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RESPONSE OF SNAP BEAN "*Phaseolus vulgarus,* L." TO SOME SALICYLIC ACID DREVATIVS AND SELENIUM UNDER HIGH TEMBERATURE STRESS.

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ABSTRACT

The field experiments were conducted during the two successive summer season of 2004 and 2005 at Kafer El-Wekala, Sherbin, Dakahlia, Egypt to study the effect of foliar nutrition of some salicylic acid derivatives and selenium on growth and productivity of snap bean (c.v. Branco). The complete randomized block design was used. Salicylic acid, acitylsalicylate and salicylamid were used as salicylic derivatives at 0, 100 and 150 ppm. Sodium selenate at 0, 25 and 50 ppm was used as a source of selenium. The main findings obtained from this investigation showed that using 150 ppm of salicylic acid as a foliar spray gave the highest increase in No. of branches, fresh weight and dry weight. On the other hand, plant height was not significantly affected by all used treatments.

The highest reducing sugars, non reducing sugars, total sugars and total protein were produced by foliar application of 150 ppm of salicylic acid and 50 ppm of sodium selenate. Moreover, number of flowers was not significantly affected by all used foliar treatments. No. of pods, pods sitting and green podes yield were significantly affected by foliar application of salicylic acid at 150 ppm.

INTRODUCTION

Snap bean (*Phaseolus vulgarus*, L.) is considered one of the most important vegetable crops grown in Egypt for both export and local consumption. Snap bean is a sensitive plant to heat stress, the optimum temperatures for growth and productivity are 18 – 24°C, linear increase in temperature during late summer planting season resulted in thermal damage of pigment-protein complex structure of chlorophyll (Murkowski, 2001), heat stress also, led to internal disturbance in all of the physiological process. Among the methods that extensively used to increase stress tolerance are the use of salicylic acid and selenium. Salicylic acid is stress signaling compound in plant, treating chili seeds with salicylic acid or sulfosalicylic (sulfer derivative) was effective in inducing seedling resistance to cold stress, manifested as increasing leaf number, plant fresh and dry weight (Benavides *et al.*, 2002).

Several studies indicated that foliar spray with salicylic acid increased the fresh and dry weight of plant, pod setting and total proteins of leaves and fruits. (Sitaramaiah and Pathak, 1981, on tomato, Jasiswal and Bhambie, 1989, on vigna radiate (L.), Liu Xini *et al.*, 2000 and Sanaa *et al.*, 2001, on broad bean. Moreover, Kalarani *et al.* (2002) reported that foliar application of salicylic acid at all used concentration i.e. 50, 100, 150 and 200 ppm showed its efficiency in inducing tomato early flowering moreover, fruit set % and yield components significantly recorded maximum values with spraying tomato plants with 100 ppm of salicylic acid.

Selenium is antioxidant nutrient which have the ability to quench free radicals and thereby form a protective screen around the cells and hence

increasing plant resistance to stress. Stimutatory effect of low concentrations of selenium on plant growth have been reported (Mengel and Kirkby, 1982). However, Xu ChunXia *et al.* (1996) found that folior application of sodium selenate had no significant effect on growth of tea. On the other hand, selenium application increased the contents of serene, histidine, proline and cystine in potato tubers (Koutnik *et al.*, 1997).

Hu QiuHui *et al.* (2001) mentioned that spraying soybean plants with 200 or 400 mg/L of sodium selenite significantly increased linolic acid content in seeds, however, selenium application had no effect on protein and amino acid.

The objective of this study was to evaluate the effect of foliar spraying of some salicylic acid derivatives and selenium on growth and yield of snap paean under height temperature stress.

MATERIALS AND METHODS

Two field experiments were laid out at Kafer El-Wekala, Sherpine, Dakahlia, Egypt, during two successive seasons of 2004 and 2005 to investigate the effect of some salicylic derivatives and selenium on growth, flowering and yield of snap bean under heigh temperature stress. The monthly average temperature during seasonal growth 2004 and 2005 are shown in Table (1). The complete randomized block design was used with three replicates. Salicylic acid, acitylsalicylate and salicylamid were used as salicylic derivatives at 0, 100 and 150 ppm. Sodium selenate at 0, 25 and 50 ppm was used as a source of selenium. Snap bean seeds (c.v. Branco) were sown on 1st of May of 2004 and 2005 respectively. Sprays were started after 7 days from germination and repeated at 7 days intervals during the growth seasons. All agriculture treatments were followed according to the instructions laid by Ministry of Agriculture. At 60 days from sowing five plants were randomly taken from each plot for determining the vegetative growth parameters i.e. plant height, No. of branches, fresh weight and dry weight per plant. Reducing, non-reducing and total sugars were determined in the dry matter of shoots as described by Nelson (1944). Total protein in shoots dry matter (%) was determined by using the Modified Micro Kjeldahl apparatus according to Anonymous (1975), then the obtained values were multiplied by 6.25 as used by Tripathi, *et al.* (1971). All obtained data were subjected to statistical analysis according to Gomez and Gomez (1984).

Table (1): The monthly average temperature during seasonal growth 2004 and 2005.

Month	2004		2005	
	Max.	Min.	Max.	Min.
May	28.3	16.7	28.0	17.0
June	31.3	19.4	32.5	20.6
July	32.0	20.3	31.6	20.3

RESULTS AND DISCUSSION

1- Vegetative growth parameters:

The data reported in Table (2) showed significant differences in the response of spraying salicylic derivatives and selenium.

Table (2): Effect of some salicylic acid derivatives and selenium on plant height, No. of branches, fresh weight and dry weight of snap bean during 2004 and 2005 seasons.

Treatments	Season 2004				Season 2005			
	No. of branches	F.W. g/plant	D.W. g/plant	Plant height (cm)	No. of branches	F.W. g/plant	D.W. g/plant	Plant height (cm)
Control	21.92	3.13	22.30	2.47	24.13	3.27	24.41	2.76
Se 25 ppm	22.11	3.20	21.53	2.41	25.34	3.13	25.01	2.81
Se 50 ppm	21.74	3.27	24.14	2.68	24.56	3.27	24.31	2.73
Act 100 ppm	25.13	3.53	26.13	3.09	23.16	3.32	25.16	2.85
Act 150 ppm	24.12	3.53	25.19	3.02	26.10	3.63	27.00	3.06
Sa 100 ppm	29.22	3.66	29.12	3.52	24.11	3.67	27.52	3.17
Sa 150 ppm	32.11	3.87	31.72	4.01	27.64	3.93	28.98	3.40
Sam 100 ppm	27.27	3.13	27.11	3.20	27.09	3.66	25.09	3.81
Sam 150 ppm	29.00	3.33	25.14	2.94	25.74	3.53	26.03	2.92
Act 100 ppm + Se 25 ppm	26.14	3.45	25.21	2.97	24.21	3.53	25.21	2.78
Act 100 ppm + Se 50 ppm	28.00	3.40	24.13	2.85	25.61	3.67	26.71	2.97
Act 150 ppm + Se 25 ppm	27.60	3.60	23.11	2.78	25.01	3.73	26.03	2.98
Act 150 ppm + Se 50 ppm	24.77	3.67	24.71	2.94	27.00	3.73	27.11	3.09
Sa 100 ppm + Se 25 ppm	30.12	3.27	26.13	3.12	25.14	3.87	27.18	3.11
Sa 100 ppm + Se 50 ppm	31.05	3.45	26.03	3.11	26.15	3.67	27.01	3.14
Sa 100 ppm + Se 25 ppm	29.14	3.60	29.81	3.85	25.89	3.93	28.99	3.37
Sa 100 ppm + Se 50 ppm	28.99	3.73	28.61	3.78	22.74	3.87	29.51	3.41
Sam 100 ppm + Se 25 ppm	27.09	3.20	26.11	3.06	24.77	3.53	25.14	2.85
Sam 100 ppm + Se 50 ppm	31.14	3.33	25.87	3.06	23.13	3.67	26.19	2.96
Sam 100 ppm + Se 25 ppm	29.06	3.40	26.41	3.16	26.19	3.53	24.99	2.85
Sam 100 ppm + Se 50 ppm	30.13	3.33	27.51	3.30	25.81	3.67	26.51	3.04
L.S.D. at 5%	N.S	0.19	2.01	0.351	N.S	0.24	1.87	0.223

Se = Sodium selenate **Act = acitylsalicylate**
Sa = Salicylic acid **Sam = salicylamid**

Using 150 ppm of salicylic acid gave the highest increase in no. of branches, fresh weight and dry weight. The same data reveal that foliar sprayers of salicylic derivatives and selenium at different used levels had No. significant effect on plant height, the two seasons had the same trend. These results are coinciding with Sitramaiah and Pathak, 1981, on tomato, Jasiswal and Bhambie, 1989, on *Vigna radiate* (L.), Liu Xini *et al.*, 2000 and Sanaa *et al.*, 2001, on broad bean.

2- Chemical composition of plant foliage:

Data presented in Table (3) show that the highest reducing sugars, non reducing sugars, total sugars and total protein resulted by foliar application of 150 ppm of salisylic acid and 50 ppm of sodium selenate, however, the increment did not reach the level of significant with respect to non reducing sugars at the first season and total sugars at the second season of this work. Such results are in agreement with those of Koutnik *et al.* (1997) and Hu QiuHui *et al.* (2001).

The stimulatory effect of salicylic acid upon the formation of sugar contents and total protein might be due to the role of such agent in the stimulation of the pentose-phosphate pathway and glucose-6- phosphate as well as the synthesis of protein (McCue *et al.*, 2000).

3- Yield and it's components:

Data in Table (4) indicated that number of flowers per plant had no significant response to all used foliar treatments. The same data showed also that no of pods, pods sitting and green podes yield were statistically affected by foliar applications of salicylic acid either in the presence or absence of selenium. The highest incrsment in the 1^{st} and 2^{nd} seasons, respectively were realized for the treatment of 150 ppm salicylic acid, whereas the lowest one was happened for the untreated plants. Such results relatively are in harmony with those of Kalarani *et al.* (2002) on tomato. The enhancing effect of salicylic acid on pods sitting may be due to the stimulatory effect of salicylic acid on IAA (Oxine) and IPA (Cytokinin) in leaves (Liu Xin *et al.*, 2000). Meanwhile, the promotional effect of salicylic acid on yield and it's components could be logically true under the present work conditions since, such treatment improved the vegetative growth parameters and the contents of sugars compared with control (Tables 2 and 3). In addition, salicylic acid stimulate the phenolic synthesis, phenolic secondary metabolites and proline contents (McCue, 2000) those that in closely relation with hot tolerane. All of those attributes might lead to the improvement of bean yield and it's components.

Table (3): Effect of some salicylic acid derivatives and selenium on Reducing sugars, Non Reducing sugars, total sugars and total protein of snap bean during 2004 and 2005 seasons.

Treatments	Season 2004				Season 2005			
	Reducing sugars mg/g DM	Non Reducing sugars mg/g DM	Total sugars mg/g DM	Total protein % mg/g DM	Reducing sugars mg/g DM	Non Reducing sugars mg/g DM	Total sugars mg/g DM	Total protein % mg/g DM
Control	14.99	8.15	23.14	18.94	11.22	7.35	18.57	17.99
Se 25 ppm	14.68	8.13	22.81	18.75	11.28	7.77	19.05	18.03
Se 50 ppm	15.51	9.00	24.51	19.69	11.34	7.62	18.96	18.11
Act 100 ppm	15.44	8.27	23.71	19.81	11.82	8.75	19.44	18.82
Act 150 ppm	15.62	10.51	26.13	19.94	11.52	8.67	20.19	18.91
Sa 100 ppm	15.04	11.07	26.11	20.50	13.31	9.03	22.34	21.00
Sa 150 ppm	17.10	11.21	28.31	20.81	14.35	9.21	23.56	22.31
Sam 100 ppm	15.89	9.02	24.91	19.44	12.01	8.23	20.24	19.35
Sam 150 ppm	15.60	10.13	25.73	19.68	11.81	8.37	20.18	20.21
Act 100 ppm + Se 25 ppm	14.89	9.22	24.11	19.69	11.53	8.55	20.08	18.91
Act 100 ppm + Se 50 ppm	14.92	8.97	23.85	19.87	11.41	8.71	20.12	18.73
Act 150 ppm + Se 25 ppm	15.24	9.41	24.65	19.82	12.05	8.61	20.66	18.82
Act 150 ppm + Se 50 ppm	14.66	10.21	24.87	20.06	12.13	8.78	20.91	18.95
Sa 100 ppm + Se 25 ppm	15.89	11.02	20.91	20.25	13.51	8.98	22.49	21.04
Sa 100 ppm + Se 50 ppm	14.91	11.30	26.21	20.69	14.22	9.00	23.22	22.82
Sa 100 ppm + Se 25 ppm	17.99	11.16	28.15	21.00	14.18	9.11	23.29	21.45
Sa 100 ppm + Se 50 ppm	16.09	11.32	28.41	20.75	14.37	9.31	23.68	22.51
Sam 100 ppm + Se 25 ppm	15.00	11.01	26.11	19.38	11.41	8.24	19.65	20.54
Sam 100 ppm + Se 50 ppm	16.51	10.59	27.10	19.41	13.51	7.92	21.43	19.87
Sam 100 ppm + Se 25 ppm	14.74	8.97	23.71	18.98	13.44	8.21	21.65	19.13
Sam 100 ppm + Se 50 ppm	15.51	9.56	25.07	19.43	14.11	8.26	22.37	21.01
L.S.D. at 5%	1.30	N.S	2.01	1.08	0.83	0.36	N.S	1.32

Se = Sodium selenate **Act = acitylsalicylate**
Sa = Salicylic acid **Sam = salicylamid**

Table (4): Effect of some salicylic acid derivatives and selenium on No. of flowers, No. of pods, pods sitting % and green pod's yield of snap bean during 2004 and 2005 seasons.

Treatments	Season 2004				Season 2005			
	No. of flowers/ plant	No. of pods plant	Pods sitting %	Green pods yield ton/fed	No. of flowers/ plant	No. of pods plant	Pods sitting %	Green pods yield ton/fed
Control	35.00	10.82	30.86	3.713	39.50	14.74	37.31	3.551
Se 25 ppm	35.32	10.32	29.22	3.905	40.12	14.89	37.11	3.595
Se 50 ppm	35.34	11.00	31.13	3.805	42.53	15.88	37.33	3.610
Act 100 ppm	34.46	11.66	33.85	4.010	36.82	14.36	39.01	4.013
Act 150 ppm	32.69	11.15	34.11	3.975	41.97	16.46	39.21	4.043
Sa 100 ppm	33.76	12.19	36.11	4.055	39.14	16.05	41.00	4.162
Sa 150 ppm	36.00	13.70	38.06	4.421	41.66	18.30	43.15	4.230
Sam 100 ppm	37.00	12.00	32.41	4.310	40.53	15.85	39.11	4.119
Sam 150 ppm	36.68	12.15	33.12	4.330	41.36	16.91	40.89	4.078
Act 100 ppm + Se 25 ppm	34.47	11.77	34.15	4.085	37.14	14.42	38.82	4.016
Act 100 ppm + Se 50 ppm	35.41	11.80	33.32	4.120	39.30	15.61	39.72	4.111
Act 150 ppm + Se 25 ppm	34.22	11.33	33.11	4.115	40.36	16.64	41.22	4.055
Act 150 ppm + Se 50 ppm	36.78	11.45	31.13	4.050	38.12	15.37	40.32	4.091
Sa 100 ppm + Se 25 ppm	35.58	12.15	34.15	4.078	40.66	17.46	42.93	4.140
Sa 100 ppm + Se 50 ppm	36.18	12.30	34.00	4.125	41.00	17.15	41.82	4.122
Sa 100 ppm + Se 25 ppm	36.96	13.00	35.17	4.355	36.97	15.90	43.02	4.180
Sa 100 ppm + Se 50 ppm	35.83	13.62	38.01	4.345	40.75	17.45	42.83	4.161
Sam 100 ppm + Se 25 ppm	35.51	11.83	33.31	4.261	37.92	14.88	39.23	4.135
Sam 100 ppm + Se 50 ppm	35.34	12.14	34.35	4.235	42.00	16.81	40.04	4.127
Sam 100 ppm + Se 25 ppm	38.69	12.45	32.18	4.344	39.75	15.90	39.99	4.139
Sam 100 ppm + Se 50 ppm	36.58	12.53	34.25	4.305	39.45	16.38	41.52	4.161
L.S.D. at 5%	N.S	0.85	2.08	0.161	N.S	1.03	1.82	0.105

Se = Sodium selenate **Act = acitylsalicylate**
Sa = Salicylic acid **Sam = salicylamid**

CONCLUSION

Under such conditions of this study, it can be concluded that salicylic acid at 150 ppm improved number of branches, fresh weight and dry weight, increased leaves sugar contents and total protein, enhanced number of pods, pods sitting and green podes yield of snap pean during late summer season planting.

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إستجابة نباتات الفاصوليا لبعض مشتقات حمض السلسليك والسلينيوم تحت ظروف الحرارة المرتفعة.

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أجريت تجربتين حقليتين خلال موسم ٢٠٠٤ و ٢٠٠٥ فى كفر الوكالة مركز شربين – محافظة الدقهلية، مصر وذلك لدراسة الرش الورقى ببعض مشتقات حمض السلسليك والسلينيوم على نمو وإنتاج الفاصوليا صنف برونكو تحت ظروف الحرارة المرتفعة، وقد استخدم ثلاث مشتقات للسلسليك وهم حمض السلسليك والأسيتيل سلسيلات والسلسيل أميد بتركيزات صفر و ١٠٠ و١٥٠ جزء فى المليون. واستخدم أيضا سلينات الصوديوم كمصدر للسلينيوم بتركيزات صفر و٢٥ و٥٠ جزء فى المليون. وقد كانت أهم النتائج المتحصل عليها هى كالتالى:

١- أدى الرش الورقى بحمض السلسليك بتركيز ١٥٠ جزء فى المليون إلى إعطاء أفضل نتائج فى عدد الفروع للنبات والوزن الغض والجاف، بينما لم يكن هناك تأثير للمعاملات على طول النبات.

٢- أدى الرش الورقى بحمض السلسليك بتركيز ١٥٠ جزء فى المليون و٥٠ جزء فى المليون من سلينات الصوديوم إلى زيادة محتوى الأوراق من السكريات والبروتينات الكلية.

٣- لم يكن هناك تأثير للمعاملات المختلفة على عدد الأزهار، بينما أدت المعاملة رشا بحمض السلسليك بتركيز ١٥٠ جزء فى المليون إلى زيادة عدد القرون ونسبة العقد ومحصول القرون الأخضر.