

THE ROLE OF PLANT DENSITY IN VEGETATIVE GROWTH AND YIELD TO FOUR VARIETIES OF FABA BEAN (*VICIA FABA L.*).

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ABSTRACT

The study was conducted in the vegetable field of the Department of Horticulture and Landscape Engineering, College of Agriculture and Forestry, University of Mosul, during the agricultural season 2018-2019 to study the effect of plant density on the vegetative growth characteristics and yield of four bean varieties, that is, by two factors: plant density (8 plants / m² and 12 plants / m²) and cultivars. (Local, Spanish, French, Dutch) within the (RCBD) design with three replications, as the number of transactions in the experiment was (8). The plant density of 8 plants/m² showed its superiority in most of the characteristics of vegetative growth and yield, except for the two characteristics of plant height and pod weight, where it was superior under the plant density of 12 plants/m². The local cultivar excelled in most of the characteristics of vegetative growth and the characteristics of total yield and plant yield compared with the Dutch or French variety. Give the lowest values for these traits.

INTRODUCTION

The broad bean (*Vicia faba. L*) is one of the economically important leguminous crops. Natalia et al. (2008) indicated that it has a high nutritional value, as the percentage of protein in the seed's ranges from 25-40%, carbohydrates 56%, nutrients, oils, fibers, vitamins, vitamin B complex, and a high percentage of Phytic acid (Wasfi, 2003; Carmen et al. 2005; Mahmoud, 2010), and it has a role in improving soil properties for its fixation of atmospheric nitrogen by root nodes. Its dry seeds or green pods are eaten, while straw is used as animal feed.

Statistics indicate that there is a decrease in yield productivity in Iraq due to reliance on primitive agriculture and as a result of the deterioration of varieties, it was found that the hybrid varieties were distinguished in their vegetative and productive characteristics, and it was found that the variety Giza-3 was superior to the variety Sakha-2 in terms of plant height, number of branches

per plant, number of leaves per plant, and yield seeds and potassium content, while the Sakha-2 cultivar was superior in the number of pods per plant (Khattab et al., 2016). Abou-El-Seba et al. (2016), while studying five cultivars (Giza 843, Giza 3, Giza 716, Nubarai 1 and Sakha 3), obtained the highest plant height, number of pods per plant, and area unit yield under Giza 843, compared with other cultivars, for both growing seasons. While the Giza 716 cultivar had the highest values in plant weight and for both growing seasons, while the Nubarai 1 cultivar excelled in the weight of 100 seeds and the seed yield per plant and the first growing season, these results are similar to those obtained by Hussien et al. (1999) and Abd El-Hafez et al. (2012). . In a study of two bean varieties under limited irrigation, it was noted that the Barakat variety was superior to the Aquodolce and Saraziri cultivars in the speed of filling the pods with grains and the unit area yield (Ghassemi-Golezani et al. 2009), Dahmardeh et al. (2010) and found that the cultivars had a significant role on the economic and biological yield. As the Algerian cultivar exceeded all other cultivars in terms of the yield of the economic and biological yield of the cultivars used in the experiment (Aljazayeri, Barekat, Shami and var. 3514).

The number of plants is very necessary per unit area in order to optimize the independence of the land, as this increases the yield of the plant and the yield per unit area. From researchers (Ameer et al., 2012).

Where the effect of plant distances (20, 30, 40, 50 cm between plants) on plant height (cm), number of branches / plants, number of pods / plants, average weight of pods (g), number of seeds / pods, seed weight was studied. / Century (g) under the drip irrigation system. They pointed out that the greater the planting distances, the lower the plant height, because in the close distances the competition between plants for sunlight increases as the number of branches increases with the increase in the planting distances. While Al-Suhaibani et al., (2013) indicated that the cultivation of 12 plants/m² achieved significantly lower plant height compared to 10 plants/m² and the number of such plants/m² achieved much lower height than 8 plants/m² under irrigation conditions.

However, Bakry et al., (2011) five bean cultivars (Cairo-4, Cairo-5, Cairo-25, Nubaria-1 and Giza-843) were grown each with 24, 21, 18, 15, 12 plants/m² in Recently reclaimed sandy soil. The results indicated that the bean cultivars differed significantly in all the studied traits, as the study showed that 18 in this type of soil followed by 16 plants / m² had the best plant density among those densities.

This led to an increase in the plant yield and the total yield per unit area. This is due to the increased distance between plants, which leads to an increase in the dynamic activity of root growth and increased branching, which provides more water and food to the plant in order to form more flowers and then the formation of pods (Peterson et al., 2017).

Low plant density may result in low production; However, higher plant density can lead to dormancy or lethargy of plants, lower light penetration between plants, lower photosynthetic efficiency, and can significantly reduce yield (Vassilev, 1998; Jettner. et al., 1998a 1998b; Lemerle. et al., 2004; Lemerle et al., 2006). Previous studies showed that yield and its components are affected by planting intensity (Turk Tawaha, 2002; Bakry. et al., 2011; Thalji, 2006 & 2010; Khalil. et al., 2011).

RESULTS AND DISCUSSION

Effect of plant density on the vegetative growth and yield of faba Beans

Table (1) shows the variation of plant density in its impact on the vegetative growth characteristics and yield of the bean. The high plant density of 12 plants/m² showed its superiority in plant height by 136.79 cm compared to the plants grown within the plant density of 8 plants/m², in which the

plant height decreased to 129.92 cm. Which at the same time gave the lowest values in the other traits represented by the number of branches per plant, the length of the pod, the number of pods per plant, the number of seeds per pod, the weight of the pod, the yield of one plant from pods and the total yield i/e compared with plants grown under high plant density 12 plants/m² which outperformed those traits.

Table (1): effect of plant density on the vegetative growth and yield of faba Beans.

p. d	P. H (cm)	N B/p	P L(cm)	N P / P	N S / P	W P (g)	Y P (g)	T Y t/h
12 p/m ²	136.79 A	6.76 B	14.94 B	26.87 B	3.60 B	22.42 A	589.42 B	58.35 B
8 p/ m ²	129.92 B	8.45 A	18.52 A	45.37 A	4.81 A	21.04 A	896.17 A	70.77 A

Effect of cultivars on the vegetative growth and yield of faba Beans.

Table (2) shows the differences of cultivars among themselves under the influence of plant density and their response to it, as the Spanish cultivar shows its significant superiority over the rest of the other cultivars in terms of plant height, but it does not differ significantly from the local cultivar in that trait and the Dutch cultivar has the least significant cultivar in plant height.

The local cultivar showed the best outperformance in the number of branches per plant, as it gave 9.38 branches/plant, but it did not differ significantly from the Spanish variety in that trait, while the Dutch variety gave the lowest values in the number of branches per plant, with a value of 5.88 branches/plant, while the French cultivar excelled in The characteristic of the length of the pod with a value of 18.53 cm compared to the rest of the other varieties, but it does not differ significantly from the Dutch variety in that characteristic.

The Spanish variety was superior in the number of pods per plant 49.25 pods/plant compared to the lowest number of pods observed under the Dutch variety, with a value of 24.25 pods per plant, but it did not differ significantly from the local variety in that variety, and the Spanish variety gave the lowest number of seeds inside the pod, reaching 3.92 seeds/pod compared with the other cultivars, which gave the best values in that trait, showing the French variety the highest values in that trait with a value of 4.67 seeds/pod.

The French cultivar was superior in pod weight with the highest values, amounting to 26.32 g, compared to the other cultivars, which gave the lowest values in that trait, but it did not differ significantly from the Dutch variety in that trait. The other two traits had values of 966.33 g/ha per plant and 84.24 i/ha, respectively, but it did not differ significantly from the Spanish cultivar in those two traits.

Table (2): Effect of cultivars on the vegetative growth and yield of faba Beans.

c	P. H (cm)	N B/p	P L(cm)	N P / P	N S / P	W P (g)	Y P (g)	T Y t/h
L	137.67 A	9.38 A	15.88 B	48.75 A	4.20 A	19.54 B	966.33 A	84.24 A
S	142.67 A	8.57 A	15 B	49.25 A	3.92 B	18.33 B	864.17 A	75.08 A
F	129.42 B	6.63 B	18.53 A	22.25 C	4.67 A	26.32 A	572.17 B	49.42 B
H	123.67 C	5.88 C	17.52 A	24.25 B	4.03 A	22.74 A	568.5 B	49.51 B

Effect of the interaction on the vegetative growth and yield of faba Beans.

Table (3) shows the effect of the interaction between the studied factors and their impact on the characteristics of vegetative growth and yield, leading to the most important traits studied through the research, which is the characteristic of the plant yield in terms of quantity and quality. 148.67 cm compared with the lowest values for the Dutch variety and for plants grown under low plant density, with a value of 121 cm. While the interaction of the local and Spanish cultivars under low density gave the highest values in the number of branches per plant, with a value of 9.767 branches/plant for each, compared with the lowest values for the Dutch variety under high plant density, which amounted to 4.767 branches/plant.

As for the length of the pod, the bilateral interaction of the local variety under low plant density gave the highest values, with a value of 19,333 cm, compared with the local variety or the Spanish variety, which gave the lowest values in that trait, amounting to 12,433 and 13.333 cm, respectively, for both cultivars, while the cultivar outperformed The Spanish variety under low plant density had the best values in the number of pods per plant, which amounted to 68,500 pods / plant compared to the French variety planted under high plant density, in which the rate of pod production decreased to 17.00 pods / plant or other varieties under the same plant density.

The French variety under low plant density gave a significant value in the number of seeds per pod, which amounted to 5,100 seeds / pod, and it was superior to the varieties grown under high plant density, where the Spanish variety gave the lowest values, reaching 3,333 seeds / pod, and even the French variety outperformed in the weight of the pod under plant density. It was higher than the Spanish variety under low plant density, which gave 14.943 g.

It appears from the table that the local cultivar under low plant density was significantly superior to the yield of one plant with a value of 1162.33 g compared with the French or Dutch cultivar, which gave the lowest values in that trait, which amounted to 443.33 and 473.00 g, respectively, but it does not differ significantly from the Spanish cultivar and for the same density. As for the total yield per unit area, it was parallel to the effect of the plant yield. The local variety under low plant density gave the highest values, recording 92.120 t/ha, compared to the French or Dutch variety, which gave the lowest values in that trait, which amounted to 43.833 and 46.733 t/ha, but it does not differ significantly from the Spanish variety and for the same plant density in this trait.

Table (3): effect of the interaction on the vegetative growth and yield of faba Beans.

p. d	c	P. H (cm)	N B/p	PL(cm)	N P / P	N S / P	W P (g)	Y P (g)	T Y t/h
12 p/ m ²	L	138.33 A B	9.000 A	12.433 D	40.00 C	3.4000 D	18.827 B C	770.33 B	76.367 A B
	S	148.67 A	7.267 B	13.333 D	30.00 D	3.3333 D	21.723 A- C	671.00 B	66.467 B C
	F	133.83 A-C	6.000 B C	17.933 A- C	17.00 E	4.2333 C	26.727 A	443.33 C	43.833 D
	H	126.33 B C	4.767 C	16.067 C	20.50 D E	3.4333 D	22.413 A B	473.00 C	46.733 D
8 p/ m ²	L	137.00 A B	9.767 A	19.333 A	57.50 B	5.0000 A B	20.253 A- C	1162.33 A	92.120 A
	S	136.7 A B	9.767 A	16.667 B C	68.500 A	4.5000 B C	14.943 C	1057.33 A	83.687 A
	F	125.00 B C	7.267 B	19.133 A B	27.50 D E	5.1000 A	25.917 A B	701.00 B	55.000 C D
	H	121.00 C	7.000 B	18.967 A B	28.00 D E	4.6333 A C	23.060 A B	664.00 B	52.287 C D

plant density = p. d plants/ m² = p/ m² cultivars= c Local = L Spanish = S French = F Holland = H

plant height = P . H Number of branches/plant = N B/p pod length = P L Number of pods = N P

Number of seeds per pod = N S / P Weight of pod = W P yield Plant = Y P Total yield = T Y

The cultivars show significant differences among themselves in most of the vegetative growth characteristics and the yield characteristics, and this may be due to the difference in genetic characteristics among them. In addition, the plant density has a major role in influencing these characteristics, as it was found that the plant height increased under the high plant density, and this is due to Intense competition between plants for light, water, and nutrients resulting in increased plant height. Othman and Assaf (2009), Khalil et al. (2010).

At the same time, the largest number of plant branches was obtained within the low agricultural density (spaced cultivation), and thus an increase in the number of plant leaves and then an

increase in leafy area, which leads to an increase in the efficiency of the photosynthesis process and then an increase in the processed food for the plant, due to the weak competition between Plants on light and nutrients. As indicated by Al-Douby et al. (2000), Bakri et al. (2011) and Abdullah (2014). For the same previous reason, there is an increase in the number of pods in the plant within the spaced cultivation, which is reflected in the vigor of the plant as a result of the decrease in shading between plants, and is consistent with the findings of (Nawar et al., 2010) and (Derogar and Mojaddam 2014).

CONCLUSION

Also, planting plants at farther distances led to an increase in the number of seeds inside the plant pods, and this is due to the increase in plant strength and its components that reduce the rate of seed abortion (El-Karamity et al., 2017). Also, the heaviness of the seeds can be attributed to the low competition between plants, which was reflected in the Vigorous growth, increased transfer of nutrients from the source to the seed and thus an increase in seed mass. The maximum yield/plant was obtained from spaced cultivation. The minimum seed/plant yield was produced from close-distance cultivation. These results may be attributed to the increase in yield components, ie number of seeds/plant and weight of 100 seeds. Similar results were obtained by (El-Murshedy et al., 2002) and (Hussein et al., 2002). This is also due to the increase in the number of plants per unit area in line with the results obtained by (El-Karamity et al., 2017) and also the results obtained by (Nassib and Hussein, 1988) and (Singh et al., 1992).

REFERENCES

- Abd El-Hafez, G.A.; T.H. Tohamy; A.M. Gabra and M.A.M. Ibrahim (2012). Influence of sowing dates, plant densities on aphid, (*Aphis craccivora* KOCH) infestation rate, yield and yield characteristics of two faba bean cultivars in minia region. *J. Plant Production, Man-soura Univ.*, Vol. 3(12): 2945-2956.
- Abdallah, Amany M. (2014). Response of faba bean (*Vicia faba* L.) to different planting densities and bio-mineral fertilization systems. *J. Agric. & Environ. Sci.*, 14 (6): 541-545.
- Abou-El-Seba, Sherifa E. A. ; A. M. Abou-Salama ; G. R. El-Nagar and M.A. El-Mohsen.(2016).Physiological Responses for Growth and Yield of Some Faba Bean Varieties Under Different Plant Densities . *Assiut J. Agric. Sci.*, (47) No. (6-1) (18-33) .
- B.A. Bakry; T.A. Elewa; M.F. El karamany; M.S. Zeidan , M.M. Tawfik, (2011) “Effect of Row Spacing on Yield and its Components of Some Faba Bean Varieties under Newly Reclaimed Sandy Soil Condition”, Department of Field Crops Research, National Research Centre, Giza, Egypt. *World Journal of Agricultural Sciences* 7 (1): 68-72 .
- Bakry, B. A.; T. A. Elewa; M. F. El Karamany; M. S. Zeidan and M. M. Tawfik (2011). Effect of row spacing on yield and its components of some faba bean varieties under newly reclaimed sandy soil condition. *World J. of Agri. Sci.*, 7 (1): 68-72 .
- Carmen, M. A., Z. J. Carmen, S. Salvador, N. Diego., R. M. Maria Teresa and T. Maria. (2005). Detection for Agronomic Traits in faba bean (*Vicia faba* L.). *Agric. Conspec. Sci.*,70 (3) pp17-20.
- Dahmardeh . M , M . Ramroodi and J . Valizadeh . (2010) . Effect of plant density and cultivars on growth, yield and yield components of faba bean (*Vicia faba* L.) . *Afr. J. Biotechnol.* Vol. 9(50), pp. 8643-8647 .
- El Douby, K. A.; S. E, Toaima, and R. A. Atalla (2000). Effect of ridge width and plant distribution patterns on faba bean yield and some of its components. *Ann. Agric., Sci., Moshtohor.* 38(2): 711-722.

- El-Karamity, A. E.; S. Sh. Abdullah and A. R. El-Ridwany . (2017) . effect of plant distribution and density on yield and yield components of some faba bean (*vicia faba* l.) cultivars . *Minia J. of Agric. Res. & Develop.* Vol. (37), No. 2, pp. 211-230,
- El-Murshedy, W. A.; M. A. ElMetwally and G. O. Mohmoud (2002). Performance of two faba bean varieties under different plant densities and nitrogen fertilization. *Assuit J. Agric. Sci., Egypt*, 30(4):200-210.
- Ghassemi-Golezani . K , S. Ghanehpour and A. Dabbagh Mohammadi-Nasab . (2009) . Effects of water limitation on growth and grain filling of faba bean cultivars . *Journal of Food, Agriculture & Environment* Vol.7 (3&4) : 442-447 .
- Hussein, A. H. A.; M. A. El Deeb and Kh. El Yamani (2002). Response of new faba bean genotypes to different sowing dates and plant densities in newly reclaimed lands in Upper Egypt. *National Ann. Coordination Meeting, Cairo*, 22-23 Sept. 70-74.
- Hussein, A.H.A.; M.A. El-Deeb; S.R. Saleeb and Kh. El-Asseily (1999). Response of the new faba bean genotypes to different plant densities in the old and newly reclaimed land in middle and upper Egypt. *Arab Univ. J. Agric. Sci., Ain-Shams Univ., Cairo*, 7(2), 467-473 .
- Jettner, R., S.P. Loss, K.H.M. Siddique and L.D. Martin. (1998a.) Response of faba bean to sowing rates in south- western Australia. i. seed yield and economic optimum plant density. *Australian J. Agri. Res.*, 49: 989-998.
- Jettner, R., S.P. Loss, K.H.M. Siddique and L.D. Martin. (1998b.) Response of faba bean to sowing rates in South-Western Australia II. Canopy development radiation absorption and dry matter partitioning. *Australian J. Agri. Res.*, 49: 999-1008 .
- K. L. Peterson. (2017) . Effect of Humic Acids and Plants Densities on Growth, and Productivity of Two Broad Bean Varieties”, A Thesis Submitted to the Faculty of Miami University in partial fulfillment of the requirements for the Master degree of Science. Miami University. Ohio,.
- Khalil, S.; A. Wahab; A. Rehman; Fida muhammad; S. Wahab; A. Z. Khan; M. Zubair; Mirkalan Shah; I. H. Khalil and R. Amin (2010). Density and planting date influence phenological development assimilate partitioning and dry matter production of faba bean. *Pak. J. Bot.*, 42(6): 3831-3838.
- Khattab, E. A., Elham A. Badr and Afifi M. H. (2016) . Response of Some Varieties of Faba bean (*Vicia faba* L.) to Boron and Potassium . *International Journal of Chem Tech Research*, 9(8),pp 98-103.
- Lemerle, D., B. Verbeek and S. Diffey. (2006) Influence of field pea (*Pisum sativum*) density on grain yield and competitiveness with annual rye grass (*Lolium rigidum*) in South-Eastern Australia. *Australian J. Exp. Agri.*, 46: 14651472.
- Lemerle, D., R.D. Causens, L.S. Gill, S.J. Peltzer, M. Moerkerk, C.E. Murphy, D. Collins and B.R. Cullis. (2004). Reliability of higher seeding rates of wheat for increased competitiveness with weeds in low rainfall environment. *J. Agric. Sci.*, 142: 395-409.
- Mahmoud A. Najm. (2010). Economic analysis of the response of broad beans to levels of n and p fertilizers. *J. Agric. Sci.*, 41 (5) PP 125-132.
- N. Al -Suhaibani, S. El-Hendawy¹, U. Schmidhalter. (2013) . Influence of Varied Plant Density on Growth, Yield of Faba bean *Vicia faba*, L”, *Turkish Journal of Field Crops* 18(2), and 185-197.
- N. N. Ameer, D. Ahmad, A. S. Abdullahi,(2012) . The effect of planting distance on the growth and yield of beans (*Vicia faba* L.) under drip irrigation system”, *African Journal of Agricultural Research* Vol. 7(46), pp. 6110 6114.
- Nassib, A. M. and A. H. A. Hussein (1988). Effect of plant density, variety and time of glyphosate application on orobanche infection and faba bean yield. *13 th Int. Cong. Stat. Comp. Sci., Demo. Res.*, pp. 31-42.

- Natalia Gutierrez., C. M, Avila., M. T, Moreno., and A.M,Torres .(2008). Development of SCAR markers linked to zt-2, one of the genescontrolling absence of tannins in faba bean, Aust J of Agric. Res., 59 pp62- 68.
- Othman, M. K and I. Assaf (2009). Effect of sowing date and density on productivity of broad bean in Deir Ezzor governorate. J. Agric. Sci. Demashk, Univ., 25(2): 77- 93.
- Singh, S. P.; N. P.Singh and R. K. Padney (1992). Performance of faba bean varities at different plant densities. FABIS Newsl., 30: 29-31.
- Thalji, T. (2006). Impact of row spacing on faba bean growth under Mediterranean rainfed conditions. J. of Agro., 5(3): 527-532.
- Thalji, T. (2010). Effect of plant density on seed yield and agronomic characters of faba bean (*Vicia faba* L.) under greenhouse conditions. Bios. Res., 7(1): 22-25.
- Turk, M.A. and A.R.M. Tawaha. (2002). Impact of seeding rate, sedding date, rate and method of phosphorus application in faba bean (*Vicia faba* L. Minpr) in the absence of moisture stres. Biotechnol. Argon. Soc. Environ., 6(3): 171-178.
- Vassilev, V.I. (1998). *Pseudomonas Marginalis* pv. *Marginalis* and some other bacteria on faba bean. FAB IS Newsletter 41: 21-24 .
- Wasfi., Z. (2003). Cultivation of field crops. Aladdin foundation for printing and publishing. Republic Musrarabn. pp2-30.