AMERICAN-EURASIAN JOURNAL OF SUSTAINABLE AGRICULTURE
ISSN: 1995-0748, EISSN: 1998-1074
2017, volume(11), issue(3): pages (1-6)
Published Online May 3 2017 in http://www.aensiweb.com/AEJSA/

Response of faba bean to spraying salicylic acid

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Received 12 January 2016; Accepted 2 May 2017 Published Online 3 May

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ABSTRACT

A field experiment was conducted during winter season of 2010 at field crops department, college of agriculture, university of Baghdad / Iraq to evaluate the effect of salicylic acid on growth and yield of faba bean (*Vicia faba* L.). A factorial arrangement in RCBD with three replications was used including two factors, first involved four varieties (Baladei, Hama, Nubaria and Local), while the second included three levels of spraying salicylic acid (0, 35 and 70) ppm. Results reveled significant differences between varieties concerning growth and yield, the Local variety gave highest yield about 3830 Kg ha^{-1}. Increasing salicylic acid from 0 to 70 ppm increased plant height, chlorophyll content, leaf area, yield and some yield components. So we recommended spraying plants at different stages at different concentrations of salicylic acid to improved growth and yield.

KEY WORDS

Vicia faba, varieties, yield components, SA.

INTRODUCTION

Faba bean (*Vicia faba* L.) is the fourth most important pules crop in the world [1] and widely used in the Mediterranean region as a source of protein in both human and animal nutrition either fresh or dried [2]. It contains a large amount of proteins, carbohydrates, B-group vitamins and minerals depend on variety [3]. Faba bean play a key role in crop rotation due to their ability to fix nitrogen, and the beans are able to provide a significant level of nitrogen from the soil air using a symbiotic relationship with *Rhizobium* bacteria. The main aim objective of when growing the crop is to obtain the highest yield, however, there are several factors that affect the production such as varieties or genotypes and improving adaptation to changing environments [4]. According to many studies carried out in faba bean, there are significant different among varieties concerning yield and yield components [5]. Growth regulators are one of the most important factors for yield improvement in various field crops. Salicylic acid as a natural plant hormone has many effects on physiological processes and growth of plants [6]. Ali and Mohmoud [7] reported that the application of 150 ppm of salicylic acid to mung bean enhanced significantly plant height, number of branches $plant^{-1}$, number of pod $plant^{-1}$, number of seeds $pods^{-1}$, 1000 seed weight, seed weight $plant^{-1}$ and seed yield (ton ha^{-1}). Gad El-Hak *et al*. [8] pointed out that the application of different salicylic acid concentration increased plant height, N% and seed protein percentage of pea. An increase in shoot height, shoot dry weight, pods weight, seed weight, number of seeds $plant^{-1}$ and100 seed weight has been found in faba bean [9]. The present work was designed with the objective to investigate the effect of salicylic acid on yield and yield components of faba bean varieties.

MATERIAL AND METHODS

A field experiment was conducted at Field Crops Department, College of Agriculture, University of Baghdad during the winter season of 2010. A randomized complete block (RCBD) with three replicates was used. Each replicate consisted of 12 experimental units (2 m x 3 m); the distance between plants was 0.25 m and four farrows were 0.75 m apart to achieve nearly plant density of 53333.33 plant ha^{-1}. First factor represented the four varieties of faba bean (Baladei, Hama and Nubaria) were obtained from the Arab Organization for agricultural development, in addition the local variety were sown on 12 October 2010, while the second factor represented two concentrations of salicylic acid (35 and 70) ppm in addition to control treatment which sprayed by distilled water. Salicylic acid (SA) was initially dissolved in 100 ml dimethyl sulfoxide and concentration 35 and 70 ppm were made up with distilled water and first applied to the plant in the stage 3- 4 leaves of growth and the second at the beginning of flowering stage. Weeds were control by spraying herbicide triflian 44% (1.25 L ha^{-1}) after plowing. Nitrogen fertilizer was applied at the rate 50 Kg N ha^{-1} as a form of urea (46% N) at two intervals (at sowing and at of beginning flowering stage) also phosphate fertilizer was applied at rate of 35 Kg P ha^{-1} in the form of calcium super phosphate (46% P_2O_5). The following measurements were recorded from five randomly guarded plants from each plot:

1. Plant height (cm).
2. Number of branches per plant.
3. Leaf area (cm^2): recorded at 100% flowering by leaf area meter system.
4. Chlorophyll content (SPAD): recorded at 100% flowering by SPAD (Chlorophyll meter SPAD-502 plus).
5. Number of pod per plant.
6. Number of seeds per pods.
7. Weight of 100 seed (gm).
8. Pods yield (Kg ha^{-1}).

The data were analyzed statistically to evaluate the effect of the treatments on yield and other traits studied using SAS program and least significant differences (LSD) test at 0.05 probability level to compare the treatments means [10].

RESULTS AND DISSCUSION

3.1 Plant Height (cm):

According to Table 1 results of statistical analysis indicated that varieties significantly differ in the plant height. The Hama variety recorded the highest value with significant differences in comparison to other varieties. Similar results are in agreement with those obtained by Alan and Geven [11], Bakry *et al* [5] and Peksan and Gulumser [12]. The SA concentrations had significant effect on plant height, and the highest plant was obtained from 70 ppm SA concentration (131.9 cm) which was significantly different from that 35 ppm SA (117.8 cm) and control treatment (108.4 cm). A significant interaction between varieties and SA concentrations was recorded. The plant height ranged from 110.2 cm (Baladei x control treatment) to 146.0 cm (Hama x 70 ppm SA).

3.2 Number of Branches $plant^{-1}$:

The varieties, SA concentrations and interaction between them showed significant differences in branches number (Table 2). Among the varieties, Nubaria and Local produced highest branches number (14.7 and 14.4) branch $plant^{-1}$ respectively as well as Hama (13.8 branch $plant^{-1}$) which were significantly differ from Baladei (11.2 branch $plant^{-1}$). These results are in agreement with study carried out by Osman *et al* [13] who found that branches number showed significant differences among varieties. The branches number was also influenced by different SA concentration. The plants treat with 70 ppm SA produced highest (15.9 branch $plant^{-1}$) which was significantly different from 35 ppm (12.7 branch $plant^{-1}$) and control treatment (11.9 branch $plant^{-1}$). These results are in agreement with those obtained by Ali and Mohmoud [7] and Gad El-Hak *et al* [8] on pea. These results may be due to the role of SA enhancing some physiological and biochemical aspects [14] or increasing N, P, K and Ca content activity in anti-oxidant enzymes and glutathione content [6]. The stimulation effect of SA on plant growth was confirmed by El-Shraiy and Hegazi [15] on pea plant and Nasseralla and Awad [16] who reported that application of 300 ppm of SA to soybean increased plant height, leaf area and branches number. A significant interaction between varieties and SA concentrations was recorded. The branches number ranged from 8.8branch $plant^{-1}$(Baladei x control treatment) to 19.3branch $plant^{-1}$(Hama x 70 ppm SA).

Table 1: Effect of salicylic acid on plant height (cm) of faba bean varieties

Varieties	SA Concentrations (ppm) 0	35	70	Mean
Local	93.4	105.3	120.6	106.4
Nubaria	116.6	120.6	130.3	122.5
Hama	113.5	135.0	146.6	131.7
Baladei	110.2	110.5	130.1	116.9
LSD 0.05	16.3		6.8	
Mean	108.4	117.8	131.9	
LSD 0.05	8.2			

Table 2: Effect of salicylic acid on branches number per plant of faba bean varieties

Varieties	SA Concentrations(ppm) 0	35	70	Mean
Local	13.6	13.9	15.7	14.4
Nubaria	14.2	14.6	15.3	14.7
Hama	11.0	11.3	19.3	13.8
Baladei	8.8	11.3	13.6	11.2
LSD 0.05	2.5			1.1
Mean	11.9	12.7	15.9	
LSD 0.05	0.9			

3.3 Leaf Area (cm^2):

The varieties, SA concentrations and interaction between them showed significant differences among them in terms leaf area (Table 3). Among the varieties, Hama gave highest leaf area (4287.3 cm^2) which was significantly different from Nubaria (2990.8 cm^2) and non-significant from other. In other study Bakry *et al* [5] and noticed the differences of leaf area in plant of faba bean varieties. The leaf area was also influenced by different SA concentrations. The plant treated with 70 ppm SA gave highest (4362.7 cm^2) which was significantly different from that 0 ppm SA (3100.6 cm^2). The result specially increment of the conductive tissues (xylem and phloem) are great importance because they could be involved in the interpretation about why vigorous growth and high yield pods were existed with different applied with SA [17]. A significant interaction between varieties and SA concentrations was recorded. The leaf area ranged from 2667.2 cm^2 (Nubaria x 0 ppm SA) to 5041.3 cm^2 (Hama x 70 ppm SA).

3.4 Chlorophyll Content (SPAD):

It is evident from the records in table 4 that the varieties Hama (42.9 SPAD) had a higher content of chlorophyll than other varieties. The increase of chlorophyll leaves of some faba bean plants may be ascribed to the differences in the genetic structure between faba bean varieties [18]. SA concentrations were significantly different (table 4). The SA concentration 70 ppm gained maximum chlorophyll content (44.8 SPAD) which has significantly different from the other concentrations. This observation was supported by Ismail and Abd El-Ali [17] who reported that leaves treated with high concentrations of SA accumulate more chlorophyll and carotene isomers, leaves treated with SA enhanced SOD activities. A significant interaction between varieties and SA concentrations was recorded. The leaves chlorophyll content ranged from 35.1 SPAD (Nubaria x 0 ppm SA) to 48.1 (Hama x 70 ppm SA).

3.5 Number of pods per plant:

Number of pods per plant is an important trait attributing to dry pod yield of faba bean production. There was a significant difference among the faba bean varieties in terms of number of pods per plant (table 5). The maximum number of pods was produce by Local variety (39.1 pod $plant^{-1}$) followed by that of the Hama (33.5 pod $plant^{-1}$), Nubaria (33.2 pod $plant^{-1}$) and Baladei (28.7 pod $plant^{-1}$). The Local variety was significantly different from the other varieties, while the Hama and Nubaria varieties were non-significant between them. Many studies indicated that faba bean varieties differ significantly in pods number [5, 13 and 19]. Different SA concentrations had significant effect on the number of pods per plant (table 5), The plant treated with 70 ppm SA concentration produced maximum number of pods (41.7 pod $plant^{-1}$) which was significantly different on other concentrations especially control treatment (0 ppm SA) that gave lowest mean of this trait (25.1 pod $plant^{-1}$). A significant interaction between varieties and SA concentrations was recorded. The number of pods ranged from 18.3 pods $plant^{-1}$ (Baladei x 0 ppm SA) to 47.1 pod $plant^{-1}$ (Hama x 70 ppm SA).

Table 3: Effect of salicylic acid on leaf area (cm^2) of faba bean varieties

Varieties	SA Concentrations (ppm) 0	35	70	Mean
Local	3575.1	3860.3	4478.9	3971.4
Nubaria	2667.2	2953.7	3351.6	2990.8
Hama	3149.6	4671.1	5041.3	4287.3

Baladei	3010.5	3249.4	4579.2	3613.0
LSD 0.05	895.3			603.4
Mean	3100.6	3683.6	4362.7	
LSD 0.05	532.5			

Table 4: Effect of salicylic acid on leaves chlorophyll content (SPAD) of faba bean varieties

Varieties	SA Concentrations (ppm)			Mean
	0	35	70	
Local	39.8	42.4	46.6	42.9
Nubaria	35.1	37.5	44.3	38.9
Hama	40.7	44.8	48.1	44.5
Baladei	36.5	38.2	40.4	38.3
L.S.D 0.05	2.8			N.S
Mean	38.5	40.7	44.8	
L.S.D 0.05	1.0			

Table 5: Effect of salicylic acid on number of pods per plant of faba bean varieties

Varieties	SA Concentrations (ppm)			Mean
	0	35	70	
Local	33.5	38.1	45.6	39.1
Nubaria	29.6	30.6	39.6	33.2
Hama	19.2	34.5	47.1	33.6
Baladei	18.3	33.3	34.6	28.7
L.S.D 0.05	7.7			4.4
Mean	25.1	34.1	41.7	
L.S.D 0.05	3.9			

3.6 Number of seeds pod:

The varieties, SA concentrations and interaction between them had non-significant effect on number of seeds per pods (table 6).

3.7 Weight of 100 seeds (gm):

Statistical analysis of the data obtained regarding weight of 100 seeds exhibited that the means for varieties, SA and interaction between them were significantly different (table 7). The Hama variety gained maximum weight of 100 seeds (136.9 gm) which was significantly different from all the other varieties especially Baladei variety which gained lowest mean of weight of 100 seeds (117.8 gm), from other hand the Nubaria variety was non-significantly different from Local variety in terms of weight of 100 seeds. In this regard, the different of 100 seeds weight between faba bean varieties was noticed by Al-Ghamdi [20] and El-Bassiouny *et al* [21]. Various SA concentrations used were significantly different from each other in terms of weight of 100 seeds. The plant treated with 35 ppm SA concentration produced maximum of weight 100 seeds 131.5 gm which was statistically different on other concentrations especially 70 ppm SA concentration that gave lowest mean of this trait (120.8 gm). Interaction between varieties and SA concentrations had a significant effect on weight of 100 seeds. The Hama variety x 35 ppm SA concentration gave highest mean of 100 seeds weight (146.7 gm), while the Baladei variety x 0 ppm SA gave lowest mean of 100 seeds weight (101.4 gm).

3.8 Pods yield (Kg ha^{-1}):

There was a significant difference among the faba bean varieties in pods yield (table 8). The highest pods yield was obtained from Local variety (3830 Kg ha^{-1}) followed by Nubaria (3053 Kg ha^{-1}), Hama (2715 Kg ha^{-1}) and Baladei (2567 Kg ha^{-1}). In other studied, El-Bassiouny *et al* [21] were noticed the difference of pods yield in plants of faba bean varieties. The SA concentrations were significantly different in terms pods yield (table 8). The plants treated with 70 ppm SA produced maximum pods yield (3365 Kg ha^{-1}) that was significantly different from the 35 ppm SA (3043 Kg ha^{-1}) and 0 ppm SA (2717 Kg ha^{-1}). These results are in harmony with those obtained by Orabi *et al* [9]. A significant interaction between varieties and SA concentrations was recorded. The pods yield ranged from 2138 Kg ha^{-1} (Baladei x 0 ppm SA) to 4142 Kg ha^{-1} (Local x 70 ppm SA).

Table 6: Effect of salicylic acid on number of seeds per pod of faba bean varieties

Varieties	SA Concentrations (ppm)			Mean
	0	35	70	
Local	3.6	4.2	4.7	4.1
Nubaria	3.4	3.7	4.2	3.7
Hama	3.0	3.9	4.5	3.8
Baladei	2.6	3.5	4.0	3.3
L.S.D 0.05	N.S			N.S
Mean	3.1	3.8	4.3	
L.S.D 0.05	N.S			

Table 7: Effect of salicylic acid on weight of 100 seeds of faba bean varieties

Varieties	SA Concentrations (ppm) 0	35	70	Mean
Local	125.1	129.2	115.1	123.1
Nubaria	128.1	131.3	114.5	124.6
Hama	144.4	146.7	119.8	136.9
Baladei	101.4	118.6	133.6	117.8
L.S.D 0.05	7.4			4.6
Mean	124.8	131.5	120.8	
L.S.D 0.05	2.5			

Table 8: Effect of salicylic acid on pods yield (Kg ha^{-1}) of faba bean varieties

Varieties	SA Concentrations (ppm) 0	35	70	Mean
Local	3520	3830	4142	3830
Nubaria	2790	3120	3250	3053
Hama	2420	2710	3016	2715
Baladei	2138	2512	3052	2567
L.S.D 0.05	387			111
Mean	2717	3043	3365	
L.S.D 0.05	204			

Conclusion:

Local variety gave high yield of faba bean due to its adaptation to Iraqi environment, and spraying of salicylic acid increased the growth and the yield, so we recommended more studies in this field.

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