Impact of planting distances and boron spraying on fenugreek growth and seed content of active ingredient

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Abstract

This experiment was conducted at the Second Agricultural Research Station of the College of Agriculture / Al-Muthanna University in the Al-Bandar area located on the banks of the Euphrates River (3 km away from the center of Samawah city), during the winter season 2023-2024, to study the effect of different planting distances (20, 25, 30 and 35 cm) and spraying the vegetative group with different concentrations of boron (0, 15, 30 and 45 mg B L-1) on the growth, yield and active ingredient of fenugreek plant. The experiment was conducted in a randomized complete block design (R.C.B.D) with split-plot arrangement and three replicates. The planting distances represented the main factor and the boron concentrations represented the secondary factor. The results showed that the distance (35 cm) was significantly superior and recorded the highest values in the number of main branches and leaf area of the plant. The distance of 30 cm recorded the highest value in the leaf content of total chlorophyll and the percentage of total alkaloids in the seeds, while The 25 cm spacing recorded the highest values for fixed oil percentage in seeds and fixed oil yield in seeds.The results showed that the boron spray treatment (45 mg/L-1) was superior, with the highest values recorded for leaf area, total leaf chlorophyll content, fixed oil percentage in seeds, total fixed oil yield in seeds, and total alkaloids in seeds.

Keywords: plant fenugreek, boron, planting distances, growth, active ingredient .

Introduction

Medical plants occupied an important space in traditional medicine, herbal treatment and 80% of the world's population is still dependent on them to provide them with access to them and the lack of cost and efficient effectiveness to avoid negative trends from the use of drugs Chemical, most medical plants are non-toxic, but some of them are very toxic for both human and animals [13.[

Trigonella Foenum - Graecum L. belongs to the Fabaceae Lighter Family, a herbal herbal plant with a self-enrichment of self-enrichment, but it has become widespread in Iraq and India [2]. There are 70-97 different kinds of circuit plant in the world [18.[

Agricultural and plant density are important factors that affect the growth and hold the ring plant through their impact on the optical construction process and the process of absorption of foods [17]. One of the important factors in controlling the proportion and efficiency of effective rays is an optical construction process that affects the growth and productivity of plant [14.[

The difference between planting distances leads to a difference in the number of plants per unit area, and consequently to a difference

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in the intensity of competition between growing plants for the basic growth elements such as light and nutrients in the soil, and thus the process of photosynthesis and the phenotypic characteristics of plants are affected, which in turn affect the growth characteristics that will be reflected in the yield [4. [

The boron is a major food and a major efficiency, which contributes to facilitating the movement and transmission of photographic construction outputs from leaves to storage areas in plant and contributes to the election and process of cells and configuring its walls as the presence of boron is increasing Control for water plant absorption and believes to have a major role in the accumulation of carbohydrate content and increasing its focus in the plant as well as its configuration for nuclear acids and increases in the construction of protein [16 .[

Studies indicate the importance of micronutrients, including boron, in increasing flower set, cell division, pollen production, and increasing the fertilization process, thus increasing the seed yield and its components [11 .[

Material and Methods

Prepare samples:

A field experience was implemented during the winter season (2023-2024) in Muthanna province, within a circie of latitude (31.320) and longitude (45.300). The soil was a clay sand. To study the impact of planting distances and boron spraying on fenugreek growth and seed content of active ingredient.

Studied traits:

Ten plants were randomly taken from the medians of each experimental unit.

Results and Discussion

-1Plant Height (cm :(

Measurements for this trait were taken from the point of stem contact with the soil to the highest peak of the plant using a measuring tape. The reading was recorded as an average of ten plants from each experimental unit.

-2Number of main branches per plant (branch plant-1:(

Count the number of branches connected to the main stem at the stage of complete cone development for the ten plants taken from each experimental unit.

-3leaf area (cm2:(

The leaf area of the fifth leaf of each plant, fully expanded from each experimental unit, was measured using the method described by [15] using a scanner and Image software on a computer.

-4Total chlorophyll content (mg 100 g^{-1} fresh weight:(

Total chlorophyll was determined by taking a 0.5 g sample of the fifth leaf from the growing tip of each treatment and placing it in a porcelain mortar. Then, 10 mL of 85% acetone was added, ground, and filtered to separate the pigment solution from the leaf tissue using Whatman No.1 filter paper. The process was repeated again to extract the remaining pigments with an additional 5 mL of acetone. The combined filtrate from both filtrations was brought up to a volume of 15 mL using acetone, and the readings were taken using a spectrophotometer and the following equation.

Total chlorophyll=20.2xD (645) +8.02xD (663) (V/W x1000) ×100

-5Percentage of fixed oil in seeds:(%)

The percentage of fixed oil was estimated in the graduate laboratory at the College of Agriculture, Al-Muthanna University, using a Sohxlet continuous extraction device according to the method described in [5.[

-6Fixed oil yield (kg ha-1:(

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Fixed oil yield (kg ha1-) is calculated by multiplying the fixed oil percentage by the seed yield per hectare as follows:

Oil yield (kg ha1-) = % oil × seed yield (kg ha1.(-

-7Total alkaloid content in plant seeds:(%)

100 grams of seeds were taken from each experimental unit and ground and sieved. The lipids were then extracted using hexane for 24 hours in a Soxhlet extraction device. The extract was then filtered and the hexane was evaporated on a rotary evaporator until dry, preparing it for the total alkaloid extraction process.

1 gram of the plant extract was taken and placed in sterile glass tubes. 5 ml of phosphate buffer and 5 ml of bromoxyl green (BCG) solution were added. 4 ml of chloroform were then added gradually with continuous stirring. The fraction present in the chloroform layer was then read at a wavelength of 470 nm using a SpectraMax Plus 384 from the American company Molecular Devices [6 .[

Results and Discussion

High plant (cm(

The results of a table (1) indicated that there was no significant impact of farming and boron spraying and interfering with the characterization of plant height

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Table 1. Effect of planting distances, boron application and their interaction on plant height (cm (

Average	mg B L^{-1}) (Boron spray levels				Planting distances (cm)
	45	30	15	0	
127.1	128.9	128.2	122.8	128.3	20
123.4	118.4	123.1	125.5	126.6	25
121.8	124.4	120.8	123.3	118.7	30
122.2	126.3	121.8	120.3	120.2	35
	124.5	123.5	123.0	123.4	Average
Interference	Boron concentrations		Planting distances		L.S.D 0.05
N.S	N. S		N. S		

Number of main branches per plant (branch plant-1

:(

It was observed in a table (2) that farming distances is moral influence in increasing the number of major plans and accompanied by this increase with increased distance between the lines. Morium for distance (30 cm) at 7.31 plant branch-1 and a significant difference on the two and 25 cm 6.68 and 6.96 plant-1 branch. Plants may return in the number of pregnant women (35 and 30) cm that the plant has taken enough area to increase the number of branches, while plants cultivated in narrow

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distances (number of more plants in the unit of space) are suffering from shading The vulnerability of environmental factors, which reduces the number of branches, these results are consistent with [7]. Who have reached the decrease of plant density caused an increase in the average number of plant branches.

The results in Table (2) also showed that there are significant differences between the boron spray concentrations, given the focus (45 Mg B L-1) higher the average of 7.27 plant branch-1 which is not significantly different with a focus of(30 Mg B L-1)that gave average 7.01 branch of plant-1, while outweight and an overview of the comparison treatment, at 6.81 plant-1 branch. This result has agreed with the mechanism [3], [8]. Which reached increased boron concentration increases the number of plant forests.

Table2. The effect of planting distances, boron spraying and the interaction between them on the number of main branches of a plant (plant branch-1 (

Average	mg B L^{-1}) (Boron spray levels				Planting distances (cm)
	45	30	15	0	
6.68	6.97	6.86	6.56	6.35	20
6.96	7.18	7.03	7.03	6.61	25
7.31	7.42	7.33	7.30	7.20	30
7.33	7.51	7.53	7.16	7.10	35
	7.27	7.19	7.01	6.81	Average
Interference	Boron concentrations		Planting distances		L.S.D 0.05
N.S	0.23		0.38		

leaf area (cm2:(

The results of table (3) indicate that farming distances are positive and moral impact on increasing the paper area. The distance (35 cm) has given an average of 10.52 cm 1,200 sheets, which are so freedy on farming distances (30, 25 and 25 and 25 and 25 20) The average gave average (9.17, 9.32 and 8.17) cm2 sheets -1 on relay, the cause of low paper space per plant may be attributed to the increase in plant density (narrow cultivation spaces) back to the intensity of competition Between plants on different growth requirements, especially light, water and nutrients, reflected negatively on paper space. This result is agreed with [1.[

The results of the table (3) indicate that the boron concentration is 45 Mg B L-1 has increased significantly in the average paper space reached 9.82 cm2 sheets, which is not significantly different from the focus of 30 Mg B L-1 liter gave an average of 9.80 cm Paper-1, comparison treatment with average 8.59 cm2 sheets. The reason for increasing paper space has been attributed to the positive role of the Puron to increase the speed of the

division of paper cells and increase its expansion. These results are consistent with what I have reached [10] and [9]. Those who have increased boron concentration increases the paper space for plant.

Table3. Effect of planting distances, boron application levels and overlap on plant leaf area (cm2 leaf-1(

Average	mg B L^{-1}) (Boron spray levels				Planting distances (cm)
	45	30	15	0	
8.17	8.60	8.74	7.79	7.57	20
9.32	10.15	9.65	8.94	8.55	25
9.17	9.51	9.89	8.66	8.63	30
10.52	11.03	10.94	10.51	9.61	35
	9.82	9.80	8.97	8.59	Average
Interference	Boron concentrations		Planting distances		L.S.D 0.05
N.S	0.26		0.94		

Total chlorophyll content (mg 100 g^{-1} fresh weight :(

The results are shown in a table (4) outstanding farming (30 cm). The highest average was given (111.61 mg 100g-1), which has not different from the average distance (35 cm), with 111.45 mg 100g-1 (25 and 20), given an average of 103.66 and 92.86 mg 100g-1, disagreed on relay and may be due to increased papers from chlorophyilles to increase farming spaces Ziad intercept the plant for light by increasing paper space (table 3) and then lack of competition between plants on growth factors. These results are consistent with what [1] when studying on the veil plant contrasting chlorophyll content among farming spaces.

The results indicated in the same table until the content of chlorophyll had been significantly affected by the boron spray concentration. The focus achieved 45 mg B L-1 higher amid (107.22 mg 100g-1), while the comparison treatment was given the lowest medium 101.47 mg 100g-1, the reason for increasing chlorophyll content in leaves increased by increasing the focus of the boron to its role in influencing the increase in paper space for plant (Table 3). These results conform to the mechanism [9.[

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Table4. Effect of planting distances, boron spray concentrations and their interaction on leaf chlorophyll content (mg/100g(

Average	mg B L^{-1}) (Boron spray levels				Planting distances (cm)
	45	30	15	0	
92.86	98.40	93.88	92.98	86.19	20
103.66	104.99	104.89	104.30	100.46	25
111.61	112.37	112.34	111.68	110.05	30
111.45	113.12	112.12	111.37	109.19	35
	107.22	105.81	105.08	101.47	Average
Interference	Boron concentrations		Planting distances		L.S.D 0.05
N.S	3.70		4.54		

Percentage of fixed oil in seeds:(%)

The results of a table (5) have shown that the percentage of firm oil in the ring plant has been affected and in a moral of agriculture, especially the distance (25 cm), with a middle high of 3.53%, which has not different from Distance (30 cm) at 3.39%, known for distance (20 cm), gave less average of 2.86%. This result is different with the mechanism [12.[

The results of table 5 showed that the increase in boron sprayed concentrations led to an increase in the percentage of firm oil in the veiled plant seeds. The concentration of the boron (45 mg B L-1) is a highest 3.58%, which has not different from Focus (30 mg B L-1) Average reached 3.53%, while the total comparator was given less 2.70%. These results are consistent with what is reached [9.[

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Table5. The effect of planting distances, boron spray concentrations, and the interaction between them on the percentage of fixed oil in seeds.(%)

Average	mg B L^{-1})(Boron spray levels				Planting distances (cm)
	45	30	15	0	
2.86	3.22	3.44	2.55	2.22	20
3.53	3.89	3.67	3.44	3.11	25
3.39	4.11	3.67	3.11	2.67	30
3.06	3.11	3.33	3.00	2.78	35
	3.58	3.53	3.03	2.70	Average
Interference	Boron concentrations		Planting distances		L.S.D 0.05
N.S	0.26		0.41		

Fixed oil yield (kg ha-1:(

The results are illustrated in a table (6) to affect the status of firm oil in moral seeds, with the farming distance (25 cm) the highest rate in the total status of firm oil of 169.2 kg e-1 superiority Moral for the rest of the distances, while no significant distance (20 cm) has given a rate of 162.0 kg ha-1, and significantly differ from a distance (35) cm and an increase of 33.23%, which has reached 127.0 A kg ha-1. The cause of the number of plants may be increased in the unit of space at high plant densities (narrow farming spaces) compared with the number of plants at the plant densities and are wide (wide cultivars.(

The results of a table (6) indicate that the macroeconomic attribute of the seeds has been significantly affected by the boron spray concentrations and internalize the total increase in the overall oil with the boron concentrations, as the transaction achieved spraying With a focus (45 mg B L-1) the highest rate in the overall oil-firewall in seeds amounted to 187.6 kg ha-1, since it has not different from the treatment of spraying (30 mg B L-1), with 178.8 kg ha-1, with an increase of 64.74% compared to the comparison treatment given less rate of 114.0 kg ha-1.

The results were shown in a table (6) to have significant differences in interference between farming and boron spraying in the macroeconomic level of firm oil. The overlap was given (20 cm x 30 mg B L-1) highest rate 219.2 kg ha-1, which has not been significantly different from interference transactions (25 cm x 45 mg B L-1) and (20 cm x 45 mg B L-1) and (30 cm x 45 mg B L-1). 205.7, 205.3 and 202.5 kg ha-1 on relay, while the two treatments (20 cm × comparison transaction) and (35 cm × comparison transaction) were given less average of 101.4 and 104.2 kg ha-1.

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Table6. he effect of planting distances, boron spraying, and the interaction between them on the total yield of fixed oil in seeds (kg h-1(

Average	mg B L^{-1})(Boron spray levels				Planting distances (cm)
	45	30	15	0	
162.0	205.3	219.2	121.9	101.4	20
169.2	205.7	176.9	156.0	138.0	25
155.9	202.5	174.1	134.6	112.2	30
127.0	137.0	144.9	121.8	104.2	35
	187.6	178.8	133.6	114.0	Average
Interference	Boron concentrations		Planting distances		L.S.D 0.05
28.44	12.73		21.29		

Total alkaloid content in plant seeds:(%)

Results in Table (7) outweigh the distance of agriculture (30 cm), with a highest average of 1.64% at other farming spaces. The two seeds (20 and 35) were given less 1.56% and could be attributed to that Distance (30) cm provide good conditions for root growth and food absorption and additional light intercept by the plant is greater and then increases the optical representation process to unwind and produce carbohydrates, fat, proteins and representative metabolism products. He agreed with [1.[

The results of the table (7) also pointed out that the proportion of fats in seeds had been morally affected by the boron spray concentration. The focus (45 mg B L-1) higher average hit 1.64% and followed the focus (30 mg B L-1) 1.63% without moral teams between them, moral superiority on concentrations (0 and 15) mg B L-1 mg of the highest and less than 1.52 and 1.55% on relay.

Table7.The effect of planting distances, boron spray concentrations, and the interaction between them on the percentage of total alkaloids in seeds(%)

Average	mg B L^{-1})(Boron spray levels				Planting distances (cm)
	45	30	15	0	
1.56	1.60	1.59	1.55	1.51	20
1.58	1.62	1.61	1.56	1.53	25
1.64	1.70	1.70	1.58	1.57	30
1.56	1.64	1.63	1.50	1.45	35
	1.64	1.63	1.55	1.52	Average
Interference	Boron concentrations		Planting distances		L.S.D 0.05
N.S	0.039		0.042		

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Conclusion

According to the obtained results, planting plants at wide planting spacings increased all studied traits compared to narrow planting spacings. Planting spacing had a significant effect on the number of main branches per plant, leaf area, total chlorophyll content of leaves, percentage of fixed oil in seeds, total fixed oil yield of seeds, and total alkaloid content in seeds. Boron application levels also significantly affected the number of main branches per plant, leaf area, total chlorophyll content of leaves, percentage of fixed oil in seeds, total fixed oil yield of seeds, and total alkaloid content in seeds.

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References

[1]Abdul Hussein, Taif Majed, Rashid Khader Al-Jabouri, and Saad Ali Ihsan. (2013). Response of fenugreek (Trigonella foenum-graecum L.) to different seeding rates and levels of nitrogen fertilizer and their effect on the active ingredient. Al-Furat Journal of Agricultural Sciences. 5(4)104-112.

[2]Acharya, S., A. Srichamroen, S. Basu, B. Ooraikul, and T. Basu.2006. Improvement in the nutraceutical properties of fenugreek.Songklanakarin J. Sci.Technol. 28:1-9 .

[3] Al-Jaheshi, Walid Khaled Shahada. (2019). The effect of phosphate fertilization and boron spraying on some growth and yield characteristics of local mung bean (Vigna radiate L.). Kirkuk University Journal of Agricultural Sciences 10(1):104-110.

[4]Al-Zirjawi, Muhammad Abdul-Ridha Abdul-Wahid. (2008). The effect of planting dates, seeding rates and mowing on the forage yield and quality of clover (Trifolium alexandrinum L.). Master's thesis, College of Agriculture, University of Basra, Iraq.

[5] A.O.A.C. 1970. Official method of analysis 11th Ed. Washington, D. C. Association of the Official Analytical Chemist. 1015 p.

[6]Ajanal M, Gundkalle MB, Nayak SU.2012 . Estimation of total alkaloid in Chitrakadivati by UV-Spectrophotometer. Ancient science of life.2012 Apr;31(4):198.

[7]Dinesh, T., S. Upadhyay and A. Paliwal.2016. Plant spacing response on growth and yield of fenugreek in high altitude of Uttarakhand. International Journal of New Technology and Research (IJNTR) .2(10):33-35.

[8]Fadhil, A.,H. and Jader, J.,J. 2020.The Effects of Folar spraying with boron and chelating Iron on growth and yield of broad bean (Vicia fada L.).Al-Musaib Technical College, Al-Furat Al-Awsat Technical University. 1(20):425-430.

[9]Habib, Golan Zein, Firas Ahmed Al-Sagri, and Omar Nazhan Ali. (2023). Effect of spraying with iron and boron on the growth, yield, and oil content of different varieties of soybean (Glycine max L.). Journal of Educational and Scientific Studies. 22(1): 27-40.

[10]Hadhili, Kadhim Hassan and Fatima Fajr Al-Jabouri. (2016). Effect of molybdenum and boron on some growth traits in broad beans (Vicia faba L.). Basra Journal of Agricultural Sciences. 29(1): 201-213.

[11]Nasrallah, Adel Yousef, Majed Shaye Hamdallah, and Fawaed Abdul Latif Ali. (2002). Effect of different concentrations of boron on seed yield and its components of

soybean. Iraqi Journal of Agricultural Sciences. 34(1): 61-66.

[12]Nazih, Ruqayyah, Nizar Maala, and Ola Qajo. (2015). Effect of planting distance and density on yield, oil and protein content of seeds of several peanut cultivars. Jordanian Journal of Agricultural Sciences. 11(2): 55-73.

[13]Okoye, Theophine Chinwuba, Phillip F. Uzor, Collins A.Onyeto, and Emeka K. Okereke A. 2014. Safe African Medicinal Plants for Clinical Studies. in Toxicological Survey of African Medicial Plant.7(1):535-555 .

[14]Rafiq, M. A., A. Ali, M. A. Malik and M. Hussain, 2010. Effect of fertilizer and Plant densities of yield and protein of autumn planted maize. Pakistan Journal of Agriculture Science. 47(3): 201-208.

[15]Sadik, K. S: al-Taweel; N.S. Dhyeab and Kalaf M. Z. 2011. new computer program for estimating leave area of several vegetable crops. American Eurasian Journal of Sustainable Agriculture., 5(2):304-309.

[16]Shaaban, M. M., 2010. Role of boron in plant nutrition and human health. American Journal of plant physiology, 5: 224- 240.

[17]Tiwari, D., Upadhyay, S. and Paliwal, A.,2016. Plant Spacing Response on Growth and Yield of Fenugreek in High Altitude of Uttarakand. International Journal of New Technology and Research, 2(10 .(

[18]Zandi, P., Basu, S. K., Cetzal-Ix, W., Kordrostami, M., Chalaras, S. K., and Khatibai, L. B. 2017. Fenugreek (Trigonella foenumgraecum L.): an important medicinal and aromatic crop. Active Ingredients from aromatic and medicinal plants, 207-224.

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