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Effect of Spraying with Gibberellic Acid on Growth and Yield of Three Cultivars of Broad Bean (*Vicia faba* L.)

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Abstract: A study of split-plot was conducted for the season 2017-2018 In the fields of Baghdad province, To study the effect of spraying with gibberellic acid and three cultivars in plant height, the number of branches in the plant, the number of pods, the number of seeds in the pod, the weight of 100 g seed, the plant yield (kg) and total plant yield tons ha^{-1} for peas. The main plot contained the genotypes (local, French and Italian), secondary plots include gibberellic acid concentrations (0, 100, 200 and 300 mg l^{-1}). The results of local genotypes showed the highest average of plant height, number of branches in the plant. The number of pods in the plant, while the Italian genotype gave the highest average of the pod length and the number of seeds per pod, weight of 100 g seed, the plant yield and total plant yield tons ha^{-1}, On the other hand, the spraying with gibberellic acid at a concentration (300 mg l^{-1}) resulted in the highest average in all studied traits. The interaction between the genotypes and the sprayed gibberellin concentrations was significant for some of the studied traits. The interaction (local and 200) gave the highest average in the number of branches of the plant, the interaction (local and 200) gave the highest average in the number of plant pods and interaction (local and 300) gave the highest average in the number of branches of plant, the number of plant pods, the interaction (Italian and 300) gave highest number of seeds per pod, weight of 100 g seed, plant yield, total plant yield, plant height and pod length were not significant for interaction .

Keywords: Broad bean, Genotypes, Gibberellic acid

Vicia faba L. is one of the main vegetable legume plants, which has high protein content. This made it one of the sources of green protein. They are an important part of human food, especially low-income people, it is also important in improving soil fertility through the biological of nitrogen fixation in the soil by commensalism with *Rhizobium* bacteria of (Kandil 2007). It is a cheap source of protein compared to the protein we get from animals. His plants are used as green manure for soils that increase the productivity of many crops grown in the field to atmospheric nitrogen fixation in the soil (Jasim 2007). The cultivation Broad bean widespread in Iraq, especially in the province of Baghdad, Babylon, Kirkuk and Nineveh, with an estimated area of 5100 hectares in 2010 with a production rate of 2.824 t ha^{-1}) (Ministry of Agriculture 2012). The cultivar different in the vegetation according to the nature of growth, which differs in large leaves and petiole length, branching and continued growth after flowering may lead to a change in the shape of the plant. Therefore, the distribution and penetration of light through the vegetation is different and is reflected in the position of the lower leaves, which found that the lower leaves do not live parasitic on the plant but die gradually, when respiration speed increases on the photosynthesis speed (Yoshida 1972). Broad bean cultivar differs in their Genotypes and also in the nature of their growth and morphological form. They are affected by environmental factors such as light, carbon dioxide, water and nutrient status in the soil, which affect either the reaction of light or systems of converting carbon into organic compounds in chloroplasts as well as their differences in the content of nutrients and protein ratio and this difference is often due to the nature of the cultivar and its genotypes and conditions environmental (Issa 1990, Daur et al 2008). The plant needs growth regulators in order to complete the growth, because of its important role in improving biological activity, as many researches and studies indicated that the treatment of plants with a specific growth regulator leads to the improvement of the plant structure and the yield quality and the production of seeds (Khalaf and Rajbo 2006). Gibberellins play a role in balancing the growth of internodes and the growth and development of the leaves. It has been found that plants grow in the long-day or Chilling requirement if they remain in the short day or in warm conditions, where it remain growing vegetatively and do not flowering. The treatment of these plants with gibberellic acid will be compensated by the requirements of the light or cold period and thus elongate the stems, flowering and the plants where the elongation of the flower stem and flowered They contain more gibberellin compounds than plants that have not elongation of the flower stem and non-flowering stems (Saleh 1990). Gibberellin is used to obtain rapid vegetative growth in leafy vegetable crops and grain feed. The aim of this study is to evaluate the performance of the genotypes and the growth regulator gibberellins (GA3) and their interaction to achieve the integration of production in quantity and quality.

MATERIAL AND METHODS

This experiment was conducted to study Effect of spraying with gibberellic acid on growth and yield of three cultivars of Broad bean *Vicia faba* L. In this experiment used three genotypes of Broad bean obtained from local markets (local, French and Italian). Several concentrations of gibberellic acid (0, 100, 200 and 300 mgl^{-1}) were used. The broad bean seeds were cultivation on lines of the distance between one line and another 70 cm. The length of the line inside the experimental unit was 3 m. Each line contains 15 pits and the distance between one pit and another 20 cm. The seeds were cultivation on 10/10/2017, After the emergence of seedlings, the seedling was thinning so that each pit contained one plant (Almayoof 1982). The weed control was manually and the urea fertilizer was added 60 kg in one batch, The harvest was completed at full maturity on 17/4/2018. The gibberellin was prepared at a concentration (100 mg l^{-1}) of acid and prepared by taking a tablet 1g containing 1g active substance and dissolving it in a liter of distilled water to obtain the stock solution and keeping the solution with a dark bottle in a dark place and take (100 ml) of the basic solution and complete the volume to (1000 ml) to obtain a concentration (100 mg l^{-1}) Then spray on the vegetative part as well as the same way prepare concentrations 200 and 300 was sprayed in the early morning with the use of dishes washing solution to break the surface tension of water The following traits were studied: plant height (cm), number of branches per plant, number of pods, length of the pod, number of seeds per pod, weight of 100 g seed, plant yield, total seed yield per tons h^{-1}

Statistical analysis: The statistical analysis was conducted split-plot arrangement according to randomized complete block design and the main plot contained the genotypes. The secondary plot was contained thiamine acid concentrations and using the statistical program Genstate. The Significant differences between the mean of the treatments were tested by using the least significant difference (LSD) with a probability level of 5%.

RESULTS AND DISCUSSION

Plant height (cm): Average of the plant height ranged between 80.75 cm in local genotypes, which also significantly excelled the French and Italian genotypes, which gave the average amounted 69.33 and 73.50 cm, respectively. As for the adding of gibberellin, the Table 1 showed that there were significant differences in the same traits, The concentration 300 mg l^{-1} gave the highest average of amounted 78.89 cm compared to the non-adding treatment which gave the lowest average in this trait amounted 70.78 cm. This is due to the role of gibberellin in stimulating the process of the plant elongation, wherever the concentration of gibberellin increased, the plant height was increased. These results agree with Saleh and Abdul (1980). The increase in plant height is due to the effect of gibberellic acid in increasing cell division and enlargement, in adding to stimulating growth and cell expansion (Abdul 1987 and Saleh 1990).

The number of branches in the plant: The results in Table 1 confirmed that there were significant differences in the genotypes in the number of leaves in the plant for the season 2017 – 2018. Local genotypes gave the highest average amounted of 7.75 on other genotypes. This results agree with other researchers have found that there were significant differences between the cultivar of broad bean in Average number of branches in the plant Afifi et al 2010, Yucel 2013). The results in Table 1 showed that there were significant differences between the spraying with concentrations of the growth regulator gibberellin. The results of the same table were significant for the interaction between (local and 300), which gave the highest average amounted 8.40, compared to the other interaction, but the difference was not significant

Table 1. Effect of spraying with gibberellic acid, three cultivars and their interaction on average plant height (cm) and number of branches $plant^{-1}$ (Season 2017-2018)

Concentration of gibberellins/ Genotypes	Plant height					Number of branches $plant^{-1}$				
	0	100	200	300	Average of the effect of genotypes	0	100	200	300	Average of the effect of genotypes
Local	75.33	78.67	81.67	87.33	80.75	6.96	7.46	8.16	8.4	7.75
French	67.67	68.67	69.67	71.33	69.33	5	5.46	5.83	6.46	5.69
Italian	69.33	71.67	75	78	73.5	5.76	6.2	6.73	7.46	6.54
Average of the effect of concentration for gibberellin	70.78	73	75.44	78.89		5.91	6.37	6.91	7.44	
LSD0.05	Concentrations 4.363		Genotypes 3.192		Concentrations* genotypes NS	Concentrations 0.241		Genotypes 0.237		Concentrations* genotypes 0.398

from the interaction between (local and 200) which also gave the highest average of the other interaction amounted 8.16.

The number of pods in the plant: The results of Table 2 showed that the effect of genotypes and gibberellin was significant and that the local genotypes excelled the of all the genotypes which it gave the highest average amounted 15.58 pods, while the French genotypes gave the lowest average of 11.00 pods. The reason for excelled of the local cultivar on other genotypes may be due to excelled in the number of branches plant^{-1}. This result agrees with Al-Jubouri (2014) and Kubare et al (2014). The results in Table 2 showed that there was a significant increase in this trait when added gibberellin concentrations. The concentration of 300 mg l^{-1} gave the highest average of 16.78 pods, compared to the no adding treatment which gave the lowest average amounted 10.44 pods interaction between (local and 300) and (local and 200) gave the highest average of 19.67 and 17.67 pods, respectively.

Pod length (cm): The results of Table 2 showed that the genotypes had a significant effect in this trait, and the Italian genotypes gave the highest average, compared to the other structures amounted (17.17 cm). The results in the same table showed a significant increase of the concentrations 300 mg L ¹ which gave the highest average amounted 18.22 cm on the all the concentrations and also on the treatment of non - adding, which gave the lowest average amounted 11.00 cm. The interaction was not significant in this trait.

The number of seeds in the pod: The results in Table 3 indicate that there were significant differences between the effect of the genotypes and the concentrations and their interaction. The Italian genotype gave the highest average amounted 6.66 seeds on other genotypes. The reason for the different effect of the cultivar in this trait is due to the variance of the cultivars in their genetic traits or variation in the nature of growth and this is reflected in turn on the number of seeds per pod. This results agree with Ayed (2012).As for the concentrations. The concentration of 300 mg l^{-1} was excelled and gave the highest average of 6.76 seeds on all the concentrations and gave the treatment of non-adding the lowest average amounted 5.67 seeds. As for the interaction

Table 2. Effect of spraying with gibberellic acid, three cultivars and their interaction on average the number of pods plant^{-1} and pod length (Season 2017-2018)

Concentration of gibberellins/ Genotypes	Number of pods plant^{-1}					Pod length				
	0	100	200	300	Average of the effect of genotypes	0	100	200	300	Average of the effect of genotypes
Local	11.33	13.67	17.67	19.67	15.58	8.33	9.33	11.67	16.33	7.75
French	10.33	9.33	10.33	14.00	11.00	11.00	12.67	15.00	18.00	5.69
Italian	9.67	11.00	13.67	16.67	12.75	13.67	16.00	18.67	20.33	6.54
Average of the effect of concentration for gibberellin	10.44	11.33	13.89	16.78		11.00	12.67	15.11	18.22	
LSD0.05	Concentrations 1.246		Genotypes 2.179		Concentrations* genotypes 2.525	Concentrations 2.285		Genotypes 2.267		Concentrations* genotypes NS

Table 3. Effect of spraying with gibberellic acid, three cultivars and their interaction on average the number of seed in the pod and weight of 100 g seed (Season 2017-2018)

Concentration of gibberellins/ Genotypes	Number of seed					Pod length				
	0	100	200	300	Average of the effect of genotypes	0	100	200	300	Average of the effect of genotypes
Local	5.06	5.53	5.85	6.30	5.68	153.67	159.33	162.67	165.67	160.33
French	5.90	6.06	6.33	6.76	6.26	160.67	164.67	168.67	173.67	166.92
Italian	6.06	6.50	6.86	7.23	6.66	164.67	169.67	175.33	182.33	173.00
Average of the effect of concentration for gibberellin	5.67	6.03	6.34	6.76		159.67	164.56	168.89	173.89	
LSD0.05	Concentrations 0.172		Genotypes 0.232		Concentrations* genotypes 0.310	Concentrations 1.324		Genotypes 1.463		Concentrations* genotypes 2.247

Table 4. Effect of spraying with gibberellic acid, three cultivars and their interaction on average plant yield and total plant yield (Season 2017-2018)

Concentration of gibberellins/ Genotypes	Plant yield					Total plant yield				
	0	100	200	300	Average of the effect of genotypes	0	100	200	300	Average of the effect of genotypes
Local	261.67	267.00	272.00	277.00	269.42	2.59	2.66	2.79	2.84	2.72
French	269.67	276.00	285.67	292.33	280.92	2.79	2.86	2.89	3.61	3.04
Italian	282.00	288.67	295.00	306.00	292.92	2.90	2.97	3.25	3.70	3.20
Average of the effect of concentration for gibberellin	271.11	277.22	284.22	291.78		2.76	2.83	2.98	3.38	
LSD0.05	Concentrations 2.983		Genotypes 3.296		Concentrations* genotypes 5.063	Concentrations 2.983		Genotypes 3.296		Concentrations* genotypes 5.063

was significant, the interaction between (Italian and 300) gave the highest average amounted 7.23 seeds on the other interaction.

The weight of 100 g seed: The results in Table 3 showed that there were significant differences in the weight of 100 g seed, the Italian genotypes gave the highest average amounted 173.00 on the other genotypes. The reason for the excelled of the Italian cultivar in this trait is due to the number of seeds per pod and the pod length and may be due to the different cultivar in the size of seeds, and that the weight of the seed of the plant is a function of the average of photosynthesis and the transfer of its products (Isa 1990). The results in Table 3 showed that there was a significant difference for this trait for the added concentrations. The concentration 300 mg l^{-1}, gave the highest average amounted 173.89 g compared to the no adding treatment which gave the lowest average amounted 159.67 g. The results in Table 3 showed that there were significant differences in the interaction treatments. The interaction between Italian and 300 gave the highest average of 182.33 g on all interaction treatments.

Plant yield (g): It is clear from the results in Table 4 that there are significant differences between the genotypes, concentrations and the interaction between them in the average the plant yield. The Italian genotypes of broad bean plants achieved the highest average amounted 292.92 g and the local genotypes gave the lowest average of 269.42 g. These results agree with (Alan and Geren 2007). It confirmed the excelled of the cultivar and that through its ability to express the genetic nature as plant yield. To find out the concentrations of growth regulator used in this research, we find that the concentration of 300 mg l^{-1} gave the highest average of 291.78 g and the treatment of non - spraying gave the lowest significant difference for this trait amounted 271.11g. It is clear from the results in Table 4 that the interaction was significant as the interference between (Italian and 300) gave the highest rate of 306.00 g compared to the other interventions. The interaction between Italian and 300 gave the highest average amounted 306g.

Total plant yield (t ha^{-1}): The results in Table 4 showed that there were significant differences in the genotypes. The Italian genotypes gave the highest average of 3.20tha^{-1} compared to the lowest average of 2.72t ha^{-1}. The reason for the excelled of the Italian cultivar in this trait is due to the different thermal requirements of the plant in the flowering stage, which led to a clear variation in the contract of the varieties in the study Sau and Minguez (2000). The results in Table 4 showed that there were significant differences for growth regulators, where The concentration300 mg l^{-1} excelled on the all other the concentrations and gave the highest average of 3.38 and The treatment non-spraying gave the lowest average amounted 2.76tha^{-1}. The results in Table 4 indicated that there were significant differences for the interaction, where the interaction between (Italian and 300) and (French and 300) gave the highest average amounted 3.70 and 3.61 t ha^{-1}, respectively on the other interactions.

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