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# GROWTH AND YIELD COMPONENTS VARIATION OF TWO FABA BEAN (*VICIA FABA L.*) VARIETIES AS RESPONSE TO PLANTING DATES AND HILL SPACING

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## ABSTRACT

**Two field experiments were conducted at the Educational Farm, Fac. of Agric., Sana'a Univ., Republic of Yemen during ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ seasons. The aim of the work was to study the effect of four planting dates (٣١th October, ٢١th November, ١١th December and ٣١th December), two varieties of faba bean (Fleeb and Giza) and three hill spacing (٨, ١١ and ١٦ cm)as well as, their interaction on faba bean growth characters and yield components. The obtained results showed that planting dates and hill spacing affected. Dry weight/plant, number of leaves/plant, number of branches/plant, plant height, number of seeds/plant, pods weight /plant, straw weights/plant and seeds weight/plant in the two seasons. In generally, crop planted on ٣١-October produced the highest values of all mentioned characters in both growing seasons. While hill spacing of ٨.٠ cm between hills produced tallest plants, maximum number of leaves and branches/plant, as well as, straw weight /plant in both seasons. Also, hill spacing of ١٦.٠ cm between hills produced the highest dry weight, number of seeds/plant, pods weight /plant and seeds weight /plant in both seasons. Data indicated that faba bean varieties were differed in number of seeds/plant and dry weight/plant at first growth stage in both seasons, as well as, number of leaves/plant in first season, plant height, pods yield/plant and seeds yield/plant in second season. Results indicated also that the effect of interactions (dates of sowing x**

**varieties), (planting dates hill spacing) ,(varieties x hill spacing) and (dates of sowing x varieties x hill spacing) affected faba bean growth and yield components characters in both growing seasons. Concerning to the effect of (D x V x P) interaction, data showed that planting Giza var. on ٣١-October under the lowest hill spacing (٨.٠ cm), gave the tallest plants and the maximum values of straw yield/plant in the two seasons. While, planting Giza cv. on ٣١-October under the highest plant spacing (١٦.٠ cm) gave the maximum values of number of seeds/plant (٣٥.٤٥ and ٣٩.٣٥), pods weight / plant (٣١.٧٧ and ٢٧.١٩ gm) and seeds weight /plant (٢٥.٥٨ and ٢١.٧٩ gm) in the two seasons, respectively.**

## INTRODUCTION

Faba bean (*Vicia faba L.)* is the fourth most important pulse crop in the world. It occupies the greatest area planted to legume crops in the Arab countries (Amin, ١٩٨٨). Faba bean is a valuable food legume rich in proteins and carbohydrate (Karamanos *et al.,* ١٩٩٤). Nutritionally, faba bean seeds contains between ٢٤-٣٢٪ proteins (Li-Juan *et al.*, ١٩٩٣). On the other hand, legumes add about ٣٠ – ١٦٠ Kg N $ha^{-١}$ to soil each year, while in fields nitrogen accumulation in soil each year reached up to ٢٠٠ – ٤٠٠ Kg N $ha^{-١}$ $year^{-١}$ mainly come from atmospheric nitrogen .

In Yemen faba bean is primarily consumed as dry seed, secondarily used as fresh pods. During ٢٠١٠ the total production of dry seeds of faba bean averaged ٧٤٠٧ ton, cultivated on area of ٤٢٠٣ hectares, also, the average seed yield was ١.٧٦ tons $ha^{-١}$ (Yemen Agricultural Statistical Year book ٢٠١٠). On the other hand, the local production is not sufficient for the consumption. Therefore, efforts should be made for boosting faba bean productivity.

In this respect, there are many effective tools, including both planting date and hill spacing, as well as, new varieties. In general, early sowing faba bean resulted in seed yield increases. Moreover, planting dates is an important factor which significantly affects the timing and duration of the vegetative and reproductive stages of faba bean as well as yield components (Refay, ٢٠٠١ and Turk and Tawaha, ٢٠٠٢). Krarup (١٩٨٤) from Chile reported higher yields from legumes sown from mid-August to mid-September than from later sowings.

## Response of faba bean (*vicia faba* l.) varieties to planting dates and hill spacing

The experience of farmers vary considerably with regards to cultural treatment of faba bean such as sides of ridges, number of broad bean rows per ridge, number of plants per hill and distance between hills. With this respect, plant spacing, also, plays an important factor affecting on faba bean growth, development and yield. Therefore, yield response of seed legumes to plant spacing were discussed by several workers such as McEwen *et al.*, (١٩٨٨; Martin *et al.*, (١٩٩٤); Noffsinger and Santen, (١٩٩٥); Tawaha and Turk, (٢٠٠١a). However, insignificant effect of plant density was detected on plant height (Shahein *et al.*, ١٩٩٥), on number of branches (Shafik *et al.*, ١٩٨٩) and on number of pods/plant (Abo El-Zahab *et al.*, ١٩٨١ and Shafik *et al.*, ١٩٨٩). In addition, Hussein *et al.* (١٩٩٩); Mokhtar (٢٠٠١); El-Metwally *et al.*, (٢٠٠٣) and Kakiuchi and Kobata (٢٠٠٤) reported that increasing plant density negatively affected numbers of branches and pods/plant.

Consequently, the present investigation aimed to study the response growth and yield components of two faba bean varieties to various planting dates under different plant spacing.

## MATERIAL AND METHODS

Tow field experiments were conducted during ٢٠٠٩ and ٢٠١٠ seasons at the Educational farm, Faculty of Agriculture, Sana'a University. The aim of the work to study the effect of four planting date (٣١-Oct., ٢١-Nov., ١١-Dec.and ٣١-Dec.) applied to main plots, two faba bean varieties (Fleeb and Giza) assigned to sub-plots and three hill spacing (٨, ١١ and ١٦ cm resulting in a population density of ١٧٨٥٧١, ١٢٩٨٧٠ and ٨٩٢٨٦ plants per hectare, respectively) were assigned in the sub-subplots, on some growth and yield components characters of faba bean crop (*Vicia faba* L.). The interaction between all factors under study were studied. A split-split-plot experimental design with four replications was used. The experimental unit was ١٧.٥ $m^2$ containing ٥ rows (٥ m long and ٧٠ cm apart). Nitrogen fertilization was added at one equal dose in the form of urea (٤٦٪ N) at rate of ٤٠ kg N/ha, was applied before the first irrigation. Also, in both seasons, phosphorus and potassium fertilizers were applied at the

each plot in one dose at sowing, in form of single super phosphate (١٨٪ $P_2O_5$) and sulphate of potash (٥٠٪ $K_2O$), respectively. Hoeing was done twice to keep the crop free of weeds.

Studied characters were: plant dry weight (g), number of leaves per plant, number of branches per plant, plant height (cm), number of seeds / plant, pods yield / plant (g), straw weight plant (g) and seeds / weight plant (g). The above mentioned parameters were calculated by the following:

**Plant height (cm)**: Data on plant height were taken from base to top of the plant for ١٠ selected plants form each sub-subplot in all the treatments and then average height was calculated out.

**Number of leaves, branches and seeds per plant:** Ten plants were selected from each treatment and their numbers of leaves, branches and number of seeds per plant were counted after threshing and then average was worked out.

**Straw, pods and seeds weight plant (g)**: Ten plants were selected form each treatment and the weight of straw, pods and seeds per plant were determine and then average was worked out. Also, ten plants were selected from each treatment and the number of seeds in each plants were separated and then average was worked out.

**Statistical analyses:** The MSTAT-C program was used for statistical analyses. Data for each season were analyzed for a randomized complete block design (RCBD) with split-split-plot arrangement according to procedure outlined by Steel and Torrie (١٩٨٠). Comparisons between means were made using least significant differences (LSD) at ٠.٠٥ probability level.

## RESULTS AND DISCUSSION

**Effect of planting dates:**

Plant growth characters (plant dry weight, plant height, number of leaves and branches per plant) and yield components traits (number of seeds/plant, pods weight/plant, straw weight/plant and seeds weight /plant) of faba bean plants were influenced significantly by planting dates in two growing seasons, except plant height in second season and pods weight plant in first season (Tables ١ and ٢). In both

growing seasons, there were insignificant effects between ٢١-Nov. and ١١-Dec (as planting dates) on plant growth and yield components characters. On the other hand, early planting (٣١-Oct.) resulted in the production of more plant dry weight at all growth stages, number of leaves/plant, number of branches/plant and plant height, this was similar in the two seasons. In the same trend, the results also, showed that early date of planting in late October (٣١-Oct.) caused an increase in each of number of seeds/plant, pods weight /plant, straw weight /plant and seeds weight /plant in the two seasons. The maximum growth and yield components of plant characters under study were: ٤٢.٠٤ and ٤٢.٧٧ g/plant for plant dry weight at last growth stage, ٦٨.١٤ and ٦٤.٧٤ for number of leaves/plant, ٤.٧٣ and ٤.٨٨ for number of branches/plant, ٧٢.٩٤ and ١٠٠.١٧ cm for plant height, ٢٤.٨٧ and ٢٧.٦٧ for number of seeds/plant, ٢٥.٧٧ and ٢٣.٨٣ g/plant for pods weight /plant, ٢٠.٣٦ and ١٩.٣٧ g/ plant for straw weight /plant and ٢٠.٥٢ and ١٩.٢٠ gm/ plant for seeds weight /plant in first and second seasons, respectively. These results were obtained by planting faba bean plants on ٣١-October, which was found superior in comparison to other three planting dates (٢١-Nov, ١١-Dec and ٣١-Dec) in both growing seasons as shown in (Tables ١ and ٢). Also, plant dry weight at last growth stage reduced by ١١.٠٧, ٢٧.٣٠ and ٢٩.٥١% in ٢٠٠٩ season and ٢٢.٥٦, ٢٢.٣١ and ٤٣.٣٠% in ٢٠١٠-٢٠١١ season, with dates of sowing on ٢١-Nov, ١١-Dec. and ٣١-Dec., respectively in comparison to the earlier planting date (٣١-Oct). Accordingly, results clearly indicated that number of leaves per plant significantly reduced by, ١٨.٤٣, ٣٢.١٠ and ٥٣.٦٥% in ٢٠٠٩ season, being ٢.٧٠, ٩.٥٦ and ١٦.٤٠% in first season, when applied dates of sowing on ٢١-Nov, ١١-Dec. and ٣١-Dec., respectively in comparison to the planting date on ٣١-Octber. While, planting faba bean on ٢١-Nov, ١١-Dec. and ٣١-Dec. reduced number of branches per plant in comparison to the planting on ٣١-Oct by ١.٩٠, ١٩.٢٤ and ٣٣.١٩%, respectively, in first season. The corresponding reductions in seconds season were ١٧.٠١, ٢٨.٨٩ and ٣٢.١٧%, respectively for three respective planting dates. Data in Table (٢) indicated that plant height reductions were of ١.٨٩, ١.٦٣ and ١٣.٤٩ % when sowing faba bean on ٢١-Nov, ١١-Dec. and

٣١-Dec., respectively, compared to the earlier planting date (٣١-Oct.) in ٢٠٠٩ season, but in ٢٠١٠ season were ٢٤.٠٠, ٢٥.٥٣ and ٢٩.٣٤٪ for respective of three planting dates, respectively. While in ٢٠٠٩ season, the second planting date (٢١-Nov.), third planting date (١١-Dec.) and fourth (٣١-Dec.) planting date contributed reduction of number of seeds/plant by ٨.٤٨, ١٤.٣٥ and ٣٦.٥٩%, respectively compared to the first planting date (٣١-Oct.), this reduction in seeds yield/plant were ١٠.٩٩, ٢١.٢٩ and ٣٠.٣٦٪ in ٢٠١٠ season for the three respective planting dates respectively (Table ٢). Whereas, results in Table (٢) recorded that planting faba bean on ٢١-Nov., ١١-Dec. and ٣١-Dec., resulted in reduction of pods yield/plant by ٣.٠٧, ٢٤.٢٥ and ٢٥.٧٣% respectively compared with the earlier planting date (٣١-Oct.) in ٢٠٠٩ season. The corresponding reduction in ٢٠١٠ season were ٢.٣١, ٢٦.٧٣ and ٢٩.٧٥٪ in ٢٠١٠ season for the three respective planting dates. With respect to straw weight /plant, reductions of ١٨.٨٦, ٢٣.٠٨ and ٤٣.٨٦% in ٢٠٠٩ season and of ١١.٠٠, ٩.٤٠ and ٣٤.٨٠% in second season were recorded, when planting faba bean on ٢١-Nov, ١١-Dec. and ٣١-Dec., respectively, comparing to planting on ٣١-October.

The present results showed that planting faba bean on ٢١-Nov, ١١-Dec. and ٣١-Dec.caused an obvious reduction in seed yield/plant by ٣.٩٠, ٢٢.٣٧ and ٣٥.٥٨% in first season and by ١٥.١٦, ١٩.٧٩ and ٢٧.٧٦%, respectively in second season comparing to planting faba bean plants on ٣١-October (Table ٢). This means that, the delay in faba bean sowing date greatly reduced its growth characters and yield components.

In addition, the reduction in plant height and other growth characters with delay in planting time might be due to the fact that planting faba bean plants during the month of October was more conducive for plant growth and development, because the early planted crop may have more time for absorbing nutrients from the soil, attaining proper vegetative growth, efficient light utilization and development of more photosynthates than late planted crop (Bae *et al*., ١٩٨٥). Whereas, Abuldahab *et al.*, (٢٠٠٢) and Grenz *et al.*, (٢٠٠٥) mentioned that planting faba bean crop over mid November resulted in steadily reduction in growth, yield and yield components. In this

respect, the reduction in plant growth characters and yield components due to delay in planting could be attributed, among other factors, to shorter growth period at the disposal of the late sown crop as the time taken by the crop to mature decreased with delay in sowing. Accordingly, Tawaha and Turk (٢٠٠١b) indicated that shorter growing period might result in less dry matter accumulated and fewer pods and branches per plant, which reduced seed yield. However, Shad *et al.* (٢٠١٠) found that decrease in seeds per pod with delayed sowing may be due to shorter seeds filling duration and poor pod formation in late sowing. Talal Thalji, (٢٠٠٦) reported that early planting date in late November resulted in a significant increase in vegetative growth (plant height, root dry weight, nodules number, nodules dry weight, production more pods per plant). In the same trend, Munir and Abdel-Rahman (٢٠٠٢) reported that high number of primary branches per plant, plant height and yield components such as seed weight per plant, seeds pod, pods per plant was influenced significantly by planting date. Similar results were obtained by Refay, ٢٠٠١; Abuldahab, *et al.*, (٢٠٠٢); Abou-Taleb (٢٠٠٢); Hussein *et al.*, (٢٠٠٢); Turk and Tawaha, ٢٠٠٢ and Mohamed, (٢٠٠٣) who reported that sowing faba bean at late October and early November resulted in significant increase in vegetative growth and produced more pods per plant, consequently increased yield and quality of seed.

**Effect of varieties:**

Results in table (١) clearly indicated that varieties of faba bean had a significant effect on plant dry weight only at the first growth stages in both seasons. Regarding to effect of varieties on yield components traits under study, there were significant variations among the faba bean varieties with respect to plant height, pods weight /plant and seeds weight /plant only in ٢٠١٠ season and number of seeds/plant in both growing seasons (Tables ٢). In contrast, data revealed insignificant differences regarding plant height, seeds and pods weight per plant in ٢٠٠٩-٢٠١٠ season as well as on straw weight at two growing seasons (Tables ٢). Also, results of the effects of varieties on number of branches/plant in both growing seasons and number of green leaves per plant in second season were statistically

insignificant (Table ١). Additionally, the Giza faba bean variety had the highest values of plant height, number of seeds/plant, straw, seeds and pods yield per plant, in comparison with the Fleeb variety. On the other hand, the Giza faba bean variety produced the taller plants which were ٧١.٩٣ cm and ٨٥.٣٤ cm, in first and second seasons, respectively. Similarly, the maximum number of seeds/plant (٢٤.٧٠ and ٢٩.٧١), begets pods weight per plant (٢٣.٨٥ and ٢١.٩١ gm) were recorded in the first and second seasons, respectively. However the highest straw weight per plant was١٧.٦٨ gm and highest seeds yield per plant was ١٧.١٧ gm in the second season through using Giza var. (Table ٢). With respect to the highest straw and seed weight g/plant (١٦.٦٣ g and ١٧.٧٣ g) respectively were obtained in the first season from planting faba bean plants by using Fleeb variety (Table ٢).

**Table ١: Effect of planting dates (D), varieties (V) and hill spacing (P) on plant dry weight (g), number of leaves/plant and number of branches/plant of faba bean in ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ seasons**

| Treatments | Growth stages (days after planting) | | | | | | Characters | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ٦٥ | ٩٥ | ١٢٠ | ٦٥ | ٩٥ | ١٢٠ | Number of leaves/plant | | Number of branches/ plant | |
| | ٢٠٠٩-٢٠١١ season | | | ٢٠١٠-٢٠١١ season | | | ٢٠٠٩-٢٠١٠ | ٢٠١٠-٢٠١١ | ٢٠٠٩ - ٢٠١٠ | ٢٠١٠ - ٢٠١١ |
| **Effect of planting dates (D)** | | | | | | | | | | |
| **٣١-Oct.** | ٦.٧٥ | ٢٤.٠٥ | ٤٢.٠٩ | ٥.٨١ | ٢٥.٣٦ | ٤٢.٧٧ | ٦٨.١٤ | ٦٤.٧٤ | ٤.٧٣ | ٤.٨٨ |
| **٢١-Nov.** | ٤.٨١ | ١٥.٣٦ | ٣٧.٤٣ | ٤.٧٨ | ١٣.١٧ | ٣٣.١٢ | ٥٥.٥٨ | ٦٢.٩٩ | ٤.٦٤ | ٤.٠٥ |
| **١١-Dec.** | ٤.٧١ | ٦.٩٨ | ٣٠.٦٠ | ٣.١٣ | ١٥.٦٩ | ٣٣.٢٣ | ٤٦.٢٧ | ٥٨.٥٥ | ٣.٨٢ | ٣.٤٧ |
| **٣١-Dec.** | ٤.٢٧ | ١٣.١٥ | ٢٩.٦٧ | ٤.٢٠ | ١٤.٦٢ | ٢٤.٢٥ | ٣١.٥٨ | ٥٤.١٢ | ٣.١٦ | ٣.٣١ |
| **L.S.D. at ٥٪** | ١.٧٣ | ٣.٣٦ | ٧.٦١ | ٠.٨٥ | ٣.٦٤ | ٤.٥٥ | ٧.٦٢ | ٦.٨٥ | ٠.٧٧ | ٠.٣٦ |
| **Effect of varieties (V)** | | | | | | | | | | |
| **Fleeb** | ٥.٤١ | ١٤.٨٣ | ٣٣.٧٣ | ٤.٩٨ | ١٧.٧٠ | ٣٢.٤٤ | ٤٦.٠٤ | ٥٧.٧٦ | ٣.٩٥ | ٣.٨٦ |
| **Giza** | ٤.٨٦ | ١٤.٩٤ | ٣٦.١٦ | ٣.٩٧ | ١٦.٧٢ | ٣٤.٢٥ | ٥٤.٧٥ | ٦٢.٤٤ | ٤.٢٢ | ٣.٩٩ |
| **L.S.D. at ٥٪** | ٠.٤٨ | N.S | N.S | ٠.٧٥ | N.S | N.S | ٥.٨٩ | N..S | N.S | N..S |
| **Effect of hill spacing (P)** | | | | | | | | | | |
| **٨ cm** | ٤.٩١ | ١٤.٤٣ | ٢٩.٥٧ | ٤.٣٣ | ١٦.٧٤ | ٣٠.٤٠ | ٥٨.٧٩ | ٦٤.٢٩ | ٤.٥٨ | ٤.٠٩ |
| **١١ cm** | ٤.٥٨ | ١٤.٤٦ | ٣٢.٣٧ | ٤.٤٠ | ١٧.٦٥ | ٣٤.٢٩ | ٤٩.٤٩ | ٥٨.٤٨ | ٤.٠٨ | ٣.٨٨ |
| **١٦ cm** | ٥.٩٢ | ١٥.٧٨ | ٤٢.٨٩ | ٤.٧٠ | ١٧.٢٤ | ٣٥.٣٤ | ٤٢.٩٠ | ٥٧.٥٤ | ٣.٦٠ | ٣.٨١ |
| **L.S.D. at ٥٪** | ٠.٨٣ | N.S | ٦.٦٢ | N.S | N.S | ٣.٤٤ | ٦.٥٥ | ٥.٣٤ | ٤.٥٢ | N.S |

**N.S**=Non-significant

## Response of faba bean (*vicia faba* l.) varieties to planting dates and hill spacing

The differences among the studied characters could be attributed to the definite genetically differences between the two varieties under study. Also, the differences between two faba bean varieties (Giza and Fleeb) may be due to the differences between in partitioning and migration of photosynthates among plant organs. Moreover, data obtained are in full agreement with those given by either Abdalla *et al.* (٢٠٠٠) for number of seeds/plant or by Metwally *et al*., (٢٠٠٠); Abou-Taleb, (٢٠٠٢) and Annicchiarico, (٢٠٠٥) for pods and straw yield per plant. The same trend was recorded for seeds yield/plant by El-Murabaa *et al.* (١٩٨٧); Dawwam and Abdel–Aal (١٩٩١), Amer *et al.*, (١٩٩٢); Khalil *et al*. (١٩٩٣) and Mokhtar (٢٠٠١), as well as for number of leaves per plant by Ahmed and Abdelrhim (٢٠١٠) and Bakry *et al*. (٢٠١١). Also, for number of branches per plant by Bakry *et al.* (٢٠١١). Such varietals differences for plant heights were previously reported by Khalil *et al.* (١٩٩٣) and Abdalla *et al.* (٢٠٠٠). Whereas Ashmawy *et al.* (١٩٩٨) found insignificant differences for this character.

**Table ٢: The effect of sowing dates, varieties and hill spacing on yield components of faba bean in ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ seasons**

| Treatments | Plant height (cm) | | Number of seeds/plant | | Pods yield g/plant | | Straw yield g/plant | | Seeds yield g/plant | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ٢٠٠٩ | ٢٠١٠ | ٢٠٠٩ | ٢٠١٠ | ٢٠٠٩ | ٢٠١٠ | ٢٠٠٩ | ٢٠١٠ | ٢٠٠٩ | ٢٠١٠ |
| **Effect of planting dates (D)** | | | | | | | | | | |
| **٣١-Oct.** | ٧٢.٩٤ | ١٠٠.١٧ | ٢٤.٨٧ | ٢٧.٦٧ | ٢٥.٧٧ | ٢٣.٨٣ | ٢٠.٣٦ | ١٩.٣٧ | ٢٠.٥٢ | ١٩.٢ |
| **٢١-Nov.** | ٧١.٥٦ | ٧٦.١٣ | ٢٢.٧٦ | ٢٤.٦٣ | ٢٤.٩٨ | ٢٣.٢٨ | ١٦.٥٢ | ١٧.٢٤ | ١٩.٧٢ | ١٦.٢٩ |
| **١١-Dec.** | ٧١.٧٥ | ٧٤.٦ | ٢١.٣ | ٢١.٧٨ | ١٩.٥٢ | ١٧.٤٦ | ١٥.٦٦ | ١٧.٥٥ | ١٥.٩٣ | ١٥.٤ |
| **٣١-Dec.** | ٦٣.١ | ٧٠.٧٨ | ١٥.٧٧ | ١٩.٢٧ | ١٩.١٤ | ١٦.٧٤ | ١١.٤٣ | ١٢.٦٣ | ١٣.٢٢ | ١٣.٨٧ |
| **L.S.D. at ٥٪** | ٨.٧٦ | **N.S** | ٦.٢١ | ٦.٠٩ | **N.S** | ٤.٤٢ | ٦.٣٢ | ٣.٨٧ | ٥.٤٧ | ٣.٦٧ |
| **Effect of Varieties (V)** | | | | | | | | | | |
| **Fleeb** | ٦٧.٧٥ | ٧٥.٥ | ١٧.٦٥ | ١٦.٩٦ | ٢٠.٨٧ | ١٩.١٦ | ١٦.٦٣ | ١٥.٧٢ | ١٧.٧٣ | ١٥.٢ |
| **Giza** | ٧١.٩٣ | ٨٥.٣٤ | ٢٤.٧ | ٢٩.٧١ | ٢٣.٨٥ | ٢١.٩١ | ١٥.٣٥ | ١٧.٦٨ | ١٦.٩٦ | ١٧.١٧ |
| **L.S.D. at ٥٪** | **N.S** | ٥.٦ | ٣.٠٥ | ٣.٥٧ | **N.S** | ٢.٠٦ | **N.S** | **N.S** | **N.S** | ١.٥٧ |
| **Effect of Plant spacing (P)** | | | | | | | | | | |
| **٨ cm** | ٧١.٧٣ | ٨٣.٥٨ | ١٨.٣٦ | ٢١.٤٣ | ١٩.٩٤ | ١٩.٠٩ | ١٨.٧٦ | ١٨.٣١ | ١٥.٢٤ | ١٤.٨٩ |
| **١١ cm** | ٦٩.١٦ | ٨٠.٢٢ | ٢٠.٢٧ | ٢٣.٠١ | ٢١.٤٢ | ٢٠.٢ | ١٥.٥٢ | ١٦.٥٦ | ١٦.٥٥ | ١٦.٠٣ |
| **١٦ cm** | ٦٨.٦٣ | ٧٧.٤٦ | ٢٤.٨٩ | ٢٥.٥٨ | ٢٥.٧١ | ٢١.٧ | ١٣.٧ | ١٥.٢٢ | ٢٠.٢٥ | ١٧.٦٤ |
| **L.S.D. at ٥٪** | **N.S** | ٢.٤٧ | ٣.٤ | ٢.٧ | ٣.٣٤ | ١.٩٤ | ٢.٨ | **N.S** | ٢.٧٢ | ١.٦١ |

**Effect of hill spacing:**

Concerning the effect of the hill distances data in table (١) indicated that number of branches in first season and number of leaves per plant in both seasons were significantly affected by patterns distances between plant. Also, decreasing the distances between hills from ١٦.٠ cm and ١١.٠ to ٨.٠ cm significantly increased number of branches and number of leaves/plant. However, the differences between last two hill spacing (١١.٠ cm and ١٦.٠ cm) was insignificant on all growth characters and yield components, except on number of leaves per plant in the second season. These results are in harmony with those obtained by El-Fieshawy and Fayed (١٩٩٠); Zeidan *et al.* (١٩٩٠); Selim and El-Seesy (١٩٩١) and Amer *et al.* (١٩٩٢) who reported that the number of branches was significantly increased under the lower spacing between hills. On the contrary, Ibrahim and Esmail (١٩٩٤) indicated that no significant differences were found in the number of branches per plant by raising plant densities from ٧٠٠٠٠ to ١٠٥٠٠٠ plants per feddan at the first stage of faba bean growth characters. On the other hand, it is quite clear from results in table ( ٢ ) that the tallest plant height of ٧١.٧٣ and ٨٣.٥٨ in the two seasons, respectively were obtained in the treatment of ٨.٠ cm between plants, while the shortest plants of ٦٨.٦٣ and ٧٧.٤٦ cm in ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ seasons, respectively was obtained at ١٦.٠٠ cm between plants. Shahein *et al.* (١٩٩٥) reported that plant height was not affected by increasing plant density. These results are in concordance with the findings of Dantuma and Thompson (١٩٨٣); Stringi *et al.* (١٩٨٦); Abdel-Aziz *et al.*, (١٩٩٩); Al- Rifaee *et al.*, (٢٠٠٤); Abdel Latif, (٢٠٠٨) and Mehdi *et al.*, (٢٠١٠). for Plant height.

In this connection, data in table (١) indicated that number of branches per plant at ٨.٠ cm apart out-numbered that of ١١ and ١٦ cm apart by ١٢.٢٥ and ٢٧.٢٢%, respectively in ٢٠٠٩-٢٠١٠ season and by ٥.٤١ and ٧.٣٥%, respectively in ٢٠١٠-٢٠١١ season. Similarly, number of leaves per plant at ٨.٠cm apart out-numbered that of ١١.٠ and ١٦.٠cm apart by ١٨.٧٩ and ٣٧.٠٤% % respectively in ٢٠٠٩ season and by ٩.٩٤ and ١١.٧٣%, respectively in ٢٠١٠ season. Also, plant dry weight at last growth stage produced of ٣٢.٥٠ and ٤٥.٠٥٪ in ٢٠٠٩

season and ٠٣.٠٦ and ١٦.٢٥٪ in ٢٠١٠ season more yield than the distances of ٨.٠ and ١١.٠ cm, respectively. Such increase in number of branches and leaves/plant with decreasing plant spacing may be attributed to more competition among plant for light at dense population which reduce the metabolic processes formation and translocation of metabolites from source to sink. The present results were confirmed by finding of Abo-Shetaia (١٩٩٠), El- Fieshawy and Fayed (١٩٩٠), Zeidan *et al.,* (١٩٩٠); Selim and El-Seessy (١٩٩١); Amer *et al.,* (١٩٩٢); Singh *et al.,* (١٩٩٢); Shahein *et al.,* (١٩٩٥); Hassan *et al.,* (١٩٩٧); Metwally (١٩٩٧) and Abdel- Aziz and Shalaby (١٩٩٩).

Results in Table (١) indicated that plant dry weight at the last growth stage (١٢٠ days after planting) in both seasons increased significantly with increasing plant spacing from ٨.٠ cm to ١٦.٠ cm between hills. This was true at all growth stages in ٢٠٠٩ season and only, at last growth stage (١٢٠ days after planting) in ٢٠١٠ season. It is quite clear from these results that the highest dry weight per plant was obtained, when faba bean planted under plant hill of ١٦.٠ cm (Table ١). These results could be explained on the bases of the reduction of plant competition, more interception of light energy per plant, higher light energy conversion of light energy to chemical energy with a balanced carbohydrate distribution in different plant parts. These results are in concordance with the findings of Lemerle *et al.,* ٢٠٠٦); Mathews *et al.,* ٢٠٠٨ and Shad *et al.,* (٢٠١٠) who showed that the dense plant population may cause more lodging, less light penetration in the crop canopy and reduced photosynthetic efficiency that resulted in low grain yield.

Different plant spacing applied in the two growing seasons had a significant effect on plant height, number of seeds/plant, pods yield/plant, straw yield/plant and seeds yield/plant, except, on plant height as well as on straw yield per plant in ٢٠٠٩ season (Tables ٢). In most cases, differences between all plant spacing were significant on all traits in both seasons, except that either between ٨.٠cm and ١١.٠ cm on number of seeds per plant, pods yield/plant, straw yield/plant and seeds yield/plant in first season or between last two plant spacing

(١١.٠ cm and ١٦.٠ cm) on pods weight/plant and seeds yield/plant in the second season. Increasing plant density reduces light penetration between plants. As a result of plant competition for light, each individual plants tries to reach the proper light intensity by increasing its height. On the other hand, the highest number of seeds per plant of ٢٤.٨٩ and ٢٥.٥٨ in ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ seasons, respectively were obtained at planting distance of ١٦.٠cm between plants (Table ٢). Accordingly, the highest pods weight/plant of ٢٥.٧١ and ٢١.٧٠gm as well as the highest seeds weight /plant of ٢٠.٢٥ and ١٧.٦٤gm in ٢٠٠٩ and ٢٠١٠ seasons, respectively were obtained in the highest hill spacing (١٦.٠ cm). But, the highest straw weight per plant, (١٨.٧٦ and ١٨.٣١g) in ٢٠٠٩ and ٢٠١٠ seasons, respectively were obtained in the lowest plant spacing (٨.٠ cm). These increases in the number of seeds per plant, seeds and pods weight per plant with increasing hill spacing may be due to the 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. The results in table (٢) revealed that the hill spacing of ٨.٠ cm caused excess plant height of ٠٣.٧٢ and ٠٤.٥٢٪ in ٢٠٠٩ season and of ٠٤.١٩ and ٠٧.٩٠٪ in ٢٠١٠ season more yield than the distances of ١١.٠ and ١٦.٠ cm, respectively. On the other hand, hill spacing of ٨.٠ cm increased number of seeds per plant by ٢٢.٧٩ and ٣٥.٥٧٪ in ٢٠٠٩ season and by ١١.١٧ and ١٩.٣٧٪ in ٢٠١٠-٢٠١١ season more than the hill spacing of ١١.٠ and ١٦.٠ cm, respectively (Table ٢). Also, the hill spacing of ١٦.٠ cm produced pods weight per plant of ٢٨.٩٤ and ٢٠.٠٣% in ٢٠٠٩ season as well as of ١٣.٦٧ and ٧.٤٣٪ in ٢٠١٠-٢٠١١ season more yield than the distances of ٨.٠ and ١١.٠ cm, respectively. Moreover, hill spacing of ٨.٠٠ cm apart significantly increased straw weight by ٢٠.٨٨% and ٣٦.٩٣% more than the weight spacing of ١١.٠٠ and ١٦.٠٠, respectively in ٢٠٠٩ season, as well as of ١٠.٥٧% and ٢٠.٣٠% in the second season over two respective hill spacing. With the same trend, the results in Table (٢) revealed that the hill spacing of ١٦.٠ cm produced seeds weight per plant of ٣٢.٨٧ and ٢٢.٣٦% in ٢٠٠٩-٢٠١٠ season and of ١٨.٤٧ and ١٠.٠٤% in ٢٠١٠-٢٠١١ season more yield

than the distances of ٨.٠ and ١١.٠ cm, respectively. Results in Table (٢), also, showed that number of seeds/plant, pods and seed weight per plant was increased with increase in hill spacing which due to a better plant establishment and therefore a higher number of pods produced. It is well known that plant growth and yield characters were influenced by among and between plants competition for water, nutrients, and light. Also, these increase in the number of seeds per plant, seeds and pods weight per plant with increasing hill spacing may be due to increase in the number of pods per node as the result of higher net assimilation rates and reduction of competition in wider spacing. Also, this result might be due to the fact that widely spaced plants suffer less from competition than closely spaced plants and thus were expected to grow and yield better. These results support the findings of Al-Rifaee (١٩٩٩); Munir and Abdel-Rahman (٢٠٠٢); Abdel Latif, (٢٠٠٨); Mehdi *et al.*, (٢٠١٠) and Bakry *et al.* (٢٠١١) who found that seed yield per plant and pods yield plant were significantly increased by decreasing plant densities per unit area.

**Effect of interactions:**

It is quite clear from these results that planting dates × faba bean varieties (D x V) interaction effect was significant on both number of branches and number of leaves per plant in ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ seasons, where the highest number of branches per plant (٤.٨ and ٥.١) as well as number of leaves per plant (٦٩.٤ and ٦٦.٥) in ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ seasons, respectively (Table ٣). Results in Table (٣) also, indicated that the interaction between planting dates and varieties (D x V) had significant effect on dry matter accumulation per plant. This was similar at all growth stages in both growing seasons, where planted Giza variety produced the highest dry matter per plant at ٢nd and ٣rd growth stages (after ٩٥ and ١٢٠ days from planting) in both growing seasons. However, the highest dry matter per plant at first growth stage was noticed, when Fleeb var. seeded on ٣١-October (after ٦٥ days from planting) in both growing seasons. Plant dry weight per plant at three growth stages, number of branches and number of leaves per plant in both growing seasons, affected significantly by (D x P) interaction. Early sowing (on ٣١-

Oct.) with the wide hill spacing (١٦.٠ cm) gave the highest plant dry weight per plant at three growth stages in both growing seasons (Table ٣). However, the maximum number of branches and number of leaves per plant were resulted from sowing faba bean plants on ٣١-October under the narrowest hill spacing (٨.٠ cm) in two growing seasons (Table ٣).

**Table ٣: Effect of interaction between (D × V), (D x P) and (V x P) on plant dry weight (g), number of leaves/plant and number of branches/plant of faba bean in ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ seasons**

| Treatments | | Growth stages (days after planting) | | | | | | Characters | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ٦٥ | ٩٥ | ١٢٠ | ٦٥ | ٩٥ | ١٢٠ | Number of leaves/plant | | Number of branches/plant | |
| | | ٢٠٠٩-٢٠١٠ season | | | ٢٠١٠-٢٠١١ season | | | ٢٠٠٩-٢٠١٠ | ٢٠١٠-٢٠١١ | ٢٠٠٩-٢٠١٠ | ٢٠١٠-٢٠١١ |
| **Effect of interaction between (D × V)** | | | | | | | | | | | |
| Fleeb | ٣١-Oct | ٧.٢ | ٢٣.٨ | ٣٩.٩ | ٦.٥ | ٢٥.٣ | ٣٩.٦ | ٦٦.٩ | ٦١.٣ | ٤.٧ | ٤.٦ |
| | ٢١-Nov | ٤.٩ | ١٥.٢ | ٣٦.٢ | ٥.٥ | ١٣.٣ | ٣٢.٤ | ٥٤.٥ | ٦٠.٢ | ٤.٦ | ٤.٢ |
| | ١١-Dec | ٤.٨ | ٦.٩ | ٣٤.١ | ٣.٤ | ١٦.٠ | ٣٢.١ | ٣٧.٩ | ٥٥.٣ | ٣.٦ | ٣.٣ |
| | ٣١-Dec | ٤.٨ | ١٣.٤ | ٢٤.٨ | ٤.٥ | ١٦.١ | ٢٤.٩ | ٢٤.٩ | ٥٢.٥ | ٢.٩ | ٣.٣ |
| Giza | ٣١-Oct | ٦.٣ | ٢٤.٣ | ٤٤.٣ | ٥.٢ | ٢٥.٤ | ٤٥.٩ | ٦٩.٤ | ٦٦.٥ | ٤.٨ | ٥.١ |
| | ٢١-Nov | ٤.٧ | ١٥.٦ | ٣٨.٧ | ٤.٠ | ١٣.١ | ٣٣.٨ | ٥٦.٧ | ٦٥.٧ | ٤.٧ | ٣.٩ |
| | ١١-Dec | ٤.٦ | ٧.٠ | ٢٧.١ | ٢.٨ | ١٥.٤ | ٣٤.٤ | ٥٤.٦ | ٦١.٨ | ٤.٠ | ٣.٦ |
| | ٣١-Dec | ٣.٨ | ١٢.٩ | ٣٤.٦ | ٣.٩ | ١٣.٢ | ٢٣.٦ | ٣٨.٣ | ٥٥.٧ | ٣.٤ | ٣.٣ |
| L.S.D. at ٥٪ | | ٠.٩٦ | ٦.٧ | ٩.٣٢ | ١.٥ | ٣ | ٩.٦٢ | ١١.٧٨ | ١٢.٦٨ | ٠.٦٥ | ٠.٦٤ |
| **Effect of interaction between (D x P)** | | | | | | | | | | | |
| ٣١-Oct | ٨ cm | ٧.٢ | ٢١.٩ | ٣٥.٦ | ٥.٨ | ٢٤.٢ | ٣٨.٢ | ٧٩.٣ | ٧٠.٦ | ٥.٧ | ٥.٢ |
| | ١١ cm | ٥.٠ | ٢٤.٠ | ٣٤.١ | ٥.٧ | ٢٥.٣ | ٤٤.١ | ٦٥.٨ | ٦٤.٥ | ٤.٧ | ٤.٨ |
| | ١٦ cm | ٨.٠ | ٢٦.٣ | ٥٦.٦ | ٥.٩ | ٢٦.٦ | ٤٦.٠ | ٥٩.٣ | ٥٩.١ | ٣.٨ | ٤.٧ |
| ٢١-Nov | ٨ cm | ٤.٢ | ١٦.٩ | ٣١.٦ | ٤.٦ | ١٣.٧ | ٣٣.٥ | ٦٣.٧ | ٦٩.٩ | ٤.٨ | ٤.٣ |
| | ١١ cm | ٤.٠ | ١٣.٩ | ٣٤.٥ | ٤.٧ | ١٣.٨ | ٣٣.٧ | ٥٧.٦ | ٥٩.٤ | ٤.٨ | ٣.٥ |
| | ١٦ cm | ٦.٢ | ١٥.٣ | ٤٦.٢ | ٥.٠ | ١١.٩ | ٣٢.١ | ٤٥.٥ | ٥٩.٧ | ٤.٣ | ٤.٣ |
| ١١-Dec | ٨ cm | ٤.٣ | ٧.٦ | ٢٥.٨ | ٣.٠ | ١٥.١ | ٢٦.٢ | ٥٥.٠ | ٥٨.٧ | ٤.٤ | ٣.٥ |
| | ١١ cm | ٤.٨ | ٦.٥ | ٣٢.٧ | ٣.١ | ١٦.٨ | ٣٥.٢ | ٤٢.٥ | ٥٨.٩ | ٣.٧ | ٣.٦ |
| | ١٦ cm | ٥.٠ | ٦.٨ | ٣٣.٣ | ٣.٣ | ١٥.١ | ٣٨.٢ | ٤١.٢ | ٥٨.١ | ٣.٤ | ٣.٣ |
| ٣١-Dec | ٨ cm | ٤.٠ | ١١.٤ | ٢٥.٢ | ٣.٩ | ١٣.٨ | ٢٣.٦ | ٣٧.٢ | ٥٧.٩ | ٣.٤ | ٣.٤ |
| | ١١ cm | ٤.٥ | ١٣.٤ | ٢٨.٣ | ٤.١ | ١٤.٧ | ٢٥.٢ | ٣٢.٠ | ٥١.٢ | ٣.٢ | ٣.٧ |
| | ١٦ cm | ٤.٤ | ١٤.٧ | ٣٥.٥ | ٤.٦ | ١٥.٣ | ٢٣.٩ | ٢٥.٦ | ٥٣.٣ | ٣.٠ | ٢.٩ |
| L.S.D. at ٥٪ | | ١.٦٧ | ٤.٧ | ١٣.٣ | ٠.٨٦ | ٣.٢٣ | ٦.٨٨ | ١٠.٧ | ١٠.٧ | ٧.٣٩ | ٠.٥٦ |
| **Effect of interaction between (V x P)** | | | | | | | | | | | |
| Fleeb | ٨ cm | ٤.٩ | ١٤.٠ | ٢٧.٤ | ٤.٥ | ١٦.٩ | ٢٧.٩ | ٥٠.٠ | ٥٩.٧ | ٤.٥ | ٤.٠ |
| | ١١ cm | ٥.١ | ١٤.٣ | ٣٠.٧ | ٥.٠ | ١٧.٨ | ٣١.٦ | ٤٨.٤ | ٥٥.٠ | ٣.٨ | ٣.٨ |
| | ١٦ cm | ٦.٢ | ١٦.٢ | ٤٣.١ | ٥.٤ | ١٨.٢ | ٣٧.٨ | ٣٩.٧ | ٥٧.٣ | ٣.٥ | ٣.٨ |
| Giza | ٨ cm | ٤.٩ | ١٤.٩ | ٣١.٨ | ٤.١ | ١٦.٦ | ٣٢.٩ | ٦٧.٦ | ٦٧.٦ | ٤.٦ | ٤.٢ |
| | ١١ cm | ٤.٠ | ١٤.٦ | ٣٤.١ | ٣.٨ | ١٧.٥ | ٣٧.٠ | ٥٠.٥ | ٦٢.٠ | ٤.٤ | ٤.٠ |
| | ١٦ cm | ٥.٧ | ١٥.٣ | ٤٢.٧ | ٤.٠ | ١٦.٢ | ٣٢.٩ | ٤٦.١ | ٥٧.٧ | ٣.٧ | ٣.٨ |
| L.S.D. at ٥٪ | | ١.١٨ | ٣.٣٢ | ٩.٣٦ | ٠.٦ | ٢.٢٨ | ٤.٨٦ | ٩.٢٧ | ٧.٥٦ | ٠.٥٥ | ٠.٩٧ |

Also, V x P interaction had considerable effect on plant dry weight per plant at the three growth stages, number of branches and number of leaves per plant in both growing seasons, where the maximum values of plant dry weight per plant at three growth stages in both growing seasons were obtained by planting Fleeb var. at ١٦.٠ cm between hills (Table ٣). Also, the maximum values of number of branches and number of leaves per plant in both seasons were obtained by planting Giza var. at ٨.٠ cm between plants (Table ٣).

Plant height, number of seeds/plant, pods yield g/plant, straw weight g /plant and seeds weight g/plant significantly affected by interactions between planting dates X varieties (D × V), planting dates X hill spacing (D × P), varieties X hill spacing (V × P) and planting dates X varieties X hill spacing (D × V × P) in both seasons as shown in (Tables ٤,٥ and ٦).

When planting Giza var. of faba bean on ٣١-October gave the tallest faba bean plants (٧٦.٨ and ١٠٤.٥ cm), highest number of seeds/plant (٢٨.٣ and ٣٤.٣), maximum pods weight /plant (٢٦.٥ and ٢٦.٣ g) as well as highest seeds weight /plant (٢٠.٨ and ٢٠.٩ g) in ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ seasons, respectively. On the other hand, concerning the effect of (D x P) interaction on weight of plant traits, the maximum values of plant height (٧٤.٥ and ١٠٣.٢ cm) and straw weight per plant (٢٤.٠ and ٢١.٥ g) were recorded in ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ growing seasons, respectively through planting faba bean crop on ٣١-October under hill spacing of ٨.٠ cm. Also, the maximum number of seeds/plant (٣٠.٣ and ٣٠.٦), pods weight /plant (٣٠.٨ and ٢٥.٥ g) and highest seeds weight /plant (٢٤.٥ and ٢٠.٩ g) in ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ seasons, respectively were obtained, with planting faba bean on ٣١-October under hill spacing of ١٦.٠ cm.

With respect the effect of (V × P) interaction on plant traits, the results in Table (٤) showed that planting Giza var. under the narrowest plant density (٨.٠ cm), gave the maximum values of plant height (٧٤.٠ and ٨٨.٥ cm) and of straw weight /plant (١٩.٨ and ١٩.٨ g) in ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ seasons, respectively. Moreover, planting Giza faba bean var. under the widest hill spacing (١٦.٠ cm) gave the maximum values of number of seeds/plant (٢٩.٣ and ٣٣.١), pods

weight /plant (٢٧.٢ and ٢٤.٠ g) and seeds weight /plant (٢٠.٧ and ١٩.٤ gm) in ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ seasons, respectively.

**Table ٤: Effect of interaction between (D × V), between (D x P) and between (V x P) on faba bean yield components in ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ seasons**

| Treatments | | Plant height (cm) | | Number of seeds/plant | | Pods weight g/plant | | Straw weight g/plant | | Seeds weight g/plant | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ٢٠٠٩-٢٠١٠ | ٢٠١٠-٢٠١١ | ٢٠٠٩-٢٠١٠ | ٢٠١٠-٢٠١١ | ٢٠٠٩-٢٠١٠ | ٢٠١٠-٢٠١١ | ٢٠٠٩-٢٠١٠ | ٢٠١٠-٢٠١١ | ٢٠٠٩-٢٠١٠ | ٢٠١٠-٢٠١١ |
| **Effect of interaction between (D × V)** | | | | | | | | | | | |
| Fleeb | ٣١-Oct | ٦٩.١ | ٩٥.٨ | ٢١.٤ | ٢١.٠ | ٢٥.١ | ٢١.٤ | ٢٢.٥ | ١٨.٦ | ٢٠.٢ | ١٧.٥ |
| | ٢١-Nov | ٦٧.٣ | ٦٨.١ | ١٧.٦ | ١٧.٨ | ٢٢.٥ | ٢٢.٩ | ١٧.٠ | ١٧.٩ | ٢١.٢ | ١٨.٢ |
| | ١١-Dec | ٧٠.٤ | ٦٩.١ | ١٩.٧ | ١٥.٦ | ١٦.١ | ١٥.٤ | ١٥.٦ | ١٥.١ | ١٥.٨ | ١٢.٢ |
| | ٣١-Dec | ٦٤.٣ | ٦٩.٠ | ١١.٩ | ١٣.٥ | ١٩.٨ | ١٥.٤ | ١١.٤ | ١١.٢ | ١٣.٧ | ١٢.٩ |
| Giza | ٣١-Oct | ٧٦.٨ | ١٠٤.٥ | ٢٨.٣ | ٣٤.٣ | ٢٦.٥ | ٢٦.٣ | ١٨.٢ | ٢٠.١ | ٢٠.٨ | ٢٠.٩ |
| | ٢١-Nov | ٧٥.٩ | ٨٤.٢ | ٢٧.٩ | ٣١.٥ | ٢٧.٥ | ٢٣.٧ | ١٦.٠ | ١٦.٥ | ١٨.٢ | ١٤.٤ |
| | ١١-Dec | ٧٣.٢ | ٨٠.١ | ٢٢.٩ | ٢٨.٠ | ٢٢.٩ | ١٩.٥ | ١٥.٨ | ٢٠.٠ | ١٦.١ | ١٨.٦ |
| | ٣١-Dec | ٦١.٩ | ٧٢.٥ | ١٩.٧ | ٢٥.٠ | ١٨.٥ | ١٨.١ | ١١.٤ | ١٤.٠ | ١٢.٧ | ١٤.٩ |
| L.S.D. at ٥٪ | | ٩.٦ | ١٣.٧٣ | ٦.١ | ٧.١٤ | ٧.٨٨ | ٥.٠٦ | ٧.١ | ٤.٢٩ | ٥.٠٥ | ٣.١٥ |
| **Effect of interaction between (D x P)** | | | | | | | | | | | |
| ٣١-Oct | ٨ cm | ٧٤.٥ | ١٠٣.٢ | ٢١.٦ | ٢٦.٠ | ٢٢.٧ | ٢٢.٥ | ٢٤.٠ | ٢١.٥ | ١٧.٥ | ١٧.٦ |
| | ١١ cm | ٧٢.٠ | ٩٩.٠ | ٢٢.٧ | ٢٦.٤ | ٢٣.٨ | ٢٣.٥ | ٢٠.٠ | ١٩.٤ | ١٩.٦ | ١٩.٠ |
| | ١٦ cm | ٧٢.٣ | ٩٨.٤ | ٣٠.٣ | ٣٠.٦ | ٣٠.٨ | ٢٥.٥ | ١٧.٠ | ١٧.٢ | ٢٤.٥ | ٢٠.٩ |
| ٢١-Nov | ٨ cm | ٧١.٥ | ٨٠.٢ | ٢٠.١ | ٢٣.٤ | ٢٢.٣ | ٢٢.٥ | ٢٠.٦ | ١٨.٢ | ١٧.٣ | ١٤.٧ |
| | ١١ cm | ٧١.٢ | ٧٦.٥ | ٢١.٥ | ٢٤.٢ | ٢٣.٨ | ٢٢.٦ | ١٥.١ | ١٧.١ | ١٨.٤ | ١٦.٦ |
| | ١٦ cm | ٧٢.٠ | ٧١.٧ | ٢٦.٧ | ٢٦.٣ | ٢٨.٨ | ٢٤.٧ | ١٣.٨ | ١٦.٤ | ٢٣.٥ | ١٧.٥ |
| ١١-Dec | ٨ cm | ٧٣.٦ | ٧٧.٠ | ١٨.١ | ١٩.٤ | ١٦.٤ | ١٥.٨ | ١٨.٥ | ١٨.٦ | ١٤.٣ | ١٤.٣ |
| | ١١ cm | ٧٠.٩ | ٧٤.٧ | ٢٢.٠ | ٢٢.١ | ١٩.٨ | ١٧.٥ | ١٥.٠ | ١٧.٨ | ١٥.٦ | ١٥.٠ |
| | ١٦ cm | ٧٠.٨ | ٧٢.١ | ٢٣.٨ | ٢٣.٨ | ٢٢.٣ | ١٩.١ | ١٣.٥ | ١٦.٣ | ١٨.٠ | ١٦.٨ |
| ٣١-Dec | ٨ cm | ٦٧.٣ | ٧٤.٠ | ١٣.٧ | ١٦.٨ | ١٨.٣ | ١٥.٥ | ١١.٩ | ١٥.٠ | ١١.٩ | ١٢.٨ |
| | ١١ cm | ٦٢.٦ | ٧٠.٧ | ١٥.٠ | ١٩.٤ | ١٨.٢ | ١٧.٢ | ١١.٩ | ١٢.٠ | ١٢.٧ | ١٣.٥ |
| | ١٦ cm | ٥٩.٤ | ٦٧.٦ | ١٨.٧ | ٢١.٦ | ٢٠.٩ | ١٧.٥ | ١٠.٤ | ١١.٠ | ١٥.١ | ١٥.٣ |
| L.S.D. at ٥٪ | | ٥.٩٩ | ٤.٠٤ | ٥.٥٥ | ٤.٤ | ٦.٦٨ | ٣.٨٩ | ٥.٦٨ | ٣.٥٢ | ٤.٤٤ | ٢.٦٣ |
| **Effect of interaction between (V x P)** | | | | | | | | | | | |
| Fleeb | ٨ cm | ٦٩.٤ | ٧٨.٦ | ١٥.٢ | ١٦.٠ | ١٩.٠ | ١٨.٠ | ١٧.٧ | ١٦.٩ | ١٥.٦ | ١٤.٥ |
| | ١١ cm | ٦٧.١ | ٧٥.١ | ١٧.٣ | ١٦.٨ | ١٩.٣ | ١٨.٨ | ١٦.٨ | ١٥.٨ | ١٧.٧ | ١٥.٢ |
| | ١٦ cm | ٦٦.٧ | ٧٢.٨ | ٢٠.٥ | ١٨.١ | ٢٤.٢ | ١٩.٤ | ١٥.٤ | ١٤.٥ | ١٩.٨ | ١٥.٩ |
| Giza | ٨ cm | ٧٤.٠ | ٨٨.٥ | ٢١.٥ | ٢٦.٨ | ٢٠.٨ | ٢٠.١ | ١٩.٨ | ١٩.٨ | ١٤.٨ | ١٥.٣ |
| | ١١ cm | ٧١.٢ | ٨٥.٤ | ٢٣.٣ | ٢٩.٢ | ٢٣.٥ | ٢١.٦ | ١٤.٢ | ١٧.٣ | ١٥.٣ | ١٦.٩ |
| | ١٦ cm | ٧٠.٦ | ٨٢.٢ | ٢٩.٣ | ٣٣.١ | ٢٧.٢ | ٢٤.٠ | ١٢.٠ | ١٥.٩ | ٢٠.٧ | ١٩.٤ |
| L.S.D. at ٥٪ | | ٥.١٨ | ٣.٤٩ | ٤.٨ | ٣.٨١ | ٤.٧٢ | ٢.٧٥ | ٣.٩٦ | ٢.٤٩ | ٣.٨٤ | ٢.٢٨ |

## Response of faba bean (*vicia faba* l.) varieties to planting dates and hill spacing

Data in Table (٥) showed that interactions between (D x V x P) had significant effect on plant dry weight per plant at three growth stages, number of branches and number of leaves per plant in both seasons. Planting Fleeb var. on ٣١-October under widest hills spacing (١٦.٠ cm.) gave the highest plant dry weight at three growth stages in both seasons.

**Table ٥: Effect of interactions between planting date, varieties and hill spacing (D x V x P) on plant dry weight (g), number of leaves/plant and number of branches/plant of faba bean in ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ seasons**

| Treatments | | | Growth stages (days after planting) | | | | | | Characters | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ٦٥ | ٩٥ | ١٢٠ | ٦٥ | ٩٥ | ١٢٠ | Number of leaves/ plant | | Number of branches/ plant | |
| | | | ٢٠٠٩-٢٠١٠ season | | | ٢٠١٠-٢٠١١ season | | | ٢٠٠٩-٢٠١٠ | ٢٠١٠-٢٠١١ | ٢٠٠٩-٢٠١٠ | ٢٠١٠-٢٠١١ |
| ٣١-Oct | Fleeb | ٨ cm | ٦.١ | ١٨.٩ | ٣١.١ | ٦.٦ | ٢٤.٥ | ٣٢.٩ | ٦٧.٣ | ٦٧.٧ | ٥.٨ | ٥.٣ |
| | | ١١ cm | ٥.٩ | ٢٣.٩ | ٣١.١ | ٦.١ | ٢٤.٩ | ٣٩.٠ | ٦٨.٨ | ٦١.٢ | ٤.٤ | ٤.٤ |
| | | ١٦ cm | ٩.٥ | ٢٨.٦ | ٥٧.٥ | ٦.٧ | ٢٦.٨ | ٤٩.٢ | ٦٤.٦ | ٦٠.١ | ٣.٩ | ٤.٢ |
| | Giza | ٨ cm | ٨.٣ | ٢٤.٨ | ٤٠.١ | ٥.١ | ٢٣.٩ | ٤٣.٦ | ٩١.٣ | ٧٣.٥ | ٥.٧ | ٥.٢ |
| | | ١١ cm | ٤.٢ | ٢٤.٢ | ٣٧.٠ | ٥.٣ | ٢٥.٦ | ٤٧.٠ | ٦٢.٨ | ٦٧.٨ | ٥.١ | ٥.١ |
| | | ١٦ cm | ٦.٦ | ٢٣.٩ | ٥٥.٧ | ٥.٢ | ٢٦.٤ | ٤٥.١ | ٥٤.٠ | ٥٨.٢ | ٣.٦ | ٥.٢ |
| ٢١-Nov | Fleeb | ٨ cm | ٤.٩ | ١٩.٢ | ٢٩.٦ | ٤.٦ | ١٣.٣ | ٣٠.٣ | ٥٧.٨ | ٦٧.٧ | ٤.٥ | ٤.٥ |
| | | ١١ cm | ٤.٦ | ١٣.١ | ٣٤.٦ | ٥.٥ | ١٣.٦ | ٣٠.٠ | ٦١.٨ | ٥٦.٠ | ٥.٠ | ٣.٥ |
| | | ١٦ cm | ٥.٤ | ١٣.٣ | ٤٤.٣ | ٦.٥ | ١٣.٠ | ٣٦.٩ | ٤٣.٨ | ٥٧.٠ | ٤.٣ | ٤.٥ |
| | Giza | ٨ cm | ٣.٦ | ١٤.٦ | ٣٣.٧ | ٤.٥ | ١٤.٢ | ٣٦.٨ | ٦٩.٥ | ٧٢.١ | ٥.٢ | ٤.١ |
| | | ١١ cm | ٣.٤ | ١٤.٧ | ٣٤.٤ | ٤.٠ | ١٤.١ | ٣٧.٤ | ٥٣.٤ | ٦٢.٨ | ٤.٥ | ٣.٦ |
| | | ١٦ cm | ٧.١ | ١٧.٤ | ٤٨.١ | ٣.٦ | ١٠.٩ | ٢٧.٣ | ٤٧.٢ | ٦٢.٣ | ٤.٣ | ٤.٢ |
| ١١-Dec | Fleeb | ٨ cm | ٣.٩ | ٦.٩ | ٢٦.٢ | ٢.٩ | ١٤.٧ | ٢٦.١ | ٤٣.١ | ٤٨.٣ | ٤.٥ | ٣.٠ |
| | | ١١ cm | ٤.٨ | ٦.٧ | ٣٣.٤ | ٣.٥ | ١٧.٦ | ٣٢.٦ | ٣٩.٣ | ٥٦.٩ | ٣.٣ | ٣.٥ |
| | | ١٦ cm | ٥.٦ | ٧.٢ | ٤٢.٦ | ٣.٩ | ١٥.٧ | ٣٧.٥ | ٣١.٣ | ٦٠.٧ | ٣.٠ | ٣.٥ |
| | Giza | ٨ cm | ٤.٦ | ٨.٣ | ٢٥.٥ | ٣.١ | ١٥.٦ | ٢٦.٤ | ٦٧.٠ | ٦٩.١ | ٤.٣ | ٤.٠ |
| | | ١١ cm | ٤.٩ | ٦.٣ | ٣٢.٠ | ٢.٧ | ١٦.٠ | ٣٧.٩ | ٤٥.٨ | ٦٠.٨ | ٤.١ | ٣.٧ |
| | | ١٦ cm | ٤.٤ | ٦.٥ | ٢٤.٠ | ٢.٧ | ١٤.٦ | ٣٨.٩ | ٥١.٢ | ٥٥.٥ | ٣.٨ | ٣.٢ |
| ٣١-Dec | Fleeb | ٨ cm | ٤.٨ | ١٠.٩ | ٢٢.٦ | ٤.٠ | ١٥.١ | ٢٢.٤ | ٣١.٧ | ٦٠.٢ | ٣.٤ | ٣.٢ |
| | | ١١ cm | ٥.٣ | ١٣.٦ | ٢٣.٦ | ٤.٩ | ١٥.٢ | ٢٤.٩ | ٢٣.٨ | ٤٥.٨ | ٢.٥ | ٣.٨ |
| | | ١٦ cm | ٤.٢ | ١٥.٩ | ٢٨.١ | ٤.٨ | ١٧.٩ | ٢٧.٥ | ١٩.٠ | ٥١.٦ | ٢.٨ | ٢.٩ |
| | iz | ٨ cm | ٣.١ | ١١.٩ | ٢٧.٨ | ٣.٩ | ١٢.٦ | ٢٤.٩ | ٤٢.٦ | ٥٥.٧ | ٣.٣ | ٣.٥ |
| | | ١١ cm | ٣.٦ | ١٣.٢ | ٣٣.٠ | ٣.٣ | ١٤.٢ | ٢٥.٦ | ٤٠.٢ | ٥٦.٦ | ٣.٨ | ٣.٥ |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ١٦ cm | ٤.٦ | ١٣.٥ | ٤٢.٩ | ٤.٤ | ١٢.٧ | ٢٠.٣ | ٣٢.٢ | ٥٥.٠ | ٣.١ | ٢.٩ |
| L.S.D. at ٥٪ | ٢.٣٦ | ٦.٦٥ | ١٨.٧٤ | ١.٢١ | ٤.٥٦ | ٩.٧٣ | ٥.٢٤ | ١٥.١٣ | ١٢.٨٠ | ٠.٧٩ |

## Response of faba bean (*vicia faba* l.) varieties to planting dates and hill spacing

**Table ٦: Effect of interactions between planting date, varieties and hill spacing (D x V x P) on yield components of faba bean in ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ seasons**

| Treatments | | | Plant height (cm) | | Number of seeds/plant | | Pods weight g/plant | | Straw weight g/plant | | Seeds weight g/plant | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ٢٠٠٩-٢٠١٠ | ٢٠١٠-٢٠١١ | ٢٠٠٩-٢٠١٠ | ٢٠١٠-٢٠١١ | ٢٠٠٩-٢٠١٠ | ٢٠١٠-٢٠١١ | ٢٠٠٩-٢٠١٠ | ٢٠١٠-٢٠١١ | ٢٠٠٩-٢٠١٠ | ٢٠١٠-٢٠١١ |
| ٣١-Oct | Fleeb | ٨ cm | ٧١.٠٠ | ٩٦.٧٤ | ١٩.٦٠ | ٢٠.١٥ | ٢٣.٠٨ | ٢٠.٠٦ | ٢٢.٩٢ | ٢٠.٣٤ | ١٧.٠٩ | ١٥.٤٥ |
| | | ١١ cm | ٦٧.٤١ | ٩٥.٦٦ | ١٩.٤٨ | ٢١.٠٠ | ٢٢.٤١ | ٢٠.٣١ | ٢٤.٧٨ | ١٨.٧٦ | ٢٠.٠٨ | ١٧.٠٩ |
| | | ١٦ cm | ٦٨.٧٥ | ٩٤.٩٨ | ٢٥.٢٣ | ٢١.٩٠ | ٢٩.٧٧ | ٢٣.٧١ | ١٩.٨٦ | ١٦.٨٣ | ٢٣.٤١ | ٢٠.٠٨ |
| | Giza | ٨ cm | ٧٨.٠٠ | ١٠٩.٦ | ٢٣.٥٨ | ٣١.٩٠ | ٢٢.٣٦ | ٢٥.٠٣ | ٢٥.١٦ | ٢٢.٧٠ | ١٧.٩٠ | ١٩.٨٣ |
| | | ١١ cm | ٧٦.٦٦ | ١٠٢.٢ | ٢٥.٨٨ | ٣١.٧٠ | ٢٥.٢٥ | ٢٦.٧٠ | ١٥.٢٤ | ٢٠.٠٢ | ١٩.٠٤ | ٢٠.٩٦ |
| | | ١٦ cm | ٧٥.٨٣ | ١٠١.٨ | ٣٥.٤٥ | ٣٩.٣٥ | ٣١.٧٧ | ٢٧.١٩ | ١٤.١٩ | ١٧.٥٨ | ٢٥.٥٨ | ٢١.٧٩ |
| ٢١-Nov | Fleeb | ٨ cm | ٦٥.٨٣ | ٧٤.١٦ | ١٥.٠٥ | ١٦.١٥ | ١٩.٨٨ | ٢٢.٦٧ | ١٨.٣٥ | ١٨.٢٢ | ١٨.٩٥ | ١٧.٨٩ |
| | | ١١ cm | ٦٦.٨٣ | ٦٧.٠٨ | ١٦.٦٠ | ١٧.٦٠ | ٢٠.٢٧ | ٢٢.٧٨ | ١٦.٨٠ | ١٧.٩٧ | ٢٠.٩٦ | ١٨.٣٩ |
| | | ١٦ cm | ٦٩.١٢ | ٦٢.٩١ | ٢١.١٥ | ١٩.٥٥ | ٢٧.٣٣ | ٢٣.٢١ | ١٥.٩٩ | ١٧.٦٥ | ٢٣.٧٠ | ١٨.٣٤ |
| | Giza | ٨ cm | ٧٧.٢٥ | ٨٦.٢٤ | ٢٥.٢٠ | ٣٠.٧٠ | ٢٤.٨١ | ٢٢.٤٢ | ٢٢.٨٢ | ١٨.١٦ | ١٥.٧٢ | ١١.٦٠ |
| | | ١١ cm | ٧٥.٥٠ | ٨٥.٩٠ | ٢٦.٣٠ | ٣٠.٨٥ | ٢٧.٣٢ | ٢٢.٣٥ | ١٣.٤٤ | ١٦.٢١ | ١٥.٧٥ | ١٤.٧٩ |
| | | ١٦ cm | ٧٤.٨٣ | ٨٠.٥٠ | ٣٢.٢٥ | ٣٢.٩٥ | ٣٠.٢٨ | ٢٦.٢٧ | ١١.٦٩ | ١٥.٢١ | ٢٣.٢١ | ١٦.٧١ |
| ١١-Dec | Fleeb | ٨ cm | ٧١.٨٥ | ٦٩.٢٢ | ١٥.٣٤ | ١٤.٧٥ | ١٤.٢٦ | ١٤.٧٣ | ١٧.٩٨ | ١٦.١٨ | ١٣.٨٤ | ١١.٩١ |
| | | ١١ cm | ٦٩.٣٥ | ٦٩.٢٢ | ٢٠.٦٨ | ١٥.٤٠ | ١٥.٥٩ | ١٦.١١ | ١٣.٨٦ | ١٥.٧٨ | ١٦.٩٧ | ١٢.٤٩ |
| | | ١٦ cm | ٦٩.٨٥ | ٦٨.٩٧ | ٢٣.٠١ | ١٦.٥٠ | ١٨.٥٣ | ١٥.٣١ | ١٤.٨٣ | ١٣.٢٠ | ١٦.٥٦ | ١٢.٢٠ |
| | Giza | ٨ cm | ٧٥.٣٠ | ٨٤.٨٠ | ٢٠.٧٨ | ٢٤.١٠ | ١٨.٥٧ | ١٦.٨٧ | ١٨.٩٤ | ٢١.٠٠ | ١٤.٦٧ | ١٦.٧٤ |
| | | ١١ cm | ٧٢.٣٥ | ٨٠.١٥ | ٢٣.٢٨ | ٢٨.٧٥ | ٢٤.٠٩ | ١٨.٨٨ | ١٦.١٨ | ١٩.٨١ | ١٤.١٥ | ١٧.٦٠ |
| | | ١٦ cm | ٧١.٨٠ | ٧٥.٢ | ٢٤.٦ | ٣١.١ | ٢٦.١ | ٢٢.٨ | ١٢.١ | ١٩.٣ | ١٩.٣ | ٢١.٤٤ |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ٢ | ٨ | ٥ | ٠ | ٥ | ٧ | ٣ | ٦ | |
| ٣١-Dec | Fleeb | ٨ cm | ٦٩.٠٨ | ٧٤.٤٧ | ١٠.٧٥ | ١٣.٠٠ | ١٨.٩٤ | ١٤.٧٣ | ١١.٥٧ | ١٢.٧٥ | ١٢.٧٠ | ١٢.٧٠ |
| | | ١١ cm | ٦٤.٩١ | ٦٨.٣٧ | ١٢.٣٢ | ١٣.١٥ | ١٩.٠١ | ١٦.١١ | ١١.٧٤ | ١٠.٥٥ | ١٢.٩٨ | ١٢.٨٧ |
| | | ١٦ cm | ٥٩.٠٠ | ٦٤.٢٢ | ١٢.٥٥ | ١٤.٣٥ | ٢١.٣١ | ١٥.٣١ | ١٠.٩٠ | ١٠.٣٦ | ١٥.٤٨ | ١٣.٠٤ |
| | Giza | ٨ cm | ٦٥.٥٠ | ٧٣.٤٧ | ١٦.٦١ | ٢٠.٦٥ | ١٧.٥٨ | ١٦.١٨ | ١٢.٣١ | ١٧.١٦ | ١١.٠١ | ١٢.٩٩ |
| | | ١١ cm | ٦٠.٢٥ | ٧٣.١٢ | ١٧.٥٩ | ٢٥.٦٠ | ١٧.٤٥ | ١٨.٣٧ | ١٢.١٠ | ١٣.٣٥ | ١٢.٤٣ | ١٤.٠٥ |
| | | ١٦ cm | ٥٩.٨٣ | ٧١.٠٥ | ٢٤.٧٨ | ٢٨.٨٥ | ٢٠.٥٧ | ١٩.٧٦ | ٩.٩٣ | ١١.٦٠ | ١٤.٧٣ | ١٧.٥٥ |
| L.S.D. at ٥٪ | | | ١٠.٣٧ | ٦.٩٩ | ٩.٦١ | ٧.٦٣ | ٩.٤٥ | ٥.٥١ | ٧.٩٣ | ٤.٩٨ | ٧.٦٩ | ٤.٥٦ |

Concerning the effect of (D x V x P) interaction on plant traits, narrowest hill the data in Table (٦) showed that planting Giza var. on ٣١-October with the lowest plant spacing (٨.٠ cm) gave the tallest plants (٧٨.٠ and ١٠٩.٦ cm) and the maximum values of straw yield (٢٥.١٦ and ٢٢.٧٠ gm/plant) in ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ seasons, respectively. With this respect, planting Giza var. on ٣١-October under the widest hill spacing (١٦.٠ cm) gave the maximum values of number of seeds/plant (٣٥.٤٥ and ٣٩.٣٥), pods weight/plant (٣١.٧٧ and ٢٧.١٩ g) and seeds weight/plant (٢٥.٥٨ and ٢١.٧٩ g/plant) in ٢٠٠٩-٢٠١٠ and ٢٠١٠-٢٠١١ seasons, respectively.

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# Response of faba bean (*vicia faba* l.) varieties to planting dates and hill spacing

# الاختلافات في صفات النمو ومكونات المحصول لصنفين من الفول (*Vicia faba, L.*) في الاستجابة للمواعيد والمسافات بين الجور

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أقيمت تجربتان حقليتان في المزرعة التعليمية التابعة لكلية الزراعة – جامعة صنعاء خلال موسمي ٢٠٠٩ – ٢٠١٠و٢٠١٠–٢٠١١ لدراسة تأثير أربعة مواعيد زراعية (٣١ أكتوبر و٢١ نوفمبر و١١ ديسمبر و٣١ ديسمبر) والتي خصصت لها القطع الرئيسية وصنفين من الفول (فليب وجيزة) وزعت في القطع المنشقة وثلاث مسافات بين الجور (٨ و١١ و١٦ سم بين الجور) وزّعت في القطع تحت المنشقة، على صفات النمو ومكونات محصول الفول. وتتلخص أهم نتائج الدراسة للموسمين فيما يلي:

بصفة عامة أظهرت النتائج المتحصل عليها أن مواعيد الزراعة والمسافة بين الجور والمسافات الزراعية أثرت تأثيراً معنوياً على جميع الصفات المدروسة في كلا موسمي الزراعة. كما تشير النتائج المتحصل عليها إن الزراعة المبكرة لنباتات الفول (٣١ أكتوبر) أدت إلى ظهور زيادة معنوية في صفات النمو (الوزن الجاف للنبات وعدد الأوراق وعدد الأفرع لكل نبات وارتفاع النبات) وصفات مكونات المحصول (عدد البذور لكل نبات ومحصول القرون والقش والبذور لكل نبات) في الموسم الأول والثاني من الزراعة. وفيما يتعلق بتأثير الأصناف على الصفات المدروسة، فإن النتائج المتحصل عليها تشير إلى أن الأصناف قد أثرت تأثيراً معنوياً على صفتي الوزن الجاف للنبات فقط في المرحلة الأولى من النمو (بعد ٦٥ يوم من الزراعة) وعدد البذور لكل نبات في كلا موسمي الزراعة، بالإضافة إلى عدد الأوراق لكل نبات في الموسم الأول من الزراعة وارتفاع النبات ومحصول القرون ومحصول البذور لكل نبات في الموسم الثاني من الزراعة.

ومن ناحية أخرى أدت زراعة نباتات الفول على مسافة بين الجور/ ٨ سم إلى الحصول على أطول النباتات في موسمي الزراعة وأعلى قيمة لعدد الأوراق ولعدد الأفرع لكل نبات ولمحصول القش لكل نبات في الموسم الأول والثاني من الزراعة. وعلى العكس من ذلك فان زراعة نباتات الفول في جور ١٦ سم بين النباتات قد أدت إلى الحصول على

أعلى القيم لكل من صفات عدد البذور لكل نبات ومحصول القرون لكل نبات ومحصول البذور لكل نبات في موسمي الزراعة.

كما توضح النتائج المتحصل عليها أيضاً إلى أن جميع التفاعلات بين عوامل الدراسة (مواعيد الزراعة × الأصناف) وبين (مواعيد الزراعة × المسافات بين الجور ) و بين (الأصناف × المسافات بين الجور) وبين (مواعيد الزراعة × الأصناف × المسافات بين الجور) قد أثرت تأثيراً معنوياً على جميع الصفات المدروسة في كلا الموسمين.

كما تشير النتائج إلي أن أعلي محصول للبذور والقرون وعدد البذور لكل نبات تم الحصول عليها بزراعة الصنف جيزة في ٣١ أكتوبر تحت المسافة النباتية ١٦ سم في الموسم الأول والثاني من الزراعة، في حين تم الحصول على أعلى القيم لصفة الوزن الجاف للنبات من زراعة نباتات الصنف فليب تحت نفس الموعد الزراعي والمسافة بين الجور في الموسم الأول والثاني من الزراعة. كما أدت زراعة نباتات الصنف جيزة في نهاية أكتوبر (٣١ أكتوبر) تحت استخدام المسافة بين الجور ٨ سم إلى الحصول على أعلى القيم لصفات عدد الأوراق وعدد الأفرع لكل نبات وارتفاع النبات ومحصول القش لكل نبات في موسمي الزراعة.