Effect of Gibbereillic Acid, Amino Acids and Boron on The Growth Attributes, Yield and Its Components and Chemical Composition of Faba Bean

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ABSTRACT: The current work was conducted in 2009/2010 and 2010/ 2011 seasons at the Experimental Farm of the Faculty of Agriculture, (Saba Basha) Alexandria University at Abees – Alexandria Egypt to study the effect of gibbereillic acid, amino acid and boron on growth yield, its components and chemical composition of faba bean plants. The experimental design was split - split plot with three replicates. The main plots were assigned to three boron fertilizer levels (0, 100 and 200 mg/L) and three levels of amino acid spraying (0, 100 and 200 mg/L) were randomly distributed to sub plots. Whereas, the sub- sub plots were represented by three Gibbereillic acid applications (0, 100 and 200 mg/L).

The obtained data showed that plant height, number of branches/plant, dry matter accumulation, number of pods/plant, number of seeds/plant, 100- seed weight, straw and seed yields/fed, and N, P, K contents in seeds increased by application of boron at 200 mg/L. The data showed that spraying amino acid significantly affected most growth and yield components whereas, applying 200 mg/L amino acid gave the highest most growth, yield and its components compared to the other nil treatments. a particularly in conjunction with 200 mg/L GA_3 foliar concerning utilization of gibberellic level, the mean values of seed yield were in the first season only (8.04, 8.04 and 9.14 ardab/fed) by 0, 100 and 200 mg/L GA_3 successively N, P and K in faba bean seeds increased with applying 200 mg/L Boron, Amino acids and GA_3 treatment in comparison with the other treatments for three factors in this study.

Keywords: Gibbereillic acid, amino acid, boron, minerals content, faba bean

INTRODUCTION

Faba bean (*Vicia faba*, L.) is one of the most important winter crops of high nutritive value in the world as well as in Egypt. Mature seeds of faba bean are a good sources of protein (about 25% in dried seeds), starch, cellulose, vitamin C and minerals (Ibrahim *et al.*, 2007).

Faba bean, is considered as one of the basic sources of protein for human consumption, so it is importance to obtain a clean product of faba bean. In this respect, many attempts took place in the recent years in order to avoid the harmful effects of chemicals and pesticides, and have considerable importance as a low cost food rich in proteins and carbohydrates (Serap and Guleryz, 2006).

Boron concentration below 0.5 mg/liter in soil solution is probably safe for most plants, but many plants are affected by boron on plant concentrations increased with at the range of 0.5 to 5 mg/liter (Wilcox 1960). Such toxic concentrations of boron have been found in the soils and irrigation waters of many arid regions.

Amino acids have a chelating effect on micronutrients when applied, that make the absorption and transportation of micronutrients insides the plant is easier due to its effects on cell membrane permeability. Some of these micronutrients play roles in plant resistance by regulating the levels of auxin in plant tissues by activating the auxin oxidase system and by it appears to the required in synthesis of intermediates in the metabolic pathway (Chowdhury, 2003).

Gibbereillic acid (GA_3) a kind of plant hormones or growth regulators, regulate many aspects of plant life from seed germinations to vegetative growth and flowering. Three have been many studies on the regulatory mechanism of gibbereillins including gibbereillin reception signal transduction and gene expression especially in seed germination (Rashad and Ahmed., 1996). Gibbereillic acid has been used to stimulate cell division and elongation (Francis and Sorrell, 2004). Therefore, the objective of the present investigation was carried out in order to study the effect of gibberellic acid, amino acid and boron on the yield productivity and technological characters of some broad bean cultivars (*Vicia faba*, L.).

MATERIALS AND METHODS

Two field experiments were carried out at the Experimental Farm of Faculty of Agriculture (Saba- Basha), Alexandria University, at Abees region Alexandria, Egypt, during the two successive winter seasons of 2009/2010 and 2010/2011. The experimental design was split-split plot with three replicates. Whereas, the main plots were conducted for the spraying with boron at nil, 100 and 200 mg / L. Mean while the three arranged in the sub plots. Nitrogen fertilizer for at the rate of 15 kg N/fed, was addressed before planting from (ammonium nitrate 33.5%N). The sub- sub plots were represented by three Gibbereillic acid applications (0, 100 and 200 mg / L). Faba bean seeds were treated with Rhizobuim inoculation (R. *Leguminosuim*. ev. *vicieae bacterium*). suspension containing 10 cell bacterium per one gram. Phosphorus fertilizer was applied before planting superphosphate at rate (15.5% P_2O_5), and potassium fertilizer (48% K_2O) at rate of 24 kg K_2O/fed. Seeds of faba bean variety (Giza 716) were sowing on 20th and 23th Oct in the first and second seasons, respectively. The experimental soil was clay loam in texture, poor in organic matter (0.90%) with pH of (8.0). available phosphorus was (3.90 mg/kg) and available nitrogen was (145 mg/kg) (average of the two seasons for upper 30 cm of the soil surface).

Each sub- plot included five ridges; each ridge was 3.5 meter long and 50 cm width .Twenty two days after sowing the plants were thinned to two plants/hill. The preceding crop was maize in both seasons.

Three samples (12) guarded plants for each were collected at random from each plot at 60, 80 and 100 days after sowing and each sample were divided on the sequent samples (A) Growth attributes: Plant height, number of branches and dry weight/plant, (B) Yield and its components: number of pods/plant, number of seeds/plant, 100-seed weight (g), straw yield (ton/fed) and seed yield (ardab/fed) and (C) Chemical contents of seeds: Sample from the dried shoot were taken to determined following characters. Nitrogen percentages were determined by using the method described by Nassler's method (Chapman and Pratt., 1978) Phosphorus percentages was determined using the Vandomolybde phosphate method (Jackson, 1973), Potassium percentages were determined using Flame photometer (Jackson, 1973).

All the data collected were subjected to statistical analysis of variance as described by Gomez and Gomez (1984). The treatment means were compared using L. S. D. test at 0.05 level of probability.

RESULTS AND DISCUSSION

A- Growth attributes

The obtained results given in Table (1) clearly showed that boron concentrations exhibited a significant effect on all estimated traits at different growth stages in both seasons. A gradual and significant increase in plant height, number of branches and dry matter/plant accompanied each increment of spraying boron levels. The highest mean values of all characters were achieved when the boron fertilizer was applied at the 200 mg / L at different growth stages in both seasons. It may be due to the positive effect of boron could be attributed to its role in cell elongation and turgidity (Hossain *et al.* 2006).

From the same table it may be noticed that treatment of tested amino acid had direct effect on plant height and dry weight/plant of faba bean. Spraying faba bean plants with amino acid at 200 mg/L were significantly improved plant height and dry weight/plant at different growth stages in both seasons. Similar results were obtained by (Fischer *et al.*, 1998 and Manoela *et al.*, 2001).

Application of Gibbereillic acid to faba bean plant significantly increased plant height, number of branches/plant and dry weight/plant. The highest mean values of these characters were achieved when the gibbereillic acid was applied at 200 mg / L compared with nil level. This finding could be explained through the functional and physiological role of GA_3 in increasing growth plants. The previous results agree more or less with the finding of (Abdel Fattah., 1997).

The first order and second order interactions coursed significant effect on growth attributes treatments at different growth stages in both seasons.

B- Yield and its components:

Table (2) concluded that seed yield and its components of faba bean were significantly affected by boron application in seasons 2009/2010 and 2010/2011, respectively. The results showed that increasing boron level accompanied with gradual increase in the mean values of the characters and maximized at 200 mg / L. It is clear that the yield was increased and its components in the productivity of faba bean plants as a result of trace elements might have increased photosynthesis activity and consequently produced more metabolites required for building up the growing pods (Abdel- Monem *et al.*, 2009). However, these finding are in accordance with those obtained by (Rizk and Abdo 2001).

Increasing organic acid levels resulted in significantly increase on number of pods/plant in the first season and 100- seed weight, straw and seed yield/fed in the second seasons. Application of 200 mg / L amino acid significantly increased these characters during both seasons. These results are harmony with those reported by Schnitzer., (2001).Yield and its components consider the main target of the present investigation. So the data recorded in Table (2) showed that spraying faba bean plants with gibberellie acid caused a marked effect on the seed yield/ fed. and its components number of pods/plant, number of seeds/pod and 100- seed weight in comparison to the untreated plants.

The highest values of seed yield/fed (14.06 and 13.07 ardab/fed) were obtained from the application of GA_3 at 200 mg ⁄ L in both seasons. Similar results were obtained by Abdel- Fattah., (1997) who found that pod length and seed yield/fed of faba bean was increased by foliar application of Gas at 50 mg⁄L. The first and second order interactions were significant effect on number of pods/plant, 100- seed weight and straw yield/fed, in the first seasons only.

C- Seed chemical composition:

Data in Table (3) declared that boron application significantly affected seed chemical composition N, P and K contents in both seasons. The highest values for such trait in 2009/2010 season (3.72, 5.05 and 4.08 g/100g) for N contents and about (325, 466, 523 mg/100g) for P content for nil, 100 and 200 ppm boron respectively while in 2010/2011 season the highest value of P (324, 479 and 510 mg/100g) and K (3.13, 3.20 and 5.10 mg/100g) respectively were recorded with foliar boron application. These results are agreement with **Akinlosotu and Akinyele (1991)** who reported that the calcium, magnesium, iron, potassium and phosphorous contents in cowpeas were 52.2, 90.8, 21.8, 4.1, 124.6 and 406.3 mg/100g on dry weight basis.

Foliar application of amino acid levels significantly increased the contents of N, P and K in both seasons. The highest mean values for N, P and K contents by application of amino acid at 200 mg ⁄ L as compared with nil treatment in both seasons. It is obvious from the data recorded in Table (3) that the seeds produced from the plants treated with Gibbereillic acid had significant increase in among N, P and K percentage as compared to those obtained from the untreated plants. The seeds produced from the plants treated with GA_3 possessed the highest values of N, P and K contents (6.06 and 7.07 & 3.77 and 3.67 & 3.44 and 3.54) during the two seasons respectively. It can be suggested here that application of GA_3 encourages the absorption of nitrogen for the soil and/or activated the photosynthesis process through then influence on some enzymatic action. Similar results were obtained by El- Etr., (2000) and Bardisi., (2004).

Table (1): Some growth attributes as affected by boron levels amino acids and gibbereillic acid applications during 2009/2010 and 2010/2011 seasons

Treatments	Plant height (cm)						Number of branches/plant						Dry weight (g)					
	2009/2010 DAS			2010/2011 DAS			2009/2010 DAS			2010/2011 DAS			2009/2010 DAS			2010/2011 DAS		
	60	80	100	60	80	100	60	80	100	60	80	100	60	80	100	60	80	100
A)Boron levels																		
0	28.82a	51.56ab	62.96b	33.93b	73.93b	90.46	3.74	3.74c	3.67	4.00	5.11	6.30	20.99b	113.00a	169.78b	16.75b	89.14b	182.4
100 mg/L	27.30b	50.88b	63.26b	33.63b	73.44b	90.66	3.52	4.06b	4.03	4.30	5.19	6.44	22.15ab	103.22b	166.26b	17.28b	93.52b	176.1
200 mg/L	29.00a	52.34a	69.63a	36.19a	75.37a	94.59	3.81	4.67a	4.20	4.41	5.33	6.56	23.371a	111.70a	188.04a	19.25a	96.00a	179.2
L.S.D.0.05	0.62	1.20	0.60	1.04	1.34	Ns	ns	0.53	Ns	ns	Ns	ns	1.61	2.17	6.45	0.75	1.36	ns
B) Amino acids																		
0	28.15	51.00	64.71b	35.96c	71.48c	90.81	3.81	4.00	3.68	4.19	5.07	6.15	23.59a	108.48c	145.59c	16.25c	88.22c	174.07
100 mg/L	28.07	52.14	65.02ab	37.07b	74.85b	91.46	3.53	4.00	4.02	4.11	5.07	6.19	20.03b	111.11b	188.82b	18.33b	94.96b	178.04
200 mg/L	28.90	52.04	66.07a	38.70a	76.41a	93.48	3.63	4.41	4.22	4.41	5.48	6.96	22.89a	118.35a	198.08a	19.26a	96.92a	185.66
L.S.D.0.05	Ns	Ns	1.26	0.47	1.01	Ns	ns	Ns	Ns	ns	Ns	ns	0.80	1.93	4.26	0.53	0.73	ns
C)Gibbereillic acid																		
0	24.04b	49.59c	64.72b	31.85c	72.30b	89.54	3.52	4.00	3.96	4.11	4.67c	6.33	21.94	99.00c	159.33a	16.66c	91.15c	174.07
100 mg/L	28.37a	52.20b	65.00b	35.15b	75.19a	91.52	3.71	4.41	3.90	4.48	5.15b	6.33	21.96	121.96	175.74b	18.04b	93.30b	178.04
200 mg/L	28.70a	53.48a	66.07a	36.74	75.26a	94.63	3.81	4.00	4.00	4.11	5.82a	6.63	22.62	120.85a	189.00a	19.04a	94.62a	185.66
L.S.D.0.05	0.50	0.96	0.83	0.47	0.79	Ns	ns	Ns	Ns	ns	0.48	ns	Ns	2.21	4.13	0.56	0.81	ns
Interactions																		
A× B	*	*	*	*	*	Ns	*	Ns	*	*	*	*	*	*	*	*	*	ns
A× C	*	*	*	*	*	Ns	ns	Ns	Ns	*	*	*	*	*	*	*	*	ns
B× C	*	*	*	*	*	Ns	ns	*	Ns	*	*	ns	*	*	*	ns	*	ns
A× B×C	*	*	*	*	*	Ns	ns	*	*	*	*	*	*	*	*	*	*	*

DAS: Days after sowing

Mean followed by the same letters within each column are not significantly different at 0.05 level of probability.

* : Significant at 0.05 level of probability.

Table (2): Yield and its components as affected by boron levels, amino acid and gibbereillic acid during 2009/2010 and 2010/2011 seasons

Treatments	Number of Pods/plant		Number of seeds/plant		100- seed weight (g)		Straw yield (ton/fed)		Seed yield (ardab/fed)	
	2009/2010	2010/2011	2009/2010	2010/2011	2009/2010	2010/2011	2009/2010	2010/2011	2009/2010	2010/2011
A) Boron levels										
0	13.89c	14.85	4.07b	4.04	89.45b	90.75b	1.43b	1.40b	8.04b	8.46
100 mg/L	15.41b	16.15	4.19b	4.19	90.26b	93.13ab	1.44b	1.51a	8.04b	8.46
200 mg/L	15.89a	16.19	4.48a	4.11	95.86a	96.00a	1.52a	1.52a	9.14a	9.46
L.S.D. 0.05	**0.30**	**Ns**	**0.20**	**Ns**	**1.60**	**3.46**	**0.05**	**0.07**	**1.05**	**ns**
B) Aminoacids										
0	14.33c	14.56	4.00	4.07	89.83b	90.77b	1.27	1.45b	9.83b	10.77
100 mg/L	15.04b	16.19	4.30	4.19	91.34a	92.16ab	1.32	1.50a	10.34ab	11.16
200 mg/L	15.82a	16.44	4.44	4.31	92.40a	96.12a	1.43	1.52a	11.40a	12.12
L.S.D. 0.05	**0.40**	**ns**	**Ns**	**Ns**	**1.31**	**4.22**	**Ns**	**0.02**	**1.10**	**ns**
C) Gibbereillic acid										
0	13.41c	15.37	3.96	3.93c	88.10c	86.74b	1.40b	1.50b	9.10c	9.74b
100 mg/L	16.16b	16.44	4.37	4.19b	91.41b	95.22a	1.51b	1.65b	12.41b	12.22a
200 mg/L	19.17a	16.89	4.41	4.42a	94.06a	97.07a	1.76a	1.77a	14.06a	13.07a
L.S.D. 0.05	**0.59**	**ns**	**Ns**	**0.17**	**1.54**	**4.19**	**0.20**	**0.19**	**1.01**	**1.65**
Interactions										
A× B	*	ns	Ns	ns	*	ns	Ns	ns	ns	ns
A× C	*	ns	ns	ns	*	ns	*	ns	ns	ns
B× C	*	ns	ns	ns	*	ns	*	*	ns	ns
A× B× C	*	ns	ns	ns	*	ns	ns	*	ns	ns

Table (3): Chemical composition (N g/100g and P and K contents mg/100g on dry weight basis) as affected by boron levels amino acid and gibbereillic acid during 2009/2010 and 2010/2011 seasons

Treatments	Nitrogen content (g/100g)		Phosphorus content (Mg/100g)		Potassium content (Mg/100g)	
	2009/2010	2010/2011	2009/2010	2010/2011	2009/2010	2010/2011
A) Boron levels						
0	3.72b	5.25	325c	324b	3.20	3.13b
100 mg/L	5.05a	5.60	466b	479a	3.18	3.20b
200 mg/L	4.58 ab	5.70	523a	510a	5.23	5.10a
L.S.D. 0.05	1.04	Ns	0.55	0.58	Ns	1.30
B) Amino acids						
0	4.37b	4.97b	439b	497b	2.99b	4.37b
100 mg/L	4.25b	5.93ab	480b	593a	3.35a	4.23b
200 mg/L	6.03a	6.06a	554a	606a	3.22ab	6.03a
L.S.D. 0.05	0.96	1.20	0.64	0.50	0.28	0.30
C) Gibbereillic acid						
0	3.67b	4.74b	423b	444b	2.91b	2.91b
100 mg/L	4.41b	5.22b	489b	518ab	3.20ab	3.18ab
200 mg/L	6.06a	7.07a	574a	557a	3.44a	3.54a
L.S.D. 0.05	1.54	1.19	0.72	0.92	0.38	0.45
Interactions						
A× B	ns	*	*	Ns	ns	*
A× C	ns	ns	ns	ns	ns	ns
B× C	*	ns	ns	ns	ns	*
A× B× C	ns	*	ns	ns	ns	Ns

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الملخص العربي

تأثير البورون ، الأحماض الأمينية ، حمض الجبريلليك علي الصفات الخضرية والمحصول ومكوناته والتركيب الكيماوي للفول البلدي

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***قسم الانتاج النباتي – كلية الزراعة ساباباشا – جامعة الاسكندرية – ** مركز البحوث الزراعية**

****قسم بحوث تكنولوجيا المحاصيل–معهد بحوث تكنولوجيا الأغذية–مركز البحوث الزراعية–مصر**

أجريت تجربتان حقليتان بالمزرعة البحثية بكلية الزراعة (سابا باشا) جامعة الإسكندرية خلال موسمي الزراعة 2009/2010، 2010/2011 بهدف دراسة تأثير البورون والأحماض الأمينية و حمض الجبريلليك علي الإنتاجية والتركيب الكيماوي الفول البلدي لصنف جيزه 716.

كان التصميم التجريبي المستخدم في الدراسة هو القطع المنشقة مرتين في ثلاثة مكررات وتم توزيع المعاملات عشوائيا وخصصت القطع الرئيسية لمعاملات التسميد بالبورون. (صفر ، 100 جزء في المليون ، 200 جزء في المليون) أما القطع الشقية الأولي وزعت المعاملات للأحماض الأمينية (صفر ، 100 جزء في المليون ، 200 جزء في المليون) ، أما داخل القطع الشقية الثانية فتم توزيع معاملات حمض الجبريلليك (صفر ، 100 جزء في المليون 200 جزء في المليون) .

<u>وأوضحت النتائج مما يلي :</u>

- أظهر الفول البلدي زيادة معنوية لكلا من الصفات الخضرية تحت الدراسة (طول النبات و عدد الأفرع /نباتو الوزن الجاف للنبات و عدد القرون | نبات و عدد البذور | نبات و وزن 100 بذرة) و المحتوي الكيماوي N, P , K نتيجة اضافة البورون بمعدل 200 جزء في المليون .
- كما أوضحت البيانات أن اضافة الحمض الأميني بمعدل 200 جزء في المليون أثر معنويا علي معظم الصفات الخضرية والمحصولية . وكذلك إتضح أن إضافة حمض الجبريلليك بمعدل 200 جزء في المليون أعطي أعلي قيم للصفات الخضرية مقارنة بالمعاملة بدون بإضافة .
- اتضح ان قيم محصول البذور / فدان كانت (9.1 ,8.4 ,8.4) أردب/ فدان علي التوالي عند إضافة (صفر , 100 ,200) جزء في المليون . وتم أيضا زيادة تركيزات المحتوي الكيماوي NPK في البذور مع التركيزات الاعلي بمعدل 200 جزء في المليون لمعاملات البورون و حمض الجبريلليك و الحمض الاميني مقارنة بالمعاملات الاخري.