BIOLOGICAL YIELD, ITS RELATED GROWTH CRITERIA AND CHOCOLATE –SPOT DISEASE AS INFLUENCED BY CULTIVARES, SOWING DATES AND PLANTING DISTANCES IN FABA BEAN.

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ABSTRACT

Two field experiments were conducted at the Experimental Farm, Fac. Agric. at Fayoum during 2001/2002 and 2002/2003 seasons to study the effect of sowing dates(S), intra-row hill distances(D) and cultivars(V) on some growth characters together with chocolate-spot infection(%) of faba bean. The experimental design applied was RCBD in split split-plot arrangement with three replications, where sowing dates (Oct. 15, Nov. 5 & 25); hill distances (15, 20 & 25 cm) and cultivars (Giza 2, Giza 429, Giza 843 and Misr 1) were allocated in main- , sub-, and sub sub-plot, respectively. The area of sub sub–plot was 10.5 m^2, included 5 ridges of 3.5 m length and 60 cm width. The preceding crops were cotton and maize in the 1st & 2nd season, respectively.

The obtained results showed that all characters were markedly affected by sowing dates in both seasons, except germination (%) and branches/plant in the first season. Most of the characters (including chocolate-spot infection %) studied in one or two seasons, except flowering date, were decreased by delaying sowing date from Oct. 15 to Nov. 25. Increasing hill distances from 15 to 25 cm significantly increased chocolate spot (%) and pods/plant in the first season and germination (%) and branches/plant in the second one, but decreased maturity date in the first season, plant height in the second one and biological yield in both seasons. The cultivars had significant effect on the performance of all characters in both seasons. G 429 surpassed all other cultivars for germination (%) and biological yield in 1st season and branches/plant in 2nd one, but it showed the highest chocolate spot (%) in both seasons. While G. 2 was the earliest flowering and maturing cultivar in both seasons and exhibited (followed by G. 843) the least disease infection (%).

The interaction effect of (S x D), (D x V) and (S x D x V) were significant for germination (%), plant height, pods/plant and branches/plant in one or the two seasons. S x V interaction showed significant effect on all of these characters in addition to maturity date in both seasons as well as flowering date and chocolate spot infection in the first season.

Key word: Faba bean cultivars, Sowing date, Plant density, Growth characters, and Chocolate-spot infection.

INTRODUCTION

Faba bean (*Vicia faba* L.) in Egypt is still ranks as the first important food and food legume. However, its cultivated area decreased from 384911 to 302845 faddan with averages of 1.359 and 1.324 ton/faddan in 1998 and 2002 year[*] respectively. These increases in crop area and average yield were clearly observed at Fayoum governorate due to its specific geographical, topographical, edaphic and climatic conditions, which promote various pests, especially chocolate-spot disease, to attack the local susceptible types frequently cultivated with haphazard cultural practices. So, to improve yield and controlling this disease, some practices such as

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sowing dates, plant spacings and cultivars were proposed and tested to integrate for the crop management.

Several foreign literatures concerned with sowing date effect on faba bean growth and performance are available and all recommended early dates. Mc Ewen *et al.* (1988) in UK, found that the earliest sowing on late of Sept. advanced flowering date by 2 weeks relative to the latest date on late of Nov., but did not affect harvest date. Stutzel *et al.* (1992) in Germany, suggested that delaying sowing was accompanied with reduced field emergence rate. The best performance of faba bean was obtained from Oct. 1 and 15 sowing (Rajender and Singh, 1993, in India). Hatam *et al.* (1999) in Pakistan, reported that when sowing was delayed from Oct. 22 to Jan. 7, marked decreases were recorded in flowering date (8.2), maturity date (21.5), plant height (30.0), number of pods (43.5) and biological yield (81.6%). The available limited Egyptian studies, regarding the effect of sowing date on growth criteria, indicated that Oct. 15 (Rabie, 1991), Nov. 1 (Amer *et al.*, 1992), Oct. 25 (Abdalla, 1995) or first week of Nov. (Amer *et al.*, 1997) sowing was the best date for faba bean growth and performance.

Plant density, on the other hand, have received extensive local attention. Several authors reported that plant height was accelerated with increasing population density up to 33.3 plant/m^2 (Nassib *et al.*, 1982; Nigem *et al.*, 1988 a & b; Selim and El-Seessy, 1991; Khalil *et al.*, 1993 and Abdel-Aziz and Shalaby, 1999), or up to 44.4 plant/m^2 (Zeidan *et al.*, 1986 and 1990 and El-Douby *et al.*, 1996). All of them, in addition to El-Metwally (1989), El-Fishawy and Fayed (1990), Abo-Shetaia (1990), Ali (1993), Shahein *et al.*, (1995), Hussein *et al.* (1999), Mokhtar (2001) and El-Metwally *al.*, (2003) reported that increasing plant density negatively affected numbers of branches and pods/plant. Sary *et al.* (1989), Abo Shetaia (1990), Shams El-Din (1991), El-Douby *et al.* (1996) and Hassan and Hafiz (1998) indicated that biological yield was enhanced by increasing plant density. However, insignificant effect of plant density was detected on plant height (El-Deib, 1982 and Shahein *et al.*, 1995) on number of branches (Shafik *et al.*, 1989) and on number of pods/plant (Abo El-Zahab *et al.*, 1981 and Shafik *et al.*, 1989).

Concerning chocolate-spot disease very little information are available. In UK, Mc Ewen *et al.*, (1988) suggested that early sowing on late of Sept. Slightly increased the risk of chocolate spot. Khalil *et al.* (1993) in Egypt, found that dense population of 33.3 plant/m^2 increased the infection level with the disease. In USA, Koike (1998) reported that severely affected plants with chocolate spot lost over 50% of foliage and pod development. Omar *et al.* (1998) stated that Food Legumes Progr. in Egypt bred faba bean lines tolerant to chocolate-spot disease but none of them was early mature. Unfortunately, there is no information about the sum effect of both sowing date and plant density for chocolate-spot control. Therefore, the present investigation was planed to search for the best-integrated combination among sowing dates, plant densities and cultivars for controlling this disease and producing high biomass, which represents the first major physiological genetic component of yield.

MATERIALS AND METHODS

The present investigation was carried out at the Experimental Farm, Faculty of Agriculture at Fayoum, during 2001/2002 and 2002/2003 seasons to study the effect of sowing dates, intra-row hill distances and cultivars on some growth characters together with chocolate spot infection of faba bean, *Vicia faba* L. The soil of the experimental site was clay loam in texture with ECe of 0.72 m mohs/cm and pH of 8.8. Each of the two experiments included 36 treatments resulted from the combination of three sowing date, i.e October 15 (S_1), November 5 (S_2) and 25 (S_3);

three intra-row hill distances, i.e 15 (D_1), 20 (D_2) and 25 cm (D_3) which equivalent to 186700, 140000 and 112000 plant/faddan or 44.4, 33.3 and 26.7 plant /m^2, respectively; and four cultivars, i.e. Giza 2 (V_1) Giza 429 (V_2), Giza 843 (V_3) and Misr 1 (V_4). The cultivar seeds were obtained from Legumes Section, Field Crops Research Institute, ARC, Giza, Egypt. Averages of temperature and relative humidity during the two seasons, according to the Meteorological Station in Itsa – Fayoum, are presented in Table (1).

The experimental design applied in both seasons was randomized complete block in a split – split plot arrangement, with three replications. The main plots were assigned to sowing dates, the sub-plots were devoted to plant densities and the sub-sub – plots were specified to cultivars. The area of each sub-sub – plot was 10.5 m^2, included 5 ridges of 3.5 m length and 60 cm width. The preceding crop was cotton in the first season and maize in the second one. Calcium super phosphate (15.5% P_2O_5) and potassium sulphate (48% K_2O) were added at the rates of 300 and 50 kg /faddan, respectively, during seed bed preparation. Immediately before sowing, the seeds were treated with fungicides (Vetavax 200 WP) at the rate of 2g/Kg seeds. Seeding was done in hills (three seeds/hill) on the two sides of the ridges. *Rhizobium* inoculation mixed with fine sand was added to the soil above covered hills after sowing and before irrigation. Thinning was practiced after 21 day from sowing to secure two plants/hill. Stimulative dose of ammonium nitrate (33.5%N) was added at the rate of 68.5 kg /faddan before the first irrigation. All the other recommended cultural practices were followed. The usage of pesticides were very restricted overall seasons, where detergents were used, if needed, instead of pesticides.

During the growing season, germination percentage (as the number of survived seedling/plot before thinning), flowering date (when 50% of plants/plot were flowered); and chocolate–spot disease infection the proportion of infected plants to the total plants in the two inner ridges) maturity date (when 90% of plants were physiologically matured) were determined. At harvest, ten guarded plants were random taken from each plot to record the averages of plant height, number of branches and number of pods. Biological yield (Biomass) of the two inner ridges / plot was determined and used for calculating that of faddan. The obtained data was statistically analyzed according Gomez and Gomez (1984) and the means were compared by LSD test at 5% level of significance.

RESULTS AND DISCUSSION

Germination percentage:

The data presented in Table (2) show that germination had the highest percentage with moderate sowing date on Nov.5, only in the second season, compared to either earliest or latest dates. In this respect, Stutzl *et al.*, (1994) found that delayed sowing reduced emergence rate and negatively affected germination (%). However, Amer *et al.*, (1997) reported that germination (%) was not affected by sowing date. Also, in the second season, gradual significant increments for germination (%) were observed by narrowing intra-plant distances, where the percentage of 25 cm treatment surpassed those of 20 and 15 cm by 2.08 and 7.71%, respectively. In regard to cultivars, it was found that they behaved differently in the two seasons. G.2 followed by G. 429 recorded the highest germination (%) in the first season, however in the second one, G.2 exhibited the lowest percentage. This varied varietal behavior may be ascribed to their different sensitivity to environmental conditions.

The highest germination percentage, as affected by (S x D) interaction, was resulted from sowing on Nov.5 with the lowest plant density only in the second season. But, the character was markedly affected by (S x V) interaction in both

seasons, where the maximum values were obtained from sowing G. 429 in the first season, and G. 843 in the second on Nov.5. These results may be reflect the suitability of this date, in respect to its climatic and edaphic conditions, for germination and emergence. (D x V) interaction had clearly effect on germination (%) in both seasons. Where, G.2 cv. under moderate or highest plant densities in the first season and Misr 1 cv. under the lowest plant density recorded the highest percentages. The second order of interaction (S x D x V) was effective in the second season, where the late sowing of G. 843 and M1 cvs. with lowest plant density recorded the highest germination percentages.

Flowering date:

Mean flowering date, expressed as number of days from sowing up to 50% of flowered plants (Table 2) was markedly increased from 57.33 to 68.14 day in the first season and from 52.81 to 66.14 day in the second one, as sowing date was delayed from Oct. 15 to Nov. 25. The increase in number of days to flowering accompanied with the late sowing may be ascribed to subjected plant to some unfavorable environmental conditions prevailing with advanced date of sowing which in turn affected plant behaviour and consequently reflected on plant character such as flowering date. This result is in line with that obtained by Mc Ewen *et al.* (1988) in UK, who reported that the earliest sowing of faba bean on late of Sept. caused advancing in flowering date by two weeks, However, Hatam *et al.* (1999) in Pakistan, found that days to 50% flowering was decreased from 61 to 56 by delaying sowing date from Oct. 22 to Jan. 7.

The data demonstrated that flowering date did not significantly affected by plant density in both seasons. This is may be due to the character was simply genetically controlled and less influenced by environmental effects. However, Farag and El-Shamma (1994) reported that wide plant spacing of 50 cm reduced number of days celapsed to the first flower anthesis.

Regarding the cultivars effect, the results indicated that M.1 cv. was the latest flowering compared with all other cultivars in the first season. Whereas in second season, G.429 was latest flowering cultivar. It is worth to note that G.2 was the earliest flowering cv. in both seasons. Abdalla *et al.* (2000) detected a wide range of flowering dates among the faba bean land races studied by them. The only respecting detected interaction effect was (S x V) in the second season. G. 2 was the earliest flowering cultivar when planted on Oct. 15, whereas G. 429 followed by M.1 were the latest ones when planted on Nov. 25.

Maturity date:

The data listed in Table (3) show that number of days to 90% maturity was markedly decreased from 160.44 to 146.20 and from 161.11 to 149.28 days in the first and second season, respectively, as sowing date was delayed from Oct. 15 to Nov.25 Hatam *et al.* (1999) detected similar results. The present data of the first season indicated that maturity date was significantly decreased from 152.78 to 151.92 days as intra-row spacing was increased from 15 to 25 cm.

Faba bean cultivars showed marked variation in their maturity dates in both seasons, where G.2 was the earliest mature followed (without significant difference) by G.843 cultivar. However, G429 followed by M1, in both seasons recorded the greatest number of days to maturity. Varietal variation respecting maturity date was previously reported by Pilbeam *et al.* (1989) and Abdalla *et al.* (2000). It is worth noting that G.2 was also the earliest flowering in both season, followed by G.843 in the second one, whereas M1 in the first season and G. 429 in the second one were the latest flowering cultivars. These results indicating that the first two cultivars, i.e. G. 2

and G. 843 possessed smaller period for both accumulation biomass and portion of photosynthates partitioned to reproductive organs, than the other two cultivars. But, this is depend upon the gene activity of a cultivar and its rate/day for accumulation of photosynthates either to flowering or during reproductive organs growth (Evans, 1993).

Maturity date found to be affected by (S x V) interaction, where G. 2 in both seasons and G. 843 in the second one, when sown on Nov. 25, were the earliest maturing cultivars. Whereas, G. 429 sown on Oct. 15 was he latest maturing cv. in the two seasons.

Plant height (cm):

As shown in Table (3) plant height was considerably decreased from 100.67 to 77.02 cm in the first season and from 104.07 to 92.80 cm in the second one, as sowing date was delayed from Oct. 15 to Nov. 25. The shortening of plant height accompanied with the late sowing may be attributed to subject plants to some unfavorable environmental conditions during the early growth stage which in turn affected plant behaviour which reflected on plant height. This is in general agreement with that reported by Hatam *et al.* (1999). The data demonstrated that changing the intra-plant spacing had clear influences on plant height at harvest, where it was increased by decreasing distances between plants in both seasons, but the differences was significant only in the second season. This increase in plant height could be interpreted on the bases of increase number of plants per unit area coupled with high plant-to-plant competition. Several faba bean investigators reached to the same result (Nassib *et al.*, 1982; Nigem *et al.*, 1988 a & b; Zeidan *et al.*, 1990; Ibrahim and Ismail, 1994; El-Douby *et al.*, 1996; Ashmawy *et al.*, 1998, and Abdel-Aziz and Shalaby, 1999). However, El-Deib (1982) and Shahein *et al.* (1995) reported that plant height was not affected by increasing plant density.

The results indicated that the tested cultivars could be divided into two categories regarding their plant height, where G.2 and G.843 were shortest and G. 429 (surpassed all other cultivars) and M1 cv. were the tallest. This was true in the two seasons. Varietal differences plant height were frequently recorded by several authors (Nigem *et al*., 1988a; Amer *et al.*, 1992, Khalil *et al.*, 1993; Abdel-Aziz and Shalaby, 1999; and Abdalla *et al.*, 2000). However, El-Tuhami and Hussien (1986) recorded insignificant differences among cultivars studied by them.

Plant height, as affected by (S x D) interaction, was markedly affected in both seasons, where early sowing on Oct. 15 with the highest plant density gave the tallest plants. It was also affected by (S x V) interaction in the two seasons, where the maximum values of plant height were obtained by planting G. 429 followed by M1cv. on Oct. 15. Concerning the effect of (S x D x V) interaction, the data showed that the earliest planting of G. 429 with the highest density (in the first season) and moderate density (in the second season) resulted in the tallest plants.

Number of branches/ plants:

It was observed that the character means were higher in the first season than those of the second one, indicating its influence by seasonal fluctuations (Table 4). The data showed that number of branches was insignificantly decreased by delaying sowing date especially in the second season. Similar trend was previously reported by Amer *et al.* (1992), Hussien *et al.* (1994) and Amer *et al.* (1997). Plant density showed clear effect on number of branches, where it increased by increasing distances between plants in both seasons, but the differences were significant only in the second season. Number of branches of 25 cm treatment surpassed that of 15 cm plant spacing by 12.24%. These results are in full agreement with those obtained by several faba

bean investigators (Nassib *et al.*, 1982; El-Tuhami and Hussein, 1986; Nigem *et al.* 1988a & b); El-Fieshawy and Fayed, 1990; Salama and El-Hawary, 1994; Ashmawy *et al.*, 1998, Mokhtar, 2001 and El-Metwally *et al.*, 2003.

In respect to cultivars, the results indicated that all of them possessed similar number of branches in the first season. However, G. 429 surpassed all cultivars in the second season. Genotypic differences detected by Nigem *et al.* (1988 a&b); Dawwam and Abdel-Aal (1991); Amer *et al.* (1992); Hassan *et al.* (1997) and Abdel-Aziz and Shalaby (1999) supported the present results. The data showed that (D x V) interaction had marked effect on the character only in the first season, where G. 843 cv. under moderate plant density gave the highest number of branches/plant. Similar findings were early obtained by Leilah *et al.* (1988), Kandil *et al.* (1988) and Amer *et al.* (1992).

Concerning (S x D x V) interaction, the data showed that it had marked effect on the character only in the first season. The earliest sowing (on Oct. 15) of G.2 cv. with moderate plant density (140000 plants/fad.), or moderate sowing (on Nov.5) of G. 843 with the same plant density gave the highest number of branches /plant. The results indicating the different responses of the tested cultivars to population density, due to their different genetic factors controlled its ability to compete.

Number of pods/plant:

The character mean was decreased by 2.59 pods/ plant, in each season, as sowing date was delayed from Oct. 15 to Nov. 25. The decrease in pods number accompanied with late sowing may be due to unfavourable environmental conditions prevailing during the pod set and development of late sowing plant. This is in general agreement with these reported by Rabie (1991) and Hatam *et al.* (1999). As shown in Table (4) the data showed that pods number of 25 cm surpassed that of 15 cm plant distance by 17.7% in the first season and 13.3% in the second one. This result is supported by several faba bean studies conducted by El-Deib (1982), Kandil (1985), El-Tuhami and Hussein (1986); Sary *et al.* (1989), Ali (1993); Metwally (1997) and Mokhtar (2001). However, Abo El-Zahab *et al.* (1981) and Shafik *et al.* (1989) found that number of pods/plant was not affected by plant spacing.

Regarding the tested cultivars, the data indicated that M1 followed by G.2 cv. produced the highest number of pods/plant in the first season. Whereas, G. 843 followed by both M1 and G. 429 surpassed G.2 in the second season. These results reflecting the differential responses of these cultivars to the environmental conditions. Such varietal differences in pods number were previously reported by El-Tuhami and Hussin (1986), El-Moarabaa *et al.* (1987), Dawwam and Abdel-Aal (1991), Khalil *et al.* (1993) and Abdalla *et al.* (2000).

The (S x D) interaction had considerable effect on the character, where the highest values was obtained from the earliest planting with the lowest plant density in both season. Also, the maximum pods numbers/plant, as affected by (S x V) interaction effect, were produced by G.2 in the first season and G. 429 in the second one when sown early on Oct. 15. (D x V) interaction showed marked effect on the character on both seasons. M1 in the first season and G. 429 cv. in the second one, under the lowest plant density, gave the highest number of pods/plant. These findings support the earlier ones recorded by Lisiewaska and Kimiecik (1981), Leilah *et al.* (1988) and Kandil *et al.* (1988). (S x D x V) interaction had also significant effect on the character in the two seasons. With the earliest planting under moderate plant density, M1 ranked as the first podding in the first season whereas, with the same planting date under the lowest plant density, G.2 was the first on in the second season.

Biological yield (t/faddan):

As shown in Table (5) the biological yield (biomass) was decreased from 5.77 to 3.79 in the first season and from 4.01 to 3.69 t/faddan in the second one, as sowing date was delayed from Oct. 15 to Nov. 25 This was may be due to clear decreases in plant height, number of branches and number of pods accompanied with late sowings. Similar trend was previously detected by several workers who recommended early sowing during first half of Oct. (Rajender and Singh, 1993 and Rajender *et al.*, 1993); end of Oct. (Rabie, 1991); first week of Nov. (Amer *et al.*, 1992 & 1997) for producing the highest biological yield compared with the latter sowing dates examined by them. It is well known that biomass is the first major physiological – genetic component of the yield, in addition to its partition between vegetative and reproductive organs and number of days to maturity as the second and third major components of the yield. Progressively greater photoperiod-gene-activity causes the available photosynthate to be partitioned toward competitively quantitatively more predominantly toward continued growth of vegetative organs which result in large biomass, and the total biomass accumulation is positively associated with duration of plant growth (Evans, 1993). This concept supports the present results where increasing biomass (and its components) was accompanied with increasing vegetative growth period up to flowering (Table 2).

The data showed also that the character was markedly decreased by increasing plant distances from 15 to 25 cm in both seasons, due to increased number of plants/unit area. Biological yield of 15 cm treatment surpassed that of 25 cm by 13.67 and 11.78% in the first and second season, respectively. These results are supported by several faba bean investigators (Sary *et al.*, 1989; Ibrahim and Esmail, 1994; El-Douby *et al.*, 1996 and El-Metwally *et al.*, 2003). In regard to cultivars, the results showed that G.429 in the first season, and M. 1 followed by G. 429 in the second one produced the highest values of biological yield. Superiority of the two cultivars may be due to their advantages in plant height and number of pods, respectively, in the first season, and number of branches and plant height, respectively, in the second season, reflecting the importance of these characters (especially plant height) as biomass contributors. In addition to that both cultivars were latter flowering than the other two one and consequently accumulated more biomass during their growth stages. Markedly varied variation among cultivars detected herein supports those reported by Nigem *et al.* (1988b), Dawwam and Abd El-Aal (1991) and Hassan *et al.* (1997).

The character was significantly affected by (S x D) interaction, where the maximum value was result from sowing on Nov. 25 under the highest plant density. This result is in agreement with those obtained by Leilah *et al* . (1988) and Nassib and Hussein (1988) who recorded the largest biological yield from the highest plant density. Also, the character was affected by (S x V) interaction only in the first season, where G. 429 cv. (which was the tallest plants in the first season) under the densest population produced the highest biomass. Similar interaction effect was previously detected by Abd El-Aziz and Shalaby (1999). The data showed that (S x D x V) interaction effect was significant only in the second season. With latest sowing under densest population, G. 429 produced the highest biological yield.

Disease character (Chocolate-Spot infection %):

The data presented in Table (5) show that the percentage infection with chocolate-spot disease caused by *Botrytis* faba was decreased from 6.24 to 4.26% and from 5.62 to 3.49% in the first and second season, respectively, as sowing data was delayed from Oct 15 to Nov 25. These results are in line with those obtained by Mc Ewen *et al.* (1988) in UK, who found that early sowing on late of September

increased the risk of chocolate-spot disease. The present results showed that the infection percentages were higher in the first season than those of the second one, and this may be attributed to lower temperature and higher relative humidity (RH) of the first season (Table 1) as two climatic factors affecting this disease(Harrison, 1981). Overall two seasons, infection percentages indicating that the virulence of the pathogen was higher on the plant sown early, where the temperature was still high 24.7^{o}C with R.H of about 61.2%, than on the plants sown on November, where the temperature decreased up to 21^{o}C with about 60.8% RH (Table1). Harrison (1981) suggested that, at any stage of plant growth, the rate of aggressive lesion progress was linear and proportional to RH between 60 to 100%, the optimum temperature was between (6 to 20 ^{o}C, and neither light intensity nor a film of free water affected lesion development. So, the logical explanation of the results detected herein that, the infection occurred initiating from December (16.4^{o}C & 62.0 RH) and January (15.7^{o}C & 64.2 RH, as shown Table 1) where the plants sown early on Oct. 15 were well established and thereafter exposed to infection for long time more than those sown on latter dates. This explanation may be confirmed by the larger differences between maximum and minimum temperature (which encourage infection, Harrison, 1981) during Dec. (13.5^{o}C) and Jan. (13.7^{o}C) compared with that of Oct. (11.2^{o}C).

It is worth to note that although the earliest sowing showed the highest infection percentages it produced highest values of plant highest number of pods branches/plant and biomass/faddan, indicating its ineffectiveness. This confirmed again that infection occurred late after pods setting on early sown plants and thus was lesser influence on the biomass and its components, compared to the plant sown later on November. This interpretation is strongly related with those reported by Monsour *et al.* (1976), Williams (1975), Griffiths and Lawes (1977) who suggested that infection with chocolate spot after pod formation had little effect on biomass and yield.

Chocolate-spot infection (%) was increased by decreasing intra–plant distance in both seasons. In other word, level of infection was increased by enhancing plant density. The value of 25 (26.7 plants/m^2) surpassed that of 15 (44.4 plants/m^2) cm treatment by 77.4 and 83.0% in the first and second season, respectively. These results are in agreement with that early reported by Ingram and Hebblethwaite (1976) who suggested that chocolate-spot disease was more damaging in the relatively dense faba bean population. Also, Khalil *et al.* (1993) found that the level of infection/m^2 was increased by increasing plant density from 16 to 33 plants/m^2.

In regard to cultivars, it was observed that G. 429 and M. 1 cvs. were more susceptible for the disease than the other two cultivars. The results showed that G.2 followed by G.843 cvs. in the first season, as well as G. 843 followed by G.2 cvs. in the second one, exhibited disease tolerance where all recorded least infection levels. The relative tolerance of these two cvs. evintly due to their genotypic factors which may be delayed the infection or enabled the plants to prevent its spreading. Harrison (1981) suggested that a toxin produced by infected faba bean plant tissue caused cell death and thereby drying of the tissue, thus preventing further fungal growth and lesion development.

Chocolate-spot infection (%) was significantly affected by (S x D) interaction only in the first season, where the lowest level was resulted from earliest sowing with highest plant density. However latest sowing with 25cm plant spacing showed the highest infection percentage. (S x V) interaction effect was clearly observed the character in both seasons G.2 in the first season and G.843 cv. in the second one when sown on Nov.25 showed the least infection levels, whereas the highest level was recorded by G.429 cv. when sown on Oct.15 in both seasons. Significant (S x D x v)

interaction detected in the two seasons revealed that the lowest infection level was recorded by G.843 cv. when sown early on Oct. 15 with the lowest plant density. The above mentioned results revealed the preference of both G. 843 and G.2 cvs. for growing faba bean to avoid the losses caused by chocolate-spot disease.

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Table (2): Germination percentage and flowering date as affected by sowing dates , plant spacing and faba bean cultivars during 2001/2002 and 2002/2003 seasons.

Plant spacing(D)	Cultivars (V)	Germination %								Flowering date							
		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	25th Nov.	Mean	25th Nov.	Mean	15th Oct	5th Nov.	25th Nov.	Mean
15 cm	G.2	81.33	87.00	88.67	85.67	88.03	87.60	86.77	87.47	55.00	53.00	65.00	57.67	50.00	58.33	65.33	57.89
	G.429	75.33	84.67	82.33	80.78	89.90	89.97	89.37	89.75	57.00	57.00	69.33	61.11	54.00	60.67	68.67	61.11
	G.843	72.00	71.67	84.33	76.00	85.90	94.47	86.70	89.02	59.00	55.00	67.00	60.33	50.67	58.33	62.67	57.22
	M.1	70.00	65.33	68.67	68.00	85.80	86.20	85.73	85.91	59.00	59.00	70.67	62.89	54.00	61.67	68.33	61.33
	Mean	**74.67**	**77.17**	**81.00**	**77.61**	**87.41**	**89.56**	**87.14**	**88.04**	**57.50**	**56.00**	**68.00**	**60.50**	**52.17**	**59.75**	**66.25**	**59.39**
20 cm	G.2	83.67	88.00	85.33	85.67	87.90	96.80	87.20	90.63	55.33	52.33	66.00	57.89	50.33	58.33	63.33	57.33
	G.429	79.00	93.00	79.00	83.67	88.30	93.50	98.03	93.28	58.00	55.33	69.33	60.89	56.00	61.00	69.00	62.00
	G.843	72.67	75.00	81.33	76.33	91.87	96.80	90.83	93.17	56.33	56.00	67.00	59.78	52.00	58.67	63.33	58.00
	M.1	72.33	73.00	70.67	72.00	93.00	95.87	94.70	94.52	58.33	57.67	70.00	62.00	54.00	62.33	68.00	61.44
	Mean	**76.92**	**82.25**	**79.08**	**79.42**	**90.27**	**95.74**	**92.69**	**92.90**	**57.00**	**55.33**	**68.08**	**60.14**	**53.08**	**60.08**	**65.92**	**59.69**
25 cm	G.2	78.67	78.67	79.67	79.00	90.20	97.00	84.40	90.53	55.33	53.33	66	58.22	50.33	58.00	63.00	57.11
	G.429	80.00	83.00	77.00	80.00	97.00	96.33	94.07	95.80	59	57.33	69.33	61.89	57.33	61.67	69.00	62.67
	G.843	70.00	70.33	81.67	74.00	98.20	99.40	88.70	95.43	56.67	56.00	67.33	60.00	50.67	57.33	63.67	57.22
	M.1	78.33	70.33	77.67	75.44	95.20	99.40	98.07	97.56	59.00	58.00	70.67	62.56	54.33	61.33	69.33	61.66
	Mean	**76.75**	**75.58**	**79.00**	**77.11**	**95.15**	**98.03**	**91.31**	**94.83**	**57.50**	**56.17**	**68.33**	**60.67**	**53.17**	**59.58**	**66.25**	**59.67**
Mean for cultivars	G.2	81.22	84.56	84.56	83.45	88.71	93.80	86.12	89.54	55.22	52.89	65.67	57.92	50.22	58.22	63.89	57.44
	G.429	78.11	86.89	79.44	81.48	91.73	93.27	93.82	92.94	58.00	56.55	69.33	61.29	55.78	61.11	68.89	61.93
	G.843	71.56	72.33	82.44	75.44	91.99	96.89	88.74	92.54	57.33	55.67	67.11	60.04	51.11	58.11	63.22	57.48
	M.1	73.55	69.55	72.34	71.81	91.33	93.82	92.83	92.66	58.78	58.22	70.45	62.48	54.11	61.78	68.55	61.48
Mean for sowing dates		**76.11**	**78.33**	**79.70**	**78.05**	**90.94**	**94.45**	**90.38**	**91.92**	**57.33**	**55.83**	**68.14**	**60.43**	**52.81**	**59.81**	**66.14**	**59.58**

LSD at 5% level for:

Sowing dates (S)	=	n.s	2.43	0.95	1.59
Plant spacing (D)	=	n.s	1.12	n.s	n.s
Cultivars(V)	=	3.32	1.37	0.59	0.71
S x D	=	n.s	1.95	n.s	n.s
S x V	=	5.75	2.36	n.s	1.23
D x V	=	5.75	2.36	n.s	n.s
S x D x V	=	n.s	4.09	n.s	n.s

Table (3): Maturity data(day) and plant height in cm as affected by sowing dates , plant spacing and faba bean cultivars during 2001/2002 and 2002/2003 seasons.

Plant spacing(D)	Cultivars (V)	Maturity date								Plant height in cm							
		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	25th Nov.	Mean	25th Nov.	Mean	15th Oct	5th Nov.	25th Nov.	Mean
15 cm	G.2	157.67	147.33	143.33	149.44	159.33	150.33	147.00	152.22	94.20	92.53	80.33	89.02	101.2	86.57	90.27	92.69
	G.429	163.00	153.67	150.00	155.56	164.00	156.00	152.00	157.33	107.5	88.17	88.17	94.62	110.3	94.43	101.5	102.1
	G.843	159.00	148.33	144.67	150.67	158.67	150.67	146.67	152.00	98.90	73.30	77.00	83.07	104.0	95.97	94.83	98.28
	M.1	167.67	150.67	148.00	155.45	163.33	155.33	151.33	156.66	103.4	75.60	74.00	84.36	108.7	99.03	94.43	100.7
	Mean	**161.84**	**150.00**	**146.50**	**152.78**	**161.33**	**153.08**	**149.25**	**154.56**	**101.03**	**82.40**	**79.88**	**87.77**	**106.07**	**94.00**	**95.28**	**98.45**
20 cm	G.2	157.33	147.33	142.00	148.89	158.00	150.00	147.00	151.67	93.27	86.40	70.83	83.50	91.07	77.90	83.93	84.30
	G.429	163.00	153.33	150.00	155.44	164.00	156.33	150.33	156.89	105.03	92.87	81.50	93.13	112.40	99.30	96.60	102.77
	G.843	159.00	148.00	144.00	150.33	159.00	150.33	148.67	152.67	92.61	80.20	83.50	85.44	102.13	82.50	90.07	91.57
	M.1	160.00	150.00	148.00	152.67	163.33	155.33	150.67	156.44	95.50	87.07	72.00	84.86	109.40	92.57	97.33	99.77
	Mean	**159.83**	**149.67**	**146.00**	**151.83**	**161.08**	**153.00**	**149.17**	**154.42**	**96.60**	**86.64**	**76.96**	**86.73**	**103.75**	**88.07**	**91.98**	**94.60**
25 cm	G.2	157.00	149.00	142.00	149.33	158.33	150.33	147.00	151.89	93.67	81.97	66.33	80.66	93.00	95.07	87.10	91.72
	G.429	163.00	151.00	150.67	154.89	164.00	155.67	152.00	157.22	114.23	81.03	80.67	91.98	112.93	105.03	98.40	105.45
	G.843	158.33	149.00	144.00	150.44	159.00	150.00	147.33	152.11	101.13	79.47	71.17	83.92	96.30	85.57	86.33	89.40
	M.1	160.33	151.00	147.67	153.00	162.33	155.67	151.33	156.44	108.53	78.47	78.77	88.59	107.33	106.4	92.70	102.14
	Mean	**159.67**	**150.00**	**146.09**	**151.92**	**160.92**	**152.92**	**149.42**	**154.42**	**104.39**	**80.24**	**74.24**	**86.29**	**102.39**	**98.02**	**91.13**	**97.18**
Mean for cultivars	G.2	157.33	147.89	142.44	149.22	158.55	150.22	147.00	151.92	93.71	86.97	72.50	84.39	95.10	86.51	87.10	89.57
	G.429	163.00	152.67	150.22	155.30	164.00	156.00	151.44	157.15	108.93	87.36	83.45	93.24	111.89	99.59	98.86	103.44
	G.843	158.78	148.44	144.22	150.48	158.89	150.33	147.56	152.26	97.55	77.66	77.22	84.14	100.82	88.01	90.41	93.08
	M.1	162.67	150.56	147.89	153.70	163.00	155.44	151.11	156.52	102.50	80.38	74.92	85.93	108.48	99.33	94.82	100.88
Mean for sowing dates		**160.44**	**149.89**	**146.20**	**152.18**	**161.11**	**153.00**	**149.28**	**154.46**	**100.67**	**83.09**	**77.02**	**86.93**	**104.07**	**93.36**	**92.80**	**96.74**

LSD at 5% level for:					
Sowing dates (S)	=	0.29	0.73	2.96	3.38
Plant spacing (D)	=	0.23	n.s	n.s	1.76
Cultivars(V)	=	0.28	0.35	1.94	1.69
S x D	=	n.s	n.s	3.97	3.05
S x V	=	0.49	0.61	3.36	2.92
D x V	=	n.s	n.s	3.36	2.92
S x D x V	=	n.s	n.s	5.81	5.06

Table (4): Number of branches/plant and number of pods/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 branches/plant								Number of pods /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	25th Nov.	Mean	25th Nov.	Mean	15th Oct	5th Nov.	25th Nov.	Mean
15 cm	**G.2**	3.27	3.57	3.07	3.30	4.17	2.97	2.87	3.34	13.27	12.10	8.10	11.16	7.33	8.17	6.33	7.28
	G.429	3.67	3.13	3.23	3.34	5.33	3.03	2.83	3.73	11.93	8.87	9.10	9.97	8.40	5.93	7.77	7.37
	G.843	3.53	3.43	3.13	3.36	4.00	3.10	2.83	3.31	12.60	8.90	7.67	9.72	8.43	9.70	5.83	7.99
	M.1	4.20	3.87	3.13	3.73	4.30	2.87	2.87	3.35	11.9	11.93	8.87	10.90	10.50	7.70	7.07	8.42
	Mean	**3.67**	**3.50**	**3.14**	**3.44**	**4.45**	**2.99**	**2.85**	**3.43**	**12.43**	**10.45**	**8.44**	**10.44**	**8.67**	**7.88**	**6.75**	**7.76**
20 cm	**G.2**	4.37	3.37	3.80	3.85	4.43	3.17	3.33	3.64	13.00	10.40	9.23	10.88	7.77	5.93	5.7	6.47
	G.429	3.33	4.20	3.47	3.67	4.80	3.60	2.90	3.77	10.37	10.93	9.80	10.37	10.4	8.17	6.33	8.30
	G.843	4.33	4.37	3.60	4.10	4.33	3.17	2.63	3.38	13.07	12.37	9.40	11.61	8.80	8.77	7.70	8.42
	M.1	3.87	3.83	3.17	3.62	4.83	2.67	2.73	3.41	13.93	10.70	10.40	11.68	10.37	8.20	7.73	8.77
	Mean	**3.98**	**3.94**	**3.51**	**3.81**	**4.60**	**3.15**	**2.90**	**3.55**	**12.59**	**11.10**	**9.71**	**11.13**	**9.34**	**7.77**	**6.87**	**7.99**
25 cm	**G.2**	3.70	4.13	3.90	3.91	4.53	3.33	2.87	3.58	13.80	11.43	11.93	12.39	12.20	7.50	7.33	9.01
	G.429	3.83	3.60	3.70	3.71	5.37	3.70	3.60	4.22	12.47	11.93	12.97	12.46	12.10	9.07	7.10	9.42
	G.843	3.97	3.73	3.83	3.84	5.37	2.97	3.10	3.81	12.97	9.60	10.87	11.15	11.83	6.67	8.40	8.97
	M.1	3.57	4.03	4.07	3.89	5.23	3.17	2.9	3.77	13.3	13.03	13.17	13.17	8.03	7.57	7.73	7.78
	Mean	**3.77**	**3.87**	**3.88**	**3.84**	**5.13**	**3.29**	**3.12**	**3.85**	**13.1**	**11.50**	**12.24**	**12.29**	**11.04**	**7.70**	**7.64**	**8.79**
Mean for cultivars	**G.2**	3.78	3.69	3.59	3.69	4.38	3.16	3.02	3.52	13.36	11.31	9.75	11.47	9.10	7.20	6.45	7.58
	G.429	3.61	3.64	3.47	3.57	5.17	3.44	3.11	3.91	11.59	10.58	10.62	10.93	10.30	7.72	7.07	8.36
	G.843	3.94	3.84	3.52	3.77	4.57	3.08	2.85	3.50	12.88	10.29	9.31	10.83	9.69	8.38	7.31	8.46
	M.1	3.88	3.91	3.46	3.75	4.79	2.90	2.83	3.51	13.04	11.89	10.81	11.91	9.63	7.82	7.51	8.32
Mean for sowing dates		**3.80**	**3.77**	**3.51**	**3.69**	**4.72**	**3.15**	**2.96**	**3.61**	**12.72**	**11.02**	**10.13**	**11.29**	**9.68**	**7.78**	**7.09**	**8.18**

LSD at 5% level for:

Sowing dates (S)	=	n.s	0.59	0.81	0.41
Plant spacing (D)	=	n.s	0.28	0.58	0.24
Cultivars(V)	=	0.22	0.29	0.55	0.30
S x D	=	n.s	n.s	1.00	0.41
S x V	=	n.s	n.s	0.94	0.52
D x V	=	0.39	n.s	0.94	0.52
S x D x V	=	0.87	n.s	1.64	0.90

Table (5): Biological yield (ton/faddan) and chocolate-spot as affected by sowing dates , plant spacing and faba bean cultivars during 2001/2002 and 2002/2003 seasons.

Plant spacing(D)	Cultivars (V)	Biological yield (ton/faddan)								chocolate-spot							
		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	25th Nov.	Mean	25th Nov.	Mean	15th Oct	5th Nov.	25th Nov.	Mean
15 cm	**G.2**	5.63	5.20	4.00	4.94	4.17	4.17	3.70	4.01	3.13	2.73	2.03	2.63	3.99	3.29	2.08	3.12
	G.429	6.03	5.77	4.27	5.36	4.07	4.03	4.60	4.23	5.07	3.80	1.97	3.61	6.42	5.20	3.47	5.03
	G.843	6.20	3.90	4.27	4.79	4.07	3.80	3.90	3.92	5.90	3.73	1.90	3.84	3.47	2.08	1.73	2.43
	M.1	6.37	4.60	3.60	4.86	4.17	3.73	4.50	4.13	5.43	3.93	3.70	4.36	3.64	3.64	3.29	3.52
	Mean	**6.06**	**4.87**	**4.04**	**4.99**	**4.12**	**3.93**	**4.18**	**4.08**	**4.88**	**3.55**	**2.40**	**3.61**	**4.38**	**3.55**	**2.64**	**3.53**
20 cm	**G.2**	5.47	4.33	4.00	4.60	3.93	3.23	3.10	3.42	4.63	3.60	3.73	3.99	2.77	4.16	4.39	3.77
	G.429	5.47	4.53	4.00	4.67	4.10	3.63	3.40	3.71	7.07	4.47	5.57	5.70	7.87	7.40	2.54	5.94
	G.843	5.63	4.60	4.40	4.88	3.93	4.27	3.33	3.84	6.77	5.53	4.17	5.49	3.47	3.00	3.00	3.16
	M.1	5.73	4.53	3.20	4.49	4.33	4.07	3.53	3.99	6.93	5.37	6.20	6.17	5.77	3.93	1.96	3.89
	Mean	**5.58**	**4.50**	**3.90**	**4.66**	**4.07**	**3.80**	**3.43**	**3.74**	**6.35**	4.74	**4.92**	**5.34**	**4.97**	**4.62**	**2.97**	**4.19**
25 cm	**G.2**	5.5	4.07	3.47	4.35	3.47	3.63	3.77	3.62	6.40	**6.57**	5.20	6.06	6.84	6.25	5.06	6.05
	G.429	5.67	4.73	4.33	4.91	4.20	3.10	3.77	3.69	9.43	6.17	4.60	6.73	10.41	9.52	5.95	8.63
	G.843	5.33	3.33	2.93	3.86	3.70	3.43	3.33	3.49	7.47	5.53	5.80	6.27	4.76	5.35	2.77	4.29
	M.1	6.17	4.13	2.97	4.42	3.97	4.13	3.27	3.79	6.70	6.73	6.27	6.57	8.03	6.87	5.65	6.85
	Mean	**5.67**	**4.07**	**3.43**	**4.39**	**3.84**	**3.57**	**3.54**	**3.65**	**7.50**	6.25	**5.47**	**6.41**	**7.51**	**7.00**	**4.86**	**6.46**
Mean for cultivars	**G.2**	5.53	4.53	3.82	4.63	3.86	3.68	3.52	3.69	4.72	**4.30**	3.66	4.23	4.53	4.57	3.84	4.31
	G.429	5.72	5.01	4.20	4.98	4.12	3.59	3.92	3.88	7.12	4.81	4.04	5.35	8.23	7.37	3.99	6.53
	G.843	5.72	3.94	3.87	4.51	3.90	3.83	3.52	3.75	6.71	4.93	3.96	5.20	3.90	3.48	2.50	3.29
	M.1	6.09	4.42	3.26	4.59	4.16	3.99	3.77	3.97	6.36	5.34	5.39	5.70	5.81	4.81	3.63	4.75
Mean for sowing dates		**5.77**	**4.48**	**3.79**	**4.68**	**4.01**	**3.77**	**3.69**	**3.82**	**6.24**	**4.85**	**4.26**	**5.12**	**5.62**	**5.06**	**3.49**	**4.72**

LSD at 5% level for:

Sowing dates (S)	=	0.77	0.40	0.65	0.98
Plant spacing (D)	=	0.32	0.14	0.32	1.21
Cultivars(V)	=	0.28	0.17	0.46	0.94
S x D	=	n.s	0.24	0.56	n.s
S x V	=	0.48	0.28	0.60	1.63
D x V	=	0.48	n.s	n.s	n.s
S x D x V	=	n.s	0.51	1.38	n.s

الملخص العربي

المحصول البيولوجي وصفات النمو ذات العلاقة ومرض التبقع البني وتأثرها بالأصناف ومواعيد ومسافات الزراعة في الفول البلدي

اجريت تجربتان حقليتان بمزرعة كلية الزراعة بالفيوم في دار الرماد خـــلال موســـمي ٢٠٠١-٢٠٠٢، ٢٠٠٢-٢٠٠٣ لدراسة تأثير مواعيد الزراعة والمسافة بين الجور والأصناف علي بعض صفات النمو وكذلك الاصابة بالتبقع البني في الفول البلدي. وقد استخدم تصميم القطاعات الكاملة العشوائية في توزيع القطع المنشقة مرتين في ثـــلاث مكـــررات، وزعت مواعيد الزراعة (١٥ أكتوبر و٥نوفمبر و٢٥ نوفمبر) في القطع الرئيسية والمسافات بين الجور (١٥، ٢٠، ٢٥سم) في الشقية الأولي والأصناف (جيزة ٢، جيزة٤٢٩، جيزة٨٤٣، مصر ١) في القطع الشقية الثانية وضمت القطع التجريبية خمسة خطوط بطول ٣,٥م وعرض ٦٠سم. وكان المحصول السابق هو القطن في الموسم الأول والذرة في الموسم الثاني.

أظهرت النتائج المتحصل عليها تأثر كل الصفات باختلاف مواعيد الزراعة في الموسمين ما عدا نسبة الإنبات وعدد الأفرع للنبات في الموسم الأول. ونقص متوسطات معظم الصفات ومنها نسبة الإصابة بالتبقع البني في موســـم واحـــد أو الموسمين ما عدا تاريخ التزهير نتيجة تأخير موعد الزراعة من ١٥ أكتوبر إلي ٢٥ نوفمبر.

أدت زيادة المسافة بين الجور من ١٥الي ٢٥سم لزيادة نسبة التبقع البني وعدد القرون علي النبات في الموسم الأول ونسبة الإنبات وعدد الأفرع بالنبات في الموسم الثاني. لكنها أدت إلي نقص عدد الأيام حتى موعد النضج في الموسم الأول وطول النبات في الموسم الثاني والمحصول البيولوجي في الموسمين. وقد تأثرت جميع الصفات معنويـــا فـــي الموســـمين بالأصناف المختبرة. تفوق جيزة٤٢٩ علي كل الأصناف في نسبة الإنبات والمحصول البيولوجي في الموسم الأول وعـــدد الأفرع في الموسم الثاني ولكنة سجل اعلي نسبة إصابة في التبقع البني في كلا الموسمين. بينما كان جيزة(٢) هو الابكـــر في التزهير والنضج في كلا الموسمين وكان الصنف الأقل إصابة بمرض التبقع البني يتبعة جيزة ٨٤٣.

وكان التفاعل بين مواعيد الزراعة والمسافات بين الجور والمسافات بين الجور والأصـــناف ومواعيـــد الزراعـــة والمسافات بين الجور والأصناف معنويا علي نسبة الإنبات وطول النبات وعدد قرون النبات وعدد الأفرع بالنبـــات فـــي موسم واحد أو الموسمين. كما اطهر التفاعل بين مواعيد الزراعة والأصناف تأثيرا معنويا علي هذة الصفات بالإضافة إلي موعد النضج في الموسمين وتاريخ التزهير ونسبة الإصابة في الموسم الثاني.