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EFFECT OF DISTANCE BETWEEN PLANTS AND SPRAYING OF HUMIC ON THE YIELD AND ITS COMPONENTS OF THREE OF BEAN (*VICIA FABA* L.) VARIETIES

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Abstract

A field experiment was carried out at the second research station (Al-Bandar) of College of Agriculture, Al-Muthanna University during the winter season 2017-2018 to determine the effect of planting distances and spraying with humic acid in the characteristics and growth of three genetic structures of the others. The Split Plot Design (RCBD) with three replicates. The main plates occupied the genotypes and consisted of three structures (V1, Koalaji, V2 Primato, V3 and Zinia). Three parameters were treated for planting (20, 30 and 40 cm), humic acid in three concentrations (H0, H1H2) secondary plates, the results showed that: Primato genotype was superior in number of branches 6.09 branches plant $^{-1}$ number pods 10.15 plant $^{-1}$, Zinia genotype was superior in 100 seeds weight 90.15 g, plant yield 48.3 g. Plant^{-1} and the total yield was 1658 kg h^{-1}. The concentration of H_2 gave the highest plant height 69.45 cm and the number of branches 8.03 branch^{-1} and the number of pods 13.11 pods plant^{-1}, the weight of 100 seeds 98.15 g, the plant yield 68.6 g. Plant^{-1} and the total 2403 kg $^{-1}$. The distance exceeded 20 cm on the rest of the treatments, average height of the plant 64.27 cm, while the treatment 30 cm in the number of branches plant^{-1} (6.11 branch plants^{-1}), the weight of 100 seeds 87.67 g. The results of V3XH2 was superior in plant height 74.36 cm, branch number 9.44, seed number 5.21 pod^{-1}, number of pods 5.22 pods plant^{-1}, plant yield 85.5 g and the total plant was 2993 kg h^{-1} and the combination of V2XS2 was higher in plant height 73.14 cm, the number of seeds 4.97 seeds pods^{-1} the weight of 1000 seeds 100.89 g, the number of pods per plants 10.78 and V2 X S3 was higher in the plant yield of 52.5 g, H2 X S2 in plant height 77.98 cm, the weight of 100 seeds 101.67 g. H2 X S3 exceeded the number of branches 9.22 branches and the number of pods 14.44 pods plant $^{-1}$. The total plant yield is 2682 kg h^{-1}. The triangular overlap showed the results of V3 × S2 × H2 was superior in the number of branches 10.67 branches, the number of seeds 5.76 seeds of pod^{-1} and the number of pods 17.33 pods plant $^{-1}$, the weight of 100 seeds 117 g and the plant yield 91.5 g.

Key words : Bean (*Vicia faba* L.), genetic structure, yield, chemical fertilizer.

Introduction

Vicia faba L. is a strategic crop in Iraq and is grown in large areas. Its nutritional importance is due to its high dry protein content of 25-40%, carbohydrates, oil, mineral salts, fiber and vitamins. Many of the amino acids are Lysine, Lucine and Arginine. It is also used to improve soil fertility as green fertilizer (Al-Shteiwi, 2000 and Natalia *et al*., 2008). The use of organic manufactured and non- manufactured fertilizers has appeared in recent times because it does not cause any harm to the life of humans, animals and plants. It is not a substitute for chemical fertilizer, but it is complementary to it. It is added to the soil or sprinkled on the plant at low concentrations. It contains some organic compounds such as fertilizers humic that used to Improved of growth and yield of plant as they play an important role in improving enzymatic reactions, cellular division, elongating cells, increasing the production of plant enzymes and stimulated intracellular vitamins (Pettit, 2003). Both planting distances between plants and humic acid affect in the growth and yield of plant. Humic acid, derived from soft brown coal deposits known as Leonardite, which are extracted in biotic ways (Mohammed, 2002), it is characterized by its high ability to hold most of the ions found in the soil solution it also

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affect the degree of interaction in the root environment, which increases the readiness of many elementsby chelation action and keeping them ready for the plant this is due to the containment of humic acid on the active groups such as carboxyls, phenols, alcohol, Quanin, caronels and amines (Stevenson, 1990). The humic acid contains a number of organic compounds that help to increase plant growth and yield and is used to reduce the negative impact of salt stress, and the development of the root system (Eslah, 2010), it is also an active source of carbon for microorganisms, as well as increasing the readiness of certain nutrients by chelation action for some elements and forming chelation compounds, which makes element ions free in soil solution and increases the chances of their absorption by the plant (El-Sharkawy and Abdel-Razzak, 2010). For planting distances, determining the optimum plant density is one of the most important determining factors for the crop which depends on the distance between hole and number of plants left per hole. Numerous studies have been conducted in different regions of the country to determine optimum plant density. Al-Jubouri (1985) showed that the increase in distance between plants led to a significant decrease in plant height and seed yield, but a significant increase in the number of branches of the plant when using the distances (20, 30, 40) cm between the plants of the cultivated in the Abu Ghraib in Baghdad. Al-Rifai (2001) showed a significant increase in plant height, green yield and seed yield of local variety at planted at a distance of 30 cm compared with the distances of 10 and 20 cm under Saudi conditions. Kassem (2002) found that the cultivation of the feeders at a distance of 30 cm between the lines was given the highest seed yield compared with the other distances (10, 20, 40) cm under the conditions of the city of Mosul. The aim of this study is to investigate the extent to which the planted distances and the spray of different concentrations of humic acid affect newly introduced genotypes to Iraq for bean varieties.

Materials and Methods

The field experiment was carried out during the winter season (2017-2018) at the second research station (Al Bandar) of the College of Agriculture, Al-Muthanna University to study the effect of three plant distance (20, 30 and 40) and foliar fertilization using three levels of humic acid (H0, H1, H2) g/L, in the growth characteristics and yield of three genotypes of bean. The soil was plowed by the tearing plow. The Split Plot Design was used in the design of RCBD with three replicates, where the main plot were occupied genotypes treatment (V1 Koalaji, V2 Primato, V3 Zinia) obtained from the General Authority for Agricultural Research, Ministry of Agriculture, Iraq, while the plant distance (S1=20 cm, S2=30 cm and S3=40 cm) and foliar spraying with three concentration of humic acid (H0 = 0 g, H1=2 g and H2 = 4 g) treatment occupied the secondary plot. The seeds were obtained from the Public Authority of Agricultural Researches, the seeds were planted on 15/10/2017 and the rate of 3 seeds per hole after two weeks of emergence reduced number of plant per hole to one plant. The chemical fertilizer NPK (50 kg $N.h^{-1}$ + 35 kg $P.ha^{-1}$ + 84 kg $K.h^{-1}$) as recommended by AL-Zubaidy (2014), patching was performed two weeks after planting. The midline plants of each experimental unit were harvested on 10/4/2018.

Soil properties

A number of samples were taken randomly from different places of the studies soil befor planting at depth of 30 cm, then dried and refined and passed through a sieve of 2 mm diameter then mixed , samples were taken from it to be chemically and physically analyzed, to determine some of the physical and chemical properties facilities of Soil and Water Department Laboratories, College of Agriculture, Al-Muthanna University was utilized. Table 1 presents a view of soil properties.

Table 1 : Some physical and chemical properties of the experimental soil.

Properties	Unit	Results
ECE	$Ds.m^{-1}$	3.2
pH	-	7.6
OM	%	0.9
N	$mg.kg^{-1}$	38.8
P	$mg.kg^{-1}$	14.11
K	$mg.kg^{-1}$	118.2
Sand	$g.kg^{-1}$	260
Silt	$g.kg^{-1}$	600
Clay	$g.kg^{-1}$	140
Soil texture		**Silty loam**

The studied traits : Ten random plants were selected from the intermediate lines to calculate the following characteristics.

1. Plant height (m)
2. No.branches per plant
3. No. pods per plant
4. No. seed per pods
5. Weight of 100 seeds per plant(g)
6. Yield per plant (g)
7. Total yield (kg/h)

Results and Discussion

Plant height (cm)

The results in table 2 showed significant differences of single bilateral and trilateral factors, while non-significant differences were shown in the genotypes of this trait.

The results showed that there was a significant difference of the concentrations of humic acid in plant height. The highest mean concentration (H2) which was 69.45 cm while the comparison treatment (H0) recorded the lowest average of 51.23 cm, this is due to the positive effect of humic acid on plant growth by increasing the permeability of cellular membranes, stimulating enzymatic reactions, improving cell division, elongation of cells of cells, increasing plant enzyme production and stimulating intracellular vitamins (Pettit, 2003) and these activities are working to increase the vegetative growth of the plant and thus increase the carbohydrates manufactured in the leaves and the transfer of any fruit parts leads to increase plant yield.

The results indicated the superiority in plant height of (S2 = 20 cm), which recorded the highest average plant height which was 64.27 cm and there was non-significant difference between the distances 10 and 30 cm, this is due to the optimal distribution of plants in the field, which ensures light reception and the efficiency of photosynthesis to manufacture their food, which leads to increase the height of the plant as a result of elongation of the parasites. These results are consistent with the findings of Al-Othman and Al-Assaf(2009) and AL-Jubouri and Ali (2012), who founded a relationship between plant height plant density.

The results of the interaction between the genotypes and concentrations of humic acid indicated the significant effect of the plant height character which recorded the highest mean in the combination (V3 × H2) which was 74.36 cm, while the lowest mean was in the combination (V1 × H0), which was 52.34 cm. The results showed that there was a significant interaction between the genotypes and the planting distances in this trait. The

Table 2 : The effect of the distance between the plants and the spraying of the humic acid in the plant height (cm) of three genotypesof bean.

Genotypes	Distances	Humic acid			Genotypes × distances
		H0	H1	H2	
V1	S1	60.14	61.05	43.84	**55.01**
	S2	49.93	65.85	71.73	**62.50**
	S3	46.95	59.77	72.37	**59.70**
V2	S1	45.33	50.04	80.37	**58.58**
	S2	62.30	74.30	82.83	**73.14**
	S3	53.85	58.10	50.84	**54.26**
V3	S1	49.33	58.43	68.33	**58.70**
	S2	46.50	65.66	76.00	**62.72**
	S3	46.70	54.45	78.73	**59.96**
Mean of humic acid		**51.23**	**60.85**	**69.45**	
LSD (H) (0.05) = **2.62**		LSD (V×S) (0.05)=**4.22**		LSD (V×S×H) (0.05)=**7.51**	Mean of distances
Humic acid ×distances	S1	51.60	56.51	64.18	**57.43**
	S2	51.98	62.84	77.98	**64.27**
	S3	50.09	63.20	66.19	**59.83**
LSD (S) (0.05)=2.80		LSD (H×S) (0.05)=4.50			Mean of genotypes
Genotypes × humic acid	V1	52.34	62.22	62.65	**59.07**
	V2	53.83	60.81	71.35	**62.00**
	V3	47.51	59.51	74.36	**60.46**
LSD (V) (0.05)=N.S		LSD (V×H) (0.05) = 4.04			

Table 3 : Effect of the distance between the plants and the spraying of the humic acid in the number branches per plants of three genotypesof bean.

Genotypes	Distances	Humic acid			Genotypes × distances
		H0	H1	H2	
V1	S1	3.33	4.08	3.92	**3.78**
	S2	4.17	5.33	6.67	**5.39**
	S3	3.50	4.42	8.33	**5.42**
V2	S1	6.11	5.42	7.67	**6.40**
	S2	4.67	6.00	8.67	**6.45**
	S3	3.50	4.17	8.67	**5.45**
V3	S1	4.25	4.17	7.00	**5.14**
	S2	3.50	5.33	10.67	**6.50**
	S3	4.33	4.50	10.67	**6.50**
Mean of humic acid		**4.15**	**4.82**	**8.03**	
LSD (H) (0.05)=**0.67**		LSD (V×S) (0.05)=**0.91**		LSD (V×S×H) (0.05)=**N.S**	Mean of distances
Humic acid × ditances	S1	4.56	4.56	6.19	**5.10**
	S2	4.11	5.56	8.67	**6.11**
	S3	3.78	4.36	9.22	**5.79**
LSD (S) (0.05)= 0.16		**LSD (H×S) (0.05)= 1.05**			Mean of genotypes
Genotypes × humic acid	V1	3.67	4.61	6.31	**4.86**
	V2	4.76	5.19	8.33	**6.09**
	V3	4.03	4.67	9.44	**6.05**
LSD (V) (0.05)= 0.75		LSD (V×H) (0.05)= 10.9			

combination (V2 × S2) showed the highest mean which was 73.14 cm, superior to the rest of the combinations, while the combination (V1 × S1) showed a lowest average which was 55.01 cm. The results of the interaction between the distances of plants and the concentrations of humic acid indicated the significant difference. The combination (S2 × H2) recorded the highest average, which was 77.98 cm, while the lowest average was recorded (S3 × H0), which was 50.09 cm.

The triple interaction factors of plant height was also significant. The combination (V2 × S2 × H2) of Primato genotype and the distance of 30 cm, which was sprayed with the concentration of humic acid recorded highest mean, which was 82.83 cm, while the combination (V1 × S1 × H2), which recorded lowest mean which was 43.84 cm.

Number of branches per plant

Table 3 shows the significant differences for the number of branches per plant in single, bilateral and trilateral factors.

The results showed a significant increase in the genotypes for the number of branches per plant, which recorded 6.09 and 6.05 branches per plant, respectively for the compounds Brimato and Zinia, while the lowest number of branches was in Kualgy genotype, reached 4.86 branch per plant, this is due to the appropriateness of these genotypes to the environmental conditions in the region. As for the spraying of humic acid, the third concentration (H2) was significantly higher than the rest of the concentrations, which was 8.03 branches per plant, while the lowest number of branches recorded a control treatment (H0), which amounted to 4.15 branches per plant, this is due to the role of humic acid in increasing vegetative growth as well as increased permeability of cellular membranes which eventually leads to an increase in the number of branches and the evolution of the vegetative and root system (Kaya *et al*., 2005). The results showed an increase in the number of branches per plant. The effect of distance between plants was 30 cm, with the highest number of branches 6.11 branches per plant compared with other distances. The reason of

these results is that increasing the distances between plants leads to an increase in the number of branches per plant due to reduced competition between plants and this result is consistent with the findings of Mekkei (2014).

As for interaction between the genotypes and the humic acid concentrations showed significant differences. The highest average of combination was 9.44 branches per plant in (V3 × H2), while the lowest average was for the combination (V1 × H0) at 3.67 branches per plant. As for the interaction between genotypes and distances of planting, showed significant differences were found where the combinations (V3 × S2) and (V3 × S3) gave the highest mean of 6.50 branch per plant compared with the combination (V1 × S1), which gave the lowest average of 3.78 branches. The results of the interaction between the distances of plants and the humic acid concentration showed significant differences that exceeded the combination (S3 × H2), which gave the highest average, which was 9.22 branch per plant, while the lowest average recorded in combination (S3 × H0) was 3.78 branch per plant.

The results of interaction between genotypes, humic acid and distance between plant showed significant differences for this trait. The highest mean was recorded by the combinations (V3 × S2 × H2) and (V3 × S3 × H2), which reached 10.67 branches per plant, that was superior to the rest of the combinations, while the least significant difference was recorded in the combination (V1 × S1 × H0), which amounted to 3.33 branch per plant. The reason for this superiority may be attributed to the response of genotypes to the interaction between the distances of the planting and the concentration of the humic acid, the increased distance between the plants leads to reduced of competition between the plants and the role of the humic acid, which increases the permeability of the cellular membranes and thus increases the vegetative growth of the plant.

Number of seeds per pods

In table 4, the results showed that there were non-significant differences between the genotypes and also the distance between plants. While the results indicated

Table 4 : Effect of the distance between the plants and the spraying of the humic acid in the number of seeds per pods of three genotypesof bean.

Genotypes	Distances	Humic acid			Genotypes × distances
		H0	H1	H2	
Vl	S1	4.17	4.02	3.90	**4.03**
	S2	4.17	4.93	4.83	**4.64**
	S3	4.33	4.50	4.80	**4.54**
V2	S1	3.37	5.19	4.17	**4.24**
	S2	4.92	5.53	4.47	**4.97**
	S3	3.83	4.43	4.13	**4.13**
V3	S1	4.00	4.45	4.24	**4.23**
	S2	3.40	5.76	3.75	**4.30**
	S3	3.67	5.43	4.50	**4.53**
Mean of humic acid		**3.98**	**4.92**	**4.31**	**4.31**
LSD (H) (0.05)= 0.29		**LSD (V×S) (0.05) = 0.54**		**LSD (V×S×H) (0.05) = N.S**	Mean of distances
Humic acid × distances	S1	4.36	4.67	4.20	**4.41**
	S2	3.65	5.29	4.25	**4.40**
	S3	3.94	4.79	4.48	**4.40**
LSD (S) (0.05)= N.S		**LSD (H×S) (0.05)= 0.47**			Mean of genotypes
Genotypes × humic acid	Vl	4.22	4.48	4.51	**4.40**
	V2	4.04	5.05	4.26	**4.45**
	V3	3.70	5.21	4.16	**4.36**
LSD (V) (0.05) = N.S		**LSD (V×H) (0.05) = 0.58**			

Table 5 : Effect of the distance between the plants and the spraying of the humic acid in the number of pods per plants of three genotypes of bean.

Genotypes	Distances	Humic acid			Genotypes × distances
		H0	H1	H2	
V1	S1	4.67	6.33	9.67	**6.89**
	S2	5.67	7.33	9.67	**7.56**
	S3	4.67	10.33	14.67	**9.89**
V2	S1	6.67	11.00	12.67	**10.11**
	S2	7.33	13.33	11.67	**10.78**
	S3	5.00	11.33	14.00	**10.11**
V3	S1	5.67	8.67	13.67	**9.34**
	S2	6.00	9.00	17.33	**10.78**
	S3	6.00	7.33	14.67	**9.33**
Mean of humic acid		**5.74**	**9.41**	**13.11**	
LSD (H) (0.05)= 0.97		**LSD (V×S) (0.05)= 1.46**		**LSD (V×S×H) (0.05)= N.S**	Mean of distance
Humic acid × distance	S1	5.89	9.44	11.67	9.00
	S2	6.11	9.11	13.22	9.48
	S3	5.22	9.67	14.44	9.78
LSD (S) (0.05)= N.S		**LSD (H×S) (0.05)= N.S**			Mean of genotypes
Genotypes × humic acid	V1	5.00	8.00	11.33	6.74
	V2	6.33	11.89	12.78	10.15
	V3	5.89	8.33	15.22	9.59
LSD (V) (0.05)= 0.76		**LSD (V×H) (0.05)= 1.46**			

significant difference in spraying with humic acid in seeds per pod, as H1 gave the lowest average 4.92 seeds per pods compared with the control treatment, which recorded 3.98 seeds per pods.

And also for distances between plants there were significant differences for this trait, the distance S2 gave the highest mean was 4.97 seeds per pods compared with control treatment, which recorded 4.03 seeds per pods.

The results of the interaction between the genotypes and the humic acid concentration also showed significant differences in the number of seeds per pods. The combination (V3 × H1) recorded the highest mean of 5.21 seeds per pods, while the combination (V3 × H0) recorded the lowest average of 3.70 seeds per pods; this is due to the nature of the genotype (Al-Jubouri and Ali, 2012).

The results also showed significant differences in interaction between the genotypes and the distance between the plants, the combination (V2 × S2) recorded the highest average, which was 4.97 seed per pod, while the lowest mean recorded in (V1 × S1), which reached 4.03 seed per pod, it may be due to the nature of the genotype and its suitability to the conditions of the region. In addition, the wide distances between the plants reduced the competition between the plants, which made the plant take sufficient light, water and other nutrients, which was reflected in increasing the number of seeds per pods (Al-Farih and Al-Obaidi, 2003). As for the interaction between the distances between the plants and the concentrations of the humic acid, significant differences were found. The combination (S2 × H1) recorded the highest average was 5.29 seeds per pod. The lowest average recorded in (S2 × H0), which was 3.65 seeds per pod, this may be due to the role of organic acids in stimulating physiological and biochemical processes by combining protein synthesis and carbohydrate synthesis by building chlorophyll and stimulating photosynthesis (Shafeek *et al*., 2013). The larger distances between the plants led to an increase in the number of seeds per pods (Sharaan *et al*., 2004).

Table 6 : Effect of the distance between the plants and the spraying of the humic acid in the weight of 100 seeds of three genotypesof bean.

Genotypes	Distances	Humic acid			Genotypes × distances
		H0	H1	H2	
Vl	S1	68.00	74.67	91.67	**78.11**
	S2	67.33	80.67	93.67	**80.56**
	S3	68.67	77.67	88.00	**78.11**
V2	S1	68.33	78.00	94.00	**80.11**
	S2	66.33	84.00	94.33	**81.55**
	S3	70.33	85.00	99.33	**84.89**
V3	S1	68.67	91.00	102.00	**87.22**
	S2	66.67	119.00	117.00	**100.89**
	S3	64.00	79.67	103.00	**82.22**
Mean of humic acid		**67.59**	**85.52**	**98.11**	
LSD (H) (0.05)= 3.09		**LSD (V×S) (0.05)= 3.66**		**LSD (V×S×H) (0.05)= 8.27**	Mean of distances
Humic acid × distance	S1	68.33	81.22	95.89	81.81
	S2	66.78	94.56	101.67	87.67
	S3	67.67	80.76	96.89	81.78
LSD (S) (0.05)= 2.08		**LSD (H×S) (0.05) = 4.75**			Mean of genotypes
Genotypes × humic acid	Vl	68.00	77.67	91.11	78.93
	V2	68.33	82.33	95.89	82.19
	V3	66.44	96.56	107.44	90.15
LSD (V) (0.05)=2.93		**LSD (V×H) (0.05) = 4.87**			

As for the interaction of the three factors non-significant differences were recorded in this trait.

Number of pods per plant

In table 5, the results showed that there were significant differences in the genotypes of the number of podsper plant. The highest average was recorded for the genotypes V2, which reached to 10.15 pods per plant, while the genotypes V1, which scored the lowest average of 6.74 pods per plant. The results also showed significant differences between spraying with the concentrations of humic acid for the number of pods per plant, where the concentration of H2 gave the highest mean, which reached 13.11 podsper plant compared with the control treatment, which recorded 5.74 pods per plant, the increase in this trait may be attributed to the role of the amino acids in improving vegetative growth and reducing the food competition between the pods and thus increasing the number of podsper plant. The results showed that there was non-significant difference in the distance between the plants, where the distance S3 gave the highest average of 9.78 pod per plant compared with other distance S1 and S2. This may be due to the high of density leads to increased shading and thus affect the flowers and may lead to their fall, which reduces the number of podsper plants (Al-Jubouri and Ali, 2012).

The results of the interaction between the genotypes and the spraying humic acid showed significant differences for the number of pods per plants. The combination (V3 × H2) recorded the highest average which was 15.22 pods per plant, while the combination (V1 × H0) recorded the lowest average which was 5.00 pods per plant. The results of interaction between the genotypes and the distance between the plants showed significant differences. The combinations (V2 × S3) and (V2 × S1) showed the highest mean of 10.78 pods per plant, while the lowest mean in (V1 × S1) was 6.89 pods per plant. As for the interaction between the distances between the plants and the concentrations of humic acid, there were non-significant differences. The combination (S3 × H2) recorded the highest average of 14.44 pods

per plant, while the lowest recorded average in (S3 × H0) was 5.22 pods per plant.

As for the triangular interaction of the factors, non-significant differences were recorded.

Weight of 100 seeds (g)

The results in table 6 showed significant differences in the genotypes. V3 was significantly higher than the other genotypes as it recorded the highest average which was 90.15 g, while the lowest average recorded in V1 was 78.93 g; the reason of genotypes superiority may due to its nature and its suitability to the region. The results indicated that the weight of 100 seeds of the genotypes increased by the increased levels of sprayed the humic acid. The H2 level gave the highest mean of 98.15 g, compared with control treatment H0, which gave 67.59 g, the components of the good yield are directly correlated with the increase in the indices of good vegetative growth. The spraying of the humic acid has improved the vegetative growth by activating the biological processes and the subsequent increase in nitrogen uptake and increasing the number of pods (table 5), which indicates a good food representation in the leaves and transfer these products to the seeds. The reason is that the humics acids contain amino acids or proteins directly from the plant and this is reflected in the increased weight of 100 seeds (Al-Shater and Al- Balkhi, 2010), which is consistent with El-Galad (2013). As for the distance between the plants, this trait was reversed in the weight of 100 seeds from the two traits of number of podsper plant and the number of seeds per pods, where the distance S2 gave the highest average which was 87.67 g, while the lowest average at the S3 distance was 81.78 g, the reason behind that is that in the high plant density, the number of podsper plant and the number of seeds per pods decreased which increased the weight of 100 seeds, because the few number of seeds and the accumulation of food became more but the size of seeds is large, which led to increased the weight of 100 seeds, and confirms these results (tables 4 and 5) and these are consistent with the result of Al-Qtarani (2016).

The results of the interaction between the genotypes and the humic acid also showed significant differences in the weight of 100 seeds. The combination (V3 × H2) recorded the highest mean of 107.44 g, while the combination (V3 × H0) recorded the lowest mean of 66.44 g. This is due to the superiority of this combination of the number of seeds by number of seeds per pods and the number of pods per plants (tables 4 and 5). As for the interaction between the genotypes and the distance between the plants, significant differences were observed. The combination (V3 × S2) recorded the highest mean of 100.89 g, while the lowest mean (V1 × S1) was 78.11 g. It may be due to the nature of the genotypes and its suitability to the conditions of the region, or because of the increase in the number of branches and the number of pods per plants as well as the increased in the number of seeds per pods, which reflected negatively on the weight of 100 seeds and confirms the results (tables 4 and 5). As for the interaction between the distances between the plants and the concentrations of the humic acid, there were significant differences. The combination (S2 × H2) recorded the highest average of 101.67 g, while the lowest recorded average (S2 × H0) was 66.78 g, the reason for this superiority may be attributed to the role of organic acids in stimulating physiological and biochemical processes by combining protein synthesis and carbohydrate synthesis by building chlorophyll and stimulating the process of photosynthesis (Shafeek *et al*., 2013). This reflected positively on weight of 100 seeds trait, this agreed with Hassan (2010) that the spraying of humic acid increased the weight of 100 seeds.

As for the triangular interaction of this characteristic, there were significant differences. The highest mean recorded by the combination (V3 × S2 × H2) was 117.00 g, and the lowest mean of the combination (V2 × S2 × H0) was 66.33 g. This may due to the positive correlation between spraying of humic acid and plant growth which reflected on number of seeds trait, number of seeds per pod and number of pods per plant (tables 4 and 5).

Yield per plant (g)

The results showed in table 7 that there were significant differences between the genotypes of this trait, where the V3 genotype recorded the highest average of 48.3 (g), while the lowest average recorded V1 genotype, which amounted to 33.5 (g). There was also a significant difference in the spraying of the humic acid concentration of this trait. The concentration of H2 gave the highest mean, which was 68.6 (g), compared with the control treatment of 19.6 (g), the increase in plant yield due to the increase in number of branches per plant trait and number of pods per plant trait (table 3), weight of 100 seeds (table 6), which caused increase in plant yield. This may be due to thahumic acid containson the nitrogen and phosphorus that are ready to be absorbed by vegetative parts and then to the manufacturing sites, which is the reason for the increase in the rate of photosynthesis, this leads to an increase in the products of representation and transfer to the seeds where the materials are accumulated and which increase the weight of seed and thus increase the yield per plant (g) and this result is

Table 7 : Effect of the distance between the plants and the spraying of the humic acid in the yield per plant (g) of three genotypesof bean.

Genotypes	Distances	Humic acid			Genotypes × distances
		H0	H1	H2	
Vl	S1	16.2	18.9	38.6	24.6
	S2	18.0	32.6	49.6	51.5
	S3	18.0	46.2	64.3	43.8
V2	S1	31.6	54.6	68.3	33.2
	S2	18.3	47.8	69.9	45.3
	S3	17.9	47.0	70.9	52.5
V3	S1	19.5	41.6	70.3	42.8
	S2	18.3	47.7	91.5	45.3
	S3	18.4	33.0	64.7	48.7
Mean of humic acid		**19.6**	**41.0**	**68.6**	
LSD (H) (0.05)= 8.09		**LSD (V×S) (0.05)= N.S**		**LSD (V×S×H) (0.05)= N.S**	Mean of distances
Humic acid × distances	S1	22.5	38.4	59.1	40.0
	S2	18.2	42.7	70.2	43.7
	S3	18.1	42.1	76.6	45.6
LSD (S) (0.05)= N.S		**LSD (H×S) (0.05)= N.S**			Mean of genotypes
Genotypes × humic acid	Vl	17.4	32.6	50.7	33.5
	V2	22.6	49.8	69.7	47.4
	V3	18.7	40.7	85.5	48.3
LSD (V) (0.05)= 10.75		**LSD (V×H) (0.05)= 14.06**			

accepted with El-Hak *et al*. (2012) that the increase in seed weight reflected positively on plant yield. The results showed that there were non-significant differences in distances between the plants. Where the S3 distance gave the highest mean of 45.6 (g).

The results of the interaction between the genotypes and the humic acid showed a significant difference in the yield per plant (g),the combination (V3 × H2) recorded the highest average of 85.5 (g), while the combination (V1 × H0) recorded the lowest average of 17.4 g. As for the interaction between the genotypes and the distance between the plants, there was non-significant difference between the plants.

As for the triangular interaction of the factors, also showed non-significant differences were recorded. The highest average recorded by the combination (V3 × S2 × H2) was 91.5 (g) and the lowest average recorded by the combination (V1 × S1 × H0) was 16.2 (g).

Total yield kg.h^{-1}

The results in table 8 showed significant differences between the genotypes of this traite, the genotypes V3 and V2 recording the highest mean of 1692 and 1658 kg.h^{-1}, respectively, while the lowest V1 was 1174 kg.h^{-1}, this is due to the nature of the genetic variety and suitability of environmental conditions.

The total yield in plants of Bean has increased by increasing the levels of spraying of humic acid on the plant compared to the control treatment, It showed significant differences, with the level of spraying H2 recording the highest average of 2403 kg.h^{-1}, compared with control treatment recorded the lowest average which was 685 kg.h^{-1}. The increase in total yield may due to the increase in number of branches per plant trait (table 3) and number of pods per plant trait (table 5) and weight of 100 seeds trait (table 6), which causes increase in plant yield and reflected on the total yield increase and the role of humic acid in improving yield quality (Ali and Shaker, 2016) pointed out that the humic acids stimulate many enzymes and increase photosynthesis, which is reflected positively on higher yields. This is consistent with the

Table 8 : Effect of the distance between the plants and the spraying of the humic acid in the total yield kg.h^{-1} of three genotypes of bean.

Genotypes	Distances	Humic acid			Genotypes × distances
		H0	H1	H2	
Vl	S1	568	661	1353	861
	S2	629	1141	1722	1803
	S3	629	1617	2249	1533
V2	S1	1106	1912	2392	1164
	S2	640	1675	2446	1587
	S3	626	1645	2483	1837
V3	S1	684	1455	2462	1498
	S2	639	1670	3203	1584
	S3	644	1154	3319	1705
Mean of humic acid		**685**	**1436**	**2403**	
LSD (H) (0.05)= 283.1		**LSD (V×S) (0.05)= N.S**		**LSD (V×S×H) (0.05)= N.S**	Mean of distances
Humic acid × distances	S1	786	1342	2069	1399
	S2	636	1495	2457	1529
	S3	633	1472	2682	1596
LSD (S) (0.05)= N.S		**LSD (H×S) (0.05)= N.S**			Mean of genotypes
Genotypes × humic acid	Vl	609	1139	1775	1174
	V2	791	1744	2440	1658
	V3	656	1426	2993	1692
LSD (V) (0.05)= 376.2		**LSD (V×H) (0.05)= 492.2**			

findings of Shafeek *et al.* (2013), who found that spraying of humic acid increased the number of branches per plant and reflected on increasing weight of 100 seeds and as a results increased plant yield. While the distances between the plants showed non-significant differences for this trait.

As for the interaction between the genotypes and the concentrations of the humic acid, significant differences were observed. The combination (V3 × H2) recorded the highest average of 2993 kg.h^{-1}, while the lowest recorded average in the combination (V1 × H0) was 609 kg.h^{-1}. As for the interaction between the genotypes and the planting distances between the plants, non-significant differences were observed. The combination (V2 × S3) recorded the highest mean of 1837 kg.h-1, while the lowest mean of the combination (V1 × S1) was 861 kg.h^{-1}. As well as the interaction between the distances between the plants and concentrations of the humic acid showed non-significant differences.

Conclusion

1. We concluded that using organic acids (humic acid) significantly affected yield traits through increasing the total plant yield for its effective role in photosynthesis and facilitating the absorption of other nutrients.
2. The best plants distribution in the field led to plants receiving of its necessary requirements specially light and also reduced food competition by plants and weeds.
3. The response of Zinia genotype (Italian) to the organic fertilizers and it showed distinctive results compared with other genotypes and also its suitability with environmental conditions of AL-Mutana province.

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