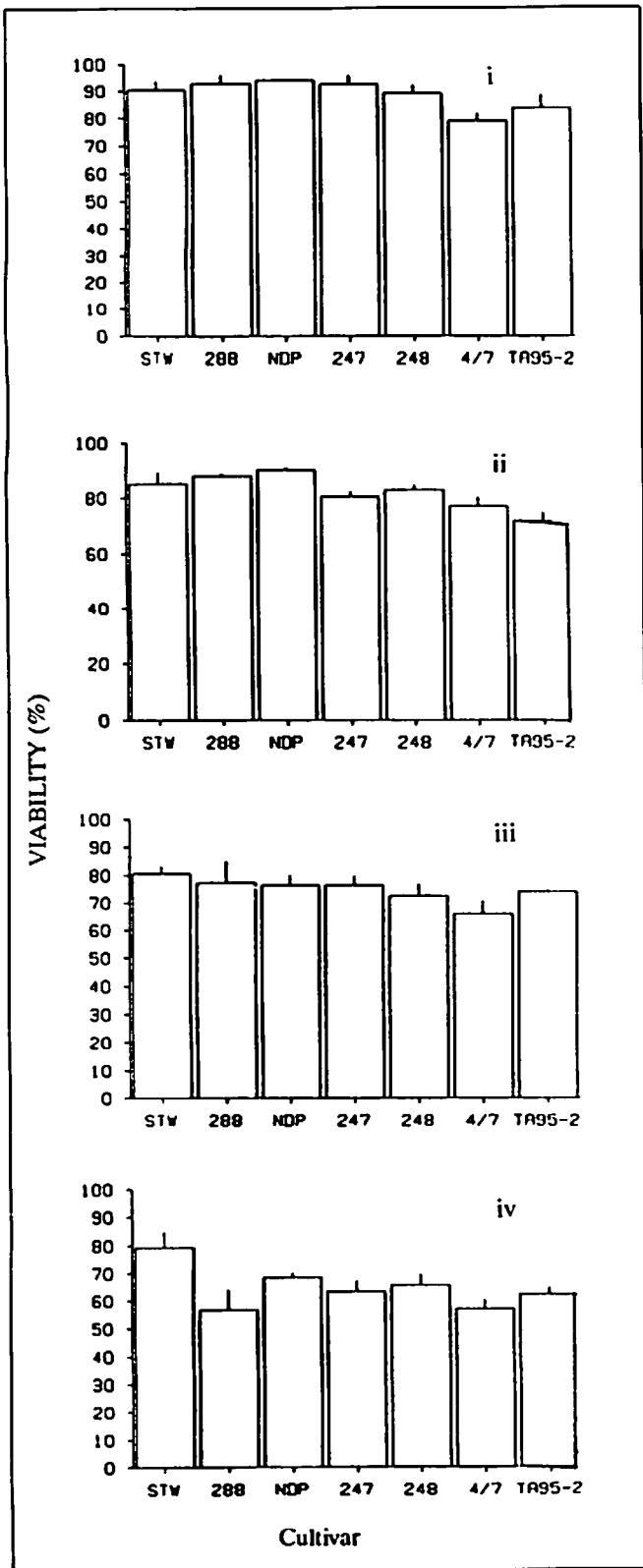


Fig 1. Effect of temperature on *Vicia faba* pollen viability: i) fresh pollen; ii) dried at 20.5°C/24 h; iii) desiccated at 20°C/6 h; and iv) desiccated at 30°C/6 h.

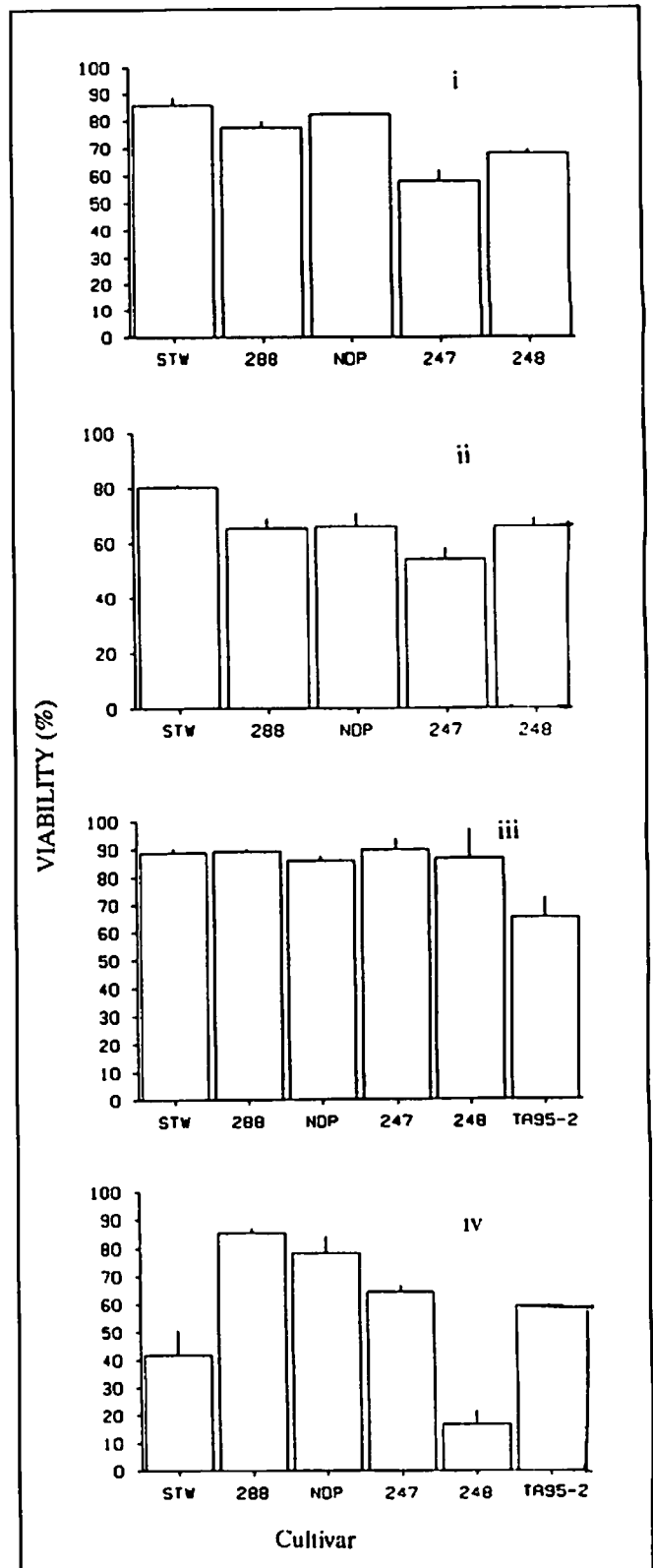


Fig 2. Effect of storage temperature on *Vicia faba* pollen viability: i-iii) dried at 20°C and stored at -80°C, -20°C, and -169°C (LN2), respectively; iv) fresh pollen stored in LN2.

Herrero and Johnson (1980) attributed this to possible genetic control of temperature tolerance in pollen. In this connection it is sucrose in pollen that acts as a protective agent preventing leakage at low water content (Hockstra *et al.* 1989). According to these authors, in crops such as *Pennisetum typhoides* pollen with 14% sucrose will only fail to germinate after predessiccation to 3% water, whereas in maize (pollen with only 5% sucrose), desiccation to 7-8% water will stop germination of the pollen. Therefore, genotypes with greater pollen tolerance to high temperatures should have an advantage in stressed environments. Thus in a different set of studies, *Vicia faba* line STW demonstrated best fruit settings under relatively higher (20-27°C) day Ethiopian temperature regimes (Telaye, unpublished). Barrow (1983) also found that pollen of cotton was viable even at 40°C; above this temperature a severe reduction in viability was observed.

The practical value of prolonging the life of pollen is recognized by plant breeders. The principal factors affecting longevity are temperature and moisture (see Fig. 2-IV). In pollen of most plant species the whole wall area, together with the specially adapted aperture sites which form potential points for the exit of pollen tubes, is involved in the regulation of water content. The consequence of the onset of hydration is to increase the area of intine exposed at the aperture and hence further increase the rate of water uptake (Heslop-Harrison 1987).

During the freezing process, damage to fresh pollen by intracellular ice formation is due directly to the effect of ice crystals on the membrane system rather than to indirect effects associated with the loss of liquid water. On the other hand, predessiccation of cells results in the concentration of solutes which are precipitated and the plasmolysis of cells resulting in reduced ice crystal formation and hence damage to the cell membrane (Mazur 1969) during the long-term storage of pollen at -80°C or in liquid nitrogen.

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## تأثير التجفيف والتخزين في حيوية حبوب لقاح الفول

### الملخص

جرت دراسة مخبرية لحيوية حبوب لقاح (المحددة بتفاعل الإصطباغ المفلور FRC) سبع سلالات من الفول *Vicia faba* بعد تجفيفها على حرارة 20 أو 30 مئوية، وعلى حرارة الغرفة (20.5 مئوية) لمدة 24 ساعة. كما أجريت دراسة على تخزين حبوب اللقاح الطازجة والتي سبق تجفيفها على حرارة الغرفة لمدة شهر. وتم التخزين على حرارة -20 و -80 مئوية أو في أزوت سائل LN2 (حرارته -196 مئوية). إن حبوب اللقاح المجففة على حرارة 30 مئوية كانت الأقل حيوية في تجارب التجفيف مع وجود تباين معنوي بين السلالات. وكانت السلالة STW الأقل تأثراً بهذا التجفيف. وفي تجارب التخزين كانت أقل حبوب اللقاح حيوية - سواء الطازجة أو التي سبق تجفيفها - تلك المخزنة على حرارة -20 مئوية، أما المخزنة في LN2 فكانت الأكثر حيوية. ومع وجود بعض التباين المعنوي بين الطرز الوراثية للفول، تُشير النتائج إلى أنه كان للتجفيف على حرارة 30 مئوية لفترة 6 ساعات تأثير ضار في حيوية حبوب اللقاح. وكان اللقاح المجفف على حرارة الغرفة لمدة 24 ساعة هو الأفضل تخزيناً في LN2. وقد ثبت أن إنقاص رطوبة حبوب اللقاح قبل التخزين أمرٌ له أهميته في إطالة حياة حبوب اللقاح عند التخزين.

## The Action of Igran, Topogard, and Eptam Herbicides on Germination, Seedling Growth, and Mitotic Behaviour of Faba Bean (*Vicia faba* L.)

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### Abstract

The effects of the herbicides Igran, Topogard, and Eptam on germination, growth, and mitotic activity and mitotic aberrations were studied on faba bean. Four different concentrations, ranging from one fourth up to two times the recommended field rate, were used from each herbicide. The three herbicides not only reduced seed germination, seedling growth, and mitotic activity, but also increased the percentage of aberrant cells. The herbicide Eptam showed the greatest effect in reducing seed germination and seedling growth, whereas Topogard was the most potent in reducing mitotic index and increasing aberrant cells. Study on the seeds which allowed to dry after having being exposed to herbicides before test showed the adverse effect of herbicides on the parameters studied. The tested herbicides were effective in inducing different types of mitotic aberrations, such as C-metaphase, tetraploid, binucleate cells, stickiness, and disturbed spindle. It is concluded that these herbicides caused inhibition of spindle formation and cytokinesis.

### Introduction

Herbicide use for controlling weeds in field crops is increasing because of intensification of agriculture and rising cost of hand weeding. However, some herbicides may cause damage to the crops particularly when the proper rates and methods of application are not adopted. The possible hazards may involve reduced plant growth and development. Other abnormalities may also occur. It is well known that hereditary variations (chromosomal or genetical) caused by some pesticides in crop plants may impose a reduction in yield and its quality in subsequent generations. It is important,

therefore, for plant breeders and herbicides users to be acquainted with the efficiency and hazards of each compound used. This work was undertaken to study the immediate and 'dry-back' effects of the three selective herbicides Igran, Topogard, and Eptam on the germination, root and shoot growth, and mitotic behaviour of faba bean. Igran and Topogard are recommended for weed control in faba bean, whereas Eptam is recommended for weed control in beans (Beste *et al.* 1983).

## Materials and Methods

The herbicides: Igran 80% WP "Terbutryn: 2-tert-butylamine-4-ethylamino-6-methylthio-s-triazine", Eptam 72% EC "EPTC: S-ethyl dipropyl thiocarbamate", and Topogard "a combination product containing 35% Igran and 15% chlorotriazine" were used for treating *Vicia faba* seeds. Seed lots (200 each) were soaked for 6h at 20°C either in distilled water (control), or in solutions containing different

concentrations of the three herbicides for both immediate and dry-back treatments (Table 1). After treatment, the seeds were washed thoroughly in distilled water. One-half of the seeds (100 seeds) of each treatment was allowed to germinate immediately, whereas the other half was dried for two weeks 'dry-back treatment' on filter paper and, then allowed to germinate in petridishes. Observations on germination and on root and shoot growth were recorded 14 days after the start of germination tests.

The main roots were excised during seedling emergence to enhance development of secondary roots. When lateral roots reached 0.5-2.0cm, seedlings with vigorous growth of young roots were moved and grown individually in vials containing distilled water. For cytological examination; secondary rootlets 5-10mm long were excised and fixed in a 3:1 solution of ethanol: glacial acetic acid for 12h, then stored in a refrigerator in a solution containing 70% ethanol. Later, fixed rootlets were stained by the Feulegen technique, and preparations from five seedlings were examined for

**Table 1** Effect of the three herbicides Igran, Topogard, and Eptam on seed germination and seedling growth of faba bean in both immediate and dry-back treatments.

Concentration (ppm)	Immediate treatment			Dry-back treatment		
	Germination (%)	Shoot length (cm)	Root length (cm)	Germination (%)	Shoot length (cm)	Root length (cm)
Control	100±0.00	13.9	12.4	100±0.00	10.9	6.6
Igran						
625	98±1.40	13.8	12.9	80±4.00	11.2	9.6
1250	96±1.96	11.9	10.6	72±4.49	9.4	7.2
2500	96±1.96	9.2	8.3	66±4.74	8.3	6.1
5000 <sup>a</sup>	94±2.37	8.0	6.4	54±4.98	7.1	5.4
Topogard						
937.5	82±3.84	10.0	7.3	70±4.58	7.0	5.9
1875.0	64±4.80	8.3	6.2	64±4.80	5.8	4.6
3750.0	60±4.90	1.2	5.1	52±5.00	3.2	0.9
7500.0 <sup>a</sup>	52±5.00	0.6	3.4	36±4.83	2.7	0.5
Eptam						
3750	80±4.00	8.6	5.1	60±4.90	6.3	4.2
7500	70±4.58	6.8	3.9	54±4.98	6.1	2.7
15000	55±4.97	4.7	3.2	42±4.94	4.0	3.0
30000 <sup>a</sup>	40±4.90	3.2	2.3	24±4.27	2.2	2.1

a) = Concentration of two times the field rate.

each treatment of both immediate and dry-back effects of herbicides. The mitotic activity and mitotic aberrations were estimated.

## Results and Discussion

**Seed germination:** The toxic effect of the three herbicides on the treated seeds was evident from the results of the germination tests (Table 1). Generally, germination was decreased as the herbicide level was increased. Eptam was the most toxic herbicide, whereas Igran was the least toxic one. Germination was affected more by the dry-back treatments than by the immediate ones. These results may be due to retention of herbicides in the seeds, especially after treatment for a longer time which gave the chemical a

higher chance to affect the germinated seeds (Konzak *et al.* 1964). Reduced germination in immediate treatments was also reported by Abdou and Ashour (1986).

**Seedling growth:** Reduction in shoot and primary root's length of seedlings were observed in both the dry-back and immediate treatments (Table 1). However, it was more obvious in the former than in the later. Igran showed the least effects on the seedlings' growth and proved to be the safest compound as compared with the other herbicides.

The secondary roots of the seedlings treated with topogard were few and dispersed nine days after germination, particularly at the two highest concentrations in both the immediate and dry-back treatments. Nawar *et al.* (1970) attributed the damage occurring in the dry-back treatment

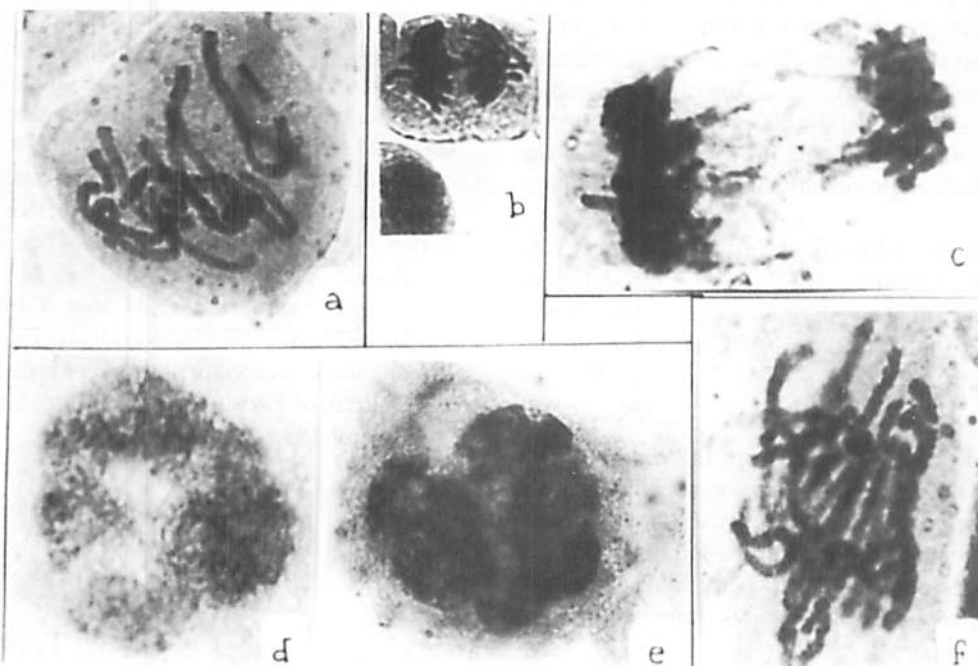
Table 2. Effect of herbicides Igran, Topogard and Eptam on mitotic and mutagenic activity of faba bean in both immediate and dry-back treatments.

Concentration (ppm)	Immediate treatment					Dry-back treatment				
	Mitotic activity			Mutagenic activity		Mitotic activity			Mutagenic activity	
	No. of cells scored	Mitotic index (%)	Mitotic inhibition (%)	No. of c. anal. sco.ab.	Aberr. cells (%)	No. of cells scored	Mitotic index (%)	Mitotic inhibition (%)	No. of c. anal. sco.ab.	Aberr. cells (%)
Control	3220	16.15±0.65		100	0.00	3110	15.69±0.65		100	2.00±1.40
<b>Igran</b>										
625	3400	15.15±0.61	6.19	266	3.01±1.05	2950	13.90±0.64'	11.41	210	4.29±1.40
1250	3006	15.59±0.66	3.47	278	5.04±1.31	2615	12.05±0.64''	23.20	175	6.29±1.84
2500	2915	14.24±0.65*	17.15	199	8.04±1.93	1872	10.74±0.72''	31.55	91	9.89±3.13
5000 <sup>a</sup>	2020	10.40±0.68''	35.60	182	10.44±2.27	2018	8.82±0.63''	43.79	108	12.96±3.23
<b>Topogard</b>										
937.5	1644	9.43±0.72''	41.61	105	16.19±3.59	1780	6.85±0.60''	56.34	72	16.67±4.39
1875.0	1580	7.97±0.68''	50.65	92	16.30±3.85	1520	5.59±0.59''	64.37	55	20.00±5.39
3750.0	1226	2.37±0.43''	85.33	20	25.09±9.68	990	1.92±0.44''	87.76	14	28.57±12.07
7500.0 <sup>a</sup>	1002	1.90±0.43''	88.24	15	33.33±12.17	758	1.32±0.41''	91.59	18	37.50±17.12
<b>Eptam</b>										
3750	2875	14.43±0.66	10.65	196	3.57±1.33	2006	11.76±0.72''	25.05	176	5.11±1.66
7500	3110	11.77±0.58''	27.12	168	5.95±1.83	1920	9.11±0.66''	41.94	85	7.06±2.78
15000	2230	9.42±0.62''	41.67	110	9.09±2.74	2360	7.50±0.54''	52.20	88	10.23±3.23
30000 <sup>a</sup>	1877	8.84±0.66''	45.26	88	11.36±3.38	1488	6.59±0.64''	58.00	67	14.93±4.35

1) No of c. anal. sco. ab. = Number of cells analysed for scoring aberrations.

\*, \*\* Significant at 5% and 1% levels of probability, respectively.

a) = Concentration of two times the field rate.



**Plate 1.** C-metaphase (a); anaphase bridge (b); telophase bridge with stickiness (c); giant nucleus (d); two giant nuclei (e); and disturbed spindle (f) in the treated rootlets of *Vicia faba* seedlings.

to the increase in the relative concentration of the chemical within cells leading to slow metabolic activity that may interrupt the energy-requiring repair mechanisms.

**Mitodepressive and mutagenic activity:** The effects of the three herbicides on the mitotic activity of root-tip cells of faba bean in both treatments are shown in Table 2. The rate of mitotic activity in all treatments suffered a marked decline with the increase in concentrations of each herbicide. The highest effect in reducing mitotic index was caused by Topogard, whereas the lowest effect was by Igran. Mitotic activity reached its minimum (1.32%) when Topogard was used at 7500 ppm in the dry-back treatment. Generally, the values of mitotic indexes in the root-tip cells of germinated seeds were lower in the dry-back treatments than in the immediate ones.

Mitotic inhibition, in general, increased with increasing herbicide concentration (Table 2). Similar antimutagenic effects of different pesticides have been reported in several crops

(Skoblin 1981; Anantha Reddy and Suberamaniam 1984; Abdou and Ashour 1986, 1987; Badr and Ibrahim 1987).

The effect of the three herbicides was evident on the faba bean chromosomes. This indicates that all the tested herbicides are mutagenic agents, especially at the higher concentrations. A substantial increase in the percentage of aberrant cells have been observed in the rootlets of the treated seeds (Table 2). Topogard was more effective in inducing chromosome damage than Igran or Eptam.

The amount of aberrations induced in the dry-back treatments was slightly larger than that induced in the immediate treatments. The most frequent abnormalities noticed were C-metaphase, chromosome stickiness, and disturbed spindle. Other kinds of aberrations included, binucleate cells, laggards, bridges, giant nucleus, and polyploid cells (Plate 1).

C-metaphase aberrations resulted from the inhibition

of spindle formation, especially at the highest concentration used. C-metaphase cells are known to give rise to polyploid cells after restitution. These results proved that the tested herbicides affected greatly both cytokinesis and spindle formation, but did not prevent chromosome replication. Spindle disfunction also leads to scattering of chromosomes at meta-anaphase and unequal distribution of chromosomes. Giant interphase nuclei might be polyploid, whereas the binucleate condition might result from cytokinesis failure.

The results on the induction of clastogenic effects, e.g., breaks, fragments, laggards, and bridges caused by the tested herbicides are in line with those reported by Tobgy *et al.* (1969), Banda and Sharma (1980), and Abdou and Ashour (1986; 1987).

The herbicide Igran seemed, from the results of this study, to be safer than Topogard on crop seedling growth, mitosis, and genetic material. This raises the need for comparing the effects of the recommended herbicides on crop growth and cytology. Minimizing herbicidal applications in an integrated weed management system would also minimize the hazards.

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## تأثير المبيدات العشبية:

Eptam, Topogard, Igran في الإنبات ، ونمو  
البادرات والإنقسام الخيطي في الفول

## الملخص

تمت دراسة تأثيرات المبيدات العشبية Eptam, Topogard, Igran في الإنبات والنمو ونشاط وانحرافات الانقسام الخيطي في الفول. واستخدمت أربعة تراكيز من كل مبيد عشبي تراوحت ما بين ربع وحتى ضعف المعدل الحقل الموصى به. ولم تؤد المبيدات العشبية الثلاثة إلى خفض نسبة إنبات البنور ونمو البادرات ونشاط الإنقسام الخيطي فحسب، بل أدت كذلك إلى زيادة النسبة المئوية للخلايا الشاذة. وفيما أظهر المبيد العشبي Eptam أكبر تأثير في خفض نسبة إنبات البنور ونمو البادرات، أظهر المبيد Topogard أنه الأكثر قدرة على تقليل دليل الانقسام الخيطي وزيادة الخلايا الشاذة. وأظهرت الدراسة على البنور التي تُركت تجف بعد معاملتها بالمبيدات العشبية قبل الاختبار تأثيراً معاكساً للمبيدات العشبية بالنسبة للمعايير المدروسة. وكانت المبيدات العشبية المختبرة فعالة في استحداث أنماط مختلفة من الانحرافات الصبغية الخيطية مثل: الطور الإستوائي - ج، التضاعف الصبغي الرباعي، والخلايا الثنائية النواة، ولزوجة الصبغيات، والمغزل المنحرف. وخُصّص البحث إلى أن تلك المبيدات قد حدثت من تشكّل المغزل وانقسام الهيولى.



## Agronomy and Mechanization

## المعاملات الزراعية والمكننة

### Responses to Sowing Depth of Winter Faba Bean

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#### Abstract

The effects of different sowing depths ranging from 50-350 mm on the establishment and productivity of an autumn sown determinate population of faba bean (858) were investigated at the University of Nottingham, UK, in two seasons, 1986/87 and 1988/89. Higher mean temperatures with increasing depth in the soil promoted more rapid germination of the deeper sown seed which resulted in similar rates of emergence for seeds sown at all depths. Plant populations were reduced, however, at the shallowest sowing in 1988/89 because the seeds were eaten by birds. Yields were unaffected by sowing depth, although it is suggested that plants were less vigorous when the seed was sown more deeply.

#### Introduction

Depth of sowing of seed is one aspect of the agronomy of faba bean (*Vicia faba* L.) which has been poorly studied (Hebblethwaite *et al.* 1983) but which may have considerable impact on the productivity of the crop. Seeds sown too close to the soil surface can be easily eaten by birds and small mammals and they are also more vulnerable to the effects of residual pre-emergence herbicides (Barry and Storey 1977). Shallow sowing can also result in uneven germination in dry conditions. While it may confer increased resistance to cold temperatures on seed sown in the autumn (McEwen *et al.* 1988), deeper sowing may ultimately produce plant populations significantly below the desired plant density because many seedlings fail to emerge. Also those seedlings which do emerge may be less vigorous, less disease resistant and yield less.

In common with the husbandry of faba bean in developing countries, the method employed for sowing winter faba bean cultivars in western European agriculture is often by broadcasting the seed on the soil surface and ploughing the seed in. Although this method has the advantages of being energy efficient (a single operation cultivates the soil and drills the seed), of facilitating the timeliness of sowing, particularly on heavy soils, and the burying the stubble so improving weed control, it affords less precise control over the position of the seed in the soil profile which may be disadvantageous for the reasons outlined above. Accurate control of sowing depth can only be achieved by the use of sophisticated and often expensive machinery, such as precision drills, which require thorough preparation of the seed bed prior to sowing which may not always be practicable.

In an attempt to answer the direct question of the effect of sowing depth on the productivity (including the problems of bird damage and winter survival) of an autumn-sown faba bean crop, and simultaneously the indirect question of the merits of particular sowing methods, a field trial was conducted at the University of Nottingham.

#### Materials and Methods

Seed of an autumn-sown determinate faba bean population, 858 (provided by Dr D.A. Bond, PBI, Cambridge, UK) was hand sown in 3 x 2 m plots on 17 Nov 1986 and 17 Oct 1988 at densities of 50 and 40 seeds/m<sup>2</sup> respectively, in rows 25 cm apart. Seed was sown at four different depths in 1986, namely 50, 100, 150 and 250 mm, to which a fifth depth (350 mm) was added in 1988. Holes were made with a 15 mm diameter iron bar, the seed placed at the bottom and the hole back-filled with soil and the surface firmed and raked. This was assumed to simulate agricultural practice where a seed is buried beneath a loosened soil layer. The plots were arranged in a randomised block design with 3 blocks. Weeds were controlled by hand and *Botrytis fabae* and *Ascochyta fabae* were controlled when necessary by a chlorothalonil carbendazim mixture.

Counts of the number of seedlings to emerge in a 1 m length of row from each plot commenced two weeks after sowing and continued twice weekly until the end of January 1987 and 1989. Soil temperatures at each depth were

measured daily from sowing until the end of the emergence counts. A mean temperature for the period from sowing to the emergence of the first seedling was calculated.

At final harvest (i.e., 30 Sept 1987 and 4 Aug 1989) two areas were harvested by hand. The plants from the smaller area (0.75 m<sup>2</sup>) were counted and a subsample of 10 plants taken for yield component analysis. The numbers of stems, pod-bearing nodes, and pods and seeds on these plants were counted and the dry weights of seed and stem determined together with the weight of the remainder, by drying at 80°C for 48h. Plant height was also measured. The plants from a larger area (2.25 m<sup>2</sup>) were counted and threshed and the seed weighed. Seed numbers were counted and the fresh and dry weight of the seed measured in order to determine the percentage moisture content and the 1000-seed weight.

## Results and Discussion

Time to emergence of the first seedlings on each plot was not significantly affected by sowing depth (Table 1). In order for seedlings from different depths to appear at similar times at the soil surface both the rate of germination and the rate of shoot extension must be greater in those plants sown more deeply. In the Autumn, soil temperatures commonly increase as depth increases. Since the germination rate of faba bean seeds increases as temperature increases, towards an optimum of approximately 25°C, above a base temperature (Ellis *et al.* 1987; Dumur *et al.*, in Press) then germination rates will be more rapid in the deeper sown seeds. Regression analysis of the rate of emergence (the reciprocal of the time to the emergence of the first seedling) against mean soil temperature shows that in both years (Table 2) the rate of progress to emergence was unaffected by sowing depth, indicating a constant thermal time requirement for emergence in any year ( $O =$

129.4°C d in 1987 and  $O = 83.4^\circ\text{C d}$  in 1989). However, sowing depth affected the intercept of this relationship (Table 2), which decreased as sowing depth increased, suggesting that the base temperature for emergence increased as sowing depth increased (Table 1). While these conditions apply in the autumn and result in similar emergence times for seed sown at different depths, in the spring there is no gradient of increasing temperature down the soil profile and so emergence rates will be slower in the deeper sown seeds. Dumur (1989) at the University of Nottingham has shown this for Alfred, a spring sown cultivar of faba bean.

Although initial rates of emergence were unaffected by sowing depth, climate or pests and pathogens may subsequently affect plant stands. However, winter temperatures were not sufficiently cold to unequivocally demonstrate that deeper sowing promoted winter survival. Losses from the original sown seed were larger in 1986/87 than in 1988/89. On average, 13 seeds/m<sup>2</sup> failed to produce a plant at final harvest in 1986/87, whereas only 7.5 seeds/m<sup>2</sup> failed in 1988/89. Plant populations at final harvest were largely unaffected by sowing depth, except that the shallowest sown seeds (5 cm) in 1989 were eaten by birds, as Barry and Storey (1977) also showed, and plant population accordingly were reduced (Table 3).

Seed yields were unaffected by sowing depth in either year (Table 3) averaging 3.6 and 2.0 t/ha in 1986/87 and 1988/89, respectively. These yields of faba bean population 858 were similar to those previously reported for plants sown to achieve a population of 40 plants/m<sup>2</sup> (e.g., Pilbeam *et al.*, in Press). Yield components/m<sup>2</sup> too were unaffected by sowing depth in either year (Table 3).

In 1989 only, plant heights were significantly greater at intermediate sowing depth (Table 3), and stem weights and therefore total biomass followed a similar trend. At the shallower sowings, which had a lower plant population because of bird damage, competition for light may be less than at the higher densities from the deeper sowings and so plant height reduced. However, the smaller plants from seed sown more deeply suggests that deep sowing may reduce subsequent plant vigour.

In conclusion, faba bean can be sown at considerable depth in the autumn without adversely affecting seed yield. Deep sowing has benefits in avoiding losses of seeds or seedlings through pests or residual chemical effects and perhaps also in minimizing over-wintering losses by placing the seed in a more favorable edaphic environment in terms of temperature and moisture supply. Practically, concern over the consequences of different methods of sowing on the position of seed in the soil profile and the subsequent plant stand in unwarranted.

Table 1 Days after sowing and mean temperature for emergence of first seedling and base temperature of emergence (°C).

	Depth (cm)					SE±
	5	10	15	25	35	
<i>Season 1986/87</i>						
Days	27.3	27.3	33.3	37.0		3.52
Mean temperature	6.31	6.31	6.11	6.84		0.228
T <sub>b</sub>	1.57	1.57	2.15	3.13		
<i>Season 1988/89</i>						
Days	29.2	26.3	29.8	24.5	17.8	3.28
Mean temperature	7.88	7.66	8.02	9.90	11.76	0.415
T <sub>b</sub>	4.6	4.37	5.01	6.43	6.87	

**Table 2** Regression equations for rate of emergence against mean soil temperature (SE in brackets).

Season	Depth (cm)	Slope	Intercept	R <sup>2</sup>
1986/87	5	+0.00773 (±0.00238)	-0.0121 (±0.0152)	0.78
	10	+0.00773 (±0.00238)	-0.0121 (±0.00268)	
	15	+0.00773 (±0.00238)	-0.0166 (±0.00272)	
	25	+0.00773 (±0.00238)	-0.0242 (±0.00296)	
1988/89	5	+0.01199 (±0.000744)	-0.05345 (±0.00605)	0.94
	10	+0.01199 (±0.000744)	-0.05244 (±0.00211)	
	15	+0.01199 (±0.000744)	-0.06011 (±0.00211)	
	25	+0.01199 (±0.000744)	-0.07704 (±0.00259)	
	35	+0.01199 (±0.000744)	-0.08231 (±0.00358)	

**Table 3** Population, yield, yield components and biomass of faba bean grown during the 1986/87 and 1988/89 seasons.

Depth (cm)	Population	Seed yield (plant/m <sup>2</sup> )	Stem <sup>1</sup> (t/ha)	Pod-bearing node <sup>1</sup>	Pod <sup>1</sup>	Seed <sup>1</sup>	1000-seed weight (g)	Harvest index	Plant height (cm)	Stem weight (g/m <sup>2</sup> )	Biomass (g/m <sup>2</sup> )
<b>1986/87</b>											
5	38	3.4	76.5	68.1	94.6	234	551	40.2	94.2	417	836
10	40	3.6	79.4	71.8	94.0	232	557	40.4	95.5	491	994
15	37	3.7	71.0	70.5	88.2	225	636	41.2	98.4	447	922
25	32	3.5	67.6	73.1	97.5	248	610	44.0	90.9	383	838
SE±	1.96	0.18	4.72	6.68	9.81	24.7	24.3	1.68	3.57	22.1	46.2
<b>1988/89</b>											
5	20	2.0	85.7	190.4	247	545	545	32.2	94.6	920	1622
10	33	2.1	112.4	232.6	305	684	570	30.1	103.2	1216	2039
15	37	1.9	100.7	221.4	286	594	526	29.2	100.4	1158	1899
25	36	2.0	109.6	241.3	323	683	563	32.9	101.6	1083	1913
35	36	2.1	107.4	244.5	281	600	584	31.8	96.5	1151	2009
SE±	2.27	0.17	5.33	14.88	24.1	50.4	17.5	1.43	1.80	23.9	45.8

1 = Numbers/m<sup>2</sup>

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## استجابات الفول الشتوي لعمق الزراعة

### المخلص

تمت في جامعة نوتنغهام بالملكة المتحدة خلال موسمي 1986/87 و 1988/89 دراسة مختلف مسافات عمق الزراعة التي تراوحت بين 50 - 350 مم، وتأثيرها في استرساء وإنتاجية عشيرة من الفول الخريفي (858) المحبوبة النمو. وقد أدى ارتفاع متوسط درجات الحرارة المترافق بزيادة عمق الزراعة إلى تزايد سرعة إنبات البذور الأكثر عمقاً، الأمر الذي أسفر عن حدوث معدلات متشابهة من ظهور البادرات بالنسبة للبذور المزروعة على جميع الأعماق. غير أنه حصل في موسم 1988/89 انخفاض في الكثافة النباتية عند الزراعة السطحية بسبب التقاط الطيور للبذور المزروعة. ولم تتأثر الغلال بعمق الزراعة، مع أنه لوحظ عند زراعة البذور على عمق أكبر أن النباتات كانت أقل قوة.

## Effect of Time of Harvesting and Topping on Yield of Faba Bean (*Vicia faba L.*)

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### Abstract

The effects of three harvesting dates (at 50, 75, and 100% pod maturity) and three toppings (at 110, 120, and 130 days after sowing) were studied on faba bean. Harvesting time significantly affected faba bean yield. The optimum time of harvest was at 75% pod maturity; delaying the harvest beyond this date reduced the grain yield significantly. The effect of topping was variable and should be further investigated.

### Introduction

Topping is practiced in faba bean to induce earliness and synchronized maturity, especially in the indeterminate types. This helps to avoid problems when harvesting is at full maturity. The influence of topping on yield of faba bean is variable; Hodgson and blackman (1975) observed a yield decrease as the level of young pods abortion increased due to topping, whereas Gehringer and Keller (1980) observed a slight grain yield loss due to topping. Ali (1965) reported that harvest date showed highly significant effects on faba bean grain yield and its components. Salih (1983) observed that shattering tended to reduce seed yield when harvest was delayed beyond 120 days over a harvest range of 80-140 days after sowing. Optimum time for harvest of faba bean was reported to be when all pods contained fully developed seeds (Toynbee-Clarke 1973), or when 66% of the pods

Table 1. Seed and total dry matter yields as affected by time of harvest and topping.

Treatment	Seed yield (kg/ha)		Total dry matter yield (kg/ha)	
	1984/85	1985/86	1984/85	1985/86
H 50% <sup>a</sup>	3218	3055	6366	6134
H 75%	4005	3843	7735	7986
H 100%	2684	2132	4693	3935
LSD (5%)	6.31	5.15	11.43	9.55
T 110 <sup>b</sup>	2445	2072	5195	4519
T 120	3012	2326	5577	4898
T 130	3301	2634	6482	5903
LSD (5%)	ns <sup>1</sup>	ns	ns	ns
SE ± (H) or (T)	2.01	1.64	3.64	3.04
CV (%)	15.82	15.00	14.78	13.61

a) Harvesting at 50, 75, or 100% pod maturity.

b) Topping at 110, 120, or 130 days after sowing.

1) Not significant

**Table 2.** Yield and yield components of faba bean as affected by time of harvest and topping.

Treatment	No. of pods/plant		No of seeds/pod		Seed yield/plant (g)	
	1984/85	1985/86	1984/85	1985/86	1984/85	1985/86
H 50% <sup>a</sup>	75.74	58.83	3.05	3.20	25.10	25.09
H 75%	85.07	68.90	3.18	3.13	33.15	32.33
H 100%	61.63	49.03	3.15	3.17	21.07	20.29
LSD (5%)	6.78	6.97	ns <sup>1</sup>	ns	3.64	4.44
T 110 <sup>b</sup>	69.40	61.33	3.13	3.24	22.70	20.92
T 120	72.17	64.60	3.11	2.91	24.00	23.57
T 130	77.00	69.36	2.83	3.24	16.43	25.43
LSD (5%)	ns	ns	0.09	0.16	ns	ns
SE ± (H) or (T)	2.16	2.22	0.03	0.05	1.16	1.41
CV (%)	7.36	10.44	2.30	3.82	11.22	14.06

a) Harvesting at 50, 75, and 100% pod maturity.

b) Topping at 110, 120, and 130 days after sowing.

1) Not significant

turned brown (Qiu and He 1985). This study was conducted to investigate the effect of time of harvesting and topping on faba bean in north India.

## Materials and Methods

The trial was conducted at the Agronomy Research Farm, Haryana Agricultural University, Hisar, India, during the winter seasons of 1984-86. The treatments, comprising three harvesting dates at 50, 75, and 100% pod maturity and three topplings at 110, 120, and 130 days after sowing, were arranged in a randomized block design with three replications.

## Results and Discussion

Time of harvest significantly affected both seed and total dry matter yields in both seasons, whereas topping had no significant influence (Table 1). Harvesting the crop at 75% pod maturity increased grain and total dry matter yields significantly as compared to harvesting at 50 and 100% pod maturity. Delaying the harvest time beyond 75% pod maturity reduced the grain yield significantly. Similar findings were reported by Ali (1965), Toynbee-Clarke (1973), Salih (1983), and Qiu and He (1986). The increase in grain yield/plant was mainly due to the increase in number of pods/plant (Table 2).

Topping at different stages of growth did not cause significant differences in grain and total dry matter yields

during the two years of test (Table 1). Therefore, further investigations are recommended to better understand the effects of topping on faba bean yield in light with the variable results reported by other researchers.

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## تأثير موعد الحصاد والشرنقة Topping في غلة الفول (*Vicia faba* L.)

### الملخص

تمت دراسة تأثير ثلاثة مواعيد حصاد (عند نضج القرون بنسبة 50 و 75 و 100٪)، وثلاث عمليات شرنقة (قطع أعلى النبات) للفول (بعد 110 و 120 و 130 يوما من الزراعة). وكان لموعد الحصاد تأثير معنوي في غلة الفول، وتبين أن موعد الحصاد المثالي هو عند نضج القرون بنسبة 75٪؛ إذ أن تأخيرها عن ذلك قد أدى إلى تقليل الغلة الحبية بدرجة معنوية. أما تأثير الشرنقة فكان متبايناً، لذا يجب البحث فيه أكثر.

## Effects of Fungicides and Crop Density on Autumn-Sown *Vicia faba* L.

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### Abstract

Two field experiments were conducted at the Rothamsted Experimental Station, UK, to test the effects on autumn-sown *Vicia faba* of 12 and 36 seeds sown/m<sup>2</sup> in combination with three fungicide treatments applied in response to chocolate spot (none, benomyl + chlorothalonil, and maneb + mancozeb) and the same three fungicide treatments applied later in response to rust. The larger seed rate increased yield and the incidence of rust but had little effect on chocolate spot. The most consistent and largest average yield of 6.2 t/ha was given by the combination of 36 seeds/m<sup>2</sup> with benomyl + chlorothalonil initially, followed by maneb + mancozeb. It was not possible to apportion yield increases separately to control of chocolate spot or rust, partly because the fungicide treatments reduced both diseases and partly because of the difficulty of measuring relative amounts of disease on faba beans.

## Introduction

The use of fungicides to control chocolate spot (*Botrytis fabae* Sardina and *B.cinerea* Fr.) on autumn-sown faba beans (*Vicia faba* L.) is a well-established practice in the United Kingdom (Bainbridge *et al.* 1985). Mixtures of fungicides, e.g. benomyl and chlorothalonil, are often preferred. On the spring-sown crop the use of fungicides to control rust (*Uromyces viciae-fabae* Pers.) is also often economically justified, (Yeoman *et al.* 1987), a mixture of maneb and mancozeb is particularly effective. The little evidence available for the autumn-sown crop (Jones 1986) suggests a lack of response to rust control, perhaps because this crop is relatively nearer maturity when the disease appears. The density of sowing has sometimes been shown to affect damage by chocolate spot (Ingram and Hebblethwaite 1976). Our experiments were designed to gain more information on the control of rust and the extent to which this was affected by crop density and the prior use of fungicides to control chocolate spot.

## Materials and Methods

Two experiments were done at Rothamsted on clay-with-flints soil well-supplied with P, K, and lime. The cultivar 'Bourdon' was used, sown on 12 Oct 1986 (harvested 25 Sept 1987) and 23 Oct 1987 (harvested 30 Oct 1988) - referred to as the 1987 and 1988 experiments respectively hereafter. The experiments tested all combinations of (i) two seed rates (12 and 36 seeds/m<sup>2</sup>), (ii) three fungicide treatments applied in response to chocolate spot becoming aggressive (none, benomyl at 0.5 kg/ha + chlorothalonil at 1.0 kg/ha and maneb + mancozeb each at 0.8 kg/ha), (iii) the same three fungicide treatments applied in response to the first rust pustules being found, repeated if necessary. For the 1987 experiment the first-set fungicides was applied on 18 June, the second on 9 July and 5 August. For the 1988 experiment first and second-set fungicides were applied on 20 and 29 June, respectively. The treatments were arranged as two randomised blocks of 18 plots for the combinations of 2x3x3. Plots were 6x10 m separated by 6 m unsprayed discards. Seed yields were taken from a central 3x10 m area. Foliar diseases were assessed on two occasions in the summer and components of yield were measured at maturity.

## Results and Discussion

The primary effect of a foliar disease is to cause loss of photosynthetic area for a particular time. Whether or not yield is affected depends on the size of this loss and on whether

or not the period in which it was sustained was essential for the fulfillment of the yield potential set by other limitations. To measure fully the combined effects of size and period of loss is almost impossible in an indeterminate crop like faba bean which sheds old leaves and produces new ones regularly for many weeks. Table 1 has average figures for chocolate spot and rust on the middle canopy of leaves in August each year because these give a good indication of differences between years and the relative effects of treatments on that date. However, because of the foregoing considerations good correlations between these figures and yield are not to be expected.

In 1987, when amounts of chocolate spot and rust were relatively small, the first-set fungicides had no effect on seed yield (Table 1), although they did reduce both diseases significantly. Second-set fungicides gave small increases in yield at the lower seed rate, larger ones at the higher seed rate, which gave an overall benefit of 2 t/ha. Second-set fungicides also reduced both diseases significantly. There was no evidence for an interaction between first and second-set fungicides.

In 1988 both diseases were more prevalent and rust appeared on 28 June, 10 days sooner than in 1987. In August

**Table 1** Effects of fungicides and crop density on the seed yield and foliar diseases, assessed on the middle canopy of leaves in August.

Treatments			1987			1988		
Seeds sown/m <sup>2</sup>	1st set fungicides	2nd set fungicides	Yield t/ha	% leaf area infected		Yield t/ha	% leaf area infected	
				C.S.	R.		C.S.	R.
12	0	0	2.9	4.4	2.0	4.9	17.0	18.5
12	0	B + C	3.2	1.2	0.6	4.9	11.4	15.5
12	0	M + M	3.3	1.4	0.2	6.5	8.6	7.3
12	B + C	0	2.8	2.2	0.8	7.1	8.8	15.0
12	B + C	B + C	2.8	1.3	0.1	6.6	6.6	14.0
12	B + C	M + M	2.8	1.0	0.2	6.3	4.0	1.7
12	M + M	0	3.0	3.1	0.1	5.4	6.2	4.8
12	M + M	B + C	3.7	1.1	0.2	5.6	8.1	5.9
12	M + M	M + M	3.5	0.9	0.1	6.6	3.2	1.4
36	0	0	4.6	4.4	0.9	5.3	19.0	35.5
36	0	B + C	5.3	2.6	1.2	5.6	9.6	10.6
36	0	M + M	5.6	4.4	0.0	6.1	6.4	2.0
36	B + C	0	4.6	3.0	1.5	5.8	6.8	16.5
36	B + C	B + C	5.0	0.7	0.5	6.5	5.2	10.7
36	B + C	M + M	6.2	1.1	0.1	6.2	3.7	2.1
36	M + M	0	4.7	2.1	0.4	6.2	8.3	6.5
36	M + M	B + C	5.4	1.2	0.0	6.5	8.7	9.5
36	M + M	M + M	5.3	0.7	0.1	5.9	3.7	2.5
SE±			0.33	0.18	0.11	0.34	1.18	1.13

B+C = Benomyl + chlorothalonil; M+M = Maneb + mancozeb; C.S. = Chocolate spot; R = Rust.

both first-set fungicides alone continued to give significant control, with maneb + mancozeb more effective against rust. Both increased yield, although the very large increase for benomyl and chlorothalonil with the lower seed rate appears anomalous. The second-set fungicides alone were generally a little less effective in controlling chocolate spot but more effective against rust at the higher seed rate. Yields from these single applications were on average better from the early spray when benomyl + chlorothalonil was used, from the later spray with maneb + mancozeb. As in the 1987 experiment there was no evidence for an interaction between first and second-set fungicides. There was no overall benefit from the larger seed rate in 1988. It had little effect on chocolate spot but nearly doubled the amount of rust on unsprayed plots while only slightly limiting the effectiveness of its control by fungicides.

In 1987 the larger seed rate increased yield primarily by increasing the number of pods from 150 to 230/m<sup>2</sup>. Increases from second-set fungicides were attributable to increases in individual seed mass, from 5.3g with none to 6.3g with maneb + mancozeb.

Larger yields in 1988 were primarily attributable to greater numbers of pods. Even the smaller seed rate gave 320 pods/m<sup>2</sup> by the higher seed rate which did not give an overall greater yield because these pods had fewer grains. Increased yields from both first and second-set fungicides came from increased seed mass, from 5.9g with none to 6.2g with any of the fungicides.

## Conclusions

The most consistent and largest average yield was obtained from the combination of 36 seeds sown/m<sup>2</sup>, benomyl + chlorothalonil early followed by maneb + mancozeb later. However, the results illustrated the impossibility of obtaining unequivocal data when more than one foliar disease is present and the fungicides available do not give specific control. Although yield was nearly always greater on plots where rust had been controlled, these were the same plots showing chocolate spot control. The difficulty of adequately measuring relative amounts of disease on an indeterminate leaf-shedding crop prevented effective correlations with yield.

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## تأثير المبيدات الفطرية والكثافة المحصولية في القول المزروع في الخريف

### الملخص

نُفذت تجربتان حقليتان في محطة بحوث روئامستد في المملكة المتحدة، لاختبار تأثير القول المزروع في الخريف بمعدل 12 و 36 بذرة/م<sup>2</sup> باتباع ثلاث معاملات مبيدات فطرية لمكافحة التبقع الشوكولاتي (بدون مبيد، بينوميل + كلوروثالونيل، ومانيب + مانكوزيب). وطبقت نفس المعاملات بالمبيدات الفطرية فيما بعد لمكافحة الصدأ. وقد أدى ارتفاع معدل البذار إلى زيادة الغلة والإصابة بالصدأ، لكنه أثر بشكل ضئيل في التبقع الشوكولاتي. وتم الحصول على أكبر معدل للغلة - 6,2 طن/هـ - من معاملة 36 بذرة/م<sup>2</sup> أولاً بمزيج من بينوميل + كلوروثالونيل، أعقبه مانيب + مانكوزيب. ولم يكن في الإمكان توزيع الزيادات في الغلة بصورة منفصلة لمكافحة التبقع الشوكولاتي أو الصدأ، وذلك لسببين: أولهما تأثير المبيدات الفطرية في الحد من كلا المرضين، وثانيهما صعوبة قياس شدة المرض نسبياً على القول.

## Performance of Faba Bean in Punjab, India

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## Abstract

The effect of sowing date and row spacings on faba bean performance was studied for three consecutive seasons (1985-1987) in the Punjab state, India. Faba bean performance was excellent in two out of the three years of test. However, delaying the sowing date from October to November reduced the grain yield significantly. In general, row spacing did not show significant effects on yield or its components except during the second year of test (1986). Crop grown at 22.5cm row spacing gave yields slightly higher than that grown at 30cm. Faba bean can be successfully grown in Punjab if sowing was between 10 and 25 October at a row spacing of 30cm.

## Introduction

Faba bean (*Vicia faba* L.) is often grown as a vegetable crop in India. Currently it is gaining importance as a pulse crop in the cropping patterns of north Bihar, eastern Uttar Pradesh and Madhya Pradesh (Rai and Thakur 1986). Khare and Sharma (1984) highlighted the potential of faba bean as a *rabi* crop in rainfed agriculture in India. Rao *et al.* (1984) reported faba bean yields ranging from 2799 to 4638 kg/ha under irrigated conditions in Haryana, India. Considering the high yield potential of faba bean and the need for diversification of cereal dominated cropping pattern with a potential legume crop, it was found desirable to study the performance, potential, and prospects of faba bean using different sowing dates and row spacings in Punjab, India.

## Materials and Methods

The experiment was conducted for three consecutive seasons (1984/85-1986/87) at the experimental fields of the Punjab Agricultural University, Ludhiana, India (30°56'N and 70°52'E). The soil of the site was sandy loam in texture with pH of 8.7, low in available nitrogen (110 kg/ha) and phosphorus (12.1 kg/ha), and medium in available potassium (147.7 kg/ha). The climate is subtropical with hot summers and cool winters. In winters, freezing temperatures accompanied by frosty spells are common during December to January. The treatments including three sowing dates (25 Oct, 10 Nov, and 25 Nov 1984) and two row spacings (22.5 and 30cm), were arranged in a randomized block design with four replications in 1984/85 season. Plant to plant spacing was maintained at 20cm in all the treatments. In the subsequent years of test (1985/86 and 1986/87 seasons) an additional early date of sowing (10 October) was included. Uniform dose of 15 kg N and 40 kg P<sub>2</sub>O<sub>5</sub>/ha was applied at sowing.

The average rainfall during the growing seasons of the three years of test is given in Table 1.

**Table 1** Average rainfall (mm) received during the growing seasons of 1985-1987.

Month	1984/85	1985/86	1986/87
October	3.0	27.3	16.5
November		2.2	7.4
December	1.3	29.2	3.7
January	0.6	2.2	38.0
February		60.0	20.3
March	2.2	79.0	8.0
Total	7.1	199.9	98.9

Source: Department of Agrometeorology, Punjab Agricultural University, Ludhiana, India.

## Results and Discussion

Faba bean performance was excellent in two (1984/85 and 1986/87) out of the three years of test, with mean seed yields of 2327 and 2458kg/ha, respectively (Table 2). The mean seed yield in the 1985/86 season was only 1422 kg/ha. This may be attributed to the excessive rainfall received during the reproductive period of crop growth in 1986 which adversely affected the number of pods/plant. Delaying the sowing date from October to November reduced the grain yield significantly during the three seasons (Table 2). There were no significant differences with respect to yield and its components when sowing was delayed from 10 to 25 October in the last two seasons (1985/86 and 1986/87).

November sown crops were less vigorous than the October sown crops --as evident from the significantly reduced plant height, leading to significantly lesser number of pods/plant, which is a character highly related to grain yield. Number of seeds/pod and 1000-seed weight varied insignificantly with sowing date, except in the 1986/87 season where October sowings resulted in a significantly more seeds/pod as compared with November sowings. Similar results were also obtained by Rao *et al.* (1984) under irrigated conditions in Haryana. They reported that flowering of late sown crops often coincides with increasing temperatures in March, resulting in high degree of flower shedding and poor pod development.

Yield differences due to row spacing were significant only in the second season (1985/86) although the yield level

Table 2. Seed yield and yield components of faba bean as influenced by date of sowing and row spacing.

Date of Sowing	Seed yield (kg/ha)			Plant height (cm)			No. of pods/plant			No. of seeds/pod			1000-Grain weight (kg)		
	1984/ 85	1985/ 86	1986/ 87	1984/ 85	1985/ 86	1986/ 87	1984/ 85	1985/ 86	1986/ 87	1984/ 85	1985/ 86	1986/ 87	1984/ 85	1985/ 86	1986/ 87
October 10		1108	2458		60.1	83.0		14.8	19.5		2.0	2.4		224	249
October 25	2327	1422	2236	47.8	67.8	88.0	20.0	15.8	19.0	2.2	2.0	2.3	246	236	250
November 10	1719	562	1129	40.7	48.0	66.4	16.5	10.1	13.6	2.0	1.7	1.8	242	206	243
November 25	1151	264	588	32.4	35.8	44.9	13.3	5.0	11.0	2.0	1.5	1.7	230	200	229
C D (0.05)	245	15	49	5.7	7.4	15.1	2.8	2.2	2.6	NS	NS	0.5	NS	NS	NS
<b>Row Spacing</b>															
30.0 cm	1674	712	1548	40.1	52.8	68.1	17.0	11.5	16.4	2.1	1.8	2.1	240	216	246
22.5 cm	1790	965	1657	40.5	53.1	73.0	16.2	11.4	15.2	2.1	1.8	2.0	238	217	240
C D (0.05)	NS	10	NS	NS	NS	NS	NS	NS	0.9	NS	NS	NS	NS	NS	NS

was too low due to the abnormal weather conditions during this year. In general, crop grown at row spacing of 22.5cm gave yields slightly higher than that grown at 30cm. Salih (1989) reported higher faba bean yields with increased plant density. Similar to yield, number of pods/plant, plant height, 1000-seed weight, and number of seeds/plant varied insignificantly in most of the cases (Table 2). However, Coelho (1987) observed reduction in number of pods/plant as well as small changes in seeds size and number of seeds/pod with increased plant density.

It can be concluded from the results of this study that faba bean can be successfully grown in Punjab, India if sowing was between 10 and 25 October at a row spacing of 30cm.

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## الكفاءة المحصولية للفلول بالبنجاب في الهند

### الملخص

تمت بولاية البنجاب في الهند دراسة تأثير موعد الزراعة والمسافة بين السطور في الكفاءة المحصولية للفلول على مدار ثلاثة مواسم متعاقبة (1985 - 1987). وقد أظهر الفلول كفاءة ممتازة في سنتين من أصل الثلاث سنوات من الاختبار. إلا أن تأخير موعد الزراعة من 1/ أكتوبر إلى 2/ نوفمبر قد خفض الغلة الحبيبة بدرجة معنوية. وبشكل عام لم تظهر للمسافة بين السطور تأثيرات معنوية في الغلة أو مكوناتها، إلا في السنة الثانية من الاختبار (1986). وقد أعطى المحصول المزدوج على سطور المسافة فيما بينها 22.5 سم غلة أعلى بقليل من ذلك المزدوج على مسافة 30 سم. ويمكن زراعة الفلول بنجاح في البنجاب ما بين 10 و 25/ أكتوبر وبمسافة بين السطور تعادل 30 سم.

## On-Farm Evaluation of Some Agronomic Factors Affecting Productivity of Faba Bean

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### Abstract

On-farm trials were conducted at four different sites in the Northern Region of the Sudan to validate on-station research findings on six agronomic factors (date of sowing, irrigation, weed control, seed rate, sowing method, and cultivar) for faba bean production. Variations between sites for yield response to the tested factors were large. The only consistent beneficial effect over all sites was that of frequent irrigation.

### Introduction

Research on faba bean at Hudeiba Research Station in Sudan highlighted the importance of cultural practices in ensuring high and reliable yields, and based on this work recommendations were formulated on the crop agronomy (El Karouri 1979). However, there was little on-farm testing of these recommendations in different agro-climatic zones. There was a need to validate the on-station research findings at farm level and to get a feed-back on the feasibility of their adoption by farmers. On-farm trials were, therefore, initiated in the 1979/80 cropping season under the ICARDA/IFAD Nile Valley Project, and the results of one of the first studies are presented here.

### Materials and Methods

Six production factors were studied at two levels (farmer's practice and an 'improved' practice) at four sites in the Northern Region of the Sudan, namely Burgeig, Selaim, Aliab, and Zeidab. Each factor was examined separately and in combination with each of the other factors in an incomplete block design that permitted the assessment of main effects and first-order interactions (Salih 1980). Two

checks (one with all factors at the farmer's level of management and the other with all factors at the 'improved' level) were also included. Thus there were 23 treatments (Table 1), replicated twice at each site. The factors studied and their levels were as follows:

Factor	Improved practice	Farmer's practice
Planting date	3rd week of October	2nd week of November
Irrigation	10-day interval	20-day interval
Weed control	Weed-free until flowering by repeated hand weeding	One weeding four weeks after planting
Seed rate	16.7 seeds/m <sup>2</sup>	33.3 seeds/m <sup>2</sup>
Sowing method	In rows on ridges by hand hoe	Dropping the seeds in the furrow of the local plough
Cultivar	Hudeiba 72	Local

### Results and Discussion

The grain yields as affected by various treatment combinations are shown in Table 1. The response to early planting was significantly positive at Selaim but negative at Burgeig. At Zeidab the early-sown crop was a complete failure except in the treatment with all the factors at the high input levels (Table 1). The Zeidab site was characterized by a heavy clay soil with a very serious water-logging problem. This resulted in poor germination. In addition, infection with wilt and root-rot diseases was very high in the early sown crop. The negative response to sowing date at Burgeig was mainly due to bird damage. The seed yield difference between the two sowing dates was not significant at Aliab site.

The response to frequent irrigation was positive at all sites, whereas the effect of weed control was significant at Zeidab only. Yield differences between the two seed rates were negligible at Selaim, Burgeig, and Zeidab, but at Aliab site the lower seed rate reduced yield. The response to the method of sowing was significantly positive ( $P < 0.01$ ) at Zeidab, negative at Selaim, and negligible at both Aliab and Burgeig. The recommended cultivar (Hudeiba 72) yielded higher than the local at Zeidab but lower at Selaim and Burgeig where farmers use some of the locally selected material.

There were negative interactions between planting date and irrigation, planting date and seed rate, and irrigation and method of sowing at Selaim. The interactions were not significant at Burgeig, Aliab, and Zeidab sites. The treatment with all the six factors at the 'improved' level gave significant increase in yield over the one with all the factors at the farmer's level at Aliab and Zeidab only with a yield gain of 157% and 555%, respectively. At Selaim, there was

**Table 1** The effect of various agronomic factors on the seed yield of faba bean at different sites in Sudan (1979/80).

Treatment combination <sup>1</sup>	Seed yield (kg/ha)			
	Selaim	Burgeig	Aliab	Zeidab
dhwriv (traditional)	740	598	871	333
Dhwriv	1980*	462-**	894	0
Hdwriv	2682*	1715**	1492**	906**
Whdriv	1064	285	1120	584**
Rwdhiv	1009	1031	1034-*	270
Irdhwiv	836-**	820	1013	680**
Vidhwi	746	445-**	1031	752**
DHwriv	1998-**	940	1705	0
DWhriv	1839	219	1480	0
DRhwiv	944-**	729	648	0
Dlhwrv	1645	209	990	0
DVhwrv	1942	135	815	0
HWdriv	3476	1588	1661	1030
HRdwiv	2899	1869	1543	669
Hldwrv	1201-**	1892	1804	1369
HVDwri	3498	1556	1906	1775
WRdhiv	1648	1114	1034	321
Wldhrv	1083	267	994	658
WVdhri	586	321	1281	823
Rldhwv	1232	530	779	537
RVdhwi	875	429	1277	739
IVdhwi	359	249	987	992
DHWRIV (improved)	1034	250	2236**	1448**
S.E. ±	207	249	197	110
Mean	1536	768	1234	817

1) D, H, W, R, I and V refer to improved level of planting date, irrigation, weed control, seed rate, method of planting and cultivar, respectively; d, h, w, r, i and v refer to farmer's level of these respective factors.

\* = Main effect or interaction significant at 5% level.

\*\* = Main effect or interaction significant at 1% level.

(-) = Indicates a negative response to improved level of management.

a 40% yield increase but it was not statistically significant. At Burgeig, the farmer's practice out-yielded the improved method of production by 139%, mainly due to bird damage on the early-sown crop.

## تقييم بعض المعاملات الزراعية المؤثرة في إنتاجية الفول عند الزراع

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### المخلص

أجريت تجارب عند الزراع في أربعة مواقع مختلفة ضمن المنطقة الشمالية من السودان للتثبت من صحة نتائج البحوث الجارية في المحطة التجريبية على ست معاملات زراعية (موعد الزراعة، الري، مكافحة الأعشاب، معدل البذار، طريقة الزراعة، وتأثير الصنف) لإنتاج الفول. وكانت الفروق بين المواقع - والخاصة باستجابة الغلة للعوامل المختبرة - كبيرة. وتبين أن الري المتكرر كان العامل الوحيد المفيد باستمرار بالنسبة لجميع المواقع.

الصنفين الآخرين إلى زيادة مساحته الورقية، وعدد القرون ووزنها وعدد البذور ووزنها/النبات، وترجع زيادة غلة الصنف أكوابولشي على الصنف الإيطاليانا إلى الزيادة المعنوية في المساحة الورقية، وطول النبات، وعدد الفروع، ووزن الألف حبة.

كما يظهر الجدول أيضا تفوق الصنف المصري في نسبة الافتصاص (0.96) مقابل الصنفين أكوابولشي (0.83) والإيطالي (0.63). وهذا يعكس بوضوح ارتفاع نسبة وزن البذور إلى القرون في الصنف المصري مقارنة بكل من الصنفين الآخرين.

ولوحظ على العموم عدم تكيف الصنف الإيطالي تحت الظروف المحلية للجماهيرية، وشدة حساسيته للإصابة وخاصة بمرض تبقع الأوراق، مقابل الصنفين أكوابولشي والمصري اللذين كانا أقل عرضة للإصابة به. كما لوحظ تأخر موعد نضج قرون الصنف الإيطالي عشرة أيام لدى مقارنته بالصنف أكوابولشي، ونضج الصنف المصري قبل الصنف المحلي بأسبوع. ورغم تأخر موعد نضج الصنف الإيطالي فإن درجة قابليته للانفراط كانت عالية مقارنة بالصنفين الآخرين.

وهذا الموضوع بحاجة للمزيد من البحث لدراسة مختلف الصفات الكمية والنوعية، وتحديد أفضل المعاملات الزراعية المناسبة، والتعرف إلى أصناف جديدة مدخلة تستطيع التكيف مع البيئة المحلية في الجماهيرية، ومن ثم إكثارها، وتوزيعها على الزراع كأصناف وفيرة الغلة.

### Evaluation of Growth and Productivity of Three Faba Bean (*Vicia faba* L.) Cultivars Tested under Sprinkler Irrigation System

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#### Abstract

A field experiment was conducted at the Agriculture Research Station of Al-Fateh University, Tripoli, Libya, to evaluate growth, yield, and yield components of three faba bean cultivars 'Giza', 'Italiana', and 'Aquadulce' from Egypt, Italy, and Libya, respectively. Cv Giza proved superior to the other two cultivars in almost all the characters studied. It outyielded cvs Aquadulce and Italiana by 44.9% and 96.5%, respectively, and had the highest shelling percentage (96%) as compared to Italiana (63%) and Aquadulce (83%). Cv Aquadulce was highest in 1000-seed weight (1.314 g) followed by Giza (0.881 g), and then Italiana (0.569 g). The superiority of cv Giza to Italiana and Aquadulce may be attributed to its higher leaf area/plant, number of pods/plant, pod weight, and number and weight of seeds/plant.

النتائج إلى تفوق الصنف المصري بدرجة معنوية في عدد ووزن القرون والبذور/النبات، في حين أعطى الصنف أكوابولشي أعلى عدد من الفروع، وزيادة معنوية في وزن الألف حبة (1314 غ) بفضل كبر حجم بذوره مقارنة بالصنف المصري أو الصنف الإيطالي ذي الحبة الأصغر حجماً. ومن حيث عدد الفروع/النبات، لم تظهر النتائج أي فروق معنوية بين الصنفين المصري والإيطالي، إلا أنها كانت معنوية بين الصنف أكوابولشي (9.6 فروع) والإيطالي (4.8 فروع).

وفي الصنف جيزة ازداد كل من عدد القرون (14.7) والبذور (52.5)/النبات بدرجة معنوية مقارنة بالصنفين أكوابولشي وإيطاليانا (4.1، 2.4 قرن/نبات و 16.2، 7.1 بذرة/نبات على الترتيب). ولم تظهر النتائج أي فروق معنوية بين الصنفين الآخرين في عدد القرون أو البذور.

### ثالثاً: الغلة

تدل النتائج الموضحة في الجدول 3 على أن الصنف المصري قد أعطى زيادة معنوية (81.4 %) في الغلة البذرية بلغت (2.070 طن/هـ) مقارنة بالصنف أكوابولشي (1.141 طن/هـ). وكانت غلة الصنف الإيطالي متدنية جداً (0.073 طن/هـ)، بحيث تراجعت أمام الصنف أكوابولشي بنسبة 1463 %. ويعزى تفوق الصنف المصري على

15 نباتاً ناشجاً، لتقدير الغلة البذرية، وأخذت متوسطات القراءات التالية: طول النبات، عدد الفروع/النبات، عدد القرون ووزنها/النبات، عدد البذور ووزنها/النبات، ووزن الألف حبة. وتم حساب نسبة التصافي بقسمة وزن البذور على وزن القرون وضرب الناتج في 100. وجميع المحصول وتم تقدير الغلة البذرية بالطن/هـ. واستخدم أقل فرق معنوي (بمستوى 5 %) لمقارنة النتائج.

### النتائج والمناقشة

#### أولاً: صفات النمو

لم تظهر النتائج في الجدول 1 فروقا معنوية في طول النبات بين الصنف أكوابولشي وجيزة المصري، وكان أطولهما الأول (95.3 سم). وبمقارنتهما بالصنف الإيطالي ظهر أنه أقصر طولاً (70.6 سم) بدرجة معنوية، وأصغر مساحة ورقية (15.7 سم<sup>2</sup>). كما تفوق الصنف المصري على أكوابولشي في المساحة الورقية وبدرجة معنوية (45.1 مقابل 35.8 سم<sup>2</sup> على الترتيب).

#### ثانياً: مكونات الغلة

يوضح الجدول 2 قراءات مكونات الغلة، الخاصة بعدد الفروع والقرون والبذور/النبات، ووزن القرون والبذور/النبات، ووزن الألف حبة. وتشير

الجدول 3 . متوسطات الغلة البذرية ونسبة التصافي عند الأصناف المدروسة .

النسبة التصافي /	الغلة البذرية، طن/هـ	الصنف
83	1.141	أكوابولشي
96	2.070	المصري
63	0.073	الإيطالي
0.19	0.575	أقل فرق معنوي، 5/

الجدول 1 . متوسطات أطوال النباتات والمساحة الورقية لأصناف الفول الثلاثة: أكوابولشي والمصري والإيطالي تحت نظام الري بالرش.

الصنف	طول النبات، سم	المساحة الورقية، سم <sup>2</sup>
أكوابولشي	95.3	25.4
المصري	89.8	45.1
الإيطالي	70.6	15.7
أقل فرق معنوي، 5/	7.91	3.61

الجدول 2 . متوسطات عدد ووزن الفروع والقرون والبذور/النبات ووزن الألف حبة لأصناف الفول الثلاثة: أكوابولشي والمصري والإيطالي .

الصنف	عدد الفروع /النبات	عدد القرون /النبات	عدد البذور /النبات	وزن القرون /النبات، غ	وزن البذور /النبات، غ	وزن الألف حبة، غ
أكوابولشي	9.6	4.9	16.2	16.44	14.8	1314
المصري	7.8	14.7	52.5	49.32	47.3	881
الإيطالي	4.8	2.4	7.1	14.81	9.39	569
أقل فرق معنوي، 5/	3.9	6.1	21.9	17.8	18.2	125

## تقييم نمو وإنتاجية ثلاثة أصناف من الفول تحت نظام الري بالرش

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### الملخص

تم في محطة أبحاث كلية الزراعة التابعة لجامعة الفاتح بطرابلس تقييم ثلاثة أصناف من الفول (*Vicia faba* L.)، هي: البلدي جيزة من مصر، وإيطاليانا من إيطاليا، وأكادولشي المزروع محليا في الجماهيرية الليبية. تناولت الدراسة صفات النمو والغلة ومكوناتها. وقد تفوق الصنف جيزة في جميع الصفات المدروسة على أكادولشي وإيطاليانا إذ كان إنتاجه للغلة البذرية أعلى بنسبة 44.9% و 96.5% على الترتيب، وكان له أعلى نسبة تصافي أو افتصاص (shelling 96%) مقارنة بالصنف الإيطالي (63%) وأكادولشي (83%). ويعزى تفوق الصنف المصري على الصنفين الآخرين إلى زيادة مساحته الورقية، وعدد القرون ووزنها وعدد البذور ووزنها/النبتات. وأوضحت الدراسة وجود زيادة معنوية في وزن الألف حبة عند الصنف أكادولشي (1.314 غ) مقابل الصنف جيزة (0.881 غ) والصنف إيطاليانا (0.569 غ).

### المقدمة

يعتبر الفول (*Vicia faba* L.) أحد محاصيل البقول الشتوية الهامة الشائع زراعتها في الجماهيرية، والذي يقل معدل إنتاجه عن معدلات الاستهلاك المحلي لاستعمال بذوره في العديد من المأكولات الشعبية.

وأجريت في كثير من البلدان الأخرى بحوث لدراسة تأثير المسافة بين الخطوط والتسميد الفوسفاتي في غلة الفول. فقد حصل Kushnir (1969) على أعلى غلة بذرية من الزراعة على مسافات متقاربة مقارنة بالزراعة على مسافات واسعة باستعمال معدل بذار واحد. ووجد Kolic (1971) أن إنتاج الفول يزداد بزيادة الكثافة النباتية (889 ألف نبات/هـ)، ويقل بقلتها رغم زيادة محصول النبات ووزن الألف حبة. وفي السودان أخبر Saeed (1968) عن تدني الغلة البذرية للفول في الغدان عند الزراعة بمعدل 140 رطل/الغدان، في الوقت الذي تؤدي فيه الكثافة النباتية الشديدة ومعدلات البذار العالية إلى تقليل غلة النبات وطول الساق، وتدني إنتاج القرون، دونما تأثير في عدد البذور وحجمها.

ولم تنفذ في الجماهيرية أي دراسة لمقارنة صنف الفول أكادولشي - الوحيد المنزرع - بأية أصناف أخرى مزروعة سواء في بلدان مجاورة أو في مناطق مشابهة من حيث الظروف البيئية، باستثناء دراسة بعض المعاملات الزراعية على صنف الفول المزروع محليا هنا. وقد درس Shaalan *et al.* (1977) تأثير مسافات الزراعة والتسميد الفوسفاتي في نمو نباتات الفول المحلي، ووجدوا أن الزراعة على مسافة 30 سم بين الخطوط والتسميد بمعدل 72 و 108 كغ  $P_2O_5$ /هـ قد أديا إلى زيادة معنوية في وزن القرون والغلة البذرية بالهكتار. ودرست Farida & El-Gayed (1976) تأثير السماد الفوسفاتي والمنغنيزي في نمو الفول المحلي تحت ظروف الجماهيرية، وأشارت نتائجهما إلى زيادة معنوية في الوزن الأخضر والجاف للنبات، والغلة البذرية، وحجم الحبة عند التسميد بالجرعتين 300 و 750 كغ سوبر فوسفات (20%  $P_2O_5$ ) هـ. كما لاحظا أن إضافة السماد المنغنيزي - سواء عند نقع البذور أو برشه على النباتات وهي بعمر أربعة أسابيع - لم تؤثر معنويا في الوزن الأخضر والجاف، بل قللت الغلة البذرية للفول المحلي بدرجة معنوية. ولم تظهر النتائج أيضا أي أفعال متبادلة بين السمادين الفوسفوري والمنغنيزي على الفول في الجماهيرية.

ويهدف هذا البحث إلى تقييم صنف الفول أكادولشي المزروع محليا ومقارنته بالصنفين المصري والإيطالي من حيث النمو والغلة ومكوناتها.

### المواد والطرق

أقيمت التجربة في محطة أبحاث كلية الزراعة التابعة لجامعة الفاتح بطرابلس، خلال الموسمين التاجحين 82/1981 و 83/1982، وتحت ظروف الري بالرش المتبع عادة هناك. وجرى قبل الزراعة إعداد مهد البذور جيدا، وأضيف السماد المركب 12 أزوت - 24 فوسفور - 12 بوتاسيوم بمعدل 20 طن سماد/هـ. كانت تربة موقع التجربة رملية طمية، تتراوح درجة حموضتها (pH) ما بين 8.1 - 8.4، وتحتوي 0.3 - 0.5% مادة عضوية وأقل من 1 ج ف م فوسفور متاح.

زرعت التجربة في الأسبوع الأول من 2/نوفمبر عام 1981، باستعمال نصف البذار من كل صنف بعد تجزيته إلى جزأين، وذلك لزراعة النصف الآخر في العام التالي (1982) وينفس الموعد. اتبع في البحث تصميم القطاعات العشوائية الكاملة بأربعة مكررات، بحيث توزعت مستويات أصناف الفول الثلاثة: المصري والإيطالي وأكادولشي على 12 قطعة تجريبية، أطوالها 3 X 3 م، وتحري 10 خطوط في كل منها 10 جور وفي كل جورة بذرة مستتبعة، بحيث كانت المسافة الفاصلة بين الخطوط وبين الجور في الخط الواحد 30 سم. رويت التجربة كلما دعت الحاجة، وأضيف سماد السوبر فوسفات (20%  $P_2O_5$ ) بمعدل 4طن/هـ بعد الزراعة بشهر.

ولإجراء التحاليل اللازمة، أخذ متوسط نتائج التجريبتين بعد أن اختير 5 نباتات عشوائية من كل قطعة تجريبية لتقدير متوسط المساحة الورقية باستعمال جهاز خاص بذلك. وقبيل الحصاد أخذ عشوائيا أيضا

## Pests and Diseases

## الآفات والأمراض

### Weight Loss in Faba Bean Seeds Caused by Feeding Larvae of *Bruchidius incarnatus* (Boh.)

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#### Abstract

The apparent weight loss in faba bean seeds caused by feeding larvae (1, 2, or 3 larvae/seed) of *Bruchidius incarnatus* (Boh.) was estimated in the laboratory. The emerged females were significantly heavier and consumed more food than the males. Weight loss caused by one larva/seed was significantly higher than that caused by two or three larvae/seed. Development time was not affected by multiple (more than one larva) infestation. The percentage apparent weight loss in faba bean seeds infested by *B. incarnatus* can be estimated by multiplying the percentage damaged seeds by 0.074, 0.114, or 0.163 for seeds with one, two, or three exit holes, respectively.

#### Introduction

Considerable weight loss in faba bean seeds occur during storage due to infestation by *Bruchidius incarnatus* (Boh.) in the Sudan. This insect, unlike other *Bruchidius* spp., is a multivoltine (9-10 generations/year), predominantly associated with stored faba bean seeds and does not attack ripe pods in the field (Shazali 1986). The adult female attaches her eggs onto the seed surface, and the newly hatched larvae tunnel directly into the cotyledons where they complete their development. On emergence, the adult leaves a characteristic hole. In addition to weight loss, the beetle reduces faba bean quality, nutritional value, and consequently loss of revenue (Salkini *et al.* 1982).

Estimation of losses in food grains caused by storage insects have involved laboratory studies on feeding insects and field application of loss assessment methods (Shazali 1987). Parkin (1956) and Adams (1977) have reviewed the methods of assessment and reduction of losses due to storage insects. Adams (1976) distinguished two types of weight losses, (i) apparent weight loss in which only the change in sample weight is considered and (ii) real loss in which the apparent loss and the weight of feces and exuviae inside the seed are considered. Caswell (1981) estimated weight loss in cowpea (*Vigna unguiculata* L.) caused by *Callosobruchus maculatus* (F.). Adams and Schulten (1978) estimated percentage weight losses in stored pulses by using percentage damaged grains and a conversion factor. The present study was undertaken to estimate food consumption by larvae of *B. incarnatus* feeding on faba bean seed and to calculate a conversion factor based on the number of exit holes/seed.

#### Materials and Methods

The experiment was conducted in the laboratory at room temperature of  $32 \pm 3^\circ\text{C}$  and relative humidity of  $35 \pm 5\%$ . A commercial local faba bean variety, known for its uniform seed size, was used. Test samples were kept at  $10^\circ\text{C}$  for one week to destroy any existing infestation, then moved to tightly screwed glass jars until used. Faba bean seeds were allowed to equilibrate to the experimental conditions for three weeks, after which their moisture content was 7.5% as determined by the standard air-oven method. The seed samples were then infested for one day by 0-24h old *B. incarnatus* adults taken from cultures maintained for several generations on faba bean seeds. Two days later, infested seeds with one, two, or three fertilized eggs, were sorted out under a binocular microscope, and 100 seeds/treatment was selected for further testing. The egg density was manipulated artificially by scraping off excess eggs using a razor blade. Fertilized eggs are turgid and brown, whereas unfertilized ones remain white and usually collapse within that period. Seed weight prior to larval feeding was determined using an analytical balance. Egg weight was ignored. The average seed weight was  $0.546 \pm 0.093\text{g}$ . Infested seeds were then placed in glass vials ( $5 \times 1.2\text{cm}$ ) with perforated plastic lids and kept at the



experimental conditions for insects to develop. Ten uninfested seeds were also placed separately in glass vials to help monitor changes in moisture content.

The seeds in glass vials were examined daily for adult emergence three weeks after oviposition. Emerged adults were sexed, placed in an air-tight glass vials and kept in a deep-freeze for subsequent weight determinations. The insects were sexed by the characteristic elytral pattern as described by Southgate *et al.* (1957). Development periods of the emerging adults were also recorded. Apparent weight loss due to the feeding activity of the developing larvae was determined by individually weighing the faba bean seeds from which all the eggs laid had turned into adults without removing the fecal material and exuviae from the seeds. The experiment was terminated after 39 days, when there was no adult emergence for five consecutive days. Student's T-test and one way analysis of variance were used to compare treatment means.

## Results

The change in the moisture content of the uninfested seeds was less than 0.4%. Therefore, no correlations were made between moisture content and weight of the infested seeds. The data in Table 1 were arranged according to the number of adults emerging from each lot.

Table 1 shows that the average weight loss/larva for seeds with one emerging adult was highly significantly different ( $P < 0.01$ ) from that with two or three adults larvae/seed. However, the average weight loss/larva was

**Table 1** Loss in faba bean seed weight due to larval feeding of *B. incarnatus*.

	Number of emerged adults/seed		
	1	2	3
Loss in weight (mg/seed) $\pm$ SD	40.5 $\pm$ 2.8	62.2 $\pm$ 4.3	89.1 $\pm$ 5.6
Percent weight loss $\pm$ SD	7.4 $\pm$ 0.2	11.4 $\pm$ 0.5	16.3 $\pm$ 0.4
Loss in weight (mg/larva) <sup>1</sup>	40.5	31.1	29.7
Mean development time (days)	26.4	27.3	27.1
Seeds assessed in each lot	82	69	57

<sup>1</sup>) SE for differences between any two means is  $\pm 3.5$ .

not significantly different in the later two groups. In solitary infestation, the weight loss caused by developing female larva (45.1  $\pm$  2.7mg) was highly significantly greater than that of males (35.7  $\pm$  1.9mg). The sex ratio was 1:0.93 males to females. The average weight of females (5.2  $\pm$  0.16mg) was highly significantly heavier than that of males (3.1  $\pm$  0.12mg). The differences in mean development period for one, two, and three adults/seed was not significant. No relationship was observed between seed weight and weight loss (i.e., larger seeds did not influence weight loss in all grains tested).

## Discussion

Although the size of faba bean seeds used in this study was sufficient to allow development of eight larvae/seed, the maximum number of larvae/seed was restricted to three. This is because the relation between exit holes and weight loss may be disturbed under severe (multiple) infestation, leading to an underestimation of weight loss (Adams and Schulten 1978). Shazali (1986) reported that under natural conditions higher larval densities occur only under severe infestations.

Development time was not affected when up to three insects shared the same faba bean seed. However, multiple infestation appeared to reduce the amount of food consumed/larva. This is in agreement with the findings of Booker (1967), Adams (1976), and Caswell (1981).

It is evident from the results of this study that when assessing weight loss in a sample of stored faba bean infested by *B. incarnatus*, one exit hole/seed can be considered as equivalent to an apparent weight loss of 40.5mg out of 546mg (7.4%). Two and three exit holes/seed caused an apparent weight loss of 62.2mg (11.4%) and 89.1mg (16.3%) out of 546mg, respectively. Using this information, the percentage apparent weight loss in a sample of infested faba bean seeds can be estimated by multiplying the percentage of seeds with one, two, or three exit holes by 0.074, 0.114, or 0.163, respectively. Caswell (1981) assumed that each emergence hole, for cowpea seeds with 1-4 *C. maculatus* holes, causes 10% loss of seed weight. However, such an average leads to an under estimation of loss, particularly if the seeds were lightly infested.

The average percentage weight loss for faba bean seeds was less than that reported by Caswell (1981) for cowpea infested by *C. maculatus*. Pointel and Coquard (1979) stated that it is important to calculate separate conversion factor (coefficient of specific loss) for each insect attacking each crop. The results of this study further indicated

that special attention should be given to the number of emergence holes/seed when calculating conversion factors for weight loss assessment in faba bean.

The converted percentage damage method, described by Adams (1976), provides a useful means for quick estimate of weight loss of seeds due to insect infestations. It has given very good results in practice (Adams and Schulten 1978). The method is particularly suitable for the estimation of weight loss in stored faba bean seeds infested by *B. incarnatus*. This is because faba bean seed is easier to manipulate and examine visually than other small grains, the emerging adult makes a well defined exit hole, adults do not feed on seeds, and this beetle is the principal, if not the only, insect attacking stored faba bean seeds in the Sudan.

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## الفاقد في وزن بذور الفول المتسبب عن تغذية يرقات خنفساء الفول الصغيرة *Bruchidius incarnatus* (Boh.)

### الملخص

جرى في المختبر تقدير الفاقد في وزن بذور الفول الناجم عن تغذية يرقات خنفساء الفول *Bruchidius incarnatus* (1 و 2 و 3 يرقات/البذرة). وكانت الإناث المنبثقة أكثر ثقلًا واستهلاكًا للغذاء من الذكور بدرجة معنوية. أما الفاقد في الوزن الناجم عن يرقة واحدة/البذرة فكان أعلى بكثير من ذلك المتسبب عن يرقتين أو ثلاث/البذرة. ولم يتأثر زمن النمو نتيجة الإصابة المتعددة (بأكثر من يرقة). ويمكن تقدير النسبة المئوية للفاقد الظاهر في وزن بذور الفول المصابة بالخنفساء المذكورة بحاصل ضرب النسبة المئوية للبذور المصابة في 0.074 أو 0.114 أو 0.163 للبذور ذات الثقب الواحد أو الإثنيين أو الثلاثة على الترتيب.



## *Colletotrichum dematium* (Pers. ex Fr.) Grove f.sp. *truncata* (Schw./Arx), a New Seed-Transmitted Pathogen of *Vicia faba* L.

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## Abstract

*Colletotrichum dematium* f.sp. *truncata* caused lesion on faba bean infected seeds and seedling-rot, but was a rather minor pathogen in the routine seed health testing. The fungus was isolated from diseased seeds and was identified according to pure isolate. Its pathogenicity was tested on faba bean plants by artificial inoculation, and a damping off was observed.

Occurrence of *Colletotrichum dematium* (Pers. ex Fr.) f.sp. *truncata* (Sschw.) Arx was observed in the course of routine seed-health testing of *Vicia faba* L. seed samples. The seeds were germinated on moisted blotter in petridishes.

The fungus caused blackish lesions on the seed-coat with light reddish ring around them. The pathogen was isolated from the seeds and was grown on Leonine-agar for identification, which was carried out according to Arx (1981). Its sporulation was observed on water-agar wheat straw. The colonies were incubated in continuously fluorescent light at 25°C, and 50 acervuli and 100 conidia were measured for identification from both Leonine-agar and wheat straw media.

The colonies reached a 5.5-7.5 cm diameter after a week; they were light at first but became grayish or brownish later. The acervuli were setose, especially on wheat straw medium, 120-560 µm diameter. The conidia were falcate, hyaline 16.8-26.6 x 3.6-4.8 µm.

The pathogenicity of the isolated fungus was tested on five-leaved *V. faba* var *equina* 'Bakony I' plants, by placing 5 mm diam mycelium plugs on the second and the third leaves and the stems of plants in green-house using the tooth-pick method. The infected plants were covered with polyethylene tent for two days.

The first symptoms developed after four days were dark lesions with reddish edges. The lesions grew continuously, and the stems became narrow, then broke down at the lesions. The acervuli developed on the basal part of the lesions and some pinkish conidial-mass was also observed. The fungus was isolated and reidentified from the artificially infected plants.

*C. dematium* f.sp. *truncata* commonly occurs and is seed-transmissible on soybean and some other legumes (Neergaard 1977). However, *C. lindemuthianum* (Sacc. and Magn.) Briosi and Cav. and *C. villosum* Weim. are reported from *V. faba* or other *Vicia* sp. seeds (Radulescu and Negru 1971; Neergaard 1977). This is the first report on occurrence of *C. dematium* f.sp. *truncata* on seeds of *V. faba*.

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## *Colletotrichum dematium* (Pers. ex الفطر Fr.) Grove f. sp. *truncata* (Schw./Arx)

### مُمرض جديد للقول محمول على البذور

#### الملخص

أحدث المرض *Collectotrichum dematium* F.Sp. *truncata* بقعاً على بذور القول المصابة، وتعتقناً للبادات، وكما أظهرت اختبارات صحة البذور الروتينية فإنه يعتبر ممرضاً ثانوياً إلى حدٍ ما. وقد تم عزل الفطر من بذور مصابة، وأمكن تحديده من عزلة نقية، وجرى اختبار قدرته الإراضية على نباتات القول بإعدادها إصطناعياً، إذ لوحظت الإصابة بمرض انحلال البادات.

## Faba Beans Storage and Adoption of Recommended Practices in Selaim Basin (Northern Region), The Sudan

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## Abstract

Calculation of an acceptability index of new storage practices recommended by the Agricultural Research Corporation (ARC), Sudan showed that the level of adoption was 100%. The recommended practices allowed the farmer to store larger amounts of his crop for longer periods than what he used to, and to sell his faba bean whenever the market prices were favorable and consequently increase his income. The cost of the recommended practices was estimated to be

around Sudanese Pound (SDP) 24/t. A total net benefit of SDP 1076/t was obtained from the adoption of the recommended practices as compared to SDP 335/t from the traditional practice.

## Introduction

Following the recommendations of Dongola (Sudan) Seminar on faba bean improvement in North Sudan, held in January 1984, an experimental educational campaign on the control of store pests in Selaim area (Sudan) sponsored by the ICARDA/IFAD Nile Valley Project was launched.

The objectives of this campaign were:

1. To estimate insects depredation during the storage of faba bean
2. To advise farmers on proper storage methods
3. To demonstrate to farmers the methods and value of disinfestation of the store by residual insecticidal sprays and, fumigation of the stored produce
4. To initiate an integrated pest management approach for the control of the bruchid pest(s) of faba bean in that area; by utilizing other means such as underground storage pits, use of improved sacks for bagging the crop, and use of non-insecticidal protectants to reduce pests damage.

The campaign was concluded by the end of the 1985/86 season with highly positive results.

This paper reports on an evaluation of the rate of adoption of store disinfestation and fumigation of the stored produce as recommended by the Project scientists in Selaim area, and identifies problems which may handicap the continued adoption of these practices.

The usefulness of underground pit stores, improved sacks and non-insecticidal protectants will be reported separately.

## Materials and Methods

The recommended package for the control of store pests emphasized the harvesting of fully mature crop, prompt threshing, thorough cleaning of the seeds from foreign materials; and packing the crop in new sacks. Before stacking the crop inside the store, all structural faults should be repaired; cracks and crevices of the store should be plastered, and the store thoroughly cleaned from debris. Prior to storage, spraying of the store with one of the following chemicals is recommended as an initial disinfestation practice:

1. Fenitrothion at the rate of 1 g a.i./m<sup>2</sup>
2. Etrifos at the rate of 1 g a.i./m<sup>2</sup>
3. Baythroid at the rate of 0.5 g a.i./m<sup>2</sup>

When stacking the crop-sacks, passage ways should be left between the stacks as well as between the stacks and walls.

Fumigation of the crop may be carried out under trampoline sheets or alternatively the whole store may be fumigated taking extra care to make the store as gas tight as possible. Phostoxin pellets are recommended to be used at the rate of 10 pellets/t or 1 pellet/m<sup>3</sup> in case of space or store treatment. If phostoxin round tablets are to be used the rate should be reduced to 5 tablets/t.

## Sampling

A random sample of 27 farmers from the Selaim area was interviewed during the first two weeks of July 1989. About one third of the interviewed farmers (29.6%) had not participated in the educational campaign. Farmers' age ranged between 30 and 70 years; 14.8% of the farmers were between 30 and 40 years, 40.8% were between 40 and 50 years, and 44.4% were between 50 and 70 years. Most of the interviewees (92.6%) were predominantly illiterate or with minor levels of education --Khalwa and primary schools.

## Results and Discussion

Results of the survey were analyzed depending on the farmers' viewpoint. It was found from the field survey results that all farmers cleaned their stores before the application of the insecticides and crop storage.

Inspection of faba beans for freedom from infestation and for general cleanliness just before storage was done by three quarters (74.1%) of the farmers. The reasons given by those who did not inspect their commodity were:

1. Inspection was done during the harvest time.
2. The exposure of crop to sun before moving to stores assured its freedom from infestation.

All the interviewed farmers adopted the recommendation regarding insecticidal sprays, fumigation, and stacking of sacks in rows 50 cm apart from walls, with passage ways of 50 cm between rows. Although the recommended dose of phostoxin is 10 pellets/t, only one farmer applied the recommended dose. The rest of the farmers reported applying 5 pellets of phostoxin/t. No explanation was given by the farmers for the use of reduced dose.

After fumigation of stores, farmers were asked to seal the doors' and windows' frames with thick adhesive paper tape to insure a gas light structure. All the interviewed farmers did so, but they used mud instead of the tape. The reasons given by the farmers for such practice were:

1. Unavailability, and high cost of the adhesive paper tape.
2. The children could easily remove the paper tape.
3. Most of the farmers reported that the mud is more practical and effective than the thick adhesive paper tape.

The costs of recommended practices of storage of faba beans - estimated at SDP 24/t (Table 1) - was reasonable. All the farmers reported that they can afford such cost even if it is to increase by 50% in the coming seasons.

An acceptability index of the recommended practices of storage of faba beans in the Selaim area was calculated as follows:

$$AI = (FAR + QUN)/100$$

where; FAR is the percentage of the farmers adopting all the recommended practices of storage, QUN is the percentage of the farmer's produce of faba beans stored according to the recommended practices, and AI is the acceptability index. The calculations revealed an acceptability index of 100%. Thus, the recommended practices of storage were unanimously accepted by the farmers.

An economic evaluation of the effect of the new storage technology on the farmers' income was made through the comparison with the traditional practices of faba beans storage. The calculation was based on the assumption that

**Table 1** Estimation of the costs of the recommended storage practices in the Selaim area, Northern region, Sudan during 1988/89.

Operation	Cost (SDP/t)	Relative age (%)
Cleaning	4	16.7
Inspection	5	20.8
Pests control	5	20.8
Stacking	4	16.7
Fumigation	5	20.8
Sealing	1	4.1
Total	24	

decrease in prices is proportional to the level of infestation. Bushara (1984) reported that the level of infestation of faba bean crop stored by the traditional methods is about 15%. Accordingly, it was assumed that the prices decrease by 15% due to infestation, though in actual practice the decrease in price is not proportional to percentage infestation, e.g., a 15% infestation may cause as much as 50% decrease in price.

Net benefits due to the two practices are shown in Table 2. Farmers who treated their stores could gain about SDP 741/t over those who did not treat their stores. This increase is mainly due to the disinfestation of the produce, insecticidal spray and fumigation.

To test the stability of the profitability of the new storage technology, a break even increase in the costs of store treatment (ratio of increase in the gross benefits due to new storage technology to the increase in store treatment costs) was calculated with no change in the expected price of faba beans. The test indicated that the cost of store treatment may increase 32 times over the current costs before the new technology starts to be non-profitable.

As a result of the adoption of the new faba beans storage practices, farmers have increased their storage capacity, and consequently their income. They found that they can hold their crop much longer than was possible with traditional storage and that they can get higher prices because the new storage practices enabled them to release their produce whenever the market prices are favorable.

These results will have an important implications on the future of faba bean production in the Sudan. The

**Table 2** Economic comparison between the recommended and the traditional storage practices of faba bean in the Selaim area, Northern region, Sudan during 1988/89.

	Cost (SDP/t)	
	Recommended	Traditional
Expected price by August (SDP/t)	5100	4335
Store treatment	24	
Difference	5076	4335
Price at harvest	4000	4000
Net to storage benefit due	1076	335

incentives for farmers to adopt the new technologies of production and to adjust their cropping pattern to include more faba beans will be boasted as a result of the adoption of the recommended practices of storage.

The reputation of the Northern Region Extension Service has been enhanced by the successful introduction and adoption of the new faba bean storage technology.

### Acknowledgements

The authors wish to thank Mr Sayed Hassan Mohamed Osman for his valuable assistance during data collection. Also, they would like to express their appreciation to the Director General (ARC) for granting approval to publish this report.

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## تخزين الفول وتبني معاملات موصى بها لحوض السليم (المنطقة الشمالية) في السودان

### الملخص

أظهر حساب دليل مدى تقبل إجراءات التخزين الجديدة، التي أوصت بها هيئة البحوث الزراعية (ARC) في السودان، أن نسبة تبنيها وصلت إلى 100%. وهذه المعاملات الموصى بها أتاحت أمام المزارع إمكانية تخزين كميات أكبر من محصوله لفترات أطول من المعتاد، وبيع محصوله من الفول عندما تكون أسعار السوق ملائمة، الأمر الذي يزيد من دخله. وقد قُدرت كلفة المعاملات الموصى بها بحوالي 24 جنيهاً سودانياً (ج.س) /طن. وتم الحصول على ربح صافٍ إجمالي قدره 1076 ج.س/طن نتيجة تبني تلك المعاملات مقابل 335 ج.س/طن من المعاملات التقليدية.

## Seed Quality and Nutrition

## جودة البذور والتغذية

### Effect of Feeding Faba Bean Seed Meal on Growth Rate, Rumen, and Blood Parameters of Buffalo (*Bos bubalus*) Calves

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#### Abstract

The effect of faba bean seed meal was studied on the growth, rumen, and blood parameters of 16 growing male Murrah buffalo calves. There were no significant differences between animals fed rations containing up to 60% faba bean seed protein and those fed the conventional mixture (control) containing groundnut-cake protein, with respect to all the parameters studied. Furthermore, the feed:cost ratio was lower in the faba bean fed groups than in the control. Faba bean seeds can be safely incorporated into the conventional mixture to replace about 60% of the groundnut protein without any adverse effects on the animals.

#### Introduction

Faba bean (*Vicia faba* L.) is commonly used in human and animal diets as a source of protein. The use of faba bean as animal feed has, however, been limited due to several reasons, including availability, storage problems, and the presence of antinutritional factors, which may cause some undesirable effects on the feeding animals. The present work was undertaken to study the effects of faba bean seed meal on growth, rumen, and blood parameters of about one year old male Murrah buffalo calves.

#### Materials and Methods

A feeding trial was conducted on 16 growing (one year old) male Murrah buffalo calves. The calves were divided into

four groups (4 each) according to their body weights. One group was fed the conventional mixture, containing groundnut-cake protein (control; T<sub>1</sub>). The test mixtures were formulated by replacement of 20 (T<sub>2</sub>), 40 (T<sub>3</sub>), and 60% (T<sub>4</sub>) of the protein in T<sub>1</sub> with crushed faba bean seed, corresponding to about 15, 30, and 45% of faba bean in the mixture. The trial lasted for 150 days, including 7 days for metabolism trial. Samples of rumen liquor were collected at the end of the trial (4h post feeding) to study the rumen fermentation pattern. Blood samples of the experimental animals were taken at the end of the feeding trial to determine the effect of faba bean feed on different blood parameters, e.g., blood glucose, serum total protein, serum urica nitrogen, serum ammonia nitrogen, serum creatinine, serum total cholesterol, and haemoglobin content.

#### Results and Discussion

There were no significant differences among the four treatments with respect to dry matter intake, body weight gain, and feed:gain ratio. The average daily dry matter intake by animals fed rations of T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub> was about 2.34, 2.34, 2.41, and 2.31 kg/ 100kg body weight, respectively. The average daily body weight gains were 511.6, 501.7, 573.3, and 583.3 g in groups T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub>, respectively.

The animals in all the four groups were in positive balance for nitrogen, calcium, and phosphorus. The intake values for vicine in groups T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub> were 1.67, 3.78, and 5.44 g/day and for convicine 1.02, 2.16, and 3.17 g/day, respectively. These values seem to be within the tolerance limits of buffalos, as no deleterious effects were observed during the feeding trial.

Analysis of the rumen liquor indicated that rumen pH and protozoal and bacterial counts were statistically similar in all the four treatments. No significant differences were found in ruminal total nitrogen. Similarly, no significant differences were observed among the four treatments with respect to the different blood parameters studied.

The feed cost for 1 kg gain in body weight was 13.20, 12.88, 12.38, and 10.66 Indian Rupees (INR) in treatments T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub>, respectively, indicating a lower feed cost in faba bean fed groups (T<sub>1</sub>, T<sub>2</sub>, and T<sub>3</sub>) as compared with the control (T<sub>4</sub>).

It is concluded, from the results of this study, that faba bean (*V. faba* L.) can be safely used as a supplementary source for protein in the conventional feed mixture for buffalo calves; up to 60% of the groundnut protein can be replaced by faba bean protein without an adverse effects on the calves.

### تأثير عليقة من جريش بذور الفول في معدل النمو والكرش ومعايير الدم في عجول الجاموس (*Bos bubalus*)

#### الملخص

تمت دراسة تأثير جريش بذور الفول في النمو، والكرش ومعايير الدم في 16 عجلاً من جواميس Murrah. ولم تظهر فروق معنوية في جميع المعايير المدروسة بين الحيوانات التي تناولت علائق تحتوي على 60 % من بروتين بذور الفول وتلك التي تناولت علائق من الخلطة التقليدية (الشاهد)، التي تحوي بروتين كسبة فول سوداني. علاوة على ذلك، كانت نسبة العليقة:التكلفة أقل في المجموعات التي تناولت الفول منها في مجموعات الشاهد. ويمكن إضافة بذور الفول بأمان إلى الخلطة التقليدية لإحلالها محل ما يقرب من 60% من بروتين كسبة الفول السوداني دون أي تأثير مضاد على الحيوانات.

### Nutritive Value of Faba Bean (*Vicia faba* L.) Seeds, Fodder, and Silage

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#### Abstract

Four feeding experiments were conducted to find out the nutritive value of faba bean (*Vicia faba*) seed meal, green fodder, and silage for sheep and cattle. Faba bean seed meal can be fed to ruminants as protein supplement without any adverse effect, but green faba bean as sole source of feed was not suitable. An effective utilization of green

faba bean in ruminants could be achieved either by ensiling or by mixing it with other forage like oat. Feeding of green faba bean oat mixture at 2:1 ratio gave optimum growth in lambs.

#### Introduction

Traditionally, chickpea (*Cicer arietinum*) has been the major food legume in the state of Haryana, India, accounting for more than 95% of area and production of all the food legumes. However, the area under chickpea has been decreasing with increasing irrigation facilities. There is a need for an alternative grain legume which could be adapted to the irrigated farming systems of Haryana State. Faba bean (*Vicia faba* L.) is being introduced as a promising alternative to chickpea, both as a source of food and feed.

Langille (1974) and Massey and McKnight (1975) reported that faba bean fodder may have a value as an alternate leguminous to alfalfa and clovers. There is however a need for the assessment of the value of the seed and green forage of faba bean in feeding ruminants. Keeping this in view, four experiments were conducted at the Haryana Agricultural University, Hisar, India to find out the nutritive value of faba bean seed meal, green fodder, and silage for sheep and cattle.

#### Materials and Methods

In the first experiment, the nutritive value of faba bean was determined through feeding trial with adult male sheep. Ten sheep (body weight range from 36 to 47.5 kg) were divided into two groups of five each. One group was fed chickpea straw alone, whereas the other group was fed chickpea straw plus crushed faba bean seed, as per the requirement (NRC 1978) in 60:40 ratio on metabolizable energy basis, for 35 days including five days of collection period. The sheep were put individually in metabolic cages five days before the collection period for adjustment to the experimental conditions. During feeding and collection period the animals were given weighed quantity of feed daily. The digestibility of nutrients and nutritive values in different rations were calculated according to AOAC (1984), whereas for crushed faba bean they were worked out by difference as suggested by Schneider and Flatt (1975).

The chemical composition of the faba bean seed meal was: dry matter (DM) 88.80, organic matter (OM) 88.25, crude protein (CP) 23.76, crude fiber (CF) 11.60, ether extract (EE) 2.29, nitrogen free extract (NFE) 55.60, and ash 6.75%.



In the second experiment, green faba bean was fed to cattle either alone, or mixed with green oat in 1:1 ratio. Feed intake and digestibility and nutritive value percentages of the two rations were compared.

In the third experiment, pure faba bean was ensiled for 50 days and offered to sheep. Same parameters were evaluated as in the second experiment.

In the fourth experiment, faba bean green fodder was fed with oat at different ratios (i.e., 1:1, 1:2, and 2:1) to lambs to study the effect on growth and nutrient digestibility. The proximate compositions of the diets fed to different groups are shown in Table 1.

## Results and Discussion

### Experiment 1:

The results obtained from this experiment are shown in Table 2. Digestibility of faba bean was considerably higher than that of the chickpea straw. Thus, the overall digestibility of various nutrients in mixture of chickpea straw and faba bean meal was increased.

### Experiment 2:

The results of this experiment revealed a significant ( $P < 0.01$ ) reduction in feed intake by the cattle fed faba bean fodder alone (1.70 kg/100 kg body weight) as compared with the group fed faba bean forage mixed with oat (Table 3). This may be due to lesser palatability and the presence of toxic factors such as vicine and convicine (Bond 1976; Marquardt *et al.* 1978; Bjerg *et al.* 1980). However, feed intake increased when faba bean fodder was mixed with green oat in 1:1 ratio, which might have increased the palatability and diluted the effects of toxic factors.

When digestibility coefficients of the nutrients were compared between two groups, it was found that the values were statistically similar except that for NFE, which may be

due to the presence of more soluble carbohydrates. The DCP value was significantly higher in sole green fodder of faba bean in comparison to the mixture with oat because of a higher CP content (13.89%) in faba bean forage. On the other hand, TDN values were significantly higher in the mixture because of its higher digestible NFE content. Taking feed intake into consideration it was clear that faba bean forage could not be fed as a sole ration.

Therefore, attempts were made to increase the feeding value of green faba bean fodder by mixing with different levels of green oat or by ensiling in the other experiments.

Table 2 Dry matter intake, nutrient digestibility, and nutritive value under different dietary treatments in adult sheep. Each value is an average of replications.

Attribute	Chickpea straw <sup>1</sup>	Faba bean + chickpea straw <sup>1</sup>	Faba bean (through difference)
Body weight (Kg)	40.30 +2.25	42.10 +1.95	
Dry matter intake (kg/day)	1.08 <sup>a</sup> +0.15	0.94 <sup>a</sup> +0.06	
Dry matter intake (kg/100 kg body weight)	2.63 <sup>a</sup> +0.26	2.25 <sup>a</sup> +0.12	
<i>Nutrient digestibility (%)</i>			
Dry matter (DM)	50.50 <sup>d</sup> +1.35	55.42 <sup>c</sup> +0.46	67.41 +1.84
Organic matter (OM)	59.54 <sup>a</sup> +2.47	63.02 <sup>a</sup> +2.34	71.97 +8.42
Crude protein (CP)	46.48 <sup>b</sup> +1.95	63.98 <sup>a</sup> +1.93	74.22 +2.38
Ether extract (EE)	56.17 <sup>a</sup> +3.30	61.30 <sup>a</sup> +1.17	67.95 +5.56
Crude fiber (CF)	48.29 <sup>a</sup> +1.84	50.03 <sup>a</sup> +0.41	57.78 +3.60
Nitrogen-free extract (NEF)	68.59 <sup>a</sup> +2.79	73.28 <sup>a</sup> +0.82	84.64 +2.68
<i>Nutritive value</i>			
Digestible crude protein (DCP) (%)	2.67 <sup>b</sup> +0.11	7.45 <sup>a</sup> +0.48	17.63 +0.57
Total digestible nutrients (TDN) (%)	52.13 <sup>b</sup> +1.91	63.07 <sup>a</sup> +2.23	69.41 +1.84
Digestible energy (DE) (Mcal/kg)	2.21 <sup>b</sup> +0.08	2.73 <sup>a</sup> +0.01	3.13 +0.08
Metabolizable energy (ME) (Mcal/kg)	1.93 <sup>b</sup> +0.07	2.37 <sup>a</sup> +0.08	2.69 +0.07

1) Figures in rows followed by the letters ab are significantly different at  $P < 0.01$ , whereas those followed by cd are significantly different at  $P < 0.05$

Table 1 Nutrient composition of different combinations of faba bean and oat fodder fed to experimental sheep (exp. 4).

	As percent of dry matter				
	CP	CF	EE	NFE	Ash
Faba bean + oat (1:1)	10.50	21.84	4.35	49.96	13.35
Faba bean + oat (1:2)	9.35	23.16	4.50	49.54	13.45
Faba bean + oat (2:1)	13.83	17.87	3.91	48.64	15.75

### Experiment 3:

The DM intake of silage by sheep was 2.65kg/ 100kg body weight, which is quite satisfactory (Table 4). The sheep fed faba bean fodder silage maintained their body weights, indicating that such silage could be fed to sheep for maintenance.

**Table 3** Dry matter intake, average body weight, nutrient digestibility, and nutritive value of different experimental rations offered to cattle. Each figure is an average of four replications.

Attribute	Treatment	
	Green faba bean + green oat (1:1)	Green faba bean fodder alone
Average body weight (kg/animal)	409.50 <sup>a</sup> ± 22.74	402.25 <sup>b</sup> ± 20.62
Dry matter intake (kg/100 kg body weight)	2.65 <sup>a</sup> ± 0.64	1.70 <sup>b</sup> ± 0.16
<i>Digestibility coefficient</i>		
DM	56.15 <sup>a</sup> ± 3.13	51.23 <sup>a</sup> ± 1.40
CP	54.12 <sup>a</sup> ± 1.59	59.34 <sup>a</sup> ± 2.70
CF	52.02 <sup>a</sup> ± 0.94	48.52 <sup>a</sup> ± 1.13
NFE	64.24 <sup>a</sup> ± 2.14	54.62 <sup>b</sup> ± 1.55
<i>Nutritive value</i>		
DCP	5.68 <sup>b</sup> ± 0.21	8.21 <sup>a</sup> ± 0.38
TDN	54.31 <sup>a</sup> ± 1.45	48.02 <sup>b</sup> ± 0.72

ab: Figures in rows bearing different superscripts differ significantly at P < 0.05.

**Table 4** Dry matter intake, nutrient digestibility, and nutritive value of faba bean silage offered to sheep.

Attribute	Treatment
	Faba bean silage
Dry matter intake (kg/100 kg body weight)	2.65 $\pm$ 0.06
Average body weight (kg/sheep)	19.2 $\pm$ 0.37
<i>Digestibility coefficient</i>	
DM	49.31 $\pm$ 1.52
CP	57.41 $\pm$ 4.06
CF	53.41 $\pm$ 3.02
EE	60.20 $\pm$ 3.85
NFE	46.88 $\pm$ 0.75
<i>Nutritive value (%)</i>	
DCP	6.33 $\pm$ 0.45
TDN	49.93 $\pm$ 0.76

### Experiment 4:

The DM intake (kg body weight) did not differ due to different dietary treatments, indicating that all the treatments were equally palatable. Average body weight gain did not differ significantly, however, apparently more body weight gain was observed with diet mixture of two parts of faba bean forage + one part of oat forage (Table 5). The digestibility coefficients for dry matter and proximate nutrients were statistically similar. The DCP content was significantly higher in the 2:1 mixture followed by 1:1 and 1:2 mixtures. The higher DCP value of the 2:1 mixture was due to higher protein content in this diet because of the presence of more faba bean green in the diet. As dry matter intake values in dietary treatments were similar, there was more DCP intake by the lambs reared with 2:1 mixture which might be responsible for a gain of about 75g in body weight/day. The TDN values emanated from different dietary treatments were statistically similar (Table 5).

It is clear from the above feeding trials that faba bean seed is a good protein supplement for straw based diet, but faba bean forage could not be fed as a sole source of feed. Effective utilization of green faba bean fodder could be achieved either by ensiling or by diluting it with other good

**Table 5** Dry matter intake, growth rate, nutrient digestibility, and nutritive value of different experimental rations offered to lambs. Each figure is an average of four replications.

Attribute	Treatment		
	Faba bean + oat (1:1)	Faba bean + oat (1:2)	Faba bean + oat (2:1)
DM intake (kg/100 kg b.w.)	2.89 <sup>a</sup> ± 0.23	2.62 <sup>a</sup> ± 0.24	2.79 <sup>a</sup> ± 0.26
Average body weight gain (g/day)	70.66 <sup>a</sup> ± 1.36	62.33 <sup>a</sup> ± 1.36	75.00 <sup>a</sup> ± 1.28
<i>Digestibility coefficient</i>			
DM	60.12 <sup>a</sup> ± 1.36	58.70 <sup>a</sup> ± 6.01	55.75 <sup>a</sup> ± 5.15
CP	59.98 <sup>a</sup> ± 1.59	56.69 <sup>a</sup> ± 3.35	62.51 <sup>a</sup> ± 1.47
CF	51.33 <sup>a</sup> ± 2.24	55.87 <sup>a</sup> ± 6.60	45.12 <sup>a</sup> ± 7.48
EE	68.25 <sup>a</sup> ± 0.95	63.61 <sup>a</sup> ± 4.42	52.71 <sup>a</sup> ± 5.61
NFE	65.43 <sup>a</sup> ± 2.67	62.56 <sup>a</sup> ± 5.56	55.87 <sup>a</sup> ± 4.37
<i>Nutritive value (%)</i>			
DCP	6.30 <sup>b</sup> ± 0.09	5.29 <sup>a</sup> ± 0.40	8.82 <sup>c</sup> ± 0.27
TDN	56.88 <sup>a</sup> ± 1.74	55.67 <sup>a</sup> ± 4.90	52.61 <sup>a</sup> ± 3.19

abc: values in rows bearing different superscripts differ significantly (P < 0.05)

quality non-leguminous forage like oat. Feeding faba bean fodder with oat at 2:1 ratio seems to be promising to achieve optimum growth in lambs.

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## القيمة الغذائية لبذور وأعلاف الفول

(*Vicia faba* L.) الخضراء والمُسَيْلِجَة

### الملخص

تُغذت أربع تجارب تغذية لتحديد القيمة الغذائية لجريش بنور الفول (*Vicia faba* L.) والعلف الأخضر والسيلاج لكل من الأغنام والأبقار. إذ يُمكن تقديم جريش بنور الفول إلى المجترات كعليقة تكميلية بروتينية دون أي تأثير مضاد، غير أن أعلاف الفول الخضراء كمصدر علقي وحيد لم تكن ملائمة، ويمكن تحقيق الفائدة المرجوة منها في تغذية المجترات سواءً بسيلجتها أو خلطها بأعلاف أخرى كالشوفان. وقد حققت خلطة مؤلفة من أعلاف الفول والشوفان الخضراء بنسبة 2 : 1 نمواً مثالياً في الحملان.

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# Contributors' Style Guide

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

## Style

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

## Disclaimers

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

## Manuscript

Articles should be typed double-spaced on one side of the page only. The original and two other legible copies should be submitted. The contributor should include his name and initials, title, program or department, institute, postal address, and telex number if available. Figures should be drawn in India ink: send original artwork, not photocopies. Define in footnotes or legends any unusual abbreviations or symbols used in a figure or table. Good quality black and white photographs are acceptable for publication. Photographs and figures should preferably be 8.5 cm or 17.4 cm wide.

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

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

## Examples of common expressions and abbreviations

3 g; 18 mm; 300 m<sup>2</sup>; 4 Mar 1983; 27%; 50 five-day old plants; 1.6 million; 23 ug; 5°C; 1980/81 season; 1980-82 seasons; Fig.; No.; FAO/USA. Fertilizers: 1 kg N or P<sub>2</sub>O<sub>5</sub> or K<sub>2</sub>O/ha.

Mon, Tues, Wed, Thurs, Fri, Sat, Sun; Jan, Feb, Mar, Apr, May, June, July, Aug, Sept, Oct, Nov, Dec. Versus = vs., least significant difference = LSD, standard error = SE +, coefficient(s) of variation = CV(s). Probability: Use asterisks to denote probability \* = P<0.05; \*\* = P<0.01; \*\*\* = P<0.001.

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

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*Books:* Witcombe, J. R. and Erskine, W. (eds.). 1984. Genetic resources and their exploitation-chickpea, faba beans, and lentils. Advances in Agricultural Biotechnology. Martinus Nijhoff/Dr. W. Junk Publishers, The Hague, The Netherlands, 256 pp. *Articles from books:* Hawtin, G. C. and Hebblethwaite, P. D. 1983. Background and history of faba bean production. Pages 3-22 in *The Faba Bean (Vicia faba L.)* (Hebblethwaite, P.D., ed.). Butterworths, London, England.

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

## Submission of articles

Contributions should be sent to FABIS, ICARDA, P.O. Box 5466, Aleppo, Syria.

## NEWS

## اخبار

### Need More Information?

### للمزيد من المعلومات

#### Need More Information on ICARDA Publications and Services ?

##### Free Catalog of ICARDA Publications

Request your list of all currently available publications from the Communication, Documentation and Information Unit (CODI).

##### ICARDA Information Brochure

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

##### LENS (Lentil Newsletter)

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

##### RACHIS (Barley, and Wheat Newsletter)

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

##### Field Guide to Major Insect Pests of Faba Bean in the Nile Valley (English and Arabic)

This pocket field guide for research and extension workers explains how to identify and control the main

insect pests of faba bean in Egypt and Sudan. The distribution, description, and biological characteristics are given for each insect, along with the type of injury, assessment of damage, and recommended control measures. A key to injuries is included. Insects and the damage they cause on faba beans are illustrated with 41 color photos. For your copy, write FLIP.

##### Field Manual of Common Faba Bean Diseases in the Nile Valley (English and Arabic)

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

##### Field Guide to Major Insect Pests of Wheat and Barley (Arabic)

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

##### Introduction to Food Legume Physiology

This comprehensive 105-page technical manual is designed for food legume scientists and their support staff. It covers several areas of food legume physiology in a practical way, with examples whenever possible. The book contains four chapters covering the following: plant structure and physiological functions; mineral nutrition; photoperiodism, vernalization, crop

canopy and radiation, and growth analysis; and physiology and crop improvement. For your copy, write Training Coordination Unit.

#### **ICARDA's Food Legume Improvement Program**

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

#### **Screening Chickpeas for Resistance to Ascochyta Blight A Slide-tape Audio-tutorial Module**

This slide-tape audio-tutorial module is the first in the food legume training series. It is designed for the use of legume trainees during the training courses at ICARDA as well as for scientists and their support staff in the various national programs. This module is also useful educational material for universities and training departments in national research systems. For your copy of this publication or package, write Training Coordination Unit.

#### **Checklist of Journal Articles from ICARDA 1978 - 1987**

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

#### **Opportunities for Field Research at ICARDA**

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

#### **Opportunities for Training and Post-Graduate Research at ICARDA**

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

#### **TO OBTAIN PUBLICATIONS:**

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

#### **Reprints**

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

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

#### **FABIS**

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

#### **Mailing List**

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

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



## Forthcoming Events

## أحداث مُرتقبة

1990

### September

International Conference on Genetic Engineering and Biotechnology

Kathmandu, Nepal, 9-13 Sept.

Contact: Secretary General, ICGEB Conference Organizing Committee, NBA, P.O. Box 2128, Kathmandu, Nepal.

Telex: 2492 MURARKA NP

This conference, organized by the Nepal Biotechnology Association (NBA), aims to create awareness about genetic engineering and biotechnology and give the Nepalese scientists an opportunity to interact with scientists working in various areas of biotechnology. There will be invited speakers, contributed papers, as well as poster sessions.

### November

Modern Methods of the Study of *Rhizobium*

Bangkok, Thailand 01-28 Nov.

Contact: NIFTAL Project Director, NIFTAL Project, 1000 Holomua Rd., Paia, Hawaii 96779-9744, USA.

This course aims to provide training in rhizobia culture, strain identification, genetics of rhizobia, and inoculant production and field application. The course sponsors are the Biological Nitrogen Fixation Resource Center, for South and Southeast Asia, Thailand Department of Agriculture, NIFTAL (Nitrogen Fixation by Tropical Agricultural Legumes) Project and Miran, and the University of Hawaii's Biotechnology Program.

1992

### June

1st European Conference on Grain Legumes

Angers, France, 1-3 June

Contact: Secretariat, First European Conference on Grain Legumes, UNIP, 12, Avenue George V, 75008 Paris, France.

The conference will cover the following legume species: Field pea, faba bean, white lupin, chickpea, and lentil. Oral presentations and posters will be grouped into the following nine areas of interest: Genetic resources and breeding, molecular biology and biotechnology, plant physiology, agronomy, pathology, seed composition, use for animal feed, use for human feed, and economics.

## Second International Food Legume Research Conference 12 - 16 April 1992, Cairo, Egypt

The First International Food Legume Research Conference (IFLRC-I) on pea (*Pisum sativum*), lentil (*Lens culinaris*), faba bean (*Vicia faba*), and chickpea (*Cicer arietinum*) was held at Spokane, Washington, U.S.A. in 1986. It was a resounding success with over 500 registrants from 50 countries. The program consisted of 91 papers coauthored by 202 contributors from 40 countries. The Conference Proceedings were published as: Summerfield, R.J. (ed.). World Crops: Cool Season Food Legumes, 1988. Kluwer Academic Publishers, Dordrecht, The Netherlands.

The success of IFLRC-I has promoted development of the Second International Food Legumes Research Conference (IFLRC-II), which will be held 12 -16 April 1992 in Cairo, Egypt. Recent success in development of low neurotoxin lines of grass pea (*Lathyrus sativus*) has resulted in the addition of this promising cool season food legume to the list of species covered.

The objectives of IFLRC-II are to 1) review and assess recent results from national and international research programs on cool season food legumes and 2) develop strategies for increasing production per unit area and increasing use of these cool season food legumes in various cropping systems. Both basic and applied research will be addressed and multidisciplinary research efforts will be emphasized.

For further information please contact:

Dr. A.E. Slinkard  
Crop Development Center  
University of Saskatchewan  
Saskatoon  
Saskatchewan, S7N 0W0  
Canada

### Editors' Note

FABIS Newsletter has published many articles which use data from variety trial grown at only one location and in one year. The data are usually analyzed for genetic and phenotypic variation, heritability, genetic advance and correlations between characters. We, the Editors, feel that there is little merit in adding to the literature more articles of this type. To this end we will only consider publishing articles which discuss the results of a variety trial sown in a single environment under exceptional circumstances (i.e. when the number of entries or genetic diversity is particularly high or when an unusual trait is discussed).



## ICARDA Publications deposited at AGRICULTURAL Libraries

ICARDA publications are now deposited in the following AGRICULTURAL libraries to make them available to other users under normal inter-library loan and photocopy procedures:

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USA

## DOCUMENT COLLECTION

ICARDA is building up its document collection on faba bean. The collection will be used to supply needed documents to scientists in developing countries.

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

FABIS  
ICARDA  
Box 5466  
Aleppo, Syria

## تعليمات النشر باللغة العربية



### سياسة النشر :

تهدف هذه النشرة العلمية إلى نشر نتائج البحوث الجديدة بالسرعة الممكنة . والغاية من هذه التعليمات مساعدة الباحثين على صياغة بحوثهم بالشكل الذي يسهل تبادل المعلومات فيما بينهم على اختلاف أمصارهم ومشاريهم العلمية . وهذه المطبوعة تُعنى بنشر الأوراق العلمية والبحوث المختصرة والمقالات المكتوبة بلغة واضحة وأسلوب علمي، والمطبوعة أيضاً بمسافات مزبوجة بين السطور على ورق أطواله 21 x 28 سم على وجه واحد فقط . ترسل نسخة أصلية عن البحث، وتُعنون جميع المراسلات إلى عنوان النشرة . ويشترط في المادة المرسلة للنشر ألا تقدم إلى أي جهة أخرى . ولا تعبر نتائج البحوث المنشورة إلا عن وجهة نظر أصحابها . كما أن استعمال أسماء تجارية لا يعني بالضرورة أن إيكاردا تحبذ استعمال أي من هذه المنتجات مقارنة بمثيلاتها التجارية .

### منهج الكتابة :

تكتب وترتب البحوث بالشكل التالي : (1) عنوان مناسب لا يزيد على 70 حرفاً، يليه اسم وعنوان الباحث/ الباحثين . (2) ملخص بالعربية يتألف من فقرة واحدة لا تزيد على 200 كلمة توجز العمل والنتائج المتوصل إليها بأقصر وأوضح طريقة ممكنة . (3) مقدمة تبرز أهمية موضوع البحث، وتستعرض بشكل نقدي الأعمال والبحوث السابقة المتعلقة بالموضوع المدروس . (4) المواد والطرق وتشمل المعلومات الخاصة بموقع تنفيذ التجربة، والمواد والطرق المستعملة، مع تحديد تصميم التجربة المتبع . (5) النتائج والمناقشة، وتظهر المعلومات والبيانات التي حصل عليها الباحث، ومدى أهميتها . (6) التوصيات إن وجدت وتُكتب بفقرات محددة ومُرقمة . (7) كلمة الشكر عند اللزوم . (8) ملخص بالإنكليزية مترجم عن العربية بأسلوب علمي ينسجم وروح اللغة الإنكليزية . (9) المراجع ويتم العزو إليها في النص بكتابة كنية المؤلف وعام النشر بين قوسين. وإذا كان للمرجع أكثر من ثلاثة مؤلفين تكتب كنية الأول وتضاف إليها كلمة "آخرون" إذا كان المرجع بالعربية أو *et al.* إذا كان المرجع بالأجنبية . أما عن ترتيب المراجع في نهاية المطبوعة فيتم هجائياً وبصورة مستقلة، ولكل من المراجع العربية والأجنبية . تستثنى المقالات من الترتيب السابق : مقدمة ومواد وطرق ... إنما يكفي بوضع ملخص لها بالعربية وآخر بالإنكليزية، يضاف إلى ذلك ضرورة تقسيمها إلى فقرات تحمل كل منها عنواناً مناسباً. وينصح هنا بالرجوع إلى آخر أعداد هذه النشرة للتعرف إلى طريقة إعداد المخطوطة، وترتيب المراجع .

### الجداول والأشكال والصور :

تفضل الجداول الصغيرة على الكبيرة، والبسيطة على المعقدة . ويجب أن يحمل كل جدول رقماً معيناً حسب وروده في النص، مع عنوان مناسب . وتستعمل الصور ( الأبيض والأسود فقط ) والأشكال والرسوم الأصلية وليس صوراً عنها، على أن تكون بعرض عمود واحد ( 8.8 سم ) أو عمودين ( 17.7 سم )، ويشار إلى مكانها المناسب في النص، ويراعى فيها أن تكون واضحة المعالم، وتحمل عنواناً وأرقاماً متسلسلة حسب ورودها في النص .

### الأرقام ووحدات القياس :

تستعمل في جميع مطبوعات إيكاردا الأرقام العربية Arabic figures ( 1, 2, 3, .... 9 ) ، ووحدات القياس الدولية SI Unites مثل : طن/هـ، كغ، غ، م، كم، مم، م<sup>2</sup> .

### الاختصارات والرموز :

5 غ، 325 مم، عام 1983، موسم 89/1988، موسماً 1987 - 1989، مواسم 1986 - 1989، 20 م<sup>2</sup>، الجنول 1، الشكل 5، الفاو ( منظمة الأغذية والزراعة )، ف م ع ( الفرق المعول عليه LSD ) .

## إلى العلماء العرب الكرام

تعلمون أن إدراج اللغة العربية ضمن هذه النشرة كان أحد أهم أهداف مشروع "فابس"، الذي كان يدعمه مركز بحوث التنمية الدولية IDRC . وبمزيد من السرور تعلن أسرة تحرير " فابس " عن وصول بعض الأوراق العلمية المكتوبة باللغة العربية . والتي أخذت تظهر على صفحات هذه النشرة بدءا من العدد 26 . لذا يرجى من الباحثين العرب، العاملين في مجال تحسين محصول الغول، الراغبين في نشر بحوثهم باللغة العربية إرسالها إلى العنوان التالي :

نشرة " فابس "

قسم التوثيق

ايكاردا

ص.ب. 5466، حلب، سورية .

## الآفات والأمراض

- 20 تخزين الفول وتبني معاملات موصى بها لحوض السليم (المنطقة الشمالية) في السودان (بالانكليزية)
- 21 الفطر *Colletotrichum dematium* (Pers. ex Fr.) Grove f.sp. *truncata* (Schw./Arx) مُمرض جديد للفول محمول على البذور (بالانكليزية)
- 23 الفاقد في وزن بذور الفول المتسبب عن تغذية يرقات خنفساء الفول الصغيرة *Bruchidius incarnatus* (Boh.) (بالانكليزية)

## المعاملات الزراعية والمكننة

- 24 تقييم نمو وانتاجية ثلاثة أصناف من الفول تحت نظام الري بالرش
- 28 تقييم بعض المعاملات الزراعية المؤثرة في انتاجية الفول عند الزراع (بالانكليزية)
- 31 الكفاءة المحصولية للفول بالبجناب في الهند (بالانكليزية)
- 33 تأثير المبيدات الفطرية والكثافة المحصولية في الفول المزروع في الخريف (بالانكليزية)
- 35 تأثير موعد الحصاد والشرنفة Topping في غلة الفول (*Vicia faba* L.) (بالانكليزية)
- 38 استجابات الفول الشتوي لعمق الزراعة (بالانكليزية)

## الفيزيولوجيا والأحياء الدقيقة

- 43 تأثير المبيدات العشبية: Eptam, Topogard, Igran في الإنبات، ونمو البادرات والانتقسام الخيطي في الفول (بالانكليزية)
- 47 تأثير التجفيف والتخزين في حيوية حبوب لقاح الفول (بالانكليزية)

## التربية والوراثة

- 50 دراسات حول مُعامل المسار للغة ومكوّناتها في الفول (*Vicia faba* L.) (بالانكليزية)



## مشروع المعلومات المتخصصة عن الفول

فابيس، نشرة علمية 26، آب/اغسطس 1990

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القيمة الغذائية لبذور وأعلاف الفول (*Vicia faba* L.) الخضراء والمسيلجة (بالانكليزية)

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تأثير عليقة من جريش بذور الفول في معدل النمو والكرش ومعايير الدم في عجول الجاموس (*Bos bubalus*) (بالانكليزية)

## ايكاردا والمجموعة الاستشارية للبحوث الزراعية الدولية

يتمثل الهدف العام للمركز الدولي للبحوث الزراعية في المناطق الجافة (ايكاردا) في زيادة الإنتاجية الزراعية، والموارد الغذائية المتاحة، في المناطق الريفية والحضرية، بهدف تحسين الوضع الاجتماعي والاقتصادي لشعوب البلدان النامية وخاصة في شمالي إفريقيا وغربي آسيا. وتركز ايكاردا اهتماماتها بصورة رئيسية في المناطق التي تعتمد في زراعتها على الأمطار الشتوية التي تتراوح من 200-600 مم سنوياً. وعندما تستدعي الضرورة ستمتد دائرة بحوثها لتغطي مناطق بيئية مرويّة أو ذات أمطار موسمية.

ويضطلع المركز الدولي بمسؤولية عالمية عن تحسين الشعير والعدس والفلول، وبمسؤولية إقليمية عن تحسين القمح والحمص والنظم الزراعية ومحاصيل المراعي والأعلاف والثروة الحيوانية. كما ويُعتبر تدريب وتأهيل الباحثين الزراعيين في البلدان النامية، وتبادل نتائج البحوث معهم أحد أهم الأنشطة التي تقوم بها ايكاردا.

وقد ساهمت المجموعة الاستشارية للبحوث الزراعية الدولية (CGIAR) بتأسيس ايكاردا في سورية عام 1977، كمركز للبحوث لا يتوخى الربح. أما المجموعة الاستشارية للبحوث الزراعية الدولية فهي هيئة غير رسمية من المتبرعين، تضم حكومات ومنظمات ومؤسسات خاصة، وتدعم البحوث الزراعية في جميع أنحاء العالم، بهدف تحسين الإنتاج الغذائي في البلدان النامية، وذلك من خلال شبكة مؤلفة من ثلاثة عشر مركزاً دولياً للبحوث من بينها ايكاردا. وتغطي أعمال الشبكة بحثاً على أنظمة المحاصيل والثروة الحيوانية، التي تسهم بتأمين ثلاثة أرباع الغذاء في البلدان النامية.

### فابيس

تُصدر ايكاردا نشرة "فابيس" العلمية مرتين في السنة. وهي نشرة علمية متخصصة بالفلول، وتعتبر وسيلة اتصال لتبادل نتائج البحوث حول هذا النبات. وتضم النشرة بحثاً مختصرة تهدف إلى إيصال المعلومات بسرعة، إضافة إلى بعض المقالات العامة التي تدعو إليها أسرة التحرير بشكل منتظم، وتتناول مجالات معينة من بحوث الفول، كما تضم النشرة بعض الإعلانات. وهذه النشرة تُقدّم المعلومات حول بحوث الفول دون مقابل من خلال قسائم الاستجواب، والتصوير النسخي (الفوتوكوبي)، وجمع الوثائق العلمية المتعلقة بالفلول.

### الاشتراكات

توزع نشرة "فابيس" العلمية دون مقابل على الباحثين المعنيين بنبات الفول. وللإشتراك فيها يُرجى الكتابة إلى:  
نشرة فابيس / قسم التوثيق / ايكاردا، ص ب 5466، حلب، سوريا

### هيئة التنسيق

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البرازيل: الدكتور هـ. ايدار، المركز الوطني لبحوث الرز والفاصولياء، BR-153, km 4- Gionia/Anapolis Caixa Postal 179, 74.000-Goiania, Goias

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إيطاليا: البروفيسور سي. دويانتشه، معهد البيولوجيا الزراعية، جامعة توشيا، فيتريو.

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المملكة المتحدة: الدكتور د. آ. بوند، معهد تربية النبات، ماريس لين، ترومبينجتون، كامبردج.

### هيئة التحرير في ايكاردا:

الدكتور موهان ساكسينا/محرر علمي.

الدكتور حبيب إبراهيم/مساعد محرر علمي.

السيد نهاد مليحة/محرر

الدكتور وليد سراج والسيد خالد الجبيلي/الترجمة العربية والتحرير.

صورة الغلاف: حبات فول مصابة بخنفساء اللربياء *Callosobruchus chinensis*

# فابِس

نشرة علمية متخصصة بالفول

أب/اغسطس 1990

العدد 26



المركز الدولي للبحوث الزراعية في المناطق الجافة  
ايكاردا

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