SEED YIELD, YIELD COMPONENTS AND QUALITY CHARACTERS AS AFFECTED BY CULTIVARS, SOWING DATES AND PLANTING DISTANCES IN FABA BEAN.

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ABSTRACT

During 2001/2 and 2002/3 winter seasons at the Experimental Farm, Fac. Agric. At Fayoum, two field experiments were conducted to evaluate four faba bean cultivars (G.2, G. 429, G.843 and Misr 1) sown under three sowing dates (Oct. 15, Nov. 5 and 25) with three intra – row plant spacings (15, 20 and 25 cm between hills). The investigation was done with aim of searching for the best combination between genotypical and environmental factors produced high yield with improved quality. Randomized complete block design, in split-split plot arrangement, with three replications was applied.

The obtained results revealed that delaying sowing from Oct. 15 to Nov. 25 resulted in increases for number of seeds/pod (16.14%) in the first season, and seed index (7.74 and 8.28%) in both seasons. However, seeds number/ plant and seed yield/faddan were decreased by (6.88 and 24.84) and (28.85 and 15.84%) respectively, in the two seasons. The highest seed weight/plant was recorded from the intermediate date in the first season and from the earliest date in the second one. Sowing on Nov. 5 gave the highest harvest index in both seasons. Concerning plant density, seeds/ pod (9.66 and 6.64), seeds/ plant (31.08 and 6.01) and seed weight/ plant (34.40 and 10.67%) were decreased as intra – row plant distance was decreased from 25 to 15 cm in the first and second season, respectively. Whereas, seed yield/faddan was increased (14.29%) by increasing plant density in the first season. Seed protein content was decreased by 7.79% in the first season with delaying sowing date, and increased by 5.00% in the second season with increasing plant density. However, seed carbohydrate content did not affect by both sowing dates or plant density. The tested cultivars showed significant differences for all of the studied characters, except carbohydrate content (%), in both seasons. Several significant first and second order of interactions were detected and discussed. The data indicated that sowing G. 2 or G. 429 on Nov. 5 with density of 112 or 140 thousand plants/faddan resulted in highest seed yield with acceptable quality.

Key word : Faba bean cultivars, Sowing date, plant density, interaction, yield, yield component, protein & carbohydrate.

INTRODUCTION

Faba bean (*Vicia faba* L.), as a legume member belonging to *Fabaceae* family, is a multi benefits crop. It is important for soil fertility, human nutrition, animal feeding and industry purposes. However, its production in Egypt is limited and fails to face the increasing local consumption of seeds due to gradual decreases in its cultivated area and average yield. In 1998, the area cultivated for dry seeds was 384911 faddan produced yield with an average of 1.359 t. Whereas , the area and average yield were decreased to 302845 faddan and 1.324 t , respectively, in 2002[*].

So, increasing crop production is the major target of the national agriculture policy and can be achieved through both increasing the cultivated area and growing the high yielding and stable cultivars under favourable environmental conditions. Therefore, to improve yield and quality of faba bean, it is imperative to search for the suitable and integrated cultural practices such as proper sowing date, appropriate plant density and well adapted cultivars.

[*] Bull. Agric. Econ., Min. Agric., Egypt, 1998 – 2002.

Concerning sowing date, Rabie (1991) recommended the end of October as the best date for producing the highest seed yield and quality average compared with the latest dates. Amer *et al*. (1992) obtained the greatest seed yield from sowing on Nov. 1 in the first season and on Nov. 15 in the second one, whereas sowing on Nov. 30 decreased yield and its components. Amer *et al*. (1997) reported that planting on the first week of Nov. surpassed that on the last week of Nov. in yield, most of yield components. Hatam *et al*. (1999) indicated that number of seeds/pod, seed weight/plant and seed yield/ha were decreased by 13.35 and 85% respectively, as sowing date was delayed from Oct.22 to Jun.7, whereas seed index did not affect.

several faba bean investigators reported the dense planting resulted in decreases for seeds/pod, seeds/plant, seed weight/plant and seed index (khalil and Thompson, 1982; Nassib *et al*., 1982; El-Tuhami and Hussein, 1986, Abo-shetaia (1990; Khalil *et al*, 1993; Hussein *et al*., 1994; Hassan and Hafiz, 1998 and Mokhtar, 2001). While, dense planting had no effect on seeds/pod (Abo El-Zahab *et al*,1981 and 1982; El-Fieshawy and Fayed, 1990 and on seed index (Abo El-Zahab *et al*., 1982, and Zeidan *et al.*, 1990). However, Zeidan *et al*.(1986). Ibrahim and Esmail (1994) Metwally, 1997 and Hassan and Hafiz, 1998 found that seed index was increased in the densest plant population. On the other hand, seed yield was increased by increasing plant density up to 26.7 plant/m^2 (Abo Salama and Dawood, 1994), up to 31.7plant/m^2 (Mokhtar, 2001) up to 33.3 plant/m^2 (Nassib *et al*., 1982; Nigem *et al.*, 1988a &b; Selim and El-Seessy, 1991; Khalil *et al.*, 1993 and Abdel–Aziz and Shalaby, 1999) and up to 44.4 plant/m^2 (Zeidan *et al*., 1990; El-Douby *et al.*, 1996 and Hassan and Hafiz, 1998). However, Saxena and Stewart (1983) obtained the lowest seed yield from the highest dense planting (33 plant/m^2). In addition, insignificant yield differences were found between 16.7 and 22.2plant/m^2 (Abo El-Zahab, *et al.*1981) and between 24 and 67 plant/m^2 (Teama, 1994). While Zeidan (1986) found that intermediate density of 33.3 outyield both of 22.2 and 44.4 plants/m^2.

Genotypic differences due to plant density were recorded for seeds/pods by El-Tuhami and Hussein (1986), for seeds/plant by El-Murabaa *et al*. (1987) and Khalil *et al*. (1993), for seed weight/plant, seed index and seed yield/faddan by Nigem *et al*., (1998b), Dawwam and Abdel – Aal (1991), Amer *et al*., (1992) and Ashmawy *et al*., (1988) and for all of these characters by Abdalla *et al*. (2000).

Unfortunately, very little information were available. about. the Whole integrated effect of sowing dates, plant density and cultivars on faba bean yield, yield components and quality characters. To confirm this integration among these factors, the present investigation was designed.

MATERIALS AND METHODS

Two field experiments were executed during 2001/2002 and 2002/2003 winter seasons at the experimental Farm, Faculty of Agriculture at Fayoum, to evaluate seed yield and its related characters of faba bean, *Vicia faba* L., sown under different planting dates and spacings. The soil of the experimental site was clay loam in texture with ECe of 0.72 mmohs/cm and pH of 8.8. The preceding crops were cotton and maize in the first and second season, respectively. The used experimental design was randomized complete block, in split-split plot arrangement, with three replications. Three sowing dates (October 15, November 5 and 25), three intra-row plant distances (15, 20 and 25 cm, which equivalent to 186.7, 140 and 112 thousand plants/faddan or 44.4 , 33.3 and 26.7 plants /m^2, respectively) and four cultivars (Giza 2, G. 429, G. 843 and Mirs 1) were allocated in main, sub– and sub sub–plots,

alternatively. The plot area was 10.5m^2, included 5 ridges of 3.5 in length and 60 cm width.

The seeds of the cultivars were obtained from Legumes Sec., Field Crops Res. Inst., ARC, Giza, Egypt. 300 kg calcium super phosphate (15.5% P_2O_5) and 50 Kg of potassium sutphate (48% K_2O) were added during seed bed preparation. Planting was done with seeds, treated by "Vetavax 200 WP" at the rate of 2g/kg seeds, in hills (3 seeds/hill) on the two sides of the ridges. *Rhizobium* inoculation, mixed with fine sand was sprinkled on the covered hills after sowing and before irrigation. Thinning was practiced after 21 days from sowing to secure two plants/hill. Simulative dose of ammonium nitrate (33.5% N) was added at the rate of 68.5 Kg/faddan before the first irrigation. All of the other recommended cultural practices for growing faba bean were followed.

At harvest time, ten guarded plants were randomly taken from each plot to measure the averages of number of sees/pod, number and weight of seeds/plant. Plants of the two inner ridges/plot were wholly harvested to determine its biological and seed yields and used to estimate harvest index, seed index (100 seeds weight) and seed yield/faddan. Representative dry seed sample/plot was taken to estimate the percentages of protein (using Orange–dye cloromietric method, Hafez and Hikkelsen, 1981) and carbohydrate content (using phenol-sulphoric aced regent, Dubois *et al.*, 1956). The obtained data ware subjected to statistical analysis outlined by Gomez and Gomez (1984) and the means were compared by LSD test.

RESULTS AND DISCUSSION

Crop scientists considered the yield to be the least heritable quantitative character depend upon different components, due to control by almost all the genes of the plant and greatly influenced by many variable factors of environment. The rate of growth and development of the reproductive organs is depend upon the available photosynthates partitioned to these organs, which controlled by genetical and environmental actions and interactions. So, to obtain high yield, it is essential to search for suitable growing conditions under which the balanced compensation of yield contributors occurs toward the maximum yield.

Number of seeds/pod:

The data presented in Table (1) show that number of seeds/pod was increased significantly in the first season and insignificantly in the second one, as sowing date was delayed from Oct. 15 to Nov. 25. This result contradicts that reported by Hatam *et al.*(1999) in Pakistan, due to differences in the experimental materials and environmental conditions under which the former were studied. Changing the intra-plant distance had clear influences on seeds/ pod in both seasons, but in different trends. In the first season, the character mean of 25 cm (low density) surpassed that of 15 cm treatment. Khalil and Thompson (1982), Abo-Shetaia (1990) and Mokhtar (2001) supported this result. However, the reverse was found in the second season, due to seasonal fluctuations. Connecting with this, Abo El-Zahab *et al*. (1982) and El-Fieshawy and Fayed (1990) reported that seed/pod was not affected by plant density. The tested cultivars were markedly different in their seeds/pod in both seasons. G.2 followed M.1 cvs. in the first season, and G.2 in the second one surpassed all other cultivars. Genotypic differences for this character were also recorded by El-Tuhami and Hussien (1986), Dawwam and Abdel-Aal (1991) and Abdalla *et al.* (2000). Whereas, Ashmawy *et al*. (1998) found insignificant differences among G.3, G461 and G. 716 cvs. for this character.

Seeds/pod found to be markedly affected by S x D interaction in the second season, where the maximum number was obtained from planting on Oct. 15 under

moderate plant density. Also, the effect of S x V interaction was significant only in the first season, where the highest numbers of seeds/pod were recorded from planting M.1 and G. 429 on Nov. 5 as well as G. 843 on Nov. 25. The character was affected by D x V interaction in both seasons. G. 843 under the lowest plant density in the first season and under the highest density in the second one possessed the greatest number of seeds/ pod. This may be attributed to the least influence of density on this character in particular of this cultivar. In this concern, Loss *et al.* (1998) reported that seeds/pod was not affected by D x V interaction. The character was also affected by S x D x V interaction in both season, where G. 843 gave the greatest numbers from moderate sowing date with lowest density in the first season and from latest date with the densest population in the second one.

Number of seeds / plant:

It was noticed, in general, that the values of seeds/plant in the first season were higher than the corresponding ones in the second season. This may be attributed to seasonal climatic changes during seed and pod sitting. The data in Table (2) show that seeds/ plant was significantly decreased by delaying sowing date in both seasons. The character means of the first season were higher than those of the second one, which may be resulted from the reduction in seeds/ pod of the later season. Concerning the plant density effect, the data showed seeds/ plant was increased by increasing intra-row plant distances in both season. These results supported those reported Nassib et al. (1982); Sary *et al.* (1989); Abo-Shetaia (1990); Khalil *et al.*, (1993); Hussein *et al.* (1994) and Mokhtar (2001). The data showed also that M.1 in the first season and G. 843 in the second one produced the greatest number of seeds/plant.

Regarding S x D interaction effect, results indicated that the highest numbers of seeds/ plant were resulted from the lowest plant density sown on Nov. 25 in the first season or on Oct. 15 in the second one. This result reflects that sowing date may be more important than plant density for this character. S x V interaction found to be significantly affected seeds/ plant in both seasons, where the maximum values were resulted from sowing G. 843 on Oct. 15 indicating its consistency relative to the other cultivars. D x V interaction effect was clearly observed in both seasons. M.1 and G.2 cvs. under lowest plant density in the first season, and G. 843 the densest planting followed by G.2 under thinnest planting in the second season possessed the highest number of seeds/plant. Significant D x V interaction affects on seeds/ plant were previously detected by Nassralla (1987) and Abdel-Aziz and Shalaby (1999). S x D x V interaction showed marked effect on the character in the two seasons. The latest sowing of M.1 with the lowest density in the first season, and the earliest sowing of G.2 with the same plant density, produced the greatest numbers of seeds /plant.

Seed weight / plant (g):

The mean weights in the first season were higher than those of the second one (Table 2) due to fluctuation of seasonal climatic conditions. The data showed that seed weight / plant was clearly affected by sowing date in the two seasons. Moderate sowing date gave the heaviest weight of seeds/plant, due to its advantage in seeds number/pod, in the first season. While in the second season, the heaviest weight was produced from the earliest sowing date, which may be attributed to that Oct. sowing was accompanied by favorable climatic conditions during grain filling period. The data presented in Table (2) show that seed weight/plant was significantly increased by increasing distances between plants in both seasons. Superiority of wide plant spacing may be due to its advantage in seeds/ pod particularly in the first season. These increases may ascribed to decreased inter plant competition that leads to increased plant capacity for utilizing the environmental inputs in building great amount of

metabolites to be used in developing new tissues and increasing its yield components. These results are in agreement with those obtained by Abo-Shetaia 1990), Khalil *et al*. (1993), Ashmawy *et al.* (1998); Mokhtar (2001) and El-Metwally *et al.* (2003). In regard to the cultivars effect, the results showed that G.843 followed by M.1 cv. had the heaviest seed weight/plant in both seasons, due to the rank of one of them or both as the highest cultivar for numbers of pods and/or seeds/ plant in one or the two seasons.

The character was clearly affected by all first and second orders of interactions. The late sowing date with the least plant density in the first season, and the earliest sowing coupled with medium plant density in the second season, produced the heaviest weights. Also, S x V interaction effect was considerable, where the maximum weights were resulted from sowing G. 843 on Oct. 15 in the two seasons. Similar interaction effect was early detected by Amer *et al.* (1992). The character, additionally, affected by D x V interaction, where M.1 under the thinnest density in the first season, and G. 843 under the densest planting in the second season. These results reflect the differential response of the two cultivars to the environmental conditions. The same trend was previously recorded by Abdel – Aziz and Shalaby (1999). As effect of S x D x V interaction, the latest sowing date with thinnest density in the first season, and the earliest sowing with moderate density in the second season, M.1 cv. possessed the heaviest weights of seeds/plant.

Seed index (weight of 100 seeds, g):

The data arranged in Table (2) show that seed index was significantly increased in both seasons, as sowing date was delayed from Oct. 15 to Nov. 25. The data also showed that the character was not affect by plant density in the two seasons. These results are in line with those of Abo El-Zahab (1982) and Zeidan *et al.* (1990), Where as Zeidan *et al.* (1986); Ibrahim and Esmail (1994), Metwally (1997) and Hassan and Hafiz (1998) found that seed index was decreased by increasing plant density. In both seasons, the tested cultivars showed considerable differences for their seed indices. G. 843 in the first season and M.1 in the second one recorded the heaviest 100 seed weight surpassing all other cultivars. Varietal differences for seed index were early detected by El-Murabaa *et al.* (1987), Nigem *et al.* (1988b), Dawwam and Abdel–Aal (1991) and Abdel-Aziz and Shalaby (1999). The data showed that the character was significantly affected only by S x D interaction in the second season, where the highest 100 seed weight was obtained from the latest sowing date coupled with the lowest plant density. Amer *et al* (1992) detected similar effective interaction.

Harvest index:

Harvest index is ranked as the second physiological –genetic component, after biomass, for a crop yield. It is considered the end point measure the partitioning of photesynthates toward the reproductive organ during actual accumulation of the yield. So, its represent the portion of net accumulated biomass partitioned to reproductive organs. Therefore, measuring it become of great importance for determining the yielding ability of a crop variety. The data listed in Table (3) reveale that harvest index was significantly affected by sowing dates only in the first season. But, in general, moderate sowing on Nov.5 recorded the highest indices in both seasons, indicating the suitability of this date for building great biomass and increasing its portion partitioned to the reproductive organs. The data also showed that harvest index was markedly increased by increasing plant spacing only in the second season, where the value of 25cm treatment surpassed that of 15 cm one by 11.72%. These results are in parallel with those of number of seed and seed weight/plant (Tables 1

and 2) indicating the importance of harvest index for seed yield. Nassib *et al.* (1982) and El-Metwally *et al.* (2003) supported these results. However, El-Tuhami and Hussein (1986) reported that harvest index was decreased by increasing density. In regard to the effect of cultivars, the results showed that G.2 and G. 843 in the first season, and M.1 followed by G. 843 in the second one gave the highest harvest indexes. As early mentioned, the three cultivars were superior for seeds number and weight/plant and / or seed index (Tables 1 and 2) revealing the importance of harvest index as indicator for these yield components. These results indicated also that both cultivars, particularly G. 843, were genetically capable to increase the portion of biomass partitioned to the reproductive organs, i.e. seed yield.

The character was markedly affected by S x D interaction only in the second season, where the highest harvest index was resulted from moderate sowing date with lowest plant density. Connecting with this, Loss *et al.* (1998) suggested that there was small trend of reduced harvest index with increasing plant density. S x V interaction showed significant effects on harvest index in the two seasons, where sowing G. 2 followed by G. 843 on Nov. 5 in the first season and M.1 followed by G. 843 on the same date in the second season gave the highest values. Also, D x V interaction had significant effect only in the second season, where M.1 under the lowest plant density possessed the highest harvest index. The character was, additionally, affected by S x D x V interaction in the second season. With moderate sowing date under the lowest density, M.1 cv. had the highest harvest index.

Seed yield / faddan (t):

The data revealed that seed yield was markedly affected by sowing dates in both seasons (Table 3). Seed yield was decreased by delaying sowing date from Oct. 15 to Nov. 25, but the earliest and moderate dates produced the largest yields without significant differences in the two seasons. In connection with these results, the previous studies confirmed sowing faba bean on the end of October (Rabie, 1991 and Hatam *et al.* 1999), during first half of November (Amer *et al.*, 1992) and the first week of November (Amer *et al.*, 1997).

Concerning the effect of plant spacing or plant density, the data showed that seed yield of 15 cm treatment (44.7 plants /m^2) was significantly higher than those of 20 and 25 cm ones, in the first season. The same trend was fairly true in the second season, but the differences did not reach to the significance level. Raising seed yield by increasing plant density was frequently reported by several workers, among them Zeidan *et al.* (1990), El-Douby *et al.* (1996) and Hassan and Hafiz (1998) who confirmed the present findings. However, Nassib *et al.* (1982), Nigem *et al.* (1988 a&b), Salem and El-Seessy (1991), Khalil *et al.* (1993) and Abdel-Aziz and Shalaby (1999) indicated that 20 cm distances between plants (33 plants/m^2) produced the largest seed yield /faddan. Moreover, Abo El-Zahab *et al.* (1982) obtained the highest yield from the lowest plant density of 16.6 plants/m^2. On the other hand, Teama (1994) did not find significant differences among plant densities of 24, 33, 48 or 67 plants/m2 for seed yield of G. 402 cv.

In regard to cultivars, the results showed that G. 2 produced the highest seed yield followed by G.843 and M.1 in the first season. Superiority of G.2 and G.843 may be due to its highest values of seeds number and weight, seed index and harvest index, particularly in this season. While in the second season, M.1, which possessed the heaviest seed index, followed by G. 843, which had the highest number and weight of seeds/plant, produced the greatest seed yield/faddan. These results reflected the importance of seed index, seed weight/plant and harvest index as yield contributors. Different performance among the tested cultivars may be attributed to

their differential responses to the environmental factors, which actually depend upon their genetic background.

S x D interaction effect was significant only in the second season, where the highest yield was obtained from the earliest sowing with the highest or moderate plant density. In both seasons, seed yield was significantly affected by S x V interaction, where sowing G843 followed by M.1 on Oct. 15 in the first season, and M.1 followed by G. 843 on Nov.5 in the second one, produced the largest seed yield. These results revealing the suitability of planting these two cultivars during the second half of October to the first week of November for producing the highest seed yield. D x V interaction effect was clearly observed in both seasons, where G.2 under the densest planting in the first season, and M.1 under the thinnest planting, in the second season, produced the largest seed yield. Similar different varietal responses were early reported by Amer *et al.* (1992), Khalil *et al.* (1993) and Hussein *et al* (1999). S x D x V interaction had marked effects on the character in the two seasons. Moderate sowing date; for G.2 under the densest planting in the first season, and for M.1 under the thinnest planting, produced the highest seed yields/faddan. These results are in line with those reported by Hussein *et al.* (1994) and confirmed the above mentioned D x v results.

Carbohydrate content (%):

Seed Carbohydrate content (%) was insignificantly affected by sowing dates, cultivars and plant densities in both seasons (Table4). However, Shahein *et al.* (1995) and Abdel-Aziz and Shalaby (1999) found that seed carbohydrate (%) was increased in high density. The data showed that Carbohydrate (%) was significantly affected by S x D interaction in the first season, where the highest percentage was obtained from sowing on Nov.5 under moderate density. While in the second season, it showed marked influence by S x V interaction, where M.1 cv. had the highest percentage when sown on Nov.5.

In the two seasons, the character was clearly affected by D x V interaction G.843 under the moderate plant density in the first season, and G.429 cv, under the lowest density, possessed the highest percentage. Also, it was markedly affected by S x D x V interaction, where the highest percentages were recorded by early sowing of M.1 under the densest planting in the first season, and by early sowing of G.429 under the thinnest planting in the second season.

Protein content (%):

Seed protein content (%) was significantly decreased as sowing date was delayed only in the first season (Table 4). Also, it was markedly decreased by increasing plant spacing towards high plant density. Whereas in the second season, protein (%) was affected insignificantly by sowing dates and significantly by plant density. Insignificant effects of these environmental factors on protein as well as carbohydrate percentage may be desirable for increasing their yields depending on cultivar and population density. Enhancing protein yield by increasing plant density was early recorded by Sary *et al.* (1989) and Shahin *et al.* (1995). Whereas, El-Fieshawy and Fayed (1990) and Zeidan *et al.* (1990) found insignificant effect of plant density on protein (%). On the other hand, Abdel-Aziz and shalaby, (1999) indicated that protein (%) was increased by increasing plant density. The data showed that, in the second season, M.1surpassed all the other tested cultivars for protein (%) Such variation in protein percentage among cultivars was previously reported by Abdel – Aziz and Shalaby (1999) and Abdalla *et al.*, (2000).

Significant S x D interaction affecting the character was observed in the second season, where the highest percentage was obtained from late sowing under

densest planting. While in the two seasons, the character was clearly influenced by S x V interaction, where the moderate sowing in the first season and late sowing in the second one, M.1 cv. possessed the highest protein (%), indicating its consistency for this character. Also, D x V interaction effect wad clearly observed, where G. 2 under the thinnest planting in he first season, and M.1 under the densest planting in the second season, gave the highest values of protein (%). The character was , additionally, affected by S x D x V interaction, where with moderate of both sowing and density in the first season, and with late sowing under he densest planting in the second season, M.1 possessed the highest protein (%), indicating again its consistency for this character.

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الملخص العربي

المحصول البذري ، ومكوناتة وصفات الجودة وتأثرها بالأصناف ومواعيد ومسافات الزراعة في الفول البلدي

أقيمت تجربتان حقليتان بمزرعة كلية الزراعة بالفيوم خلال الموسم الشتوي للعـــامين ٢٠٠١-٢٠٠٢، ٢٠٠٢-٢٠٠٣ لتقييم اربعة اصناف من الفول البلدي (جيزة ٢، جيزة٤٢٩، جيزة٨٤٣، مصر ١) زرعت في ثلاثة مواعيد زراعة (١٥ أكتوبر و٥نوفمبر و٢٥ نوفمبر) بثلاث مسافات زراعـــة بـــين الجـــور (١٥، ٢٠، ٢٥سم) وذلك للبحث عن افضل توليفة بين هذة العوامل الوراثية والبيئية لإعطاء اعلي محصول باعلي جودة. استخدم لذلك تصميم القطاعات الكاملة العشوائية في توزيع القطع المنشقة مرتين في ثلاث مكررات. اظهرت النتائج المتحصل عليها ان تأخير موعد الزراعة من ١٥ اكتوبر الي ٢٥ نوفمبر نتج عنة زيادة في عدد بذور القرن بنسبة (١٦,١%) في الموسم الاول ودليل البذرة ٧,٧٤ و٨,٢٨% في الموسمين علي التوالي. بينمـــا نقص عدد بذور النبات ومحصول الفدان بنسبة (٦,٨٨ ، ٢٤,٨٤%) و ٢٨,٨٥ ، ١٥,٨٤ خلال الموســـمين علي التوالي. اعلي محصول للنبات الفردي تم الحصول علية بالزراعة في الموعد المتوسط في الموسم الاول والموعد المبكر في الموسم الثاني. والزراعة في ٥ نوفمبر اعطت اعلي دليل حصاد في الموسمين.

بالنسبة للكثافة النباتية فقد ظهر نقص في عدد بذور القرن بنسبة ٩,٦٦، ٦,٦٤% وبذور النبات بنـــسبة ٣١,٠٨، ٦,٠١% ووزن وبذور النبات (٣٤,٣٩، ١٠,٦٧%) بنقص المسافة بين الجور من ٢٥ الي ١٥ســـم في الموسم الاول والثاني علي التوالي. بينما محصول الفدان اعطي زيادة بنسبة ١٤,٢٩% بزيـــادة الكثافـــة النباتية في الموسم الاول.

نقصت نسبة البروتين في البذور بمقدار ٧,٧٩% في الموسم الاول بتأخير مواعيد الزراعـــة وبنـــسبة ٥,٠٠% في الموسم الثاني بزيادة الكثافة النباتية. بينما محتوي البذور من الكربوهيدرات لم يتـــأثر بمواعيـــد الزراعة او الكثافة النباتية. أظهرت الاصناف المختبرة اختلافات معنوية لكل الصفات تحت الدراسة ماعـــدا محتوي البذور من الكربوهيدرات في كلا الموسمين. وأظهرت النتائج أيضا العديد من التفاعلات المعنوية بين العوامل المختبرة في الموسمين. وأشارت الدراسة الي ان اعلي محصول بذري بأفضل جودة يمكن الحصول علية بزراعة جيزة ٢ أو جيزة ٤٢٩ في ٥ نوفمبر بكثافة نباتية ١١٢ أو ١٤٠ الف نبات للفدان.

Table (1): Number of seeds/pod and number of seeds/plant as affected by sowing dates , plant spacing and faba bean cultivars during 2001/2002 and 2002/2003 seasons.

Plant spacing(D)	Cultivars (V)	Number of seeds/pod								Number of seeds/plant							
		2001/2002				2002/2003				2001/2002				2002/2003			
		Sowing dates (S)				Sowing dates (S)				Sowing dates (S)				Sowing dates (S)			
		15th Oct	5th Nov.	25th Nov.	Mean	15th Oct	5th Nov.	25th Nov.	Mean	15th Oct	5th Nov.	25th Nov.	Mean	15th Oct	5th Nov.	25th Nov.	Mean
15 cm	G.2	1.56	3.01	2.24	2.27	2.56	2.65	2.35	2.52	20.70	33.37	18.13	24.07	18.80	21.83	14.87	18.50
	G.429	1.95	2.60	2.83	2.46	1.94	2.36	2.10	2.13	23.33	23.00	25.83	24.05	16.23	14.00	16.33	15.52
	G.843	2.54	2.61	2.39	2.51	2.36	2.62	3.16	2.71	32.03	23.17	18.40	24.53	19.80	25.40	18.23	21.14
	M.1	2.14	2.13	2.56	2.28	2.02	2.33	2.43	2.26	25.50	25.33	22.73	24.52	21.17	17.97	17.03	18.72
	Mean	**2.05**	**2.59**	**2.51**	**2.38**	**2.22**	**2.49**	**2.51**	**2.41**	**25.39**	**26.22**	**21.27**	**24.29**	**19.00**	**19.80**	**16.62**	**18.47**
20 cm	G.2	2.53	2.68	2.19	2.47	2.62	2.65	2.33	2.53	32.90	27.50	20.23	26.88	20.30	15.70	13.20	16.40
	G.429	2.10	2.79	2.79	2.56	2.23	1.92	1.94	2.03	21.83	30.50	27.23	26.52	23.13	15.63	12.17	16.98
	G.843	2.10	2.82	2.39	2.44	2.75	2.18	2.29	2.41	27.50	36.47	22.23	28.73	24.07	19.13	17.57	20.26
	M.1	2.14	2.69	2.81	2.55	2.45	2.26	2.44	2.38	29.87	28.77	29.17	29.27	25.40	18.30	18.80	20.83
	Mean	**2.22**	**2.75**	**2.55**	**2.50**	**2.51**	**2.25**	**2.25**	**2.34**	**28.03**	**30.81**	**24.72**	**27.85**	**23.23**	**17.19**	**15.44**	**18.62**
25 cm	G.2	2.46	2.87	2.74	2.69	2.39	2.32	2.31	2.34	34.07	32.60	32.70	33.12	28.93	17.30	16.93	21.05
	G.429	1.96	2.69	2.68	2.44	1.91	2.10	2.40	2.14	24.50	31.97	34.77	30.41	23.00	19.00	16.73	19.58
	G.843	2.64	3.15	2.56	2.78	2.10	2.25	2.19	2.18	34.27	30.20	27.67	30.71	24.73	14.93	18.37	19.34
	M.1	2.62	1.97	2.95	2.51	2.34	2.39	2.36	2.36	34.87	25.67	38.83	33.12	18.73	18.00	18.27	18.33
	Mean	**2.42**	**2.67**	**2.73**	**2.61**	**2.19**	**2.27**	**2.32**	**2.26**	**31.93**	**30.11**	**33.49**	**31.84**	**23.85**	**17.31**	**17.58**	**19.58**
Mean for cultivars	G.2	2.42	2.67	2.73	2.61	2.52	2.54	2.33	2.46	29.22	31.16	23.69	28.02	22.68	18.28	15.00	18.65
	G.429	2.18	2.85	2.39	2.48	2.03	2.13	2.15	2.10	23.22	28.49	29.28	27.00	20.79	16.21	15.08	17.36
	G.843	2.00	2.69	2.77	2.49	2.40	2.35	2.55	2.43	31.27	29.95	22.77	27.99	22.87	19.82	18.06	20.25
	M.1	2.43	2.86	2.45	2.58	2.27	2.33	2.41	2.34	30.08	26.59	30.24	28.97	21.77	18.09	18.03	19.30
Mean for sowing dates		**2.23**	**2.67**	**2.59**	**2.50**	**2.31**	**2.34**	**2.36**	**2.33**	**28.45**	**29.05**	**26.49**	**28.00**	**22.02**	**18.10**	**16.55**	**18.89**

LSD at 5% level for:

Sowing dates (S)	=	0.07	n.s	1.21	0.72
Plant spacing (D)	=	0.11	0.12	0.62	0.92
Cultivars(V)	=	0.09	0.10	0.73	0.71
S x D	=	n.s	0.19	1.07	1.65
S x V	=	0.15	n.s	1.26	1.24
D x V	=	0.15	0.18	1.26	1.24
S x D x V	=	0.26	0.31	2.18	1.14

Table (2): Seed weight/plant (g) and seed index (g) as affected by sowing dates , plant spacing and faba bean cultivars during 2001/2002 and 2002/2003 seasons.

Plant spacing(D)	Cultivars (V)	Seed weight /plant (g)								Seed index (g)							
		2001/2002				2002/2003				2001/2002				2002/2003			
		Sowing dates (S)				Sowing dates (S)				Sowing dates (S)				Sowing dates (S)			
		15th Oct	5th Nov.	25th Nov.	Mean	15th Oct	5th Nov.	25th Nov.	Mean	15th Oct	5th Nov.	25th Nov.	Mean	15th Oct	5th Nov.	25th Nov.	Mean
15 cm	G.2	12.42	20.62	13.41	15.48	12.84	13.46	10.36	12.22	64.43	69.70	69.13	67.75	69.83	72.93	75.50	72.75
	G.429	16.24	14.97	17.37	16.19	10.35	10.06	13.83	11.41	71.97	69.80	69.03	70.27	72.37	70.87	73.13	72.12
	G.843	19.90	17.42	15.18	17.50	14.95	19.40	15.86	16.74	71.73	73.87	80.67	75.42	74.20	74.53	79.73	76.15
	M.1	16.73	18.65	16.67	17.35	12.75	12.87	12.93	12.85	72.20	75.40	71.70	73.10	76.77	79.73	78.47	78.32
	Mean	**16.32**	**17.92**	**15.66**	**16.63**	**12.72**	**13.95**	**13.25**	**13.31**	**70.08**	**72.19**	**72.63**	**71.64**	**73.29**	**74.52**	**76.71**	**74.84**
20 cm	G.2	18.98	18.51	14.15	17.21	14.68	10.58	9.43	11.56	65.83	66.23	67.73	66.60	70.10	77.60	73.70	73.80
	G.429	11.14	18.79	18.39	16.11	15.76	11.18	10.07	12.34	66.00	68.03	68.80	67.61	67.57	74.73	72.23	71.51
	G.843	25.55	25.32	18.76	23.21	18.24	15.61	14.79	16.21	72.90	72.30	85.33	76.84	72.87	77.93	78.43	76.41
	M.1	17.53	18.71	18.63	18.29	19.81	15.15	13.29	16.08	66.57	70.23	77.13	71.31	68.27	81.23	80.57	76.69
	Mean	**18.30**	**20.33**	**17.48**	**18.71**	**17.12**	**13.13**	**11.90**	**14.05**	**67.83**	**69.20**	**74.75**	**70.59**	**69.70**	**77.87**	**76.23**	**74.60**
25 cm	G.2	22.33	23.29	21.15	22.26	18.29	13.29	14.67	15.42	60.53	63.90	68.97	64.47	67.53	76.97	72.07	72.19
	G.429	14.3	22.68	22.27	19.75	16.45	12.57	14.14	14.39	65.97	72.07	70.60	69.55	67.73	72.77	73.90	71.47
	G.843	23.17	22.57	21.34	22.36	17.45	12.50	14.81	14.92	70.53	68.03	76.60	71.72	65.07	77.37	74.30	72.25
	M.1	23.75	21.99	29.41	25.05	14.97	13.42	14.22	14.20	68.77	46.40	75.00	63.39	73.73	77.50	84.10	78.44
	Mean	**20.89**	**22.63**	**23.54**	**22.35**	**16.79**	**12.95**	**14.46**	**14.73**	**66.45**	**62.60**	**72.79**	**67.28**	**68.52**	**76.15**	**76.09**	**73.59**
Mean for cultivars	G.2	17.91	20.81	16.24	18.32	15.27	12.44	11.49	13.07	63.60	66.61	68.61	66.27	69.15	75.83	73.76	72.91
	G.429	13.89	18.81	19.34	17.35	14.19	11.27	12.68	12.71	67.98	69.97	69.48	69.14	69.22	72.79	73.09	71.70
	G.843	22.87	21.77	18.43	21.02	16.88	15.84	15.15	15.96	71.72	71.40	80.87	74.66	70.71	76.61	77.49	74.94
	M.1	19.34	19.78	21.57	20.23	15.84	13.81	13.48	14.38	69.18	64.01	74.61	69.27	72.92	79.49	81.05	77.82
Mean for sowing dates		**18.50**	**20.29**	**18.89**	**19.23**	**15.55**	**13.34**	**13.20**	**14.03**	**68.12**	**68.00**	**73.39**	**69.84**	**70.50**	**76.18**	**76.34**	**74.34**

LSD at 5% level for:

Sowing dates (S) =	0.88	0.78	0.55	4.06
Plant spacing (D) =	0.64	0.45	n.s	n.s
Cultivars(V) =	0.51	0.72	2.79	1.98
S x D =	1.10	0.78	n.s	3.29
S x V =	0.88	1.24	n.s	n.s
D x V =	0.88	1.24	n.s	n.s
S x D x V =	1.53	2.07	n.s	n.s

Table (3): Harvest index and seed yield/faddan (t) as affected by sowing dates , plant spacing and faba bean cultivars during 2001/2002 and 2002/2003 seasons.

Plant spacing(D)	Cultivars (V)	Harvest index								Seed yield/faddan (t)							
		2001/2002				2002/2003				2001/2002				2002/2003			
		Sowing dates (S)				Sowing dates (S)				Sowing dates (S)				Sowing dates (S)			
		15th Oct	5th Nov.	25th Nov.	Mean	15th Oct	5th Nov.	25th Nov.	Mean	15th Oct	5th Nov.	25th Nov.	Mean	15th Oct	5th Nov.	25th Nov.	Mean
15 cm	G.2	25.67	39.40	32.27	32.45	25.73	20.20	20.10	22.01	1.47	2.05	1.28	1.60	1.07	0.83	0.74	0.88
	G.429	23.50	34.80	22.27	26.86	23.63	23.97	16.03	21.21	1.42	2.00	0.94	1.45	0.96	0.97	0.74	0.89
	G.843	30.63	35.53	32.03	32.73	27.57	30.33	25.40	27.77	1.90	1.39	1.38	1.56	1.12	1.15	0.99	1.09
	M.1	25.77	34.20	32.50	30.82	23.90	30.40	21.50	25.27	1.64	1.56	1.18	1.46	1.00	1.14	0.97	1.04
	Mean	**26.39**	**35.98**	**29.77**	**30.71**	**25.21**	**26.23**	**20.76**	**24.07**	**1.61**	**1.75**	**1.20**	**1.52**	**1.04**	**1.02**	**0.86**	**0.97**
20 cm	G.2	25.07	34.97	35.50	31.85	24.13	24.63	24.30	24.35	1.45	1.52	1.42	1.46	0.95	0.80	0.75	0.83
	G.429	23.07	29.57	24.37	25.67	24.37	22.63	21.73	22.91	1.27	1.35	0.98	1.20	1.00	0.83	0.74	0.86
	G.843	30.13	33.40	26.17	29.90	28.67	32.43	27.20	29.43	1.70	1.54	1.14	1.46	1.12	1.40	0.91	1.14
	M.1	28.90	33.00	28.97	30.29	25.67	23.03	24.03	24.24	1.66	1.5	0.93	1.36	1.10	0.94	0.85	0.96
	Mean	**26.79**	**32.74**	**28.75**	**29.43**	**25.71**	**25.68**	**24.32**	**25.23**	**1.52**	**1.48**	**1.12**	**1.37**	**1.04**	**0.99**	**0.81**	**0.95**
25 cm	G.2	26.20	36.03	30.90	31.04	21.87	22.43	25.93	23.41	1.46	1.47	1.06	1.33	0.76	0.81	0.82	0.80
	G.429	25.33	31.17	24.83	27.11	21.43	18.47	22.10	23.26	1.44	1.47	1.07	1.33	0.90	0.58	0.83	0.77
	G.843	29.8	38.03	30.23	32.69	26.67	28.57	29.07	28.10	1.56	1.26	0.89	1.24	0.98	0.97	0.97	0.97
	M.1	29.27	34.80	34.30	32.79	30.43	40.13	27.80	32.79	1.80	1.44	1.02	1.42	1.20	1.66	0.91	1.26
	Mean	**27.65**	**35.01**	**30.07**	**30.91**	**25.10**	**27.40**	**26.23**	**26.89**	**1.57**	**1.41**	**1.01**	**1.33**	**0.96**	**1.01**	**0.88**	**0.95**
Mean for cultivars	G.2	25.65	36.80	32.89	31.78**	23.91	22.42	23.44	23.26	1.46	1.68	1.25	1.46	0.93	0.81	0.77	0.84
	G.429	23.97	31.85	23.82	26.55	23.14	21.69	19.95	21.59	1.38	1.61	1.00	1.33	0.95	0.79	0.77	0.84
	G.843	30.19	35.65	29.48	31.77	27.64	30.44	27.22	28.43	1.72	1.40	1.14	1.42	1.07	1.17	0.96	1.07
	M.1	27.98	34.00	31.92	31.30	26.67	31.19	24.44	27.43	1.70	1.50	1.04	1.41	1.10	1.25	0.91	1.09
Mean for sowing dates		**26.95**	**34.58**	**29.53**	**30.35**	**25.34**	**26.44**	**23.77**	**25.18**	**1.56**	**1.55**	**1.11**	**1.41**	**1.01**	**1.01**	**0.85**	**0.96**

LSD at 5% level for:

Sowing dates (S)	=	1.14	n.s	0.23	0.23
Plant spacing (D)	=	n.s	1.26	0.15	n.s
Cultivars(V)	=	1.77	1.30	0.09	0.06
S x D	=	n.s	1.19	n.s	0.07
S x V	=	3.07	2.25	0.16	0.09
D x V	=	n.s	2.25	0.16	0.09
S x D x V	=	n.s	3.90	0.28	0.17

Table (4): Seed content of carbohydrate and protein percentages as affected by sowing dates , plant spacing and faba bean cultivars during 2001/2002 and 2002/2003 seasons.

Plant spacing(D)	Cultivars (V)	Carbohydrate percentage								Protein percentage							
		2001/2002				2002/2003				2001/2002				2002/2003			
		Sowing dates (S)				Sowing dates (S)				Sowing dates (S)				Sowing dates (S)			
		15th Oct	5th Nov.	25th Nov.	Mean	15th Oct	5th Nov.	25th Nov.	Mean	15th Oct	5th Nov.	25th Nov.	Mean	15th Oct	5th Nov.	25th Nov.	Mean
15 cm	G.2	44.10	44.55	50.40	46.35	46.97	49.27	51.63	49.29	31.50	27.39	26.50	28.46	31.00	29.96	30.13	30.36
	G.429	48.45	47.70	49.50	48.55	48.17	45.00	46.80	46.66	29.14	28.25	28.95	28.78	31.67	28.83	31.03	30.51
	G.843	46.80	43.64	43.65	44.70	47.70	49.40	48.93	48.68	29.15	30.00	26.52	28.56	32.47	23.5	29.93	28.63
	M.1	54.90	45.00	47.75	49.22	52.20	50.40	45.90	49.50	30.64	30.64	29.72	30.33	27.77	32.60	33.90	31.42
	Mean	**48.56**	**45.22**	**47.83**	**47.20**	**48.76**	**48.52**	**48.32**	**48.53**	**30.11**	**29.07**	**27.92**	**29.03**	**30.73**	**28.72**	**31.25**	**30.23**
20 cm	G.2	42.10	54.00	45.05	47.05	45.43	46.8	46.80	46.34	30.64	27.42	24.76	27.61	31.47	29.13	28.7	29.77
	G.429	46.20	49.50	42.20	45.97	49.50	44.10	48.13	47.24	31.50	32.37	28.25	30.71	26.93	32.60	28.70	29.41
	G.843	49.50	53.10	47.70	50.10	47.70	47.7	49.50	48.30	30.00	29.77	25.64	28.47	30.70	27.46	31.00	29.72
	M.1	47.70	46.80	41.40	45.30	46.27	52.20	47.23	48.57	29.12	32.37	30.64	30.71	27.46	27.80	31.07	28.78
	Mean	**46.38**	**50.85**	**44.09**	**47.10**	**47.23**	**47.70**	**47.92**	**47.61**	**30.32**	**30.48**	**27.32**	**29.37**	**29.14**	**29.25**	**29.87**	**29.42**
25 cm	G.2	52.20	48.60	45.45	48.75	49.50	48.13	51.73	49.79	29.15	32.37	30.64	30.72	27.40	28.70	28.80	28.30
	G.429	48.15	47.27	41.85	45.76	53.10	50.33	52.20	51.88	30.64	28.14	26.2	28.33	30.00	28.70	26.90	28.53
	G.843	51.75	43.65	49.50	48.30	49.5	45.93	49.17	48.20	30.00	30.02	26.52	28.85	27.40	27.40	29.07	27.96
	M.1	46.57	52.20	50.90	49.89	46.73	49.17	44.9	46.93	28.91	29.15	27.99	28.68	30.73	31.30	29.13	30.39
	Mean	**49.67**	**47.93**	**46.93**	**48.17**	**49.71**	**48.39**	**49.50**	**49.20**	**29.68**	**29.92**	**27.84**	**29.14**	**28.88**	**29.03**	**28.48**	**28.79**
Mean for cultivars	G.2	46.13	49.05	46.97	47.38	47.30	48.07	50.05	48.47	30.43	29.06	27.30	28.93	29.96	29.26	29.21	29.48
	G.429	47.60	48.16	44.52	46.76	50.26	46.48	49.04	48.59	30.43	29.59	27.80	29.27	29.53	30.04	28.88	29.48
	G.843	49.35	46.80	46.95	47.70	48.30	47.68	49.20	48.39	29.72	29.93	26.23	28.62	30.19	26.12	30.00	28.77
	M.1	49.72	48.00	46.68	48.14	48.40	50.59	46.01	48.33	29.56	30.72	29.45	29.91	28.65	30.57	31.37	30.20
Mean for sowing dates		**48.20**	**48.00**	**46.28**	**47.49**	**48.56**	**48.20**	**48.58**	**48.45**	**30.03**	**29.82**	**27.69**	**29.18**	**29.58**	**29.00**	**29.86**	**29.48**

LSD at 5% level for:

Sowing dates (S)	=	n.s	n.s	1.59	n.s		
Plant spacing (D)	=	n.s	n.s	n.s	0.37		
Cultivars(V)	=	n.s	n.s	2.92	0.86		
S x D	=	3.04	n.s	n.s	0.63		
S x V	=	n.s	2.0	1.59	1.49		
D x V	=	4.26	2.0	1.59	1.49		
S x D x V	=	7.38	3.47	2.75	2.58		