Zagazig J. Agric. Res., Vol. 47 No. (5) 2020 1153-1163

Plant Production Science

Available online at http://zjar.journals.ekb.eg
http:/www.journals.zu.edu.eg/journalDisplay.aspx?Journalld=1&queryType=Master

EFFECT OF FOLIAR SPRAY WITH SALICYLIC ACID ON DRY WEIGHT, YIELD AND POD QUALITY OF TWO SNAP BEAN CULTIVARS GROWN IN SALINE SOIL

Mary N.G. Zaky*, A. Bardisi and Dalia A.S. Nawar

Hort. Dept., Fac. Agric., Zagazig Univ., Egypt

Received: 19/07/2020 ; Accepted: 06/09/2020

ABSTRACT: This work was carried out at a Private Farm Located at Anba Bishoy Monastry, Wadi El Natroun Distract, Beheria Governorate, Egypt during the two successive summer seasons of 2017 and 2018 to study the effect of salicylic acid concentrations (SA) (0, 50, 75 and 100 ppm) as foliar spray on dry weight, productivity and pod quality of two snap bean cultivars (Buffalo and Douglas) grown in saline soil and irrigated with drip irrigation system. Spraying snap bean Buffalo cultivar grown in saline soil with SA at 100 ppm, increased dry weight of leaves, branches, shoots/plant, average pod weight, yield/plant, total yield/fad., total protein and total carbohydrates in pods, whereas decreased proline content in leaf tissues. There were no significant differences between SA at 50 ppm and control in most studied characters of snap bean. In this regard, the increases in total yield/fad., were about 65.70 and 53.84 % for the interaction between Buffalo cultivar and SA at 100 ppm as well as 45.79 and 40.30 % for the interaction between Buffalo cultivar and SA at 75 ppm over the interaction between Douglas cultivar and control in the 1st and 2nd seasons, respectively.

Key words: Snap bean, Buffalo and Douglas cultivars, salicylic acid, proline, yield and pod quality.

INTRODUCTION

Snap bean (*Phaseolus vulgaris,* L.) is one of the most popular Fabaceae crops for local consumption in Egypt and export to European countries. Snap bean also plays a significant role as a good source of carbohydrates and protein for human nutrients. In Egypt, in 2018, the acarge of green snap bean plants was 65671 fad., which produced 284299 tonne with an average of 4,327 tonne/fad. (**FAO, 2019**).

In order to improve the production of snap bean, this can be accomplished by growing the cultivated area with the use of good cultivars for the best yield and good quality.

Some researchers showed differences between snap bean cultivars for growth **(Yunsheng *et al.*, 2015; Hamaiel *et al.*, 2016; Marzouk *et al.*, 2016** and **Shafeek *et al.*, 2017)**, yield and its components **(Masa *et al.*, 2017; Abdallah, 2018; Rahman *et al.*, 2018; Saleh *et al.*, 2018**) and quality **(Mandour, 2014; Beshir *et al.*, 2015**). They showed that there were significant differences between cultivars regarding plant growth, productivity and pod quality.

Salicylic acid (SA) or ortho-hydroxy benzoic acid and other salicylates are known to affect several physiological and biochemical operations of plants, and may play a major role in regulating their growth and productivity (**Hayat *et al.*, 2010).** It exercises a varied physiological function in crops including plant development (**Khan *et al.*, 2003**), thermogenesis, flowers induction, nutrient absorption, stomatal movement (**Larque-Saavedra, 1979**). Also, SA is important phytohormone that plays a role in response to biotic stresses such as salinity and pathogenesis. Recent studies have demonstrated that SA also participates in the signaling of abiotic stress responses **(Hara *et al.*, 2012)**.

Corresponding author: Tel.: +201013237632
E-mail address: mn.weliam@agri.zu.edu.eg

Many authors showed that spraying plants with SA significantly increased vegetative growth (**El- Shraiy and Hegazi, 2009; El-Saadony *et al*., 2017** on pea), yield (**Thomson *et al*., 2017** on pea and **Ramadan 2020** on snap bean) and pod quality (**Thomson *et al.* , 2017** on pea **and Singh *et al*., 2017)** on tomato.

Therefore, the object of this work was to enhance the snap bean cultivars (Buffalo and Douglas) tolerance to salinity and obtained good yield and best green pod quality by using salicylic acid as foliar spray.

MATERIALS AND METHODS

This research was carried out at Private Farm Located at Anba Bishoy Monastry, Wadi El Natroun Distract, Beheria Governorate, Egypt, during the two successive summer seasons of 2017 and 2018 to study the effect of salicylic acid concentrations as foliar spray on dry weight, productivity and pod quality of two snap bean cultivars (Buffalo and Douglas) grown in saline soil and irrigated with drip irrigation system.

This experiment included 8 treatments which were the combinations between two cultivars (Buffalo and Douglas) and three concentrations of salicylic acid (50, 75 and 100 ppm**)** as foliar spray, beside sprayed with water as control treatment. These treatments were arranged in a split plot in a complete block design with three replications. Snap bean cultivars were randomly distributed in the main plot, while salicylic acid concentrations were randomly arranged in the sub plot.

Seeds of snap bean cultivars were sown on 1st April and 17th March in the 1st and 2nd seasons, respectively. The plot area was 7.5 m^2. Every plot consisted of three dripper lines (5 m in length and 50 cm in width) and spacing at 20 cm between hills. One dripper line was used for the samples to measure vegetative growth and the other two dripper lines were used for yield determination. Seeds of snap bean cultivars were obtained from Pop Vriend Seeds (PV) Company, Holland. The plants were sprayed with salicylic acid at different concentrations twice; *i. e.,* 25 and 50 days after sowing in both seasons.

Each plot received 2 liter solutions of each concentration using spreading agent (reflecting materials) in all treatments to improve adherence of the spray to the plant foliage for increasing salicylic acid absorption by the plants. The untreated plants (check) were sprayed with water and spreading agent. One dripper line was left between each two experimental units without spraying as a guard row to avoid the overlapping of spraying salutation.

Nitrogen, phosphorus and potassium were added at the rates of 80 kg N, 37 kg P_2O_5 and 50 kg K_2O, in the form of ammonium sulphate (20.5% N), calcium superphosphate (15.5% P_2O_5) and potassium sulphate (48% K_2O) respectively. All amounts of calcium superphosphate and one third of nitrogen and potassium fertilizers were added at the time of soil preparation with 20 m^3/fad. FYM, the rest were divided into 10 equal portions and were added through water irrigation system (fertigation) by 3 days intervals, beginning 15 days after sowing. The other normal agricultural treatments for growing snap bean plants were practiced.

Data Recorded

A random sample of 10 plants from each experimental unit was randomly taken at 60 days after sowing and the following data were recorded.

Dry weight

Different plant organs *i.e.* leaves and branches (shoots) were oven dried at 70°C till constant weight, and dry weight of leaves, branches and shoots were recorded.

Proline amino acid content

It was determined in dry leaves at 60 days after sowing in both seasons according to the method described by **Bates (1973**).

Pod yield and its components

Green pods of each plot were harvested at the proper maturity stage (at 75 days after sowing), counted and weighed in each harvest and yield/ plant and total fresh pod yield (ton/fad.) were determined. Twenty pods were randomly chosen from each experimental unit to determine average pod weight (g).

Pod quality

At harvest time, ten pods were randomly taken from each experimental unit and oven dried at 70^0C till constant weight and the chemical constituents of pods during the two seasons were determined: Total carbohydrate (%) according to the methods described by **Dubois *et al.* (1956)**.

Total protein percentage of seed, total pod N was estimated, and a factor of 6.25 was used to convert total N to protein percentage (**Kelly and Bliss, 1975)**. Total fibers were determined in both seasons as percentage according to **Maynard (1970**).

Proline amino acid content was determined on the basis of pod dry matter as previously mentioned in leaves in both seasons.

Statistical Analysis

According to **Snedecor and Cochran (1967**), the data from this experiment was subject to adequate statistical analysis of variance, and the discrepancies between treatments were measured using LSD at 0.05 level.

RESULTS AND DISCUSSION

Dry Weight/ Plant

Effect of cultivar

Buffalo cultivar gave higher values of dry weight of leaves, branches and shoots dry weight/plant than Douglas cultivar at 60 days after sowing in both seasons (Table 2). The increases in dry weight/ shoots were about 35.91 and 38.77% for Buffalo cultivar over Douglas in the 1st and 2nd seasons, respectively. The differences between snap bean cultivars could be attributed to the genetic differences between cultivars. These results are harmony with those reported by **Yunsheng *et al.* (2015), Hamaiel *et al.* (2016), Marzouk *et al.* (2016) and Shafeek *et al.* (2017)**.

Effect of SA concentrations

Spraying snap bean plants grown in saline soil with SA at different concentrations had significant effect on dry weight of leaves, branches and shoots at 60 days after sowing in both seasons (Table 3).

Foliar spray with SA at 100 ppm increased dry weight of leaves, branches and shoot dry weight/plant in both seasons, followed by spraying with SA at 75 ppm. There were no significant differences between SA at 50 ppm and control in leaves, branches and shoots dry weights/ plant.

The increases in dry weight/ shoots were about 19.98 and 26.09% for SA at 100 ppm, 13.27 and 16.39% for SA at 75 ppm as well as 1.47 and 5.43% for SA at 50 ppm over unsprayed plants in the 1st and 2nd seasons, respectively.

The enhancing effect of SA on dry matter content could be due to the increase in photosynthetic capacity which could be a reliable index of the number of leaves per plant and which could contribute greatly to the superiority of the dry weight content of snap bean plants (**Gardener *et al.*, 1985**).

These findings are in agreement with those obtained by **El-Shraiy and Hegazi (2009) and El-Saadony *et al.* (2017)** on pea. They found that foliar spray with SA gave the highest value for each of dry weight of leaves, branches and shoots/plant than unsprayed plants.

Effect of the interaction

The interaction between cultivars and SA concentrations had significant effect on dry weight of leaves, branches and shoots/plant at 60 days after sowing in both seasons (Table 4).

The interaction between Buffalo cultivar and spraying with SA at 100 ppm followed by the interaction between Buffalo cultivar and spraying with SA at 75 ppm increased dry weight of leaves, branches and shoots/plant. In general, Buffalo cultivar and spraying with SA (50, 75 and 100 ppm) and control gave the highest value for each of dry weight of leaves, branches and shoots/plant compared with Douglas cultivar under the same treatments.

The increases in shoot dry weight were about 61.93 and 84.37 % for the interaction between Buffalo cv. and SA at 100 ppm and 57.25 and 66.11% for the interaction between Buffalo cv. and SA at 75 ppm over the interaction between Douglas cv. and control in the 1st and 2nd seasons, respectively.

Table 1. Chemical analyses of water and soil of the experiment in 2018 season

	pH	EC	Soluble anions (meq/L)				Soluble (cations meq/L)			
		(ds/m)	CO_3	HCO_3	Cl	SO_4	Ca	Mg	K	Na
Water	7.61	1.60	0.40	4.60	8.80	0.02	7.61	1.60	0.32	8.48
Soil	7.56	3.61	0.40	2.60	13.00	0.19	7.56	4.61	2.30	16.15

According to reclamation and development center desert soils Cairo University.

Table 2. Effect of cultivars on dry weight of different plant organs of snap bean at 60 days after sowing during 2017 and 2018 seasons

Treatment	Dry weight (DW/g)			Relative increases in shoot DW (%)
	Leaves	Branches	Shoots	
Cultivar		**2017 season**		
Buffalo	8.97	6.33	15.29	135.91
Douglas	6.82	4.42	11.25	100.00
LSD at 0.05 level	**0.73**	**0.35**	**0.71**	**--**
		2018 season		
Buffalo	8.97	6.60	15.57	138.77
Douglas	6.72	4.50	11.22	100.00
LSD at 0.05 level	**0.62**	**0.16**	**0.86**	**--**

Table 3. Effect of salicylic acid concentration on dry weight of different plant organs of snap bean at 60 days after sowing during 2017 and 2018 seasons

Treatment	Dry weight (DW/g)			Relative increases in shoot DW (%)
	Leaves	Branches	Shoots	
		2017 season		
Control	7.36	4.86	12.21	100.00
SA at 50 ppm	7.49	4.90	12.39	101.47
SA at 75 ppm	8.14	5.69	13.83	113.27
SA at 100 ppm	8.60	6.06	14.65	119.98
LSD at 0.05 level	0.52	0.25	0.51	---
		2018 season		
Control	6.92	5.04	11.96	100.00
SA at 50 ppm	7.51	5.11	12.61	105.43
SA at 75 ppm	8.10	5.82	13.92	116.39
SA at 100 ppm	8.84	6.24	15.08	126.09
LSD at 0.05 level	0.45	0.12	0.61	---

Table 4. Effect of the interaction between cultivars and salicylic acid concentrations on dry weight of different organs at 60 days after sowing during 2017 and 2018 seasons

Treatment		Dry weight (g)			Relative increases in shoots DW (%)
		Leaves	Branches	Shoots	
Cultivar	**SA (ppm)**		**2017 season**		
Buffalo	**Control**	8.58	5.57	14.15	137.78
	SA at 50 ppm	8.61	5.63	14.24	138.66
	SA at 75 ppm	9.19	6.96	16.15	157.25
	SA at 100 ppm	9.49	7.14	16.63	161.93
Douglas	**Control**	6.13	4.14	10.27	100.00
	SA at 50 ppm	6.37	4.17	10.54	102.63
	SA at 75 ppm	7.09	4.41	11.50	111.98
	SA at 100 ppm	7.70	4.97	12.67	123.37
LSD at 0.05 level		**0.74**	**0.35**	**0.72**	**--**
			2018 season		
Buffalo	**Control**	8.47	5.92	14.39	151.00
	SA at 50 ppm	8.53	5.94	14.47	151.84
	SA at 75 ppm	8.92	6.91	15.83	166.11
	SA at 100 ppm	9.95	7.62	17.57	184.37
Douglas	**Control**	5.37	4.16	9.53	100.00
	SA at 50 ppm	6.48	4.27	10.75	112.80
	SA at 75 ppm	7.28	4.73	12.01	126.02
	SA at 100 ppm	7.73	4.85	12.58	132.00
LSD at 0.05 level		**0.63**	**0.16**	**0.87**	**---**

Proline Content

Effect of cultivars

There were no significant differences between the two cultivars in proline amino acid in leaves (Table 5).

Effect of SA concentrations

Proline content in snap bean leaves at 60 days after sowing in both seasons decreased by spraying with SA at 75 or 100 ppm compared to SA at 50 ppm or control (Table 5). In general, proline amino acid content in leaves tissues decreased with increasing SA concentration (75 or 100 ppm). SA sprays are very effective against abiotic and biotic stresses, foliar SA sprays should be used as an 'insurance policy' in suboptimal conditions, created for example by climate change and fluctuations in environmental conditions (**Henk-Maarten, 2018)**.

Effect of the interaction

The interaction between Buffalo cultivar and SA at 75 or 100 ppm and the interaction between Douglas cultivar and spraying with SA at 75 or 100 ppm decreased proline content in leaf tissues compared to the interaction between Buffalo cultivar and SA at 50 ppm or control and the interaction between Douglas cultivar and SA at 50 ppm or control in both seasons (Table 5).

Table 5. Effect of different cultivars (C), salicylic acid concentrations (SA) and their interaction (C×SA) treatments on proline amino acid (mg/mg DW) in leaves of snap bean at 60 days after sowing during 2017 and 2018 seasons

Cultivar	SA concentration (ppm)				
	Control	50	75	100	Mean (C)
			2017 season		
Buffalo	11.02	10.14	10.00	9.47	**10.16**
Douglas	10.95	10.04	9.94	9.72	**10.16**
Mean (SA)	**10.99**	**10.09**	**9.97**	**9.59**	--
LSD at 5%	**(C)= NS**		**(SA)= 0.20**	**(C×SA)= 0.29**	
			2018 season		
Buffalo	10.94	10.10	9.93	9.68	**10.16**
Douglas	10.85	10.04	9.90	9.58	**10.09**
Mean (SA)	**10.89**	**10.07**	**9.91**	**9.63**	--
LSD at 5%	**(C)=NS**		**(SA)=0.05**	**(C×SA)= 0.07**	

In general, proline amino acid content in leaf tissues of snap bean decreased with increasing concentration of SA up to 100 ppm.

Yield and its Components

Effect of cultivars

Buffalo cultivar gave the highest average pod weight, yield/plant and total yield/fad., in both seasons (Table 6). The increases in total yield/ fad., were about 24.81 and 15.34% for Buffalo cultivar over Douglas cultivar in the 1st and 2nd seasons, respectively. This means that the increases in total yield for Buffalo cultivar were about 0.755 and 0.491 ton/fad., over the Douglas cultivar in the 1st and 2nd seasons, respectively. This is in line with several reports supporting our obtained results with **Masa *et al*. (2017), Abdallah (2018), Rahman *et al*. (2018) and Saleh *et al*. (2018)**. They showed that there were significant differences between cultivars regarding average pod weight and total yield/faddan.

Effect of SA concentrations

Spraying snap bean plants with SA at 100 ppm followed by SA at 75 ppm increased average pod weight, yield/plant and total yield/ fad., in both seasons (Table 6). There were no significant differences between SA at 50 ppm and control in average pod weight and total yield/fad., in both seasons.

The increases in total yield were about 17.34 and 19.33% for SA at 75 ppm and 32.83 and 35.99% for SA at 100 ppm over the control in the 1st and 2nd seasons, respectively.

The beneficial effect of salicylic acid on fruit yield may be due to its impact on physiological and biochemical processes, including photosynthesis, ion absorption, membrane permeability, enzyme activity, flora, energy production and plant growth and productivity (**Arberg, 1981**).

The obtained results of average pod weight and total yield are in good agreement with those obtained by **Thomson *et al*. (2017)** on pea and **Ramadan (2020)** on snap bean. They found that spraying plants with salicylic acid recorded the best results for increasing average pod weight and total yield.

Effect of the interaction

The interaction between Buffalo cultivar and SA at 100 ppm significantly increased

Table 6. Effect of cultivars and salicylic acid concentrations on yield and its components of snap bean during 2017 and 2018 seasons

Treatment	Average pod weight (g)		Yield/plant (g)		Total yield (ton/fad.)		Relative increases in total yield (%)	
	2017 season	2018 season	2017 season	2018 season	2017 season	2018 season	2017 season	2018 season
Cultivar				**Effect of cultivars**				
Buffalo	7.12	7.24	91.40	88.41	3.798	3.691	124.81	115.34
Douglas	6.46	6.67	73.30	77.01	3.043	3.200	100.00	100.00
LSD at 0.05 level	**0.08**	**0.14**	**2.67**	**3.81**	**0.186**	**0.139**	--	--
				Effect of SA concentration (ppm)				
Control	6.42	6.41	72.32	72.05	3.022	3.006	100.00	100.00
SA at 50 ppm	6.50	6.60	75.80	74.42	3.101	3.102	102.61	103.19
SA at 75 ppm	6.85	7.09	84.89	85.76	3.546	3.587	117.34	119.33
SA at 100 ppm	7.40	7.72	96.40	98.63	4.014	4.088	132.83	135.99
LSD at 0.05 level	**0.05**	**0.10**	**1.91**	**2.73**	**0.133**	**0.100**	--	--

average pod weight, yield/plant and total yield/ fad., followed by the interaction between Douglas cultivar and spraying with SA at 100 ppm in both seasons (Table 7). There were no significant differences between spraying Buffalo cultivar with SA at 50 ppm or control and between spraying Douglas cultivar with SA at 50 ppm or control in average pod weight, yield / plant and total yield/faddan.

The increases in total yield/fad., were about 65.70 and 53.84 % for the interaction between Buffalo cultivar and SA at 100 ppm and 45.79 and 40.30 % for the interaction between Buffalo cultivar and SA at 75 ppm over the interaction between Douglas cultivar and control in the 1st and 2nd seasons, respectively. The stimulative effect of spraying with SA at 100 ppm on total yield/fad., of Buffalo cultivar may be due to that SA at 100 ppm increased dry weight of shoots (Table 2) , average pod weight and yield / plant and number of pods/ plant (Table 7).

Pod Quality

Effect of cultivars

Buffalo cultivar gave the higher total protein and total carbohydrates in pods in the 1st season and total fiber in the 2nd season than Douglas cultivar (Table 8).

These results agree with those obtained by **Mandour (2014) and Beshir *et al*. (2015**). They showed that there were significant differences between cultivars regarding pod quality such as total protein total carbohydrates and total fiber in pods.

Effect of SA concentrations

Spraying snap bean plants with SA at 100 ppm increased total protein and total carbohydrates in pods, on the other hand, SA at 75 ppm decreased total fiber in pods and spraying with water increased proline amino acid in pods (Table 8).

These results are confirmed by the results obtained by **Thomson *et al.* (2017)** on pea and **Singh *et al*. (2017)** on tomato. They showed that spraying plants with SA gave the best quality of pod than unsprayed.

Effect of the interaction

The interaction between Buffalo cultivar and SA at 100 ppm increased total protein and total carbohydrates in pods. On the contrary, the interaction between Buffalo cultivar and SA at 75 ppm decreased total fiber in pods, whereas the interaction between Buffalo cultivar and control increased proline amino acid content in pods (Table 9).

Table 7. Effect of the interaction between cultivars and salicylic acid concentrations on yield and its components of snap bean during 2017 and 2018 seasons

Treatment		Average pod weight (g)		Yield / plant (g)		Total yield (ton/fad.)		Relative increases in total yield (%)	
Cultivar	**SA (ppm)**	**2017 season**	**2018 season**	**2017 season**	**2018 season**	**2017 season**	**2018 season**	**2017 season**	**2018 season**
Buffalo	**Control**	6.82	6.78	79.57	76.14	3.326	3.198	122.41	113.65
	SA at 50 ppm	6.86	6.99	83.10	79.27	3.401	3.289	125.17	116.88
	SA at 75 ppm	6.97	7.23	94.30	93.99	3.961	3.948	145.79	140.30
	SA at 100 ppm	7.82	7.94	108.62	104.25	4.502	4.329	165.70	153.84
Douglas	**Control**	6.02	6.04	65.06	67.95	2.717	2.814	100.00	100.00
	SA at 50 ppm	6.13	6.21	68.50	69.56	2.800	2.914	103.05	103.55
	SA at 75 ppm	6.72	6.94	75.47	77.53	3.130	3.225	115.20	114.61
	SA at 100 ppm	6.98	7.50	84.17	93.00	3.526	3.846	129.78	136.67
LSD at 0.05 level		**0.08**	**0.14**	**2.70**	**3.86**	**0.188**	**0.141**	--	

Table 8. Effect of cultivars and salicylic acid concentrations on pod quality of snap bean during 2017 and 2018 seasons

Treatment	Total protein (%)		Total carbohydrates (%)		Proline amino acid (mg/g DW)		Total fiber (%)	
	2017 season	**2018 season**	**2017 season**	**2018 season**	**2017 season**	**2018 season**	**2017 season**	**2018 season**
				Effect of cultivars				
Buffalo	18.16	18.39	60.14	59.94	5.65	5.85	7.18	7.26
Douglas	17.07	18.15	57.90	58.10	5.49	5.63	7.08	7.16
LSD at 0.05 level	**0.72**	**NS**	**1.44**	**NS**	**NS**	**NS**	**0.04**	**0.07**
				Effect of SA concentrations (ppm)				
Control	16.40	17.77	57.22	58.34	6.04	6.40	7.42	7.50
SA at 50 ppm	17.07	17.29	60.74	57.40	5.00	4.91	7.13	7.14
SA at 75 ppm	18.03	18.22	58.19	59.06	4.97	5.50	6.90	6.95
SA at 100 ppm	18.97	19.80	59.93	62.29	6.27	6.15	7.07	7.26
LSD at 0.05 level	**0.51**	**0.56**	**1.03**	**1.77**	**0.20**	**0.18**	**0.03**	**0.19**

Table 9. Effect of interaction between cultivars and salicylic acid concentrations on pod quality of snap bean during 2017 and 2018 seasons

Treatment		Total protein (%)		Total carbohydrates (%)		Proline amino acid (mg/g DW)		Total fiber (%)	
Cultivar	**SA (ppm)**	**2017 season**	**2018 season**	**2017 season**	**2018 season**	**2017 season**	**2018 season**	**2017 season**	**2018 season**
Buffalo	**Control**	17.77	17.91	58.82	58.94	6.10	6.42	7.51	7.51
	SA at 50 ppm	17.18	17.45	61.32	57.84	5.18	4.97	7.16	7.16
	SA at 75 ppm	18.16	18.29	57.74	61.49	4.94	5.86	6.95	6.98
	SA at 100 ppm	19.56	19.95	62.69	61.85	6.41	6.16	7.11	7.41
Douglas	**Control**	15.04	17.64	55.62	57.74	5.99	6.39	7.33	7.48
	SA at 50 ppm	16.97	17.14	60.16	56.97	4.83	4.85	7.11	7.13
	SA at 75 ppm	17.91	18.18	58.65	56.98	5.01	5.14	6.85	6.92
	SA at 100 ppm	18.39	19.66	57.17	60.73	6.14	6.14	7.04	7.12
LSD at 0.05 level		**0.72**	**0.79**	**1.45**	**2.51**	**0.28**	**0.26**	**0.05**	**0.27**

From the foregoing results, it could be concluded that, spraying snap bean Buffalo cultivar grown in saline soil at Wadi El Natron Distract with SA at 100 ppm increased shoot dry weight/plant, average pod weight, yield/plant, total yield/fad., total protein and total carbohydrates in pods. There were no significant differences between SA at 50 ppm and control (spraying with water) in the most characters of snap bean.

REFERENCES

Abdallah, A.A.M. (2018). Effect of mineral, organic and bio nitrogen fertilization on growth and productivity of some snap bean cultivars. M.Sc. Thesis, Fac. Agric., Zagazig Univ., Egypt.

Arberg, B. (1981). Plant growth regulators. Monosubstituted benzoic acid. Swed. Agric. Res., 11: 93-105.

Bates, L.S. (1973). Rapid determination of proline for water stress studies. Plant and Soil 39 : 205-207.

Beshir, H.M., F.L. Walley, R. Bueckert and B. Taran (2015). Response of snap bean cultivars to rhizobium inoculation under dry land agriculture in Ethiopia. Agron., 5 (3): 291-308.

Dubois, M., K. Gilles, J. Hamillon, P. A. Rebers and F. Smith (1956). Colorimeteric methods for determination of sugars and related substances. Anal. Chem., 28:350.

El-Shraiy, A.M. and A.M. Hegazi (2009). Effect of acetylsalicylic acid, Indole-3- bytric acid and gibberellic acid on plant growth and yield of pea (*Pisum sativum* L.). Aust. J. Basic and Appli. Sci., 3 (4): 3514-3523.

El-Saadony, F.M., Dalia A.S. Nawar and H.G. Zyada (2017). Effect of foliar application with salicylic acid, garlic extract and proline on growth, yield and leaf anatomy of pea (*Pisum sativum* L.) grown under drought stress. Middle East J. Appl. Sci., 7 (3): 633-650.

FAO (2019). Statistical database food and agricultural organization of the united nations. Available at http:\\www.faostat. fao. org

Gardener, F.D., R.B. Pearce and R.L. Mitchell (1985). Physiology of Crop Plants. The Iowa State Univ., Press. Ame., 327.

Hamaiel, A.F., M.S. Hamada, M.M.B. Shokr and E.M.M. Abd-Elrhem (2016). Response

of some snap bean cultivars to foliar application with some antioxidant substances for increasing productivity and quality under local environments at early summer season. J. Plant Prod., Mansoura Univ., 7 (11): 1221 – 1231.

Hara, M., J. Furukawa, A. Sato and T. Mizoguchi (2012). Abiotic stress and role of salicylic acid in plants. From book Abiotic Stress Responses in Plants: Metabolism, Prod. and Sustainability, 235-251.

Hayat, S., S.A. Hasan, Q. Hayat, M. Irfan and A. Ahmad (2010). Effect of salicylic acid on net photosynthetic rate, chlorophyll fluorescence and antioxidant enzymes in *Vigna radiata* plants exposed to temperature and salinity stresses. Plant Stress, 4: 62-71.

Henk-Maarten L. (2018). The effects of foliar sprays with different silicon compounds. Plants, 7 (45):1-22.

Kelly, I.D. and F.A. Bliss (1975). Heritability estimates of percentage seed protein and available methionine and correlations with yield in dry bean. Crop Sci., 15: 753-757.

Khan, A.Z., P. Shah, S.K. Khalil and F.H. Taj (2003). Influence of planting date and plant density on morphological traits of determinate and indeterminate soybean cultivars under temperate environment. J. Agron., 2: 146-152.

Larque-Saavedra, A. (1979). Stomatal closure in response to acetalsalicylic acid treatment. Z Pflanzenphysiol, 93:371375.

Mandour, M.A. (2014). Response of two snap bean cultivars to nitrogen fertilizer sources under sandy soil conditions. Global J. Agric. Food Safety Sci., 1 (2):52-66.

Marzouk, N.M., R.E. Abdelraouf, S.R. Salman and M.M.H. Abd El Baky (2016). Effect of water stress on yield and quality traits of different snap bean varieties grown in an arid environment. Middle East J. Agric. Res., 5 (4): 629-635.

Masa M., T. Tana and A. Ahmed (2017). Effect of plant spacing on yield and yield related traits of common bean (*Phaseolus vulgaris* L.) varieties at Areka, Southern Ethiopia. J Plant Biol. Soil Health, 4 (2): 1-13.

Maynard, A.J. (1970). Methods in Food Analysis. Academic Press New York, London, 176.

Rahman, M.S., M.A. Kabir, B.C. Halder, E. Haque and A. Rahman (2018). Response of french bean (*Phaseolus vulgaris* L.) varieties to phosphorus levels in the active Tista Flood Plain. Int. J. Agron. Agric. Res., 12 (1): 20-25.

Ramadan M.M.A. (2020). Effect of irrigation water quantity and some antioxidants on yield and some physiological traits of snap bean grown under sandy soil conditions. Menoufia J. Plant Prod., 5(2) : 19-36

Saleh, S., G. Liu, M. Liu, Y. Ji, H. He ID and N. Gruda (2018). Effect of irrigation on growth, yield and chemical composition of two green bean cultivars. Hort., 4 (3):1-10.

Shafeek, M.R., A.M. Shaheen, M.M. Hafez, A.R. Mahmoud and A.H. Ali (2017). Influence of cattle manure levels on the snap bean cultivars grown in sandy soil condition. Middle East J. Appl. Sci., 7 (3): 430-438.

Singh, S.K., A.K. Singh and P. Dwivedi (2017). Modulating effect of salicylic acid in tomato plants in response to waterlogging stress. Inter. J. Agric., Environ. and Biotech., 10 (1): 1-8.

Snedecor, G.W. and W.G. Cochran (1967). Statistical Methods. 6th Ed. The Iowa State Univ. Press, Ame., Iowa, USA.

Thomson, T., G.S. Patel, J.B. Thakar and K.S. Pandya (2017). Effect of foliar application of acetyl salicylic acid and ascorbic acid on growth and yield of Garden Pea (*Pisum sativum* L.) *cv.* Bonneville. Int. J. Curr. Microbiol. App. Sci., 6 (6): 1971-1976.

Yunsheng, L., A.M. El-Bassiony, Z.F. Fawzy and M.E. El-Awadi (2015). Effect of foliar spray of glutamine on growth, yield and quality of two snap bean varieties. J. Agric. Sci. Eng., 1 (2): 39-45.

تأثير الرش الورقى بحمض الساليسيلك على الوزن الجاف، المحصول وجوده القرون لصنفين من الفاصوليا النامية فى أرض ملحيه

مارى نبيل جولى ذكى - عبد الله برديسى - داليا أحمد سامى نوار

قسم البساتين - كليه الزراعة- جامعه الزقازيق - مصر

أجرى هذا العمل بمزرعة خاصه بدير الانبا بيشوى بمنطقة وادى النطرون- محافظه البحيرة – مصر وذلك خلال موسمى صيف ٢٠١٧ و ٢٠١٨ ، وذلك لدراسة تأثير الرش الورقى بحمض الساليسيلك بتركيزات صفر، ٥٠ ، ٧٥، ١٠٠ جزء فى المليون على الوزن الجاف والإنتاجية وجوده القرون على صنفين من الفاصوليا (بافلو ودوجلاس) النامية فى أرض ملحية وباستخدام نظام الرى بالتنقيط، أدى رش نباتات الصنف بافلو النامى فى أرض ملحية بحمض الساليسيلك بتركيز ١٠٠ جزء فى المليون إلى زيادة الوزن الجاف للأوراق، الأفرع والمجموع الخضرى للنبات، متوسط وزن القرن، محصول النبات والمحصول الكلى للفدان، البروتين الكلى والكربوهيدرات الكلية فى القرون، بينما أدى إلى نقص نسبه البرولين فى الأوراق، ولم يوجد فروق معنويه بين الرش بحمض السالسيك بتركيز ٥٠ جزء فى المليون ومعامله المقارنة (الرش الماء) فى معظم الصفات المدروسة للفاصوليا، وفى هذا الصدد كانت الزيادة النسبية فى المحصول الكلى للفدان هى ٦٥.٧٠ ، ٥٣.٨٣% بالنسبة لمعاملة التفاعل بين الصنف بافلو والرش بحمض الساليسيلك بتركيز ١٠٠ جزء فى المليون، ٤٥.٧٩ ، ٤٠.٣٠% بالنسبة لمعاملة التفاعل بين الصنف بافلو والرش بحمض الساليسيلك بتركيز ٧٥ جزء فى المليون عن التفاعل بين الصنف دوجلاس والرش بالماء فقط خلال الموسم الأول والثانى على التوالى.

المحكمـــــون:

١- أ.د. عصام حسين أبو الصالحين أستاذ الخضر المتفرغ – كلية التكنولوجيا والتنمية – جامعة الزقازيق.

٢- د. هـــانـــي جمـــال زيـــادة أستاذ الخضر المساعد – كلية الزراعة – جامعة الزقازيق.