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Effect of Ascorbic Acid and Varieties on Yield in *Vicia faba* L.

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Abstract: Field experiment was conducted during winter season 2019-2020 in Qurna district (Al-Ghumayj area), with the aim of affecting four levels of concentrations of ascorbic acid (0, 150, 300, 450 mg^{-1} $liter^{-1}$) on growth, yield, and some specific characteristics of three varieties of broad bean American, Spanish and local), The experiment was carried out using a factor experiment method using a randomized complete block design) with three replications. The ascorbic acid spray treatment 300 mg^{-1} $liter^{-1}$ exceeded the concentration of 450 mg^{-1} in number of pods, number of seeds, and yield (4622.2 kg ha^{-1}). , The local variety achieved significant superiority in most of the studied traits, and gave a seed yield of 4512.7) kg $ha^{-1.}$ The interaction effect was significant in most of the studied traits and the local variety and the concentration 450 mg. $liter^{-1}$ gave the highest yield (5225.7kg ha^{-1}).

Keywords: Leguminous, Ascorbic acid, Varieties

The leguminous crop (*Vicia faba* L.) is one of the leguminous crops belonging to the family of leguminous Fabacea and is cultivated in various parts of the world, including Iraq. The nutritional importance of this winter crop is that green pods can be consumed directly after cooking and their fresh and dry seeds contain protein and considered food source for a number of countries in the world, especially Asian and low-income countries (Abdul Hafez 2011). The roots also contain root nodes that help stabilize atmospheric nitrogen and consider it as a crop within the agricultural cycle to improve the properties of the soil as green fertilizer (AboulEL-Yazied et al 2012). In Iraq, faba bean is cultivated in area of 25096 dunums during 2019 with 38605 ton for green pods. The faba bean suffers during its growing season from several problems that cause production to decrease. In order to increase its productivity per unit area, the antioxidant (ascorbic acid) was used an effective antioxidant for protection of plants from photo-oxidation, and its participation in building ethylene, gibberellin and anthocyanins) Smirnoff and Wheeler 2000). Ascorbic acid can act by increasing the efficiency of the photosynthesis process also participates in controlling the movement of stomata (Ahmed et al 2012) and biological effectiveness in preserving leaves from old age (Aysun 2009). The use of the antioxidant ascorbic acid alone is not sufficient to reduce the problems that occur to a plant unless it is associated with the appropriate variety, which in turn responds to the role provided by the non-enzymatic antioxidant, depending on the genetic potential of the variety and the environment. The varieties of faba bean differ in the nature of growth and the length of the period for maturity, as well as in productivity and quality. Due to the lack of studies related to the use of antioxidants and their overlap with the variety appropriate to local conditions, this study was conducted, which aims to study the effect of different concentrations of the antioxidant (ascorbic acid vitamin C) on the growth and yield of three varieties of faba bean under the conditions of the southern region in Basra Governorate.

MATERIAL AND METHODS

The experiment was carried out in the winter season (2019-2020) in Qurna district, which is 70 km north of Basra city, in a farmer's field, to study the effect of spraying with antioxidant ascorbic acid in concentrations (0-150-300-450 mg) on growth and yield of three varieties of the faba bean. The experiment was in randomized complete block design and with three replications. Ascorbic acid was sprayed in three times. The first 15 days after emergence and the second 15 days after the first and third spray 15 days after the second spray. The spray was carried out early in the morning until the leaves were completely wet. The diffuser was added to the solution to reduce surface tension and increase its efficiency to penetrate the surface of the leaves by the solution. The land was plowed and smoothed, then flattened. Soil samples were taken randomly from the experiment site, with a depth of 30 cm (Table 1) for some characteristics of soil. The distance between one row and another is 0.75 cm, and between one and the other 1 meter.

The sowing was done on October 18, 2019 at depth of 2 cm. The nitrogen fertilizer (N 46%) was applied in two batches, @ 50 kg N/ha. The superphosphate (12.12.36), was added before the planting mixed with the soil @ 108 kg/ha. The traits were measured at the stage of maturity and were

analyzed statistically using the statistical program (Genstat).

Average number of pods plant^{-1}: There was a significant effect between ascorbic acid concentrations and the cultivars, but the interaction had no significant effect in this characteristic (Table 1). The treatment C3 recorded the highest number of pods with an average of 13.41, while the comparison C0 recorded the lowest average of 10.7, followed by C1 and C2, which gave 12.09, 11.55 plant pods, respectively. The increase in the number of pods may be attributed to concentration of ascorbic acid which increased the dry weight of a plant. The increase in dry weight may be reflected positively by the formation of new sites of emergence in the plant, which is followed by an increase in the percentage of nodes and then an increase in the number of pods (Al-Dulaimi and Al-Rawi 2017) and this is in agreement with Bassiouny et al (2005) and Mansour (2014). The cultivar V3 gave the highest average of 15.98 pods, while in V2 was 13.05 pods, and V1 gave the lowest average of 6.8 pods. The dry and leafy area, which led to the difference in the number of pods per plant and is in agreement with Thaloth et al (2006) and Ibrahim (2011).

Number of seeds per pod: There were significant differences between ascorbic acid concentrations and cultivars and the interaction on number of seeds per pod. Treatment C3 recorded the highest average of 3.36 pod seeds^{-1} followed by C1 and C2 with an average of 3.19 and 2.97 pod seeds^{-1} respectively, while the treatment for C0 was the lowest average of 2.71 pod seeds^{-1} (Table 3). The increase in the number of seeds per pod is due to ascorbic acid by increasing the photosynthesis process which was positively reflected in the increase in the number of seeds (Mansour 2014).

The cultivar V2 had the highest average of 3.34 pod seeds^{-1} followed by V1 (3.33 pod^{-1}) and V3 (2.55 pod seeds^{-1}) and is attributed to the difference in varieties and the variation in their growth. The varieties' response varies according to the different concentrations of ascorbic acid, V1C3 gave the highest average of 3.95 pod seeds^{-1}, with a significant difference from all the other combinations, while the treatment V3C0 gave the lowest average of 2.3 pod seeds^{-1}.

Weight of 100 seeds: (grams): There were significant differences between the concentrations of ascorbic acid and the varieties and the interaction between them in the weight of 100 seeds (Table 4). Treatment C3 recorded the highest weight of 100 seeds with an average of 132.97 gm and C0 gave the lowest average of 122.77 gm, while the two treatments C1 and C2 gave 125.25 and 128.541 gm. The increase in the weight of the seeds when increasing the concentration of ascorbic acid may be attributed to the role that increased the efficiency of the photosynthesis process by protecting against oxidative damage to pigments and thus the increase in carbohydrate building rates, as well as the role in cell division and growth that encourages the building of proteins and acids which It reflects positively on the increase in seed weight. The variety V3 recorded the highest average of 138.90 g, while the average in V2 was 123.92 gm and V1 gave the lowest average of 119.25 gm. The difference in the seed weight of the varieties could be due to increase in the number of seeds for the Spanish variety. The decrease in the number of seeds of the local variety led to an increase in the

Table 1. Physical and chemical properties of the experiment soil

Parameter	Unit	
	Soil tissue	Clay mixture
Sand	274.2	gM kg $^{-1}$
Silt	325.4	gM kg $^{-1}$
Clay	400.4	gM kg $^{-1}$
Electrical conductivity value Ec	7.32	Designs M^{-1}
PH soil reaction value	7.81	
Organic matter	6.54	Cloudiness kg
Ready nitrogen	17.40	mg-kg^{-1}
Ready phosphorous	20.16	mg-kg^{-1}
Ready potassium	1.43	mg-kg^{-1}

Table 2. Effect of ascorbic acid and varieties on the average number of pods per plant

Varieties	Concentrations of ascorbic acid				Items Average
	C3	C2	C1	C0	
V1	9.00	6.4	5.97	5.83	6.8
V2	13.93	13.21	13.17	11.83	13.05
V3	17.3	16.67	15.5	14.43	15.98
Average	13.41	12.09	11.55	10.7	
LSD (p=0.05)			Varieties	Concentrations	Overlap
			470.0	0.543	n.s

weight of the seeds as explained according to the principle of compensation, and could be the result of the different genetic structures that the plant possesses, which differ from one variety to another, and the varieties differ among themselves by absorption and transfer of nutrients from the leaf to the fruits of the plant (Al-Sahuki 2006). The average weight of 100 seed in V3C3 was 141.9 g, without a significant difference with V3C2 and V1C3 (140.3 and 138.3 respectively). V1C0 gave an average of 114.00 gm and without a significant difference with V1C1 (116.67 gm per 100 seeds).

Individual plant yield (gm plant^{-1}): There was significant effect of ascorbic acid concentrations and cultivars and the interaction between them on yield of the plant (Table 5).The treatment C3 recorded the highest average of the individual plant yield of 57.48 gm plant^{-1}, and C0 lowest of 35.39 gm plant^{-1}, while the mean of the C1 and C2 were 43.72 and 50.27 gm plant^{-1}. The reason increase in the individual yield may be due to an increase in the concentration of ascorbic acid which increased the number of seeds per pod (Table 3) and the number of pods per plant (Table 2) and the increase in the weight of 100 seeds (Table 4). This is consistent with El-Bassiouny et al (2005) and Al-Dulaimi and Al-Rawi (2017). The variety V3 gave the highest average (58.47 g), while V1 scored the lowest average of 29.22 gm plant^{-1} and the V2 variety gave an average of 54.51 gm plant^{-1}. This is due to difference in each in number of pods, the number of seeds, and the weight of 100 seeds in varieties, as well as the difference in the thermal requirements of the plant in the flowering stage, which led to a clear variation in the studied varieties (Sau and Minguesl 2000). Similar trend was observed by Al-Othman and Ibrahim (2009) and Silawi et al (2018). The treatment V3C3 gave the highest average per plant yield (69.32 gm plant^{-1}) with significant difference from all other interactions, while the combination of V1C0 recorded the lowest mean of 18.16 gm plant^{-1}. The superiority of the treatment V3C3 is due to its superiority in the yield components (number of pods, number of seeds per pod, and weight of 100 seeds) (Table 2, 3, 4). The concentration of ascorbic acid, which varies according to the cultivars, showed the highest average in V3C3 (69.32 gm plant^{-1}) and V1C0 recorded an average of 18.16 gm plant^{-1}.

Total yield (kg per ha): There was significant effect of ascorbic acid concentrations on total seed yield (Table 6). C3 treatment recorded the highest total yield of 4622.2 kg ha^{-1}, while the lowest was recorded in C0 (2944.8 kg ha^{-1}) while the average for C1 and C2 was 3538 and 3849.5 kg ha^{1}. The increase in the total yield of seeds can be attributed to the significant effect of ascorbic acid in increasing the yield components (Table 3, 4, 5) which was reflected in an increase in the individual plant yield and thus an increase in the total yield of the treatment C3 These result are consistent with the findings of El-Bassiouny et al (2005) and Al-Dulaimi and Al-Rawi (2017). The variety V3 scored the highest yields

Table 3. Effect of ascorbic acid and varieties on the number of seeds per pod

Varieties	Concentrations of ascorbic acid				Items Average
	C3	C2	C1	C0	
V1	3.95	3.45	3.11	2.80	3.33
V2	3.65	3.51	3.17	3.03	3.34
V3	2.82	2.61	2.47	2.30	2.55
Average	3.36	3.19	2.92	2.71	
LSD (p=0.05)			Varieties	Concentrations	Overlap
			0.118	0.136	0.236

Table 4. Effect of ascorbic acid and varieties on the weight of 100 seeds. (gm)

Varieties	Concentrations of ascorbic acid				Items Average
	C3	C2	C1	C0	
V1	126.0	120.33	116.67	114.00	119.25
V2	131.0	125.00	120.67	119.00	123.92
V3	140.9	140.3	138.41	138.3	138.90
Average	132.9	128.54	125.25	122.77	
LSD (p=0.05)			Varieties	Concentrations	Overlap
			2.080	2.401	4.159

Table 5. The effect of ascorbic acid and varieties on plant yield (gm plant^{-1})

Varieties	Concentrations of ascorbic acid				Items Average
	C3	C2	C1	C0	
V1	44.79	31.81	21.66	18.61	29.22
V2	66.61	57.96	50.79	42.66	54.51
V3	69.23	61.06	58.71	44.91	58.47
Average	57.48	50.27	43.72	35.39	
LSD (p=0.05)			Varieties	Concentrations	Overlap
			1.005	1.160	2.010

Table 6. The effect of ascorbic acid and varieties on total seed yield (kg ha^{-1})

Varieties	Concentrations of ascorbic acid				Items Average
	C3	C2	C1	C0	
V1	3680.5	2505.6	2110.3	1785.5	2520.5
V2	4960.4	4332.4	3974.8	3466.12	4182.7
V3	5225.7	4740.5	4531.6	3582.8	4512.7
Average	4622.2	3849.5	3589.9	2944.8	
LSD (p=0.05)			Varieties	Concentrations	Overlap
			66.933	77.288	133.867

(4512.7 kg ha^{-1}), while V1 lowest average of 2520.25 kg ha-^{1}. The increase in V3 compared to In the two varieties V2 and V1, due to the different effect on growth and yield traits. The variety V3 outperformed in the two characteristics of the number of pods per plant and the average weight of 100 (Table 2, 4) and this is in agreement with Al-Ghamdi (2007) and AL- Silawi et al (2018). The interaction had a significant effect, highest average was in V3C3 (5225.7 kg ha^{-1}), while V1C0 recorded an average of 1785.5 kg ha^{-1}.

CONCLUSION

Add ascorbic acid led to an increase in the yield components and the seed yield in the bean crop. The local variety excels in most of the studied traits than the rest of the varieties.

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