



EFFECT OF PLANT DISTRIBUTION AND DENSITY ON YIELD AND YIELD COMPONENTS OF SOME FABA BEAN (*VICIA FABA* L.) CULTIVARS

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ABSTRACT:

A field experiment was conducted at the Agricultural Research Farm at Al-Kawthar site, Faculty of Agriculture, Sohag University, during 2014/15 and 2015/16 seasons to study the effect of plant density combined with its distribution on yield and yield components of some faba bean cultivars. Randomized complete blocks design (RCBD) in a split-plot arrangement with four replicates was used. Plant densities combined with distribution were arranged randomly in the main plots, whereas cultivars were allocated randomly in the sub-plots. Plant density combined with its distribution at four levels intra-row plant spacing (15, 25, 20 and 20 cm between hills) were performed to give 93333, 112000, 140000 and 140000 plants/fed, respectively. Four cultivars (Misr 3, Giza 843, Giza 716 and Nobararia 1) were used. The obtained results revealed that increasing plant density up to 140000 plants/fed significantly increased seed and protein yields per feddan in both seasons. Sowing at 25 cm between hills on both sides/ridge produced highest values of number of branches/plant, number of pods/plant, number of seeds/pod, seed yield/plant (g) and 100-seed weight (g) in both seasons. On the other hand, Sowing at 15 cm between hills on one side/ridge gave the lowest values for these traits except plant height which recorded the highest values in both seasons. Faba bean cultivars varied significantly in all studied characters. Giza 716 and Giza 843 cultivars produced higher seed and protein yields per feddan and significantly out-yielded the other cultivars in both seasons. It could be concluded that sowing Giza 716 with plant density of 140000 plants/fed resulted in the highest seed and protein yields.

INTRODUCTION:

Faba bean (*Vicia faba* L.), as a legume member belonging to Fabaceae family, is one of the most important winter legume crops for human consumption in Egypt as a protein source, where seeds contains between 24 and 35 % proteins. It is a multi-benefits crop that has the ability of N₂-fixing legume, so it is important for soil fertility, animal feeding and industry purposes. However production of faba bean in Egypt is still limited and falls to face the increasing local consumption of such crop.

Faba bean production affected by different factors such climatic conditions, soil fertility, water supply, varieties or genotypes, plant distribution and plant density, Many studies have been done on this concern, Zeidan *et al.* (1986) studied the effect of three plant densities (22, 33 and 44 plant/m²) on yield and yield components. They showed that increasing plant density to 44 plants/m² resulted a decrease in number of branches/plant and number of pods/plant. Density of 33 plants/m² produced the highest seed yield/feddan of 7.16 and 12.22 ardab in first and second seasons, respectively compared with the two other plant densities of 22 and 44 plants/m². Ghonema and Salama (1991) indicated that leaving one plant/hill spaced 10 cm apart and two plants/hill spaced 20 cm apart on the two sides of the ridges, yielded the highest seed yields of 10.5 and 10.35 ardab/fed, respectively through increasing 100-seed weight, number of

branches and pods per plant. Bakry *et al.* (2011) revealed that increasing plant density significantly increased seed and protein yields per feddan as well as plant height, 100-seed weight and biological yield per feddan. On the other hand, increasing plant density decreased number of branches and number of pods per plant, pods and seed yields per plant, number of seeds per pod and harvest index. Abd El-Hafez *et al.* (2012) indicated that sown Giza 843 with 27 plants/m² on November 5th maximized faba bean productivity, decreased aphid and virus infestation. Khalil *et al.* (2011) concluded that the highest seed yield was recorded from sown Giza 843 with 44 plant/m² on 15th November. Hafiz and Abd El-Mottaleb (1998) found that the differences among the three faba bean cultivars, (Giza 3, Giza 461 and Giza 716) in plant height and number of branches/plant were significant over both seasons. The highest number of seeds/pod, shelling percentage and 100 seed weight were recorded for Giza 716. Hussein *et al.* (1995) studied plant growth, nodulation, yield and yield components of new faba bean genotypes. They stated that number of pods and seeds per plant, seed yield/plant, seed and straw yields/hectare were significantly different according to the tested faba bean cultivars. Giza 716 produced the highest number of pods and seed yield per plant of 16.3, 35.4, respectively.

The objective of this investigation is to study the performance of some faba bean

cultivars under different plant densities and its distribution.

MATERIALS AND METHODS

A field experiment was carried out at the Agricultural Research Farm at Al-Kawthar site, Faculty of Agriculture, Sohag University, during 2014/15 and 2015/16 seasons. This study aimed to evaluate the response of some faba bean cultivars to plant densities and its distribution in newly reclaimed land of Sohag Governorate. Each experiment included 16 treatments, which were the combinations of four plant distribution and densities and four faba bean cultivars.

A. Plant distribution and density:

1. Planting seeds at 15 cm spacing on one side of the ridge, which equivalent 93.333 plants/fed = 23 Plants/m², **(D1)**.
2. Planting seeds at 25 cm spacing on both sides of the ridge, which equivalent 112.000 plants/fed = 27 Plants/m², **(D2)**.
3. Planting seeds at 20 cm spacing on both sides in faced hills shape, which equivalent 140.000 plants/fed = 34 Plants/m², **(D3)**.
4. Planting seeds at 20 cm spacing on both sides in alternative hills shape, which equivalent 140.000 plants/fed = 34 Plants/m², **(D4)**.

B. cultivars: Misr 3 (C1), Giza 843 (C2), Giza 716 (C3) and Nobarria 1 (C4).

Randomized complete blocks design in a split-plot arrangement with four replicates was used. Plant distribution and densities were

arranged randomly in the main plots, whereas cultivars were allocated randomly in the sub-plots. The experimental sub-plot area was 10.5 m² (3.5 m length and 3 m width), consisting of 5 ridges with 60 cm apart. The preceding winter crop was wheat (*Triticum aestivum* L.) followed by fallow in summer in both seasons. Sowing date was done on 20th and 19th of October in the first and second seasons, respectively. Thinning was done over all plots after 1st hoeing to remain the best two seedlings / hill. The phosphorus fertilizer in the form of calcium superphosphate (15.5% P₂O₅) at a rate of 200 kg/fed was added at sowing, while nitrogen fertilizer was added in the form of ammonium nitrate (33.5% N) at a rate of 20 kg/fed with sowing. Other cultural practices of faba bean were performed as recommended for faba bean production in the area by the Egyptian Ministry of Agriculture.

Data recorded were plant height (cm), number of branches/plant, number of pods/plant, number of seeds/pod, seed yield/plant (g), weight of 100 seeds (g), seed yield (Kg/fed) and protein yield (kg/fed) which was calculated by multiply protein % × seed yield (Kg/fed).

The collected data were statistically analyzed each season separately according Gomes and Gomes (1984) using Proc. GLM procedure (SAS version 9.1, SAS Institute 2003). Least significant difference (LSD) test at 5% level of probability was used for comparing

among means of the two studied factors and their interaction.

RESULTS AND DISCUSSION

Effect of plant density combined with its distribution, some faba bean cultivars and their interaction on yield and its components traits in addition to protein yields/fed will be presented as follows:

1-Plant height at harvest (cm):

Data in Table (1) showed significant differences in plant height of faba bean plants among either plant densities combined with distribution or the four studied cultivars in both seasons. However, plant densities x cultivars interaction did not exhibit significant effect on this trait in both seasons. Planting at 15 cm spacing on one side of the ridge (D₁) gave the tallest plants of 101.52 and 97.90 cm in the first and second seasons, respectively followed by planting at 25 cm spacing on both sides of the ridge (D₂) in both seasons. While, the shortest plants were recorded when planting at 20 cm on both sides in alternative hills shape (D₄) in first season (94.81 cm) and planting at 20 cm on both sides in faced hills shape (D₃) (88.93 cm) in the second season. The tallest plants obtained from the thick plant density due to competition among plants for light which consequently increased plant height. Similar results were also reported by Attia *et al.* (1987), Metwally (1997), Hatam *et al.* (1999), Othman and Assaf (2009) and Khalil *et al.* (2010).

As shown in Table (1) Giza 843 cultivar recorded the tallest plants of 102.83 and 98.07 cm in the first and

second seasons, respectively followed by Giza 716 and Misr 3 in both seasons. While, the shortest plants were recorded for Nubaria 1 cultivar of 91.51 and 86.42 cm in the first and second seasons, respectively. The differences between the faba bean cultivars under study in both seasons could be due to the variation in the genetical make up and their interaction with the environmental conditions prevailing during their growth. These results are in agreement with those obtained by Ashmawy *et al.* (1998), Hafiz and Abd El-Mottaleb (1998) and Hassan and Hafiz (1998).

2- Number of branches/plant:

Data presented in Table (2) showed significant differences in number of branches/plant among the four plant densities combined with its distribution treatments, cultivars and their interaction in both seasons. It is clear that number of branches/plant was increased significantly with increasing spacing between plants in both seasons. Planting at 25 cm spacing on both sides of the ridge (D₂) gave the highest values of number of branches/plant of 4.54 and 4.37 in the first and second seasons, respectively followed by planting at 20 cm spacing on both sides in alternative hills shape (D₄) and planting at 20 cm spacing on both sides in faced hills shape (D₃) in both seasons. On the other hand, planting at 15 cm spacing on one side of the ridge (D₁) gave the lowest values of number of branches/plant of 3.15 and 2.81 in the first and second seasons, respectively. The increase in number of branches/plant in wider

planting might be attributed to weak of competition among plants for light and nutrients. Similar results were also reported by Attia *et al.* (1987), El-Habbak and El-Naggar (1991), El-Douby *et al.* (2000), Bakry *et al.* (2011) and Abdallah (2014).

Results presented in Table (2) showed that Nubaria 1 cultivar recorded the highest values of number of branches/plant of 4.61 and 4.33 in the first and second seasons, respectively followed by Giza 716 and Giza 843 cultivars in both seasons. Whereas, Misr 3 cultivar gave the lowest values of number of branches/plant of 2.75 and 2.56 in the first and second seasons, respectively. The differences between the faba bean cultivars under the study in both seasons could be due to the variation in the genetical make up and their interaction with the environmental conditions prevailing during their growth. These results are in agreement with those obtained by Zeidan *et al.* (1986) and Hafiz and Abd El-Mottaleb (1998).

Also, the results in Table (2) indicate that the highest number of branches/plant of 5.67 and 5.42 were recorded for planting Nubaria 1 cultivar at 25 cm spacing on both sides of the ridge (D₂) in the first and second seasons, respectively. While the lowest number of branches/plant of 2.37 and 2.20 were recorded for planting Misr 3 cultivar at 15 cm spacing on one side of the ridge (D₁) in the first and second seasons, respectively.

3- Number of pods/plant:

Data in Table (3) showed significant differences in number of pods/plant among the plant densities combined with its distribution treatments, cultivars and their interaction in both seasons. It is clear that planting at 25 cm spacing on both sides of the ridge (D₂) gave the highest number of pods/plant of 12.10 and 10.58 in the first and second seasons, respectively followed by planting at 20 cm spacing on both sides in faced hills shape (D₃) and in alternative hills shape (D₄) in the first and second seasons, respectively with no significant differences between them in both seasons. So it could be said that plant distribution did not significantly affect this trait. On the other hand, planting at 15 cm spacing on one side of the ridge (D₁) gave the lowest number of pods/plant of 8.54 and 7.14 in the first and second seasons, respectively. The increase of number of pods/plant in wider planting might be due to reduce the competition among plants and shading effect which reflects on plant vigor, formation of assimilates and its translocation from source to sink. Similar results were also reported by Nawar *et al.* (2010), Bakry *et al.* (2011), Abdallah (2014) and Derogar and Mojaddam (2014).

Data in Table (3) showed clearly that Giza 716 cultivar recorded the highest values of number of pods/plant of 13.07 and 11.52 in the first and second seasons, respectively followed by Giza 843 and Misr 3 cultivars in both seasons. While, Nubaria 1 cultivar gave the lowest values of number of pods/plant of 6.28 and 5.58

in the first and second seasons, respectively. The differences between the faba bean cultivars under study in both seasons could be due to the variation in the genetical make up and their interaction with the environmental conditions prevailing during their growth. Such results agree with those reported by Zeidan *et al.* (1986), Hussein *et al.* (1995) and Hassan *et al.* (1997).

The effect of the interaction between plant densities combined with its distribution and cultivars on number of pods/plant in both seasons Table (3). The obtained data indicated that the highest number of pods/plant of 14.80 and 13.55 were recorded with planting Giza 716 cultivar at 25 cm spacing on both sides of the ridge (D₂) in the first and second seasons, respectively. While the lowest number of pods/plant of 5.20 and 4.50 were recorded by planting Nubaria 1 cultivar at 15 cm spacing on one side of the ridge (D₁) in the first and second seasons, respectively.

4- Number of seeds/pod:

The results in Table (4) indicated that number of seeds/pod was significantly affected by plant densities combined with its distribution and cultivars in both seasons, while the interaction between them did not significantly affect this trait. The maximum number of seeds/pod of 4.69 and 4.54 was obtained with planting at 25 cm spacing on both sides of the ridge (D₂) in the first and second seasons, respectively followed by planting at 20 cm spacing on both sides in alternative hills shape (D₄) and

in faced hills shape (D₃) in both seasons with no significant difference between (D₄) and (D₃). Whereas the minimum number of seeds/pod of 3.94 and 3.76 was produced with planting at 15 cm spacing on one side of the ridge (D₁) in the first and second seasons, respectively. Such increase in pod seeds number in wider planting may be due to increase plant vigor and its assimilates which reduce seed abortion rate. These results agree with those reported by El-Murshedy *et al.* (2002), Bakry *et al.* (2011) and Derogar and Mojaddam (2014).

As recorded in Table (4) Nubaria 1 cultivar possessed the highest number of seeds/pod of 5.29 and 5.06 in the first and second seasons, respectively followed by Giza 716 and Giza 843 cultivars in both seasons. While, the Misr 3 cultivar gave the lowest number of seeds/pod of 3.48 and 3.32 in the first and second seasons, respectively. In general the differences between the four cultivars of faba bean were mainly due to the differences in the genetical constitutions and its interaction with the environmental conditions prevailing during their growth. These findings are in agreement with those reported by El-Murshedy *et al.* (2002) and Bakry *et al.* (2011).

5- 100-seed weight (g):

Data in Table (5) showed significant differences in 100-seed weight among plant densities combined with its distribution treatments and cultivars in both seasons in addition to their interaction in the first season. It is clear that 100-

seed weight was increased significantly with increasing spacing between plants in both seasons. Planting at 25 cm spacing on both sides of the ridge (D₂) gave the heaviest 100-seed weight of 99.34 and 93.66 g in the first and second seasons, respectively followed by planting at 20 cm spacing on both sides in alternative hills shape (D₄) and in faced hills shape (D₃) in the first and second seasons with no significant differences between (D₄) and (D₃). On the other hand, planting at 15 cm spacing on one side of the ridge (D₁) gave the lightest 100-seed weight of 81.03 and 73.22 g in the first and second seasons, respectively. Wider planting produced the heaviest seeds might be attributed to low competition among plants which reflected on growth vigor, increase assimilates and its translocation from source to sink and increase the mass of seeds. Similar results were also reported by Nawar *et al.* (2010), Bakry *et al.* (2011), Abdallah (2014) and Derogar and Mojaddam (2014).

Concerning cultivars, Nubaria 1 recorded heavier 100-seed weight of 102.60 and 96.70 g in the first and second seasons, respectively followed by Giza 716 and Giza 843 cultivars in both seasons. Whereas, cultivar Misr 3 produced the lowest values of 100-seed weight of 82.64 and 74.28 g in the first and second seasons, respectively. The differences between the faba bean cultivars under study in both seasons could be due to the variation in the genetical make up and their interaction with the

environmental conditions prevailing during their growth. These results are in agreement with those obtained by Zeidan *et al.* (1986), Hassan *et al.* (1997) and Hassan and Hafiz (1998).

The effect of the interaction between plant densities combined with its distribution and cultivars on 100-seed weight in the first season only was recorded in Table (5). The highest value of 100-seed weight of 111.76 g was obtained with planting Nubaria 1 cultivar at 25 cm spacing on both sides of the ridge (D₂). Whereas, the lowest value of 100-seed weight of 73.01 g was obtained with planting Misr 3 cultivar at 15 cm spacing on one side of the ridge (D₁).

6- Seed yield/plant (g):

Results in Table (6) showed that seed yield/plant was significantly affected by plant densities combined with its distribution and cultivars in both seasons. The maximum seed yield/plant of 31.83 and 27.56 g was obtained from planting at 25 cm spacing on both sides of the ridge (D₂) in the first and second seasons, respectively followed by planting at 20 cm spacing on both sides in alternative hills shape (D₄) and in faced hills shape (D₃) in both seasons. However, the minimum seed yield/plant of 20.54 and 16.10 g was produced from planting at 15 cm spacing on one side of the ridge (D₁) in the first and second seasons, respectively. Such results may be attributed to increase of yield components i.e., number of seeds/plant and 100-seed weight. Similar results were obtained by El-Murshedy *et al.*

(2002), Hussein *et al.* (2002), Nawar *et al.* (2010) and Abdallah (2014).

Giza 716 cultivar recorded the highest values of seed yield/plant of 30.58 and 26.29 g in the first and second seasons, respectively followed by Giza 843 and Misr 3 in both seasons. On the other hand, Nubaria 1 cultivar recorded the lowest values for seed yield/plant of 22.74 and 16.56 g in the first and second seasons, respectively. This is due to the superiority of Giza 716 cultivar with regard to number of pods/plant. These results are in agreement with those obtained by Zeidan *et al.* (1986), Hussein *et al.* (1995) and Hassan *et al.* (1997). The interaction effect between plant densities combined with its distribution and cultivars on seed yield/plant was significant in the first season only Table (6). The highest value of seed yield/plant of 37.46 g was obtained by planting Giza 716 cultivar at 25 cm spacing on both sides of the ridge (D₂) in the first season. While, the lowest value in seed yield/plant of 17.35 g was obtained by planting Nubaria 1 cultivar at 15 cm spacing on one side of the ridge (D₁) in the first season.

7-seed yield (kg/fed):

Data in Table (7) showed significant differences in seed yield (kg/fed) of faba bean plants among the four plant densities combined with distribution treatments, cultivars and their interaction in both seasons. Planting at 20 cm spacing on both sides in alternative hills shape (D₄) treatment gave the greatest seed yield (kg/fed) of 1808.58 and 1676.30 kg in

the first and second seasons, respectively followed by planting at 20 cm spacing on both sides in faced hills shape (D₃) of 1802.63 and 1642.02 kg in the first and second seasons, respectively. Whereas, planting at 25 cm spacing on both sides of the ridge (D₂) came in the third concerning this trait in both seasons. On the other hand, the lowest values of seed yield of 1416.33 and 1220.85 kg were obtained by planting at 15 cm spacing on one side of the ridge (D₁) in the first and second seasons, respectively. Such results may be due to the increase of number of plants per unit area. These results are in agreement with those obtained by Nassib and Hussein (1988), Singh *et al.* (1992), El-Murshedy *et al.* (2002), Hussein *et al.* (2002), Nawar *et al.* (2010) and Bakry *et al.* (2011).

Giza 716 cultivar recorded highest values of seed yield (kg/fed) of 1857.54 and 1741.96 kg in the first and second seasons, respectively followed by Giza 843 cultivar which recorded 1766.22 and 1631.95 kg in the first and second seasons, respectively. Whereas, Misr 3 cultivar ranked the third which recorded 1609.89 and 1418.63 kg in the first and second seasons, respectively. While, the Nubaria 1 gave the lowest values of seed yield (kg/fed) of 1403.85 and 1165.82 kg in the first and second seasons, respectively. Giza 716 cultivar surpassed all studied cultivars in seed yield/fed in both seasons. This is to be logic since Giza 716 cultivar produced the highest mean value with regard to seed

weight/plant and consequently produced the highest seed yield. Such results agree with those reported by Zeidan *et al.* (1986), Hussein *et al.* (1995), Hassan *et al.* (1997) and Khalil *et al.* (2011).

The effect of the interaction between plant densities combined with its distribution and cultivars on seed yield (kg/fed) in both seasons was recorded in Table (7). Planting Giza 716 cultivar at 20 cm spacing on both sides in alternative hills shape (D₄) gave the greatest seed yield of 2040.61 and 1997.97 kg in the first and second seasons, respectively. On the other hand, the worst result was produced from Nubaria 1 cultivar with planting at 15 cm spacing on one side of the ridge (D₁) which were 1148.56 and 961.92 kg in the first and second seasons, respectively.

8-Protein yield (kg/fed):

The results in Table (8) indicated that the mean values of protein yield (kg/fed) were significantly affected by plant densities combined with its distribution treatments and cultivars in both seasons in addition to their interaction in the second season. Planting at 20 cm spacing on both sides in alternative hills shape (D₄) treatment gave the highest values of protein yield /fed of 549.04 and 500.03 kg in the first and second seasons, respectively followed by planting at 20 cm spacing on both sides in faced hills shape (D₃) and planting at 25 cm spacing on both sides of the ridge (D₂) in both seasons. On the other hand, the lowest values of protein yield /fed of 416.66 and 350.43 kg were obtained

by planting at 15 cm spacing on one side of the ridge (D₁) in the first and second seasons, respectively. The increase in protein yield in dense planting is mainly due to increase the seed yield per unit area. These findings are in agreement with those reported by Bakry *et al.* (2011) and Abdallah (2014). Giza 716 cultivar recorded higher values of protein yield (kg/fed) of 593.29 and 546.07 kg in the first and second seasons, respectively followed by Giza 843 in both seasons. Whereas, the Misr 3 cultivar produced the lowest value of protein yield (kg/fed) 449.05 kg in the first season and Nubaria 1 cultivar 366.41 kg in the second season. The differences between the faba bean cultivars under study for this trait in both seasons could be due to the variation of potential productivity of these cultivars. The same trend was obtained by Bakry *et al.* (2011).

The interaction effect between plant densities combined with distribution and cultivars in the second season was presented in Table (8). The highest value of protein yield/fed of 629.96 kg was obtained by planting at 20 cm spacing on both sides in alternative hills shape (D₄) with Giza 716 cultivar in the second season. While, the lowest value of protein yield/fed of 290.91 kg was obtained by planting Misr 3 cultivar at 15 cm spacing on one side of the ridge (D₁) in the second season.

It could be recommended that Giza 716 cultivar with plant density of 140000 plants/fed. gave the greatest seeds and protein yields/fed.

Table (1): Effect of plant distribution and density of some faba bean cultivars on plant height at harvest/cm in 2014/15 and 2015/16 seasons.

| Cultivars (C) | Season 2014/15 | | | | | Season 2015/16 | | | | |
|---|---------------------|----------------|----------------|----------------|--------|---------------------|----------------|----------------|----------------|-------|
| | Plant density (D) | | | | Mean | Plant density (D) | | | | Mean |
| | D ₁ | D ₂ | D ₃ | D ₄ | | D ₁ | D ₂ | D ₃ | D ₄ | |
| Misr 3 (c ₁) | 98.05 | 96.72 | 93.34 | 92.42 | 95.14 | 94.77 | 90.80 | 86.62 | 85.25 | 89.36 |
| Giza 843 (c ₂) | 107.78 | 104.20 | 101.45 | 97.90 | 102.83 | 103.50 | 98.65 | 95.75 | 94.38 | 98.07 |
| Giza 716 (c ₃) | 104.92 | 103.77 | 96.30 | 99.12 | 101.03 | 101.85 | 96.15 | 91.43 | 93.70 | 95.78 |
| Nubaria 1 (c ₄) | 95.32 | 92.62 | 88.27 | 89.82 | 91.51 | 91.48 | 87.32 | 81.95 | 84.93 | 86.42 |
| Mean | 101.52 | 99.33 | 94.84 | 94.81 | | 97.90 | 93.23 | 88.93 | 89.56 | |
| LSD 5% for: | | | | | | | | | | |
| (D): | | | | | 3.339 | | | | | 2.718 |
| (C): | | | | | 2.819 | | | | | 1.982 |
| (D x C): | | | | | n.s | | | | | n.s |
| (D ₁): Planting seeds at 15 cm spacing on one side of the ridge (23 plant/m ²). | | | | | | | | | | |
| (D ₂): Planting seeds at 25 cm spacing on both sides of the ridge (27 plant/m ²). | | | | | | | | | | |
| (D ₃): Planting seeds at 20 cm spacing on both sides in faced hills shape (34 plant/m ²). | | | | | | | | | | |
| (D ₄): Planting seeds at 20 cm spacing on both sides in alternative hills shape (34 plant/m ²). | | | | | | | | | | |

Table (2): Effect of plant distribution and density of some faba bean cultivars on number of branches/plant in 2014/15 and 2015/16 seasons.

| Cultivars (C) | Season 2014/15 | | | | | Season 2015/16 | | | | |
|---|---------------------|----------------|----------------|----------------|-------|---------------------|----------------|----------------|----------------|-------|
| | Plant density (D) | | | | Mean | Plant density (D) | | | | Mean |
| | D ₁ | D ₂ | D ₃ | D ₄ | | D ₁ | D ₂ | D ₃ | D ₄ | |
| Misr 3 (c ₁) | 2.37 | 3.05 | 2.72 | 2.87 | 2.75 | 2.20 | 3.00 | 2.65 | 2.40 | 2.56 |
| Giza 843 (c ₂) | 2.72 | 4.12 | 3.62 | 3.75 | 3.56 | 2.35 | 3.80 | 3.50 | 3.43 | 3.26 |
| Giza 716 (c ₃) | 3.65 | 5.32 | 4.25 | 4.47 | 4.43 | 3.17 | 5.25 | 3.70 | 4.20 | 4.08 |
| Nubaria 1 (c ₄) | 3.87 | 5.67 | 4.37 | 4.52 | 4.61 | 3.50 | 5.42 | 3.95 | 4.45 | 4.33 |
| Mean | 3.15 | 4.54 | 3.74 | 3.90 | | 2.81 | 4.37 | 3.45 | 3.62 | |
| LSD 5% for: | | | | | | | | | | |
| (D): | | | | | 0.223 | | | | | 0.272 |
| (C): | | | | | 0.185 | | | | | 0.255 |
| (D x C): | | | | | 0.370 | | | | | 0.509 |
| (D ₁): Planting seeds at 15 cm spacing on one side of the ridge (23 plant/m ²). | | | | | | | | | | |
| (D ₂): Planting seeds at 25 cm spacing on both sides of the ridge (27 plant/m ²). | | | | | | | | | | |
| (D ₃): Planting seeds at 20 cm spacing on both sides in faced hills shape (34 plant/m ²). | | | | | | | | | | |
| (D ₄): Planting seeds at 20 cm spacing on both sides in alternative hills shape (34 plant/m ²). | | | | | | | | | | |

Table (3): Effect of plant distribution and density of some faba bean cultivars on number of pods/plant in 2014/15 and 2015/16 seasons.

| Cultivars (C) | Season 2014/15 | | | | | Season 2015/16 | | | | |
|---|---------------------|----------------|----------------|----------------|-------|---------------------|----------------|----------------|----------------|-------|
| | Plant density (D) | | | | Mean | Plant density (D) | | | | Mean |
| | D ₁ | D ₂ | D ₃ | D ₄ | | D ₁ | D ₂ | D ₃ | D ₄ | |
| Misr 3 (c ₁) | 8.62 | 12.22 | 11.85 | 11.65 | 11.08 | 6.35 | 9.57 | 8.95 | 8.42 | 8.33 |
| Giza 843 (c ₂) | 9.75 | 14.15 | 13.80 | 12.83 | 12.63 | 8.92 | 12.40 | 11.23 | 10.86 | 10.86 |
| Giza 716 (c ₃) | 10.57 | 14.80 | 13.38 | 13.53 | 13.07 | 8.77 | 13.55 | 10.82 | 12.93 | 11.52 |
| Nubaria 1 (c ₄) | 5.20 | 7.22 | 6.18 | 6.53 | 6.28 | 4.50 | 6.80 | 5.38 | 5.65 | 5.58 |
| Mean | 8.54 | 12.10 | 11.30 | 11.13 | | 7.14 | 10.58 | 9.09 | 9.47 | |
| LSD 5% for: | | | | | | | | | | |
| (D): | | | | | 0.543 | | | | | 0.697 |
| (C): | | | | | 0.356 | | | | | 0.601 |
| (D x C): | | | | | 0.714 | | | | | 1.199 |
| (D ₁): Planting seeds at 15 cm spacing on one side of the ridge (23 plant/m ²). | | | | | | | | | | |
| (D ₂): Planting seeds at 25 cm spacing on both sides of the ridge (27 plant/m ²). | | | | | | | | | | |
| (D ₃): Planting seeds at 20 cm spacing on both sides in faced hills shape (34 plant/m ²). | | | | | | | | | | |
| (D ₄): Planting seeds at 20 cm spacing on both sides in alternative hills shape (34 plant/m ²). | | | | | | | | | | |

Table (4): Effect of plant distribution and density of some faba bean cultivars on number of seeds/pod in 2014/15 and 2015/16 seasons.

| Cultivars (C) | Season 2014/15 | | | | | Season 2015/16 | | | | |
|---|---------------------|----------------|----------------|----------------|-------|---------------------|----------------|----------------|----------------|-------|
| | Plant density (D) | | | | Mean | Plant density (D) | | | | Mean |
| | D ₁ | D ₂ | D ₃ | D ₄ | | D ₁ | D ₂ | D ₃ | D ₄ | |
| Misr 3 (c ₁) | 2.92 | 3.80 | 3.62 | 3.57 | 3.48 | 2.85 | 3.67 | 3.45 | 3.30 | 3.32 |
| Giza 843 (c ₂) | 3.80 | 4.27 | 4.15 | 3.95 | 4.04 | 3.63 | 4.15 | 3.80 | 3.75 | 3.83 |
| Giza 716 (c ₃) | 4.20 | 5.05 | 4.52 | 4.65 | 4.61 | 4.00 | 4.95 | 4.43 | 4.50 | 4.47 |
| Nubaria 1 (c ₄) | 4.85 | 5.65 | 5.27 | 5.40 | 5.29 | 4.55 | 5.40 | 5.02 | 5.27 | 5.06 |
| Mean | 3.94 | 4.69 | 4.39 | 4.39 | | 3.76 | 4.54 | 4.18 | 4.21 | |
| LSD 5% for: | | | | | | | | | | |
| (D): | | | | | 0.176 | | | | | 0.252 |
| (C): | | | | | 0.149 | | | | | 0.245 |
| (D x C): | | | | | n.s | | | | | n.s |
| (D ₁): Planting seeds at 15 cm spacing on one side of the ridge (23 plant/m ²). | | | | | | | | | | |
| (D ₂): Planting seeds at 25 cm spacing on both sides of the ridge (27 plant/m ²). | | | | | | | | | | |
| (D ₃): Planting seeds at 20 cm spacing on both sides in faced hills shape (34 plant/m ²). | | | | | | | | | | |
| (D ₄): Planting seeds at 20 cm spacing on both sides in alternative hills shape (34 plant/m ²). | | | | | | | | | | |

Table (5): Effect of plant distribution and density of some faba bean cultivars on 100- seed weight (g) in 2014/15 and 2015/16 seasons.

| Cultivars (C) | Season 2014/15 | | | | | Season 2015/16 | | | | |
|---|---------------------|----------------|----------------|----------------|--------|---------------------|----------------|----------------|----------------|-------|
| | Plant density (D) | | | | Mean | Plant density (D) | | | | Mean |
| | D ₁ | D ₂ | D ₃ | D ₄ | | D ₁ | D ₂ | D ₃ | D ₄ | |
| Misr 3 (c ₁) | 73.01 | 88.12 | 85.59 | 83.84 | 82.64 | 64.11 | 81.26 | 77.32 | 74.45 | 74.28 |
| Giza 843 (c ₂) | 76.97 | 93.01 | 88.48 | 86.03 | 86.12 | 68.97 | 87.36 | 83.51 | 81.39 | 80.31 |
| Giza 716 (c ₃) | 84.41 | 104.49 | 93.45 | 97.23 | 94.89 | 78.23 | 99.85 | 85.90 | 91.72 | 88.92 |
| Nubaria 1 (c ₄) | 89.75 | 111.76 | 102.90 | 105.99 | 102.60 | 81.54 | 106.19 | 97.65 | 101.42 | 96.70 |
| Mean | 81.03 | 99.34 | 92.61 | 93.27 | | 73.22 | 93.66 | 86.09 | 87.24 | |
| LSD 5% for: | | | | | | | | | | |
| (D): | | | | | 2.018 | | | | | 3.264 |
| (C): | | | | | 1.506 | | | | | 2.754 |
| (D x C): | | | | | 3.004 | | | | | n.s |
| (D ₁): Planting seeds at 15 cm spacing on one side of the ridge (23 plant/m ²). | | | | | | | | | | |
| (D ₂): Planting seeds at 25 cm spacing on both sides of the ridge (27 plant/m ²). | | | | | | | | | | |
| (D ₃): Planting seeds at 20 cm spacing on both sides in faced hills shape (34 plant/m ²). | | | | | | | | | | |
| (D ₄): Planting seeds at 20 cm spacing on both sides in alternative hills shape (34 plant/m ²). | | | | | | | | | | |

Table (6): Effect of plant distribution and density of some faba bean cultivars on seed yield/plant (g) in 2014/15 and 2015/16 seasons.

| Cultivars (C) | Season 2014/15 | | | | | Season 2015/16 | | | | |
|---|---------------------|----------------|----------------|----------------|-------|---------------------|----------------|----------------|----------------|-------|
| | Plant density (D) | | | | Mean | Plant density (D) | | | | Mean |
| | D ₁ | D ₂ | D ₃ | D ₄ | | D ₁ | D ₂ | D ₃ | D ₄ | |
| Misr 3 (c ₁) | 18.86 | 29.18 | 25.53 | 24.48 | 24.51 | 13.24 | 24.93 | 20.84 | 18.31 | 19.33 |
| Giza 843 (c ₂) | 22.37 | 32.45 | 28.58 | 25.92 | 27.33 | 18.60 | 29.74 | 24.57 | 22.68 | 23.89 |
| Giza 716 (c ₃) | 23.59 | 37.46 | 28.33 | 32.97 | 30.58 | 20.75 | 33.15 | 23.43 | 27.87 | 26.29 |
| Nubaria 1 (c ₄) | 17.35 | 28.22 | 21.07 | 24.32 | 22.74 | 11.81 | 22.46 | 14.55 | 17.43 | 16.56 |
| Mean | 20.54 | 31.83 | 25.87 | 26.92 | | 16.10 | 27.56 | 20.84 | 21.57 | |
| LSD 5% for: | | | | | | | | | | |
| (D): | | | | | 1.231 | | | | | 1.986 |
| (C): | | | | | 1.086 | | | | | 1.732 |
| (D x C): | | | | | 2.166 | | | | | n.s |
| (D ₁): Planting seeds at 15 cm spacing on one side of the ridge (23 plant/m ²). | | | | | | | | | | |
| (D ₂): Planting seeds at 25 cm spacing on both sides of the ridge (27 plant/m ²). | | | | | | | | | | |
| (D ₃): Planting seeds at 20 cm spacing on both sides in faced hills shape (34 plant/m ²). | | | | | | | | | | |
| (D ₄): Planting seeds at 20 cm spacing on both sides in alternative hills shape (34 plant/m ²). | | | | | | | | | | |

Table (7): Effect of plant distribution and density of some faba bean cultivars on seed yield (kg/fed) in 2014/15 and 2015/16 seasons.

| Cultivars (C) | Season 2014/15 | | | | | Season 2015/16 | | | | |
|---|---------------------|----------------|----------------|----------------|---------|---------------------|----------------|----------------|----------------|---------|
| | Plant density (D) | | | | Mean | Plant density (D) | | | | Mean |
| | D ₁ | D ₂ | D ₃ | D ₄ | | D ₁ | D ₂ | D ₃ | D ₄ | |
| Misr 3 (c ₁) | 1395.98 | 1583.61 | 1767.89 | 1692.07 | 1609.89 | 1109.77 | 1448.25 | 1621.76 | 1494.73 | 1418.63 |
| Giza 843 (c ₂) | 1519.63 | 1737.09 | 1972.22 | 1835.96 | 1766.22 | 1325.56 | 1590.24 | 1854.85 | 1757.15 | 1631.95 |
| Giza 716 (c ₃) | 1601.14 | 1826.83 | 1961.57 | 2040.61 | 1857.54 | 1486.16 | 1636.06 | 1847.64 | 1997.97 | 1741.96 |
| Nubaria 1 (c ₄) | 1148.56 | 1292.31 | 1508.85 | 1665.69 | 1403.85 | 961.92 | 1002.19 | 1243.82 | 1455.32 | 1165.82 |
| Mean | 1416.33 | 1609.96 | 1802.63 | 1808.58 | | 1220.85 | 1419.19 | 1642.02 | 1676.30 | |
| LSD 5% for: | | | | | | | | | | |
| (D): | | | | | 68.796 | | | | | 86.487 |
| (C): | | | | | 54.300 | | | | | 64.794 |
| (D x C): | | | | | 77.300 | | | | | 92.238 |
| (D ₁): Planting seeds at 15 cm spacing on one side of the ridge (23 plant/m ²). | | | | | | | | | | |
| (D ₂): Planting seeds at 25 cm spacing on both sides of the ridge (27 plant/m ²). | | | | | | | | | | |
| (D ₃): Planting seeds at 20 cm spacing on both sides in faced hills shape (34 plant/m ²). | | | | | | | | | | |
| (D ₄): Planting seeds at 20 cm spacing on both sides in alternative hills shape (34 plant/m ²). | | | | | | | | | | |

Table (8): Effect of plant distribution and density of some faba bean cultivars on Protein yield (kg/fed) in 2014/15 and 2015/16 seasons.

| Cultivars (C) | Season 2014/15 | | | | | Season 2015/16 | | | | | |
|---|---------------------|----------------|----------------|----------------|--------|---------------------|----------------|----------------|----------------|--------|--|
| | Plant density (D) | | | | Mean | Plant density (D) | | | | Mean | |
| | D ₁ | D ₂ | D ₃ | D ₄ | | D ₁ | D ₂ | D ₃ | D ₄ | | |
| Misr 3 (c ₁) | 381.14 | 447.06 | 495.96 | 472.06 | 449.05 | 290.91 | 402.27 | 435.48 | 409.82 | 384.62 | |
| Giza 843 (c ₂) | 428.32 | 512.26 | 571.51 | 533.25 | 511.34 | 362.94 | 459.41 | 522.60 | 500.09 | 461.26 | |
| Giza 716 (c ₃) | 500.30 | 595.44 | 625.49 | 651.92 | 593.29 | 454.99 | 525.98 | 573.34 | 629.96 | 546.07 | |
| Nubaria 1 (c ₄) | 356.89 | 422.85 | 484.86 | 538.91 | 450.88 | 292.88 | 324.01 | 388.51 | 460.24 | 366.41 | |
| Mean | 416.66 | 494.40 | 544.45 | 549.04 | | 350.43 | 427.92 | 479.98 | 500.03 | | |
| LSD 5% for: | | | | | | | | | | | |
| (D): | | | | | 33.250 | | | | | 27.625 | |
| (C): | | | | | 23.908 | | | | | 21.465 | |
| (D x C): | | | | | n.s | | | | | 42.780 | |
| (D ₁): Planting seeds at 15 cm spacing on one side of the ridge (23 plant/m ²). | | | | | | | | | | | |
| (D ₂): Planting seeds at 25 cm spacing on both sides of the ridge (27 plant/m ²). | | | | | | | | | | | |
| (D ₃): Planting seeds at 20 cm spacing on both sides in faced hills shape (34 plant/m ²). | | | | | | | | | | | |
| (D ₄): Planting seeds at 20 cm spacing on both sides in alternative hills shape (34 plant/m ²). | | | | | | | | | | | |

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تأثير الكثافة والتوزيع النباتي على المحصول ومكوناته لبعض اصناف الفول البلدي

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أجريت تجربة حقلية في مزرعة البحوث الزراعية بالكوثر، كلية الزراعة، جامعة سوهاج، خلال موسمي 15/2014 و 16/2015 لدراسة تأثير الكثافة والتوزيع النباتي على المحصول ومكوناته لبعض أصناف الفول البلدي، استخدم تصميم القطاعات كاملة العشوائية في ترتيب القطع المنشقة مرة واحدة في أربع مكررات. رتبت عشوائيا معاملات الكثافات مع التوزيع النباتي في القطع الرئيسية بينما رتبت الاصناف عشوائيا في القطع المنشقة. استخدم اربعة مستويات من الكثافة مع التوزيع النباتي حيث تمت الزراعة على مسافات (15، 20، 25، 20 و 20 سم بين الجور) لتعطي (93.333، 112.000، 140.000 و 140.000 ألف نبات للفدان على التوالي)، كما استخدم اربع اصناف من الفول البلدي هي مصر 3، جيزة 843، جيزة 716 ونوبارية 1. أدت زيادة الكثافة النباتية الى 140.000 ألف نبات/فدان الى زيادة معنوية في انتاجية محصولي البذور والبروتين للفدان في كلا الموسمين، بينما لم يظهر لتوزيع النباتات لنفس الكثافة النباتية تأثير معنوي على صفات المحصول ومكوناته وكذلك محصول البروتين في كلا الموسمين. وأدت الزراعة على 25 سم بين الجور الى الحصول على اعلى القيم لعدد الفروع/نبات، عدد القرون/نبات، عدد البذور/القرن، محصول البذور/نبات (جم) ووزن 100 بذرة (جم) في كلا الموسمين. ومن ناحية اخرى، أدت الزراعة على مسافة 15 سم بين الجور الى تسجيل أقل القيم لهذه الصفات باستثناء ارتفاع النبات في كلا الموسمين. وظهرت النتائج ان الاصناف المستخدمة من الفول البلدي اختلفت معنويا في جميع الصفات المدروسة، واعطى الصنف جيزة 716 يليه جيزة 843 أعلى انتاجية من محصول البذور والبروتين بشكل ملحوظ عن بقية الاصناف الاخرى في كلا الموسمين، وتأثرت معظم الصفات معنويا بالتداخل بين الكثافة مع التوزيع النباتي والاصناف في كلا الموسمين، وأظهرت النتائج أن زراعة صنف جيزة 716 مع كثافة نباتيه قدرها 140.000 ألف نبات/فدان الى الحصول على أعلى انتاجية لمحصول البذور والبروتين.