J. Agric. Sci. Mansoura Univ., 34 (6): 6715 - 6726, 2009

EFFECT OF FOLIAR APPLICATION WITH SALICYLIC ACID AND VITAMIN E ON GROWTH AND PRODUCTIVITY OF TOMATO (*Lycopersicon esculentum*, Mill.) PLANT.

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ABSTRACT

Two field experiments wee conducted to study the effect of foliar application with 50 & 100 ppm of salicylic acid (SA) and 100 & 200 ppm of vitamin E (VE) and their combination on some growth aspects, photosynthetic pigments, minerals, endogenous phytohormones, flowering, fruiting and fruit quality of tomato cv. Super strain B during 2006 and 2007 seasons. Plants were sprayed two times at 30 and 45 days after transplanting.

Results indicated that, different applied treatments significantly increased all studied growth parameters as number of branches and leaves per plant, leaf area per plant and leaves dry weight as well. Besides, the two concentrations of each applied salicylic acid or vitamin E obviously increased photosynthetic pigments, NPK, Fe, Zn, Mn, total carbohydrates and crude protein concentrations in leaves of treated plants as compared with those of untreated ones.

Also, all treatments increased gibberellins and cytokinins level in tomato shoots whereas Auxins and abscisic acid were decreased.

Furthermore, the highest early and total yields were obtained with salicylic acid 50ppm + vitamin E 200ppm followed by SA 100 + VE 200ppm, respectively. In addition, chemical composition of minerals and some bioconstituents such as carbohydrates, vitamin C, total soluble solids in tomato fruits were also increased at the same treatments. Therefore, the present study strongly admit the use of salicylic acid and vitamin E as foliar application not only increased early and total yields but also getting a good fruit quality as well.

Keywords: Salicylic acid, vitamin E, photosynthetic pigments , Endogenous phytohormones ,flowering , Yield, tomato.

INTRODUCTION

Salicylic acid (SA) is a phenolic compound and natural constituent of plant (Raskin, 1992). SA was recognized as an endogenous regulator in plants after the finding that it is involved in many plant physiological processes (Pancheva *et al.*, 1996). One of the most studied functions of SA is associated with its involvement in plant resistance response to different pathogen attacks (Enyedi *et al.*, 1992 and Durner, *et al.* 1997).

Application of salicylic acid to plants has been shown a variety of biological responses. Enzyme activities such as amylase and nitrate reductase were increased by SA application (Sharma *et al,*. 1986 and Chen *et al.*,1993). On the other hand, SA showed synergetic effect with auxin and gibberellins (Datta and Nanda, 1985 and Sanaa *et al,*. 2006). Moreover, in a number of species SA promoted flowering in combination with other plant growth regulators such as kinetin, indole acetic acid and gibberellins (Singh, 1984 and Shehata *et al,*. 2000). Applied SA induced changeable in endogenous phytohormones of tomato and other plants (Raskin, 1992 and Waffaa *et al,*. 1996).

Recently, it was known that plants can be defense against such oxidative effects via groups of naturally occurring or exogenously applied substances known as antioxidants or oxygen free radicals scavengers.

Antioxidants, i.e. vitamins A, C and E, carotenoids, phenols, glutathione, citric acid due to their molecules properties acts as cofactors for some specific enzymes, i.e., dismutases, catalases, peroxidases, those catalyzed breakdown of the toxic (H_2O_2), (OH), (O^-_2) radicals (Lascaris and Deacon, 1991; Bowler *et al,.* 1992 and Aono *et al.*, 1993).

Some investigators were used such agents to improve productivity of some vegetables, but under non stress condition, with less or no attention to their antioxidantal protective functions (El-Sayed, 1991; Arisha, 2000; El-Lithy *et al,.* 2001 and Fathy *et al,.* 2003).

The present study aimed to investigate the effect of foliar application of salicylic acid (SA) and vitamin E (VE) and their combination on the growth, flowering and tomato fruits yield. Furthermore, the effect of SA and VE on endogenous phytohormones as well as chlorophylls, minerals and carbohydrates concentration were studied.

MATERIALS AND METHODS

Two field experiments were carried out at the Experimental Farm Station of the faculty of Agriculture, Moshtohor, Benha University, Egypt, during 2006 and 2007 seasons to study the effect of foliar application with salicylic acid, vitamin E and their combination on growth, flowering, yield and fruit quality as well as photosynthetic pigments, minerals crude protein and carbohydrates of tomato (*Lycopersicon esculentum* Mill.) cv. Super strain B.

Five-week-old tomato seedlings were transplanted to the experiment plots at (February 12th in the two seasons). The experiments were arranged in a randomized complete block design with 3 replicates. The plot area was 10.5m^2 (3 x 3.5m) with five rows. Different recommended agricultural practices for this plant were followed by the Ministry of Agric., Egypt.

Salicylic acid (SA) at 50 & 100ppm and vitamin E (VE) at 100 & 200ppm and their different combination as well as distilled water as control were applied as foliar application at 30 and 45 days after transplanting.

This experiment included the following treatments:

1. Control.
2. Salicylic acid (SA) at 50ppm.
3. Salicylic acid (SA) at 100ppm
4. Vitamin E (VE) at 100ppm.
5. Vitamin E (VE) at 200ppm
6. (SA) at 50 ppm + (VE) at 100 ppm.
7. (SA) at 50 ppm + (VE) at 200 ppm .
8. (SA) at 100 ppm + (VE) at 100 ppm .
9. (SA) at 100 ppm + (VE) at 200 ppm

Sampling and collecting data:

a)Morphological characteristics: different morphological characteristics at sixty days after transplanting were inspected as following:

- Number of branches and leaves/plant.- Total leaf area (cm^2) using the disk method according to Derieux *et al.* (1973).Leaves dry weight.sample of each treatment were dried in oven at 70°C till the constant weight.

b) Photosynthetic pigments: chlorophyll a, b and Carotenoids were calorimetrically determined according to the described by Inskeep and Bloom (1985).

c) Flowering characteristics:

- Number of flowers/plant.-Fruit setting percentage was calculated as following:

$$\text{Fruit setting\%} = \frac{\text{No. of fruits/plant}}{\text{No. of flowers/plant}} \times 100$$

d) Fruiting:

- Early fruits number/plant: was considered as the number of first four pickings.
- Total fruits number: was calculated as number of fruits in all pickings.
- Fruit yield kg/plant: was calculated as fresh weight of fruits in all pickings.

e) Chemical composition:

Total nitrogen, phosphorus and potassium were determine in tomato leaves at 60 days after transplanting and in fruits at harvest according the methods described by Horneck and Miller, (1998), Sandell, (1950) and Horneck and Hanson,(1998) respectively. Also, Fe, Zn and Mn were determined according to (Black, *et al.* 1965). Total carbohydrate was determined according to (Dubois *et al.* 1956). Crude protein was calculated according to the following equation: Crude protein= Total nitrogen x 6.25 (A.O.A.C., 1990).

f) Endogenous phytohormones:

Endogenous phytohormones were quantitatively determined in tomato shoots at 60 days after transplanting in the second season using High- Performance Liquid Chromatography (HPLC) according to Koshioka *et al.*, 1983) for auxin (IAA), gibberellic acid (GA_3) and abscisi acid (ABA) while, cytokinins were determined according to Nicander *et al.*, (1993).

g) Total soluble solids (T.S.S.) was measured using a hand refractometer. Vitamin C and titratable acidity were determined according to the method described by the A.O.A.C. (1990).

h) Statistical analysis:

Data obtained in this study were statistically analyzed by using the least significant differences test (L.S.D) according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Growth behaviour:

Data in Table (1) clearly show that different sprayed treatments i.e. salicylic acid (SA) and vitamin E (VE) separately or in their combinations; in most cases significantly increased the estimated growth characteristics. Since, each of the number of branches and leaves per plant increased to reach its maximum with the combination of SA at 50 and VE at 200 ppm. Also, it could be noticed that different applied combination between SA and VE were more effective in comparison when separately applied. In addition in

case of leaf area per plant and their dry weight nearly behaved as the same as the above mentioned characteristics. Here, it could be noticed that the combination of SA at 50 + VE at 100 ppm gave the highest leaf area and dry weight per plant. The above mentioned results nearly similar during 2006 and 2007 seasons.

With regard to the stimulatory effect of SA and VE on different estimated characteristics of tomato growth it could be attributed to the effect of this components upon the endogenous phytohormones specially the growth promoters i.e. Auxins, gibberellins and cytokinins (Waffaa *et al,*. 1996 and Shehata *et al.*,2000). Also, to remark that most of the applied treatments increased each of branches and leaves number that could be reversed upon the number of formed flowers and setted fruits.. In agreement with our results are Gharib (2007) on basil and marjoram and Fathy *et al.,* (2003) on eggplant they mentioned that salicylic acid and vitamin E increased plant height, number of branches and leaves per plant and dry weight as well, respectively.

Photosynthetic pigments:

As shown in Table (2) during the two seasons of 2006 and 2007 all applied treatments either separately or in combinations led to significant increase of chlorophyll a and b as well as carotenoids pigments. The exception was that insignificant increase of chlorophyll a with SA at 50 ppm and carotenoids with the same treatment and concentration during the two seasons.

Also, it could be noticed that the combination of SA and VE were more effective when compared with them when separately applied.. In this respect, present results are in agreement with those of Sweify and Abdel-Wahid (2008), they found that application of SA increased chlorophyll a and b as well as caroteinods in *Syngonium podphyllum* plants.

Also, Fathy *et al,*. (2000) found that foliar application with VE and other antioxidant increased photosynthetic pigments in tomato plants.

This stimulative effect of the combination of SA and VE might be due to their antioxidantal scavenging effect to be protected chloroplasts and prevented chlorophyll degradation by the toxic reactive oxygen radicals (Bowler *et al.*, 1992 and Aono *et al.,* 1993).

Minerals and some bio-constituents:

Concerning the effect of SA and VE on minerals content, data in Table (3) revealed that all applied treatments were effectively improved NPK, Fe, Zn and Mn content in tomato leaves compared with those of control plants in both seasons. Also, it could be noticed that SA at 50 ppm + VE at 200 ppm was superior in this respect.

Additionally, the main function of anti-oxidants such as SA and VE were protective of cell membranes and their binding transporter proteins (H^+ - ATP – ase membrane pumps), maintained their structure and function against the toxic and destructive effects reactive oxygen species (ROS) during stress, in turn, more absorption and translocation of minerals (Dicknson *et al.,* 1991). Also, similar results were obtained by Fathy *et al.,* (2000 & 2003).

Table (1): Effect of salicylic acid (SA) and Vitamin E (VE) on some growth characteristics of tomato at 60 days after transplanting during the two seasons.

Characteristics / Treatmentss	2006 Season				2007 Season			
	Number/plant		Leaf area (cm^2)/plant	Leaves dry weight (g/plant)	Number/plant		Leaf area (cm^2)/plant	Leaves dry weight (g/plant)
	Branches	Leaves			Branches	Leaves		
Control	9.43	21.18	1342.41	16.58	8.95	23.70	1501.89	18.57
SA_1	11.35	27.30	1730.73	21.39	11.20	28.45	1802.91	22.29
SA_2	11.80	29.83	1881.24	23.38	12.15	30.35	1922.41	23.78
VE_1	10.90	30.20	1904.96	23.75	11.35	30.95	1960.41	24.32
VE_2	11.95	32.40	2044.69	25.36	12.90	33.80	2141.94	26.48
$SA_1 + VE_1$	12.25	31.45	1966.15	24.83	13.12	35.75	2265.52	28.01
$SA_1 + VE_2$	14.55	41.15	2574.73	32.35	15.70	44.25	2802.85	34.57
$SA_2 + VE_1$	12.40	33.70	2108.72	26.59	12.95	35.40	2243.34	27.74
$SA_2 + VE_2$	13.70	36.40	2283.55	28.32	14.25	37.50	2375.29	29.38
L.S.D. at 5%	2.04	5.16	548.12	3.25	2.11	4.98	564.17	3.48

SA_1: Salicylic acid 50ppm VE_1: Vitamin E 100ppm SA_2 : Salicylic acid 100ppm VE_2: Vitamin E 200ppm

Table (2): Effect of salicylic acid (SA) and Vitamin E (VE) on photosynthetic pigments content (mg/g fresh weight).at in leaves of tomato at 60 days after transplanting during the two seasons.

Characteristics / Treatments	2006 Season				2007 Season			
	Chlorophyll a	Chlorophyll b	Chlorophyll a+b	Carotenoids	Chlorophyll a	Chlorophyll b	Chlorophyll a+b	Carotenoids
Control	0.521	0.375	0.896	0.340	0.533	0.402	0.935	0.353
SA_1	0.525	0.385	0.910	0.365	0.548	0.418	0.966	0.362
SA_2	0.670	0.411	1.081	0.410	0.640	0.438	1.1078	0.412
VE_1	0.620	0.407	1.027	0.417	0.617	0.425	1.042	0.420
VE_2	0.645	0.442	0.087	0.435	0.650	0.426	1.076	0.425
$SA_1 + VE_1$	0.730	0.532	1.262	0.480	0.745	0.575	1.320	0.460
$SA_1 + VE_2$	0.874	0.534	1.408	0.513	0.843	0.530	1.373	0.522
$SA_2 + VE_1$	0.715	0.430	1.145	0.420	0.725	0.435	1.160	0.418
$SA_2 + VE_2$	0.742	0.485	1.227	0.445	0.750	0.440	1.190	0.415
L.S.D. at 5%	0.07	0.09	0.14	0.13	0.08	0.11	0.19	0.16

SA_1: Salicylic acid 50ppm VE_1: Vitamin E 100ppm SA_2 : Salicylic acid 100ppm VE_2: Vitamin E 200ppm

Regarding crude protein and total carbohydrates, data in Table (3) revealed that all applied treatments significantly increased total carbohydrates content in tomato leaves during the two seasons.

Meanwhile, all treatments insignificantly increased crude protein content in leaves excepted SA at 50ppm + VE at 200ppm treatment was significant in this respect during the two seasons. Also, high concentration of total carbohydrates is a direct result of photosynthesis with great efficiency that was preceded with large photosynthetic area (Tables 1 & 2) as well under the treatments but it reached its maximum with SA at 50ppm + VE at 200ppm one. These results results are in agreement with those obtained by Sanaa *et al.*, (2001) and Fathy *et al.*, (2000).

Endogenous phytohormones:

Data in Table (4) clearly indicate that different used SA and VE treatments decreased the level of endogenous Auxins in tomato shoots at 60 days after transplanting. Meanwhile, gibberellins and cytokinins were increased in all applied treatments. Also, SA at 50ppm and VE at 200ppm gave the highest value in this respect. On the other hand, the growth inhibitor; abscisic acid it was decreased with various applied treatments. Also, SA at 50ppm + VE at 200ppm gave the highest reduction in this respect. These data, could also be of great influence upon different vegetative and reproductive growth.

In addition, increasing cytokinin level on the account of auxin could be in favor of increasing the number of formed branches (Table 1) and improvement of photosynthetic pigments content (Table 2) in tomato plants.

Moreover, SA showed synergetic effect with auxin and gibberellins (Datta and Nanda, 1985). Applied SA induced changeable in endogenous phytohormones of tomato and other plants (Raskin, 1992 and Waffaa *et al.*, 1996).

Flowering and fruiting:

Data in Table (5) indicate that significant increase iin number of flowers, early and total fruits dominantly existed with different foliar application during the two assigned seasons. The combination treatments gave the highest values especially SA at 50 ppm + VE at 200 ppm ranked the first in this respect.

Concerning fruit setting and total fruit yield per plant data in Table (5) reveled that significant increase of the picked fruits during harvest time dominantly existed with all treatments during 2006 and 2007 seasons. Also, these data being more evident when related to the control. Similar results were obtained by SA in soybean and broad bean (Awasthi *et al.*, 1997 and Sanaa *et al.*, 2001), Also, VE in tomato (Fathy *et al.*, 2000).

Fruit quality:

Data presented in Table (6) indicate that different sprayed treatments increased NPK, crude protein and total carbohydrates concentrations in marketable stage of tomato fruits. Also, it could be noticed that SA at 50 ppm + VE at 200 ppm gave the highest concentration of total carbohydrates in ripened tomato fruits followed by SA at 50ppm + VE at 100ppm.

Table (3): Effect of salicylic acid (SA) and Vitamin E (VE) on some minerals and bio-constituents in tomato leaves at 60 days after transplanting during the two seasons.

Characteristics / Treatments	2006 Season								2007 Season							
	N %	P %	K %	Fe ppm	Zn ppm	Mn ppm	Crude protein %	Total carbohydrates mg/g D.W.	N %	P %	K %	Fe ppm	Zn ppm	Mn ppm	Crude protein %	Total carbohydrates mg/g D.W.
Control	3.48	0.318	3.59	102.22	70.17	55.70	21.75	350.70	3.42	0.353	3.48	98.60	69.48	56.20	21.38	372.18
SA_1	3.64	0.336	3.80	110.70	72.15	58.85	22.75	368.25	3.66	0.370	3.52	112.30	71.50	56.88	22.88	382.70
SA_2	3.60	0.332	3.75	127.50	72.20	60.44	22.50	380.44	3.64	3.74	3.64	118.25	71.68	59.72	22.75	388.42
VE_1	3.75	0.438	3.84	133.75	72.55	60.86	23.44	411.35	3.72	0.425	3.72	142.60	72.60	63.12	23.25	392.55
VE_2	3.84	0.490	4.10	140.22	71.75	64.12	24.00	422.15	3.88	0.460	3.87	144.70	72.88	64.78	24.25	428.35
$SA_1 + VE_1$	3.96	0.540	4.35	142.45	72.90	68.30	24.75	460.20	4.11	0.515	4.22	150.17	72.92	66.20	25.69	446.77
$SA_1 + VE_2$	4.63	0.732	4.85	178.15	73.40	78.50	28.94	625.75	4.50	0.690	4.26	166.80	73.20	70.48	28.13	498.40
$SA_2 + VE_1$	3.95	0.650	4.20	146.18	72.70	62.73	24.69	468.30	4.18	0.662	3.96	148.62	72.82	63.45	26.13	470.22
$SA_2 + VE_2$	4.20	0.675	4.42	148.60	71.40	66.80	26.25	475.35	4.22	0.650	4.21	151.40	72.28	65.30	26.38	472.48
L.S.D. at 5%	1.05	0.11	0.95	9.7	8.77	6.12	3.75	25.90	1.09	0.13	0.88	9.80	7.85	5.90	3.40	24.18

SA_1: Salicylic acid 50ppm VE_1: Vitamin E 100ppm
SA_2 : Salicylic acid 100ppm VE_2: Vitamin E 200ppm

Table (4):Effect of salicylic acid (SA) and Vitamin E (VE) on endogenous phytohormones in shoots of tomato at 60 days transplanting during 2007 season.

Characteristics / Treatments	Promoters						Inhibitors	
	Auxins (µg/10g FW)	± %	Gibberellins (µg/10g FW)	± %	Cytokinins (µg/10g FW)	± %	Abscisic acid (µg/10g FW)	± %
Control	117.33	0.00	38.55	0.00	77.12	0.00	1.321	0.00
SA_1	112.44	-4.17	48.18	+24.98	88.70	+15.02	1.151	-12.87
SA_2	109.75	-6.46	46.15	+19.72	102.80	+33.30	1.096	-17.03
VE_1	96.48	-17.77	50.78	+.31-73	110.35	+43.09	1.015	-23.16
VE_2	89.75	-23.51	68.66	+78.11	118.24	+53.32	0.525	-60.26
$SA_1 + VE_1$	94.48	-19.47	60.55	+57.07	112.78	+46.24	0.628	-52.46
$SA_1 + VE_2$	82.40	-29.77	79.42	+106.02	138.20	+79.20	0.324	-75.47
$SA_2 + VE_1$	90.18	-23.14	78.83	+104.49	120.85	+56.70	0.642	-51.40
$SA_2 + VE_2$	88.75	-24.36	75.70	+96.37	125.70	+62.99	0.724	-45.19

SA_1: Salicylic acid 50ppm VE_1: Vitamin E 100ppm
SA_2 : Salicylic acid 100ppm VE_2: Vitamin E 200ppm

Table (5): Effect of salicylic acid (SA) and Vitamin E (VE) on flowering and fruiting of tomato plants during the two seasons.

Characteristics / Treatments	2006 Season					2007 Season				
	Number per plant			Fruit set. (%)	Fruit yield (kg/ plant)	Number per plant			Fruit set. (%)	Fruit yield (kg/ plant)
	Flowers	Early fruits	Total fruits			Flowers	Early fruits	Total fruits		
Control	49.25	7.11	20.40	41.42	1.65	50.20	8.20	21.00	41.83	1.70
SA_1	52.35	11.18	28.62	54.67	2.32	54.70	12.15	29.40	53.75	2.38
SA_2	53.60	12.27	29.15	54.38	2.36	52.95	12.90	30.35	57.32	2.66
$V E_1$	54.15	12.80	30.42	56.18	2.46	55.45	13.35	30.90	55.73	2.50
VE_2	55.90	13.35	31.70	56.71	2.56	56.25	13.80	32.15	57.16	2.60
$SA_1 + VE_1$	57.12	13.90	32.40	56.72	2.62	59.44	14.12	33.45	56.28	2.71
$SA_1 + VE_2$	64.80	17.30	39.70	61.27	3.21	62.75	18.25	40.60	64.70	3.28
$SA_2 + VE_1$	58.40	11.40	33.84	57.95	2.74	59.55	12.15	35.44	59.51	2.87
$SA_2 + VE_2$	59.70	12.75	35.74	59.87	2.89	60.12	13.14	35.95	59.80	2.91
L.S.D. at 5%	2.81	2.17	1.48	2.75	0.25	2.97	2.19	1.33	2.98	0.37

SA_1: Salicylic acid 50ppm VE_1: Vitamin E 100ppm
SA_2 : Salicylic acid 100ppm VE_2: Vitamin E 200ppm

Table (6): Effect of salicylic acid (SA) and Vitamin E (VE) on NPK and some bio-constituents in tomato fruits during the two seasons.

Characteristics / Treatments	2006 Season					2007 Season				
	N %	P %	K %	Crude protein %	Total carbohydrates mg/g D.W.	N %	P %	K %	Crude protein %	Total carbohydrates mg/g D.W.
Control	1.26	0.28	1.45	7.88	612.70	1.31	0.27	1.52	8.19	625.25
SA_1	1.92	0.29	1.53	12.00	650.22	1.86	0.28	1.60	11.25	663.15
SA_2	2.05	0.30	1.64	12.81	677.25	2.15	0.32	1.66	13.44	672.40
$V E_1$	2.18	0.31	1.55	13.63	680.75	2.22	0.35	1.62	13.88	678.80
$V E_2$	2.24	0.36	1.73	14.00	710.35	2.28	0.37	1.75	14.25	664.90
$SA_1 + VE_1$	2.86	0.33	1.75	14.75	711.28	2.43	0.36	1.77	15.26	725.35
$SA_1 + VE_2$	2.80	0.43	2.04	17.5	735.40	2.75	0.42	2.11	17.19	740.26
$SA_2 + VE_1$	2.45	0.38	1.81	15.31	705.14	2.50	0.39	1.92	15.63	718.86
$SA_2 + VE_2$	2.52	0.37	1.86	15.75	690.70	2.62	0.38	1.96	16.38	714.33
L.S.D. at 5%	0.35	0.08	0.13	1.17	23.80	0.23	0.11	0.15	1.21	27.30

SA_1: Salicylic acid 50ppm VE_1: Vitamin E 100ppm
SA_2 : Salicylic acid 100ppm VE_2: Vitamin E 200ppm

In addition, vitamin C, total soluble solids and titratable acidity, data in Table (7) showed that all treatments increased the amount of vitamin C, total soluble solids and titratable acidity in tomato fruits during the two seasons. Also it could be noticed that the highest increase of vitamin C was existed with SA at 50 ppm + VE at 200 ppm.

These data are being important from the view of fruit quality since, that could be prolong the shelf time with different applied treatments specially that of SA at 50ppm + VE at 200 ppm one. The same results nearly were obtained for VE in tomato (Fathy *et al.*, 2000) and for bean (Sanaa, *et al.*, 2001).

Table (7): Effect of salicylic acid (SA) and Vitamin E (VE) on tomato fruits quality during the two seasons.

Characteristics / Treatments	2006 Season			2007 Season		
	Vitamin C (mg/100g F.W)	Total soluble solids (%)	Titratable acidity (%)	Vitamin C (mg/100g F.W)	Total soluble solids (%)	Titratable acidity (%)
Control	122.75	3.85	0.316	124.50	3.70	0.311
SA_1	128.40	3.93	0.327	126.15	3.77	0.322
SA_2	128.85	3.88	0.342	125.40	3.90	0.328
VE_1	130.42	4.11	0.350	128.66	3.94	0.337
VE_2	135.60	4.25	0.357	132.16	3.98	0.348
$SA_1 + VE_1$	136.88	4.38	0.360	133.48	4.05	0.351
$SA_1 + VE_2$	148.18	4.90	0.375	140.75	4.12	0.366
$SA_2 + VE_1$	133.70	4.75	0.363	130.80	4.22	0.352
$SA_2 + VE_2$	132.45	4.80	0.367	131.18	4.15	0.355
L.S.D. at 5%	3.70	1.22	0.08	4.25	1.25	0.10

SA1: Salicylic acid 50ppm VE1: Vitamin E 100ppm
SA2 : Salicylic acid 100ppm VE2: Vitamin E 200ppm

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تأثير الرش الورقي بحامض الساليسليك وفيتامين هـ علي نمو وإنتاجية نبات الطماطم

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أجريت تجربتين حقليتين لدراسة تأثير معاملة الرش الورقي بتركيزي ٥٠ و١٠٠ جزء في المليون من حامض الساليسليك وكذلك تركيزي ١٠٠ و٢٠٠ جزء في المليون من فيتامين هـ والتفاعل بينهما علي بعض خصائص النمو وصبغات البناء الضوئي والعناصر المعدنية الهرمونات الداخلية والإزهار والمحصول وجودة ثمار نبات الطماطم صنف سوبر سترين بى خلال عامي ٢٠٠٦ و٢٠٠٧م وقد تم رش النباتات على عمر ٣٠ ، ٤٥ يوم من الشتل .

وقد أظهرت النتائج المتحصل عليها أن جميع المعاملات المستخدمة قد أدت إلي زيادة معنوية في كل قياسات النمو المدروسة وهي عدد الأفرع والأوراق المتكونة لكل نبات – مساحة الأوراق الكلية للنبات وكذلك الوزن الجاف للأوراق. بجانب ذلك فإن كلا التركيزين المستخدمين من حامض الساليسليك وفيتامين هـ سبب زيادة واضحة في صبغات البناء الضوئي وكذلك محتوي الأوراق من النيتروجين والبوتاسيوم والفوسفور والحديد والزنك والمنجنيز وبعض المكونات الحيوية مثل البروتين والكربوهيدرات الكلية مقارنة بنظائرها في النباتات غير المعاملة. أيضا جميع المعاملات أدت إلي زيادة مستوي الجبريللين والسيتوكينين في المجموع الخضري لنبات الطماطم مقارنه بالكنترول بينما أنخفض محتوي الأوكسين وحامض الأبسيسيك.

فضلا عن ذلك تم الحصول علي أعلي محصول مبكر وكلى بمعاملة حامض الساليسليك ٥٠ جزء في المليون + فيتامين هـ ٢٠٠ جزء في المليون يليها معاملة حامض الساليسليك ١٠٠ جزء في المليون + فيتامين هـ ٢٠٠ جزء في المليون علي الترتيب. بالإضافة لذلك أظهرت المعاملات المستخدمة أيضا زيادة محتوي الثمار من العناصر المعدنية والكربوهيدرات وفيتامين ج وكذلك الجوامد الصلبة الكلية.

وبناء علي ذلك ، فإن الدراسة الحالية تؤيد وبقوة استخدام حامض الساليسليك وفيتامين هـ كمعاملات رش ورقى ليس فقط من أجل زيادة المحصول المبكر والكلى ولكن أيضا للحصول علي ثمار ذات جودة عالية.