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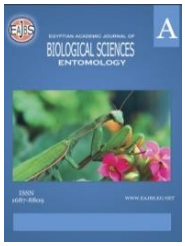

Impact of Foliar Application by Salicylic Acid on Some Pea Cultivars and Their Response to Insect Infestation

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ABSTRACT

The present study was conducted out to investigate the effect of foliar application of five pea cultivars (Entesar 1, Goara, Line 1, Line 11 and Line 14) with salicylic acid (SA) on infestation by *Aphis craccivora* (Koch.), *Thrips tabaci* Lindeman and *Liriomyza trifolii* Burg. during 2018/2019 and 2019/2020 winter seasons at Sohag Governorate. Also, the effect of SA application on the growth, yield, and some yield components of pea was included. Data revealed that the foliar application with SA at 200ppm and 100ppm reduced *A. craccivora*, *T. tabaci*, and *L. trifolii* (mines) infestations by about 50% and 30%, respectively, compared with control in both seasons. Also, plant height, the number of pods/ plant, weight, total green pods yield/ plant, and total yield/ Feddan were increased by the two SA treatments comparing to control in both seasons. The five pea cultivars varied significantly in their susceptibility to the three studied pests and in horticultural characters in both seasons. The interaction between pea varieties and SA treatments was discussed.

INTRODUCTION

Pea, *Pisum sativum* L. (Fam: Fabaceae) is one of the most important leguminous vegetable crops in Egypt for local consumption and exportation. Pea cultivates during winter season for green pods which contain a great amount of protein and carbohydrates (Hussein *et al*. 2006). In Egypt, the pea is subjected to attack by a number of insect pests include *Aphis craccivora* (Koch.), *Liriomyza trifolii* Burg., *Thrips tabaci* Lindeman, (El-Solimany, 2008 and Hassan *et al.*, 2016). Insect infestation causes great yield damage, which can result in greater than 50% yield reduction (El-Roby, 2016). Induced resistance has been defined as the " qualitative or quantitative enhancement of a plant's defense mechanisms against pests in response to extrinsic physical or chemical stimuli." (Kogan and Paxton, 1983). The use of elicitors of plant resistance like salicylic acid as a mean of controlling insect pests in agriculture have proposed by many investigators (El-Khawas, 2012; Mahmoud and Mahfouz, 2015; Elhamahmy *et al.*, 2016 and Mony *et al*., 2017). In addition to the reduction of insect pests population infesting pea, foliar application with salicylic acid can improve plant growth and yield (Murtaza *et al*., 2007; Gad El-Hak *et al*., 2012; Ratushnyak *et al*., 2012 and El-Saadony *et al*., 2017). Thus, the present investigation was conducted to assess the infestation level of aphid thrips and leafminer in pea due to the application of salicylic acid on five pea cultivars and their effects on the growth, yield and yield components of pea.

MATERIALS AND METHODS

The present study was executed at The Experimental Farm of Shandweel Agricultural Research Station, Sohag Governorate, Egypt during the winter seasons of 2018/2019 and 2019/2020. The study included 15 treatments, which were the combination of five pea cultivars and three foliar application treatments with salicylic acid. Pea cultivars used were Entesar 1, Goara, Line 11, Line 1, and Line 14. Salicylic acid was applied at 200 ppm and 100 ppm in addition to control (water only). The previous treatments were arranged in a split-plot in a complete randomized block design with three replicates. The main plots were used for pea cultivars; however, the foliar applications of salicylic acid were randomly arranged in the subplots. Each experimental unit was 1/400 fedddan (10.5 m^2) including 5 rows, each of 3.5 m length, and 70 cm width. Sowing was done on 20th October in both seasons by sowing three seeds per hill at 35 cm intervals. Growing plants were thinned into one plant/ hill. Conventional agricultural practices were performed and no insecticidal treatments were used during the whole study period. Pea plots were sprayed with Salicylic acid dissolved in a few drops of ethanol and then dispersed in water to give required rates. Plants were sprayed after 25 days of sowing by one-week interval for three times using hydraulic sprayer (control plots applied only with water).

Insect Data:

The experiment was left for natural infestation, data were recorded at the weekly interval, from first plant emergence (about 15 days from sowing) till crop harvest (the last week of January). In the early morning, 10 randomly leaves per plot were examined in the field and the number of thrips was recorded. Concerning aphid and leafminer, samples consisted of 10 leaves were randomly chosen from three levels, i.e., lower, middle, and upper of pea plants, transferred in polyethylene bags to the laboratory, and the numbers of aphid and mines due to leafminers were counted.

Horticultural Data:

Plant Height: At the end of each season, samples consisted of 10 plants were randomly taken from each plot to determine the plant height (cm).

Green Pod Yield and its Components: samples consisted of 10 plants were randomly taken from each plot to determine the number of fresh pods/ plant, the average fresh pod weight (g) and total yield of green pods/ plant (g), also, the green pod yield/fed was calculated in both seasons.

Statistical Analysis:

Statistical analysis was conducted by using one – way analysis of variance. 'F' test used to evaluate the significance of the difference between pea cultivars, salicylic acid treatments, and their interaction. The Duncan's Multiple Range Test at P = 5% was used to separate the means (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Insect Pests:

Data in Table (1) revealed that the differences between pea cultivars and between SA treatments were significant in both seasons of the study for the three studied pests. Also, the interaction between pea cultivars and SA treatments was significant in both seasons for thrips and leafminers, however, no interaction was found in both seasons in the case of aphid (Table 2). It is clear that the differences between SA treatments varied according to the pea genotype in both seasons.

Table 1: Effect of pea cultivars and foliar spray with salicylic acid on infestation with *Aphis craccivora*, *Thrips tabaci*, and *Liriomyza trifolii* during 2018/2019 and 2019/2020 seasons.

Main effect	Mean number/ 10 leaves					
	Aphis craccivora		*Thrips tabaci*		*Liriomyza trifolii*	
	2018/2019 season	2019/2020 season	2018/2019 season	2019/2020 season	2018/2019 season	2019/2020 season
Pea variety						
Entesar 1	27.85 **c**	27.96 **b**	7.65 **a**	8.16 **a**	4.29 **b**	5.93 **b**
Goara	38.87 **b**	35.65 **b**	4.85 **b**	4.74 **b**	4.21 **b**	5.02 **b**
Line 11	44.53 **b**	49.38 **b**	5.07 **b**	5.08 **b**	6.03 **a**	6.36 **ab**
Line 1	70.47 **a**	89.09 **a**	7.50 **a**	8.03 **a**	6.31 **a**	7.93 **a**
Line 14	43.03 **b**	47.57 **b**	4.56 **b**	4.65 **b**	5.98 **a**	6.08 **b**
F. value	105.03	29.68	68.73	139.53	107.88	14.30
SA treatment						
SA 200	31.53 **b**	32.46 **b**	3.94 **c**	4.31 **c**	3.79 **c**	4.54 **b**
SA 100	41.54 **b**	47.59 **b**	5.96 **b**	5.76 **b**	4.77 **b**	5.42 **b**
Control	61.79 **a**	69.73 **a**	7.87 **a**	8.32 **a**	7.53 **a**	8.83 **a**
F. value	44.36	33.62	136.44	160.75	249.29	91.82

Means in each column followed by the same letter are not significantly different at the 5% level according to Duncan ,s Multiple Range Test.

Table 2: Effect of the interaction between pea cultivars and spraying with salicylic acid on infestation with *Aphis craccivora*, *Thrips tabaci*, and *Liriomyza trifolii* during 2018/2019 and 2019/2020 seasons.

Pea variety	Salicylic treatment	Mean number/ 10 leaves					
		Aphis craccivora		*Thrips tabaci*		*Liriomyza trifolii*	
		2018/2019 season	2019/2020 season	2018/2019 season	2019/2020 season	2018/2019 season	2019/2020 season
Entesar 1	SA 200	16.10 **f**	13.64 **g**	4.51 **gh**	4.77 **e**	2.13 **h**	3.21 **g**
	SA 100	19.33 **f**	16.21 **g**	8.03 **b**	8.26 **c**	3.77 **fg**	4.82 **fg**
	Control	48.10 **cd**	54.03 **cdef**	10.41 **a**	11.46 **a**	6.97 **b**	9.77 **a**
Goara	SA 200	24.56 **ef**	22.08 **g**	2.69 **i**	3.28 **fg**	3.31 **g**	3.85 **fg**
	SA 100	37.46 **de**	36.49 **defg**	4.90 **fg**	4.45 **ef**	3.56 **g**	3.92 **fg**
	Control	54.59 **bcd**	48.38 **cdef**	6.97 **bcd**	6.49 **d**	5.77 **c**	7.28 **cd**
Line 11	SA 200	30.03 **ef**	31.67 **fg**	3.67 **hi**	3.72 **efg**	4.92 **cde**	5.05 **f**
	SA 100	39.68 **de**	46.97 **cdef**	5.10 **fg**	4.18 **efg**	5.56 **c**	5.41 **ef**
	Control	63.89 **bc**	69.49 **bc**	6.44 **cde**	7.33 **cd**	7.59 **b**	8.62 **abc**
Line 1	SA 200	49.62 **cd**	60.33 **cd**	5.74 **ef**	6.74 **d**	4.08 **efg**	6.90 **de**
	SA 100	69.77 **b**	88.54 **b**	7.26 **bc**	7.51 **cd**	5.36 **cd**	7.77 **bcd**
	Control	92.03 **a**	118.38 **a**	9.49 **a**	9.82 **b**	9.49 **a**	9.13 **ab**
Line 14	SA 200	37.33 **de**	34.56 **efg**	3.10 **i**	3.05 **g**	4.54 **def**	3.72 **fg**
	SA 100	41.44 **de**	49.77 **cdef**	4.51 **gh**	4.41 **ef**	5.59 **c**	5.15 **f**
	Control	50.33 **cd**	58.38 **cde**	6.05 **def**	6.49 **d**	7.82 **b**	9.36 **ab**
F. value		1.37	1.33	3.06	5.28	6.30	3.21

Means of among of each column followed by the same letter are not significantly different at the 5% level according to Duncan, s Multiple Range Test.

1- *Aphis craccivora*:

Data in (Table 1) showed that the highest infestation observed in Line 1 with 70.47 and 89.09 aphids/ ten leaves in the two seasons, respectively, however, lowest aphid number recorded in Entesar 1 with 27.85 and 27.96 aphids/ ten leaves in the two seasons, respectively, followed insignificantly by Goara, Line 11 and Line 14 in the second season.

The foliar application with SA at 200ppm and 100ppm reduced aphid infestation by about 50% and 30%, respectively, compared with control in both seasons. It is clear that the two SA concentrations did not differ significantly in both seasons. SA at 200ppm, 100ppm, and control recorded 31.53, 41.54, and 61.79 aphids/ ten leaves, respectively, in the first season, and 32.46, 47.59, and 69.73 aphids/ ten leaves, respectively, in the second season.

For the combination between SA treatments and pea cultivars, the lowest aphid infestation was recorded in Entesar 1 x SA at 200ppm with 16.10 and 13.64 aphids/ ten leaves in the two seasons, respectively, followed insignificantly by Entesar 1 x SA at 100ppm, Goara x SA at 200ppm and Line 11 x SA at 200ppm in both seasons, and by Goara x SA at 100ppm and Line 14 x SA at 200ppm in the second season only. While, the highest one recorded in Line 1 x control with 92.03 and 118.38 aphids/ ten leaves in the two seasons, respectively. Our results are widely in agreement with the previous studies, the spraying of SA was reported to be an effective elicitor to diminish aphid numbers on wheat (Mahmoud and Mahfouz, 2015), on canola (Elhamahmy *et al.*, 2016), and on mustard (Mony *et al.*, 2017).

2- *Thrips tabaci*:

Depending on the mean number of thrips per 10 leaves, the five pea cultivars arranged in two significant groups. The lowest infested included Goara, Line 11 and Line 14 with 4.85, 5.07, and 4.56 thrips/ ten leaves, respectively in the first season, and 4.74, 5.08, and 4.65 thrips/ ten leaves, respectively in the second season. However, the highest infested included Entesar 1 and Line 1 with 7.65 and 7.50 thrips/ ten leaves, respectively in the first season, and with 8.16 and 8.03 thrips/ ten leaves, respectively in the second season.

The results proved that the foliar application with SA reduced the mean number of thrips comparing to control by 50% and 30% at 200ppm and 100ppm, respectively, in the two seasons. SA at 200ppm, 100ppm, and control recorded 3.94, 5.96, and 7.87 thrips/ ten leaves, respectively, in the first season, and 4.31, 5.76, and 8.32 thrips/ ten leaves, respectively, in the second season.

Concerning the interaction between pea cultivars and SA treatments, it is clear that the interaction between them was significant in both seasons. The lowest thrips mean the number was recorded in Goara x SA at 200ppm (2.69 thrips/ ten leaves) and Line 14 x SA at 200ppm (3.05 thrips/ ten leaves) in 2018/2019 and 2019/2020 seasons, respectively, with insignificant differences between each of them and Line 11 x SA at 200ppm in both seasons, and with Line 11 x SA at 100ppm in the second season of the study. On the other hand, Entesar 1 x control harboured the highest thrips infestation with 10.41 and 11.46 thrips/ ten leaves in the two seasons, respectively, followed insignificantly by Line 1 x control in the second season. In most cases, the differences between SA treatments were significant in all cultivars. In agreement with these results, Dixit *et al.* (2018) who showed that foliar spray of SA at 250 mgl-1 at two or three times reduced the infestation of onion with thrips. In the same line, Hammam *et al.* (2019) found that the foliar application of marjoram plants with salicylic acid reduces the infestation of *T. tabaci*.

3- *Liriomyza trifolii*:

Depending on the mean number of mines due to *L. trifolii* per 10 leaves, two and three significant groups of effect were observed in 2018/2019 and 2019/2020 seasons, respectively. In the first season, Goara (4.21 mines/ 10 leaves) and Entesar 1 (4.29 mines/ 10 leaves) were in the lowest infested group, however, Line 11 (6.03 mines/ 10 leaves), Line 1 (6.31 mines/

10 leaves) and Line 14 (5.98 mines/ 10 leaves) were arranged in the highly infested group. In the second seasons, the lowest infested group included Goara (5.02 mines/ 10 leaves), Entesar 1 (5.93 mines/ 10 leaves) and Line 14 (6.08 mines/ 10 leaves), the highest infested group contained Line 1 (7.93 mines/ 10 leaves), while the third one consisted of Line 11 (6.36 mines/ 10 leaves) with insignificant differences with the previous two groups.

The results proved that the foliar application with SA reduced the mean number of mines due to *L. trifolii* comparing to control by 50% and 30% at 200ppm and 100ppm, respectively, in the two seasons, also, no significant differences were found between 200ppm and 100ppm in the second season. SA at 200ppm, 100ppm, and control recorded 3.79, 4.77, and 7.53 mines/ 10 leaves, respectively, in the first season, and 4.54, 5.42, and 8.83 mines/ 10 leaves, respectively, in the second season.

The combination of Entesar 1 x SA at 200ppm recorded the lowest mean of 2.13 and 3.21 mines/ 10 leaves in the two seasons, respectively, followed insignificantly by Entesar 1 x SA at 100ppm, Goara x SA at 200ppm, Goara x SA at 100ppm and Line 14 x SA at 200ppm in 2019/2020 season. Meanwhile, Line 1 x control and Entesar 1 x control harboured the highest leafminer infestation in 2018/2019 and 2019/2020 seasons, respectively, with 9.49 and 9.77 mines/ 10 leaves, respectively, with insignificant difference between them in the second season. The present results are in harmony with those of El-Khawas (2012) who suggested that using elicitors as salicylic acid to induce resistance of pea plants against leafminer has been successful as one of the alternative pest management tools.

Horticultural Data:

Data in Table (3) revealed that the differences between pea cultivars and between SA treatments were significant in both seasons for all horticultural characters. Also, the interaction between pea cultivars and SA treatments were significant in both seasons for plant height and a number of pods/ plant, however, the interaction was significant in the first season only for the average weight of pod, total yield/ plant and total yield/ feddan (Table 4). It is clear that the differences between SA treatments varied according to the pea genotype in both seasons.

Plant Height:

The highest plant length was recorded in Line 11 with 98.29 and 94.71 cm in the two seasons, respectively, by insignificant differences with Line 14 in the first season, however, Entesar 1 recorded the lowest plant length with 51.11 and 51.47 cm in the two seasons, respectively (Table 3).

Data showed that foliar spray pea plants with salicylic acid significantly increased plant length in both seasons compared to control, by the insignificant difference between 200ppm and 100ppm in the first season. SA at 200ppm, 100ppm, and control recorded 80.27, 77.51, and 74.03 cm, respectively, in the first season, and 79.71, 74.35, and 71.43 cm, respectively, in the second season.

The maximum plant length was recorded in Line 11 x SA at 200ppm (102.80 cm) and Line 14 x SA at 200ppm (104.40 cm) in the two seasons, respectively, with an insignificant difference between them in the first season. However, the minimum plant length was recorded in Entesar 1 x control with 50.07 and 50.39 cm in the two seasons, respectively, followed insignificantly by the same cultivar with the two SA treatments in both seasons. The previous results were in partial agreement with these of Gad El-Hak *et al.* (2012) who showed that the foliar application by SA markedly affected pea plant height. Also, Ratushnyak *et al.* (2012) reported that SA application increased the plant height of the pea plant.

Table 3: Effect of pea cultivars and foliar spray with salicylic acid on plant height and yield during 2018/2019 and 2019/2020 seasons.

Main effect	Plant Height (cm)		Number of Pods/ plant		Weight of pod (g)		Total yield/ plant (g)		Total yield/ Fed. (ton)	
	2018/19 season	2019/20 season	2018/19 season	2019/20 season	2018/19 season	2019/20 season	2018/19 season	2019/20 season	2018/19 season	2019/20 season
Pea variety										
Entesar 1	51.11 d	51.47 e	8.60 e	8.04 e	11.76 a	11.96 a	101.19 d	96.28 c	4.05 d	3.85 c
Goara	72.56 b	71.62 c	20.16 c	20.36 c	7.84 c	7.81 b	158.63 c	158.91 b	6.35 c	6.36 b
Line 11	98.29 a	94.71 a	25.89 b	25.30 b	8.11 c	8.21 b	210.21 b	207.99 a	8.41 b	8.32 a
Line 1	66.69 c	66.62 d	12.88 d	12.14 d	8.43 b	8.52 b	109.17 d	103.94 c	4.37 d	4.16 c
Line 14	97.69 a	91.38 b	28.39 a	26.94 a	8.09 c	8.26 b	229.49 a	222.61 a	9.18 a	8.90 a
F. value	704.72	1737.54	1153.33	1134.26	1134.44	88.54	580.68	159.51	578.34	158.85
SA treatment										
Salicylic 200	80.27 a	79.71 a	19.88 a	19.78 a	9.11 a	9.15 a	174.81 a	173.51 a	6.99 a	6.94 a
Salicylic 100	77.51 a	74.35 b	19.54 a	18.62 b	8.94 a	9.12 a	166.02 b	160.81 a	6.64 b	6.43 a
Control	74.03 b	71.43 c	18.14 b	17.26 c	8.49 b	8.59 a	144.38 c	139.51 b	5.78 c	5.58 b
F. value	39.99	147.66	44.55	72.72	69.29	5.82	163.45	33.20	165.14	33.20

Means of among of each column followed by the same letter are not significantly different at the 5% level according toDuncan, s Multiple Range Test.

Table 4: Effect of the interaction between pea cultivars and spraying with salicylic acid on plant height and yield during 2018/2019 and 2019/2020 seasons.

Pea variety	Salicylic treatment	Plant Height (cm)		Number of Pods/ plant		Weight of pod (g)		Total yield/ plant (g)		Total yield/ Fed. (ton)	
		2018/19 season	2019/20 season	2018/19 season	2019/20 season	2018/19 season	2019/20 season	2018/19 season	2019/20 season	2018/19 season	2019/20 season
Entesar 1	SA 200	52.73 i	52.07 k	9.92 h	9.33 h	11.57 b	11.93 a	114.91 i	111.46 hi	4.60 i	4.46 hi
	SA 100	50.53 i	51.47 k	8.48 i	7.81 i	12.05 a	12.22 a	102.21 jk	95.50 ij	4.09 jk	3.82 ij
	Control	50.07 i	50.87 k	7.39 j	6.99 i	11.67 b	11.74 a	86.46 l	81.87 j	3.46 l	3.27 j
Goara	SA 200	74.40 e	73.87 g	21.41 d	22.99 c	8.17 d	7.80 cd	175.16 e	179.26 ef	7.01 e	7.17 ef
	SA 100	73.07 ef	71.53 h	21.61 d	20.96 d	7.65 f	7.87 bcd	165.51 f	164.47 f	6.62 f	6.58 f
	Control	70.20 fg	69.47 hi	17.47 e	17.12 e	7.70 f	7.77 cd	135.21 g	132.99 g	5.41 g	5.32 g
Line 11	SA 200	102.80 a	99.67 b	25.28 c	25.69 b	8.56 c	8.60 bc	216.59 bc	221.13 abc	8.66 bc	8.85 abc
	SA 100	97.60 bc	93.60 c	27.49 b	26.43 ab	7.98 de	8.07 bcd	219.66 b	212.77 bc	8.79 b	8.51 bc
	Control	94.47 cd	90.87 d	24.91 c	23.79 c	7.79 ef	7.97 bcd	194.37 d	190.07 de	7.77 d	7.60 de
Line 1	SA 200	68.80 g	68.53 i	14.32 f	13.63 f	8.71 c	8.80 b	124.97 h	119.95 gh	5.00 h	4.80 gh
	SA 100	67.67 g	67.13 i	12.61 g	11.81 g	8.47 c	8.69 bc	107.33 ij	102.98 hij	4.29 ij	4.12 hij
	Control	63.60 h	64.20 j	11.71 g	10.99 g	8.10 d	8.07 bcd	95.20 k	88.89 j	3.81 k	3.56 j
Line 14	SA 200	102.60 a	104.40 a	28.45 a	27.28 a	8.51 c	8.63 bc	242.44 a	235.78 a	9.70 a	9.43 a
	SA 100	98.67 b	88.00 e	27.49 b	26.11 b	8.55 c	8.73 bc	235.37 a	228.33 ab	9.41 a	9.13 ab
	Control	91.80 d	81.73 f	29.23 a	27.44 a	7.20 g	7.43 d	210.65 c	203.72 cd	8.43 c	8.15 cd
F. value		2.62	33.16	19.15	14.97	16.85	1.09NS	3.47	0.47NS	3.49	0.47N

Means of among of each column followed by the same letter are not significantly different at the 5% level according to Duncan, s Multiple Range Test.

Number of Pods/ Plants:

The maximum numbers of pods per plant of 28.39 and 26.94 pods/ plant in the two seasons, respectively were recorded in Line 14, however, the minimum numbers of 8.60 and 8.04 were recorded in Entesar 1 in the two seasons, respectively (Table 3).

Also, numbers of pods increased significantly by the foliar spray pea plants with salicylic acid in both seasons compared to control, by the insignificant difference between 200ppm and 100ppm in the first season. SA at 200ppm, 100ppm, and control recorded 19.88, 19.54, and 18.14 pods/ plant, respectively, in the first season, and 19.78, 18.62, and 17.26 pods/ plant, respectively, in the second season.

For combination between pea cultivars and SA treatment, Line 14 x control recorded the highest numbers of 29.23 and 27.44 pods/ plant in the two seasons, respectively, with insignificant differences with Line 14 x SA at 200ppm in both seasons, and with Line 11 x SA at 100ppm in the second season (Table 4). Entesar 1 x control gave the lowest mean number of 7.39 and 6.99 pods/ plant in the two seasons, respectively, followed insignificantly by Entesar 1 x SA at 100ppm in the second season. The previous results were in the same line with these of Murtaza *et al.* (2007) who showed that the four pea cultivars differed significantly in terms of numbers of pods per plant and the treatment with SA increased number of pods, also, they reported that the interaction was found non-significant between cultivars and SA concentrations.

Average of Pod Weight:

The maximum average of pod weight was recorded in Entesar 1 with 11.76 and 11.96 g in the two seasons, respectively, however, the lowest one was obtained from Goara with 7.84 and 7.81 g in the two seasons, respectively (Table 3). The differences between the last cultivar and Line 11 and Line 14 in the two seasons, and Line 1 in the second season were insignificant.

Also, the average of pod weight increased significantly by the foliar spray pea plants with salicylic acid in both seasons compared to control, by the insignificant difference between 200ppm and 100ppm in the first season. SA at 200ppm, 100ppm, and control recorded an average of pod weight of 9.11, 8.94, and 8.49 g, respectively, in the first season, and 9.15, 9.12 and 8.59 g, respectively, in the second season.

For combination between pea cultivars and SA treatment, the highest average of pod weight of 12.05 and 12.22 g were recorded in Entesar 1 x SA at 200ppm in the two seasons, respectively, followed insignificantly by Entesar1 x SA at 100ppm and Entesar1 x control in the second season. Line 14 x control gave the lowest pod weight of 7.20 and 7.43 g in the two seasons, respectively, followed insignificantly by Goara in all SA treatments, Line 11 x SA at 100ppm and x control and Line 1 x control in the second season only. In previous studies, Gad El-Hak *et al.* (2012) found that the pod weight was significantly increased by SA foliar application.

Total Yield/ Plant:

The highest total yield of green pods per plant was achieved from Line 14 by 229.49 and 222.61 g/ plant in the two seasons, respectively, followed insignificantly by Line 11 in the second season, however, Entesar 1 recorded 101.19 and 96.28 g/ plant as the lowest total yield per plant in the two years of the study, respectively.

Using SA as foliar application increased the total yield per plant in pea plant comparing to untreated (control) in both seasons. The difference between SA at 200ppm and at 100ppm was significant and insignificant in the two seasons, respectively. SA at 200ppm, 100ppm, and control recorded 174.81, 166.02, and 144.38 g/ plant, respectively, in the first season, and 173.51, 160.81, and 139.51 g, respectively, in the second season.

Concerning the combination between pea cultivars and SA treatments, the total yield per plant was achieved from Line 14 x SA at 200ppm with 242.44 and 235.78 g in the two seasons, respectively, followed insignificantly by Line 14 x SA at 100ppm in both seasons. The lowest total yield per plant was recorded in Entesar 1 x control with 86.46 and 81.87 g in the two seasons, respectively, followed insignificantly by Entesar 1 x SA at 100ppm, Line 1 x SA at 100ppm and Line 1 x control in the second season. El-Saadony *et al.* (2017) found that

spraying pea plants with salicylic acid at (100ppm) had a positive significant effect in yield.

Total Green Pods Yield/ Feddan:

The highest green pods yield per feddan was achieved from Line 14 with 9.18 and 8.90 tons/ fed. in 2018/2019 and 2019/2020 seasons, respectively in bar with Line 11 (8.32 tons/ fed.) in the second season.

The feddan yield increased by about 1.21 to 1.36 tons in case of foliar application of SA at 200 ppm, and by about 0.85 to 0.85 tons in case of foliar application of SA at 100 ppm compared to control. SA at 200ppm, 100ppm, and control recorded 6.99, 6.64, and 5.78 tons/ fed., respectively, in the first season, and 6.94, 6.43, and 5.58 tons/ fed., respectively, in the second season.

The highest yield per feddan was achieved from Line 14 x SA at 200ppm with 9.70 and 9.43 tons/ fed. in the two seasons, respectively, followed insignificantly by Line 14 x SA at 100ppm in both seasons. The lowest total yield per feddan was recorded in Entesar 1 x control with 3.46 and 3.27 tons/ fed. in the two seasons, respectively, followed insignificantly by Entesar 1 x SA at 100ppm, Line 1 x SA at 100ppm and Line 1 x control in the second season. The present results are in agreement with Gad El-Hak *et al.* (2012)

CONCLUSION

Our results indicated that the use of salicylic acid as foliar application reduced the populations of *Aphis craccivora*, *Thrips tabaci* and *Liriomyza trifolii* on all pea cultivars adopted. Also, salicylic acid enhanced plant growth and maximized yield per feddan. The effect of SA application on studied insect pests infestation varied from pea variety to other, this means that the SA effect may depend on pea genotype. The same was obtained on plant height and yield.

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ARABIC SUMMARY

تأثير الرش بحمض السالسيلك على بعض أصناف البسلة ومدي استجابتها للإصابة الحشرية

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أجريت هذه الدراسة لبحث تأثير الرش بحمض السالسيلك علي إصابة خمسة من أصناف البسلة (إنتصار ١, جعاره, سلاله ١, سلالة ١١ وسلالة ١٤) بمن الفول, تربس البصل وصانعة أنفاق أوراق الفول خلال الزراعة الشتوية لموسمي ٢٠١٨\٢٠١٩م و ٢٠١٩\٢٠٢٠م في محافظة سوهاج. كذلك تم دراسة تأثير حمض السالسيلك علي نمو ومحصول وبعض مكونات المحصول للبسلة. أظهرت البيانات أن الرش بحمض السالسيلك بتركيز ٢٠٠ و١٠٠ جزء في المليون أدي إلي إنخفاض الإصابة بمن الفول وتربس البصل وصانعة أنفاق أوراق الفول بنسبة ٥٠٪ و٣٠٪, علي التوالي مقارنة بالكنترول في كلا موسمي الزراعة. كذلك وجد أن طول النبات, عدد القرون الخضراء/ نبات, وزن القرن, المحصول من القرون الخضراء للنبات والمحصول الكلي من القرون للفدان قد زادت بشكل معنوي عند الرش بحمض السالسيلك مقارنة بالكنترول في كلا الموسمين. إختلفت أصناف البسلة الخمسة في مدي حساسيتها للآفات الثلاثة المدروسة وكذلك في الصفات البستانية في كلا الموسمين. تم أيضا دراسة التفاعل بين الأصناف ومعاملات السالسيلك.