FACTOR ANALYSIS AND GENETICAL PARAMETERS ON YIELD AND ITS COMPONENTS OF TWO VARIETIES AND A NEW PROMISING LINE OF FABA BEAN AS AFFECTED BY MANGANESE AND ZINC APPLICATION

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ABSTRACT

Two field experiments were carried out in the Research and Experimental Center of the Faculty of Agriclture at Moshtohor, during the two successive growing seasons 2001/2002 and 2002/2003 to: - Evaluate the effect of foliar application of manganese and zinc (zero, Mn 25 ppm, Mn 50 ppm, Zn 25 ppm,Zn 50 ppm and Mn 25 ppm + Zn 25 ppm) on two varieties (Giza 674 and Sakha 1) and a new pure line (L 18) of faba bean yield and its components. Estimates of heritability, variability and covariability were calculated. Factor analysis technique was used to determine the dependence relationships between yield and its components. The design used was a split plot design with three replications.

The most important results obtained from this investigation can be summarized as follows:

1- There were significant differences between foliar application of manganese and zinc treatments in all studied traits except plant height in the second season. The maximum values of increase in seed yield were obtained by applying (Mn 25 ppm + Zn 25 ppm).
2- Results revealed significant differences between genotypes for all tested characters except plant height, number of pods/plant, number of seeds per pod and per plant, weight of pods/plant in the first season and seed yield/fed in the first season and combined analysis. Sakha 1 gave the highest mean values for seed yield per plant and per feddan followed by Giza 674.
3- The interaction between foliar manganese and zinc has an insignificant effect on yield and all studied characters
4- Broad sense heritability values, were high for all traits indicating that most variability among genotypes was due to genetic portion. Therefore, selection could be effective.
5- Simple correlation coefficients revealed that, number of pods/plant, weight of pods/plant, seed number/pod, 100-seed weight, seed number/plant and plant height had the greatest influence on seed yield/plant. Therefore selection for these characters is more effective for obtaining new higher yielding varieties.
6- Factor analysis divided characters of faba bean into two factors accounted for 78.842% of the total variability. The first factor contributed by 46.39% and included plant height, number and weight of pods/plant, number of seeds per pod and per plant and seed yield/plant. The second factor accounted for 32.452% and contained number of branches/plant and 100-seed weight.

INTRODUCTION

Faba bean is one of the most important legume crops in Egypt. It is used for human consumption as a good source of protein. It is very important to increase the vertical production of faba bean to face the increasing demant of the people through improving agricultural practices such as fertilization with macro and micronutrients and new pure lines selection.

Studies on the effect of foliar application and soil application of manganese and zinc on yield and its components of broad bean plants reported different results (Farrag, 1978; Farrag, *et al*., 1983; Gomaa, *et al*., 1986; Allam, 1993; Ahmed and Zaki, 1994; Hassanein and Ahmed, 1996 and El-Hosary and Mehasen, 1998)

Many investigators had reported high variability among faba bean genotypes and varieties for growth characters and yield and its components (El-Hosary, 1981; El-Mott, 1982; Naidu, *et al*., 1984; Salwau and El-Hosary, 1989; El-Hosary and Sedhom, 1990; Dawwam and Abdel-Aal, 1991; Gomaa, 1996 and El-Hosary and Mehasen, 1998)

Yield is the final product of several characters. The determination of the most important characters influencing yield may be useful in the breeding programmes. Walton (1972) reported that biologists must seek right assistance from statistical methodology and suggested factor analysis as a new technique to identify growth and plant characters related to yield in spring wheat. Denis and adams (1978) used factor analysis to search for and identify pattems of morphological characteristics in a set of dry bean cultivars which could relate to yield. Factor analysis is a type of multivariate analysis that reduces a large number of correlated variables to a small number of main factors. El-Kalla and El-Rayes (1984), Gad El-Karim *et al*., (1990), Nasr and Geweifel (1991), Mohamed and Sedhom (1993), Ashmawy *et al*., (1998) and Afiah and Mohamed (2000) used factor analysis in corn, faba bean, peanut, corn, faba bean and mungbean experiments, respectively.

The measurements of phenotypic and genotypic components of variance in seed yield and other characters, have been a matter of great importance. Estimates of the genetic parameters in the population have impacts methods of selection. The genetic advance from selection for a given trait is affected by the mean, the genetic variance and the heritability of this trait.

To overcome the low heritability of yield, plant breeders are trying to improve this complex trait indirectly by improving the traits known to be associated with yield. In this case the other traits should be highly heritable and highly associated with yield.

The present study was under taken to: 1- Evaluate the effect of foliar application of manganese and zinc on faba bean yield and its components 2- Check two varieties and a new pure line of faba bean in the south Delta region of Egypt. 3- Determine heritability, variability and covariability. 4- Use of factor analysis technique to determine the dependence relationships between yield components. Such information would help plant breeder for developing high yielding varieties adapted well to Egyptian conditions.

MATERIALS AND METHODS

This study was conducted in the Research and Experimental Center of the Faculty of Agriculture at Moshtohor, during the two successive growing seasons 2001/2002 and 2002/2003. Two varieties of faba bean i.e. (Giza 674 and Sakha 1) and one new pure line of faba bean L18 (developed by El-Hosary) were evaluated to spraying with manganese (as $MnSO_4$ - $5H_2O$) and zinc (as $ZnSO_4$ - $7H_2O$) at a rates (zero, Mn 25 ppm, Mn50 ppm, zn 25 ppm, zn50 ppm and Mn 25 ppm + zn 25 ppm). Chemical analysis of the soil of the experiments is presented in Table 1.

Table (1): Chemical analysis for soil over all of the two growing seasons at the experimental area.

Properties	Values
Soil reaction pH	7.85
Organic matter %	2.1
Available manganese (ppm)	1.15
Available zinc (ppm)	1.01
Soil texture	Clay

Maize was the preceding crop in both seasons. The experiments were carried out in split plot design with three replications. The main plots were allocated to the genotypes, while the sub-plots were allocated to the foliar application of Mn and Zn. Each sub-plot area was 10.5 m^2 (5 ridges of 60 cm width and 3.5 m length).

Sowing date was on November 14 $^{\underline{th}}$ and 18 $^{\underline{th}}$ in 2001/2002 and 2002/2003 seasons, respectively. The normal cultural practices for growing faba bean were practiced. Foliar application of micronutrients was sprayed twice at 40 and 60 days after sowing. The spray volume was 400 L / fed, whereas, the control treatment was sprayed with the same volume of water alone.

At harvest, a random sample of ten plants were collected from each sub-plot to determine plant height (cm) and yield attributes i.e. number of branches / plant, number of pods / plant, number of seeds / pod, number of seeds / plant, weight of pods / plant (g), 100-seed weight (g)and seed yield / plant (g). While seed yield / fed (Kg) was determined on the basis of sub-plot area (10.5 m^2).

A single analysis of variance was done for the data of each season separately and combined analysis was performed to the data over the two seasons according to Snedecor and Cochran (1980) and treatment means were compared by least significant difference test (L. S. D.) at 0.05 level of significance.

Simple correlation and coefficient of determination were computed between the above mentioned characters as outlined by Steel and Torrie (1987).

Factor analysis method according to Cattel (1965) was used. This method basically reduces a large number of correlated variables to a small number of uncorrelated factors. When the contribution of a factor to the total percentage of the trace was less than 10%, the process stopped. After extraction, the matrix of factor loadings was submitted to a varimax rotation, as applied by Kaiser (1958). The effect of rotation is to accentuate the larger loading in each factor and to suppress the minor loading coefficient and in this way to improve the opportunity of achieving a meaningful biological interpretation of each factor. Thus, factor analysis indicates both groupings and contribution percentage to total variation in the dependence structure, since the objective was to determine the way in which yield components related to each other.

The genotypic and phenotypic variances ($\sigma^2 g$ and σ^2 ph) were calculated from the results of analysis of variance as follows:

1- Genotypic variance ($\sigma^2 g$) was calculated from the formula outlined by Comstok and Moll (1963):

$\sigma^2 g$ = Mg – Msg/rs

where $\sigma^2 g$ = Genotypic variance

Mg = Mean square of genotypes

Msg = Mean square of the seasons x genotypes interaction.
r = Number of replicates.
s = Number of environments (seasons).

2- Phenotypic variance (σ^2ph) was computed according to the following equation as applied by Mathur *et al*. (1971) and Verma and Singh (1971):

$$\sigma^2ph = \sigma^2g + (\sigma^2sg/s) + (\sigma^2e/rs)$$

where σ^2sg = (Msg Ms)/r.

σ^2e = Me (error mean square).

Genotypic and phenotypic coefficients of variation were calculated according to Burton (1951) as follows:

G. C. V. = (σg/X) x 100 and ph. C. V. = (σph/X) x 100.

Broad sense heritability (H) was calculated as described by Hanson (1963) using the following formula:

$$H\% = (\sigma^2g/\sigma^2ph) \times 100$$

The expected genetic advance under selection (Gs) was calculated from the following formula as suggested by Johanson *et al* . (1966):

$$Gs = K.\ \sigma ph.\ H.$$

Where σph = The phenotypic standard deviation and

K = The selection differential in standard deviation units. In this investigation, the value used for K is 2.06, which corresponds to selecting the best 5% of the population.

RESULTS AND DISCUSSION

Foliar application effect:

Results in Table 2 indicated that increasing level of manganese or zinc sulphate as foliar application from zero to 50 ppm significantly increased seed yield per plant and per fed. As well as different yield attributes of faba bean except plant height in the second season. The maximum values of increase in seed yield per plant and per fed. were 37.144 gm and 11.226 ard., respectively, were obtained by applying (Mn25ppm + Zn 25 ppm) as foliar application. The increase in seed yield/fed was 11.497%, 22.02%, 13.033%, 23.334% and 31.699% when faba bean plants were sprayed by Mn 25 ppm, Mn 50 ppm, Zn 25 ppm, Zn 50 ppm and Mn 25 ppm + Zn 25 ppm relative to control, respectively, in the combined analysis.

From these results it could be concluded that manganese and zinc played an important role in metabolic processes and in turn affected the plant growth. These results are on line with those reported by (Farrag, 1978; Farrag, *et al*., 1981 and 1983; Gomaa, *et al*., 1986; Allam, 1993; Ahmed and Zaki, 1994; Hassanein and Ahmed, 1996 and El-Hosary and Mehasen, 1998)

Genotype effect:

Two varieties and one new pure line of faba bean were tested in the present study. There were significant differences among all studied characters except plant height, number of pods/plant, number of seeds per pod and per plant , weight of pods/plant in the first seasons and seed yield/fed in the first season and combined analysis(Table 3).

In the combined analysis, Sakha 1 gave the highest mean values for weight of pods/plant , number of seeds/pod, 100-seed weight and seed yield per plant and per fed. The new pure line L18 had the highest values for number of branches, pods and seeds/plant. Also Giza 674 gave the highest mean value for plant height.

Interaction effect:

The result of effect of the interaction between foliar manganese and zinc showed insignificant effect on yield and all studied characters (Table3). This result indicates that genotypes responded similarly to the different foliar manganese and zinc. Similar result was also reported by El-Hosary and Mehasen (1998).

Genetic parameters:

Estimates of phenotypic and genotypic variances, phenotypic and genotypic coefficients of variation, broad sense heritability, genetic advance under selection and genetic advance as percentage of grand mean of faba bean over both 2001/2002 and 2002/2003 seasons are shown in Table (4).

Results showed similar genotypic and phenotypic variances trend concerning the studied characters. The highest values of genotypic and phenotypic variances were for number of seeds / plant being 121.515 and 123.007. On the other hand, seed yield (ardb / fed.) had the lowest values of genotypic and phenotypic variances. The value of genotypic variance was 1.134 being 1.153 for phenotypic one. These results are in agreement with those obtained by Ezzat and Ashmawy (1999); Mohamed *et al.,* (2000) and Abo-Warda and Ashmawy (2001).

. The importance of the estimation of σ^2g and σ^2e is that the magnitude of variance will indicate the performance of the different genotypes in the given ecological conditions. This will allow the faba bean breeder to produce and reproduce genotypes that represent somewhat near optimum combinations of genes for a particular area. With these kinds of estimates, expected gain from various selection programs can be calculated.

Results of genotypic and phenotypic coefficients of variation in Table 4 showed that the values of Ph. C. V. were higher than those of G. C. V. for all studied traits. These results indicated the great influence of the environmental circumstances on the performance of the genotypes for the studied characters. These results are on harmony with those obtained by Ezzat and Ashmawy (1999); Mohamed *et al.,* (2000); Abo-Warda and Ashmawy (2001) and El-sayed and Hefnawy (2001).

With respect to broad sense heritability estimates, results in Table (4), ranged from 87.614% for plant height to 99.445% for number of branches / plant , meanwhile, expected genetic advance with a 5% selection intensity ranged from 0.518 and 14.975% of the mean for number of seeds / pod to 22.570 % and 41.714 % of the mean for number of seeds / plant. High heritability estimates indicating selection for a given character among the studying genotypes would be effective, but these high estimates of heritability may be due to both of the high genetic variability which occurred between these genotypes and to the confounded effects of the environmental conditions. It seems reasonable to think of heritability as a measure of degree to which the phenotype reflects the genotype and in so doing accept a nonrestrictive definition, (Rasmusson and Glass, 1967). The most objection to a nonrestriction definition can be overcome if reports of heritability are accompanied by a careful description of the experimental procedure and method of estimation. Working with the variability between and within established introductions, heritability estimates will depend on the genetic variance between genotypes as compared with the error variance. The latter depends on both the variability within each genotype which could be very low as the genotypes are supposed to be uniform, and the plot to plot variation which could be also very low depending on the interaction between genotypes and environment. The equation for computing heritability is: H = { $\sigma^2 g$ + ($\sigma^2 sg/s$) + ($\sigma^2 e/rs$)}, and since $\sigma^2 e$ is low compared with $\sigma^2 g$ and $\sigma^2 e$ is further reduced by dividing it by r, the result will be a small addition to $\sigma^2 g$ and the denominator of the equation will be almost equals to the numerator. Consequently, the rates or percent will approach 100%. Even when estimating H from a series of experiments, the addition of the interaction variance to the denominator will not affect the estimate considerably, since the interaction variance is low or negative.

The development of genotypes possessing high yielding capacity is a prime objective in faba bean. Seed yield, an extremely complex character, is the result of many growth functions of the plant. It is an example of integration in which the components of yield are partially interdependent in their development.

Simple correlation matrix:

Coefficients of phenotypic correlation among the studied characters in faba bean over 2001/2002 and 2002/2003 are shown in Table 5. The results clearly showed that there was significant and positive association between seed yield/plant and each of number of pods/plant, weight of pods/plant, seed number/pod, 100-seed weight, seed number/plant and plant height. Therefore, selection for these characters is more effective for obtaining new higher yielding varieties.

Significant positive correlation coefficients were detected between 100-seed weight and each of weight of pods/plant and number of seeds/pod. Number of branches/plant was found to be highly significant and negatively correlated with 100-seed yield. This result indicates that selection for high number of seeds/pod and weight of pods/plant would be due to increasing heavy 100-seed weight.

The results indicated that plant height, number of branches and pods/plant , weight of pods/plant and number of seeds/pod were most closely correlated with number of seeds/plant. Increasing of seeds/plant may be accompanied by these characters and that is logic.

On the other hand, plant height, number of pods/plant and weight of pods/plant were highly significant and positively correlated with number of seeds/pod. This indicated that increasing of seeds/pod may be accompanied by developing these characters.

Significant positive correlation coefficient values were detected between weight of pods/plant and each of plant height and number of pods/plant, while number of branches/plant was found to be significant and negatively associated with weight of pods/plant. Whereas the correlation coefficient between number of pods/plant and number of branches/plant was found significant and positive. These results are in accordance with Kambal (1969); Mahmoud *et al*.,(1978); Hung *et al*., (1983); Naidu *et al*., (1985);

Sindhu *et al*., (1985); Mohamed, (1992); Ashmawy *et al* (1998); El-Hosary and Mehasen (1998) and El-Douby and Mohamed (2002).

Factor analysis

Results of factor analysis are presented in Table 6. Factors were constructed using the principal factor analysis to establish the dependent relationship between yield components of faba bean. The results indicated that factor analysis divided eight characters of faba bean into two main factors. For interpretation, only factor loadings greater than 0.5 were considered important (Seilaer and Stafford, 1985).

The results cleared that the two factors explained 78.842% of the total variation in the dependent structure. Factor 1 accounted for 46.39% of the total variability. This factor contained six variables namely: plant height, number and weight of pods/plant, number of seeds per pod and per plant and seed yield/plant. The variables that were included into factor 1 were positively correlated with the factor. These variables were of almost equal importance and had high communality with factor 1.

Factor 2 included two variables which accounted for 32.452% of the total variability in the dependent structure. The two variables were number of branches/plant and 100-seed weight. The two variables had almost equal importance and high communality. These results are in the line with those reported by Gad El-Karim *et al* (1990) and El-Douby and Mohamed (2002). The results of the present investigation indicate that, the estimated communalities, (Table 6) were adequate for conclusions where the two factors together accounted for 78.842% of the total communality.

From the previous results, it can be concluded that, factor analysis is the one that can be used successfully for analysis of large amounts of multivariate data, and should be applied more frequently in field experiments(Joseph, *et al.* 1992 and Hammed, 1993). The greatest benefit of factor analysis can be delineating areas of further researches designed to test the validity of the suggested factors. Using factor analyssis by plant breeders has the potential of increasing the comprehension of causal relationships of variables and can help to determine the nature and sequence of traits to be selected in a breeding program.

Table (6): Summary of factor loading for eight characters of faba bean.

Characters	Loading	Communality(h^2)	Latent root	Factor variance ratio%
Factor 1:			3.247	46.390
Plant height	0.445	0.211		
No. of pods/plant	0.625	0.589		
Weight of pods/plant	0.794	0.783		
No. of seeds/pod	0.825	0.681		
No. of seeds/plant	0.881	0.906		
Seed yield/plant	0.841	0.803		
Factor 2:			2.272	32.452
No. of branches/plant	0.940	0.885		
100 - Seed weight	-0.865	0.819		
Cumulative variance				78.842

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تحليل العامل والمقاييس الوراثية لصنفين وسلالة مبشرة من الفول البلدى تحت تأثير الرش بالمنجنيز والزنك

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** المعمل المركزى لبحوث التصميم والتحليل الاحصائى – مركز البحوث الزراعية – الجيزة

أجريت هذه الدراسة بمركز البحوث الزراعية بكلية الزراعة بمشتهر جامعة الزقازيق خلال موسمي ٢٠٠١/٢٠٠٢ ، ٢٠٠٢/٢٠٠٣ لدراسة تأثير الرش بمعدلات مختلفة من المنجنيز و الزنك (صفر ، ٢٥ جزء فى المليون منجنيز ، ٥٠ جزء فى المليون منجنيز ، ٢٥ جزء فى المليون زنك ، ٥٠ جزء فى المليون زنك ، ٢٥ جزء فى المليون منجنيز + ٢٥ جزء فى المليون زنك) على صنفين (جيزة ٦٧٤ و سخا ١) وسلالة مبشره (L18) من الفول البلدى ، كما تم دراسة المعالم الوراثية وكذلك المساهمة النسبية لمكونات المحصول وذلك من خلال تصميم القطع المنشقة فى ثلاث مكررات وتتلخص أهم النتائج فيما يلي:

١- كانت هناك زيادة معنوية فى جميع الصفات المدروسة لتأثير زيادة معدلات الرش بالمنجنيز والزنك ولكن كانت الزياده القصوى نتيجة المعاملة (٢٥ جزء فى المليون منجنيز + ٢٥ جزء فى المليون زنك) فيما عدا طول النبات فى الموسم الثانى.

٢- أظهرت النتائج وجود اختلافات معنوية بين الصنفين والسلالة فى جميع الصفات المدروسة ما عدا طول النبات ، عدد قرون النبات ، عدد بذور القرن ، عدد بذور النبات ، وزن قروزالنبات فى الموسم الأول و محصول البذور (أردب/فدان) فى الموسم الأول وفى تحليل التجميع وقد أعطى الصنف سخا ١ أعلى محصول من البذور للفدان.

٣- لم يكن للتفاعل بين الأصناف ومعدلات الرش أى تأثير معنوى على جميع الصفات المدروسة.

٤- عند تقدير درجة التوريث بطريقة مكونات التباين وجد أن درجة التوريث بمعناها الواسع مرتفعة لكل الصفات تحت الدراسة ويدل ذلك على أن الاختلافات بين الأصناف المختبرة لهذه الصفات ترجع إلى الاختلافات الوراثية مما يجعل الانتخاب للصفات المرغوبة أكثر فاعلية.

٥- أظهر تحليل معامل الارتباط وجود تلازم معنوى بين محصول النبات وكل من : طول النبات ، عدد ووزن قرون النبات ، عدد البذور للقرن والنبات ، وزن ١٠٠ بذرة.

٦- قسم تحليل العامل المتغيرات الثمانية إلى عاملين يشتمل الأول منها طول النبات ، عدد ووزن قرون النبات ، عدد بذور كل من القرن والنبات ، وزن بذور النبات ويسهم هذا العامل بحوالى ٤٦.٣٩ % من التباين الكلى ، والانتخاب لهذه الصفات يعطى محصول عالى من البذور ، بينما يحتوى العامل الثانى على عدد فروع النبات ووزن ١٠٠ بذرة ويسهم هذا العامل ب ٣٢.٤٥% من التباين الكلى. كما أوضحت نتائج تحليل العامل أن التحليل يتسع لدراسة مزيد من الصفات حيث أن الصفات تحت الدراسة فسرت ٧٨.٨٤ % فقط من التباين.

Table (2): Mean performance of yield and its components as affected by foliar Mn and Zn application in both seasons as well as combined analysis.

Foliar rates	Plant height (cm)	Number of branches/ plant	Number of pods/plant	Number of seeds/pod	Number of seeds/plant	Weight of pods/plant(g)	100-seed weight (g)	Seed yield /plant (g)	Seed yield (ard./ fed)
2001 / 2002									
Zero	93.100	2.922	11.067	3.189	37.189	31.300	63.389	26.411	8.265
Mn 25 ppm	98.533	3.167	14.256	3.389	49.111	34.511	67.067	29.911	9.244
Mn 50 ppm	101.422	3.178	15.978	3.522	56.644	37.933	68.411	33.933	10.057
Zn 25 ppm	101.267	3.133	15.711	3.500	55.889	36.744	67.689	32.689	9.325
Zn 50 ppm	103.367	3.189	16.722	3.767	63.044	39.578	68.844	36.367	10.143
MN 25 + Zn 25	107.522	3.467	18.656	3.867	72.333	42.278	70.133	38.789	10.982
L. S. D at 5%	8.58	0.134	2.300	0.240	7.152	4.197	3.916	4.110	0.872
2002 / 2003									
Zero	86.222	2.822	11.456	2.989	35.156	29.300	66.033	25.956	8.783
Mn 25 ppm	88.856	3.078	14.356	3.244	46.667	34.644	68.700	31.300	9.763
Mn 50 ppm	90.000	3.178	16.456	3.367	55.556	37.267	70.211	33.756	10.746
Zn 25 ppm	92.489	3.267	15.400	3.344	51.611	34.933	69.778	31.900	9.944
Zn 50 ppm	95.022	3.356	16.422	3.567	58.444	37.622	72.278	33.811	10.882
MN 25 + Zn 25	98.689	3.378	18.044	3.767	67.644	39.756	74.156	35.500	11.470
L. S. D at 5%	N. S	0.120	1.991	0.392	8.425	4.669	4.482	4.226	1.183
Combined									
Zero	89.661	2.872	11.261	3.089	36.172	30.300	64.711	26.183	8.524
Mn 25 ppm	93.694	2.122	14.306	3.317	47.889	34.578	67.883	30.606	9.504
Mn 50 ppm	95.711	3.178	16.217	3.444	56.100	37.600	69.311	33.844	10.401
Zn 25 ppm	96.878	3.200	15.556	3.422	53.750	35.839	68.733	32.294	9.635
Zn 50 ppm	99.194	3.272	16.572	3.667	60.744	38.600	70.561	35.089	10.513
MN 25 + Zn 25	103.106	3.422	18.350	3.817	69.989	41.017	72.144	37.144	11.226
L. S. D at 5%	6.040	0.088	1.493	0.225	5.417	3.077	2.918	2.890	0.721

Table (3): Mean performance of yield and its components as affected by genotypes in both seasons as well as combined analysis.

Genotypes	Plant height (cm)	Number of branches/ plant	Number of pods/plant	Number of seeds/pod	Number of seeds/plant	Weight of pods/plant(g)	100-seed weight (g)	Seed yield /plant (g)	Seed yield (Kg / fed)
2001 / 2002									
Giza 674	103.694	2.533	15.061	3.489	53.544	36.228	70.728	31.750	1503.889
Sakha 1	98.861	2.533	14.811	3.706	55.433	40.694	79.528	36.722	1604.222
L 18	100.050	4.461	16.322	3.422	58.128	34.250	52.511	30.578	1388.278
L. S. D at 5%	N. S	0.228	N. S	N. S	N. S	N. S	3.760	4.627	N. S
2002 / 2003									
Giza 674	95.233	2.583	14.933	3.322	50.572	35.039	72.728	31.317	1571.167
Sakha 1	93.089	2.500	14.539	3.439	50.583	39.683	79.350	35.478	1709.556
L 18	87.317	4.461	16.594	3.378	56.383	32.039	58.500	29.317	1492.222
L. S. D at 5%	N. S	0.224	N. S	N. S	N. S	4.208	5.922	3.429	157.07
Combined									
Giza 674	99.464	2.558	14.997	3.406	52.058	35.633	71.728	31.533	1537.528
Sakha 1	95.975	2.517	14.675	3.572	53.008	40.189	79.439	36.100	1656.889
L 18	93.683	4.458	16.458	3.400	57.256	33.144	55.506	29.947	1440.250
L. S. D at 5%	N. S	0.133	N. S	N. S	N. S	2.703	2.915	2.393	N. S
Interaction (G X F):	N. S	N. S	N. S	N. S	N. S	N. S	N. S	N. S	N. S

G : Genotypes F : Foliar aplication

Table (4): Genetic parameters for all traits recorded over 2001/2002 and 2002/2003 seasons.

Characters	σ^2ph	σ^2 g	P.C. V.	G. C. V.	H %	Gs	Gs% of X
Plant height	26.093	22.861	5.300	4.961	87.614	9.219	9.566
No. of branches/plant	0.901	0.896	29.868	29.785	99.445	1.945	61.187
No. of pods/plant	5.831	5.707	15.704	15.536	97.873	4.869	31.661
Weight of pods/plant	21.982	21.583	12.908	12.790	98.185	8.614	23.715
No. of seeds/pod	0.071	0.067	7.685	7.483	94.366	0.518	14.975
No. of seeds/plant	123.007	21.515	20.498	20.373	98.787	22.570	41.714
100-Seed weight	56.826	54.781	10.942	10.744	96.401	14.970	21.730
Seed yield/plant	21.429	20.543	14.232	13.934	95.865	9.142	28.105
Seed yield Kg/fed.	1.153	1.134	10.774	10.686	98.395	2.176	21.837

- σ^2ph : Phenotypic variance. - σ^2 G : Genotypic variance.
- P. C. V. : Phenotypic coefficient of variation. - G. C. V. : Genotypic coefficient of variation.
- H% : Broad sense heritability. - Gs : Genetic advance under selection.
- GS : Genetic advance as percentage of grand mean.

Table (5): Simple correlation coefficient values for eight characters of faba bean.

Characters	X1	X2	X3	X4	X5	X6	X7
Plant height (X1)	1.000						
No. of branches/plant (X2)	-0.102	1.000					
No. of pods/plant (X3)	0.074	0.345**	1.000				
Weight of pods/plant (X4)	0.226*	-0.265**	0.289**	1.000			
No. of seeds/pod (X5)	0.417**	0.004	0.284**	0.543**	1.000		
No. of seeds/plant (X6)	0.359**	0.317**	0.713**	0.465**	0.784**	1.000	
100-Seed weight (X7)	0.165	-0.809**	-0.066	0.442**	0.216*	-0.023	1.000
Seed yield/plant (X8)	0.230*	-0.187	0.368**	0.947**	0.577**	0.539**	0.408**

- and ** : Significant at 0.05 and 0.01 level of significance, respectively.
- R^2 = 0.924 S.E. = 1.679