J. of Plant Production, Mansoura Univ., Vol. 11 (3):215 - 221, 2020

Journal of Plant Production

Journal homepage: www.jpp.mans.edu.eg
Available online at: www. jpp.journals.ekb.eg

Productivity and Pod Quality of Pea as Affected by some Growth Promoters under Early Summer Plantation

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ABSTRACT

A field experiment was carried out during the two successive early summer growing seasons of 2018 and 2019 at the Experimental Farm of El- Gemmeiza Agric. Res. Station, Gharbeya Governorate, Egypt to study the effect of foliar spray with three substances, i.e., Vitamin E (Vit.E) at 150 ppm, super Vigro –X at 1ml/L, salicylic acid (SA) at 150 ppm individually, or in combinations on plant growth, biochemical traits, pods yield and its quality of pea cv. Master B grown in clay soil. The results indicated that, spraying pea plants with Vit. E + super Vigor-X + SA three times at 20, 30 and 40 days after sowing gave the highest values of plant height , both number of leaves and branches/ plant , total dry weight/ plant , leaf chlorophyll pigments , N,P and K percentage in shoot, yield and its components and the best pod quality of pea and gave the lowest concentrations of proline amino acid and oxidase enzyme activity in shoots. Moreover, this treatment recorded increasing in total yield about 63.8 % (average two seasons) than control (unsprayed) plants Meanwhile, spraying plants with super Vigor-x +SA treatment came in the second rank in this respect.

Keywords: *Pisium sativum*, vitamin E, salicylic aced, super Vigor-X, growth ,yield, pod quality.

INTRODUCTION

Peas are commonly grown in the temperate and to a lesser extent in the subtropical regions of the world. Average growing season temperatures of 13-18^{0}C produce optimum yields (Muehlbauer and McPhee,1997).

Heat stress impacts key physiological and biochemical processes and therefore affects plant growth and productivity as a whole. An accumulation of reactive oxygen species (ROS) occurs under heat stress conditions, and free radicals damage plant biomembranes (Wahid *et al*., 2007). In addition, ROS damaged chloroplast, reduced carbohydrate synthesis and export, and hastened oxygen senescence, attacked cell membranes, caused degradation and leakage of cell solutes, denaturation of proteins and enzymes, nucleic acid damage, chlorophyll degradation and suppression of all metabolic processes, and ultimately cell and tissue senescence and death (Dicknson *et al*., 1991).

Plants have evolved a network of antioxidant defense systems to cope with the unfavorable environmental conditions, which include non-enzymatic and enzymatic antioxidants. The plants can cope with the oxidative stress by activation of some or all of these systems (Gill and Tuteja, 2010).Many substances include antioxidants i.e., Vitamin E and salicylic acid were exogenously applied to protect plant against adverse effects of environmental/ oxidative stress.

Vitamin E is thought to protect chloroplast membranes from photo-oxidation and to help provide an optimal environment for photosynthetic machinery, adding that accumulations of vitamin E often occur in response to a number of biotic stresses, including high light, drought, salt and cold, and may provide additional protection against oxidative damage (Bosch, 1995).

In this regard spraying plants with Vit. E increased plant growth , biochemical contents , yield and its components and it quality (El-Bassiouny *et al.* (2005) on faba bean, El-Tohamy, and El-Greadly (2007) on bean , Marzauk, *et al.* (2014) on faba bean , Shafeek *et al.* (2014) on snap bean and Shabana, *et al*. (2015) on sweet pepper.

Salicylic acid (SA) functions as a potential non-enzymatic antioxidant and as a plant regulator, which plays an important role in controlling a variety of plant physiological processes including photosynthesis (Arfan *et al*., 2007). Recently, salicylic acid has been identified as vegetable hormone. Salicylic acid, a phenolic compound, has been found to induce thermo-tolerance in the crop. Pretreatment with salicylic acid mediated thermo-tolerance will undoubtedly play a role in initiating various mechanisms to resolve the high temperature constraints (Bandurska and Stroinski, 2005; Kaur *et al*., 2008). Application of salicylic acid enhanced plant growth (Sanaa *et al.*, 2001 on broad bean, Amer, 2004 on common bean, El -Shraiy and Hegazi 2009 on pea) yield and its components (Kmal *et al*., 2006 , Gad El-Hak, *et al.*, 2012 on pea ; Nour *et al.*, 2012; Shafeek *et al*., 2014; Abdel-Azem *et al*., 2015 and Hamaiel *et al*., 2016 on snap bean , El-Saadony *et al*., 2017 and Singh and Dwivedi, 2018 on pea).

The major compounds of super Vigro –X were amino acids at 15 %, potassium and nitrogen at 3.1 %. In this regard , (Helal, 2006; Salib *et al*., 2012 and Ramadan 2015) indicated that spraying plants with super Vigor-X recorded the maximum values of plant growth , mineral contents in shoots , yield and its components and pod quality than unsprayed plants.

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DOI: 10.21608/jpp.2020.87098

Therefore, in light of above facts the study was aimed to investigate and identify the impact and suitable substances such as Vit. E, super Vigro-X and salicylic acid individually or in combinations to study effect of these substances as foliar application on growth and yield of pea and for induction of heat tolerance under planting in early summer season.

MATERIALS AND METHODS

A field experiment was carried out during the two successive early summer growing seasons of 2018 and 2019 at the Experimental Farm of El- Gemmeiza Agric. Res. Station, Gharbeya Governorate, Egypt to study the effect of three substances and their combination between them, i.e., Vit. E at 150 ppm, super Vigro –X at 1ml/L, SA at 150 ppm, Vit E+ super Vigro- X, super Vigro- X +SA, Vit. E+ SA and Vit. E+SA+ super Vigro- X, beside control (unsprayed) treatment on plant growth, biochemical traits, yield of pods and its quality of pea (*Pisum sativum*) under clay soil conditions.

The physical and chemical properties of the experimental soil are presented in Table 1.

Table 1. The physical and chemical properties of the experimental soil during 2018 and 2019 seasons

Season	Organic matter (%)	Clay (%)	Silt (%)	Sand (%)	Texture class	EC m.mohs/cm	pH	Available (ppm)		
								N	P	K
2018	1.39	63.65	27.41	8.94	Clay loam	1.39	7.91	8.44	0.039	0.61
2019	1.42	65.32	28.25	6.43	Clay loam	1.41	7.97	8.59	0.036	0.58

Table 2. Meteorological data of El- Gemmeiza region, Gharbeya Governorate during the experiment period from Feb. to May of 2018 and 2019

Month	2018 season				2019 season			
	Temperature (ºC)			RH	Temperature (ºC)			RH
	Max.	Min.	Mean.	%	Max.	Min.	Mean.	%
Feb.	21.6	14.6	18.1	87.6	18.4	13.6	16.0	83.4
Mar.	25.0	16.6	20.8	82.3	22.0	15.9	18.9	81.5
April	27.8	20.0	23.9	80.9	25.4	21.5	23.4	80.2
May	31.2	23.8	27.5	75.6	29.8	22.0	25.9	78.9

Central Laboratory for Agricultural Climate (CLAC), Agric. Res. Center (ARC), Ministry of Agric. and Land Reclamation.

This experiment included 8 treatments. The field experiment was laid-out in a randomized complete block design with three replications..

Before sowing, seeds of pea were successively washed and inoculated with root nodule bacteria (*Rhizobium leguminosarum*) with a dose of 5 g/kg seeds. The adhesive agent used was Arabic gum 20%. The inoculated seeds were left in a shaded place for one hour before sowing for air- drying.

The seeds were sown on 15th and 20th Feb. in the 1st and 2nd seasons, respectively and spaced in hills (two seeds/hill) at 10 cm apart on both sides of the ridge. Plot area was 12 m^2, it contains four ridges (5 m length and 0.6 m width). One ridge (3 m^2) was used to take samples, for evaluating vegetative growth parameters and the other three ridges (9 m^2) were used for yield determination. In addition, one ridge was left between each every two experimental unit as a guard ridge.

Plants of pea were sprayed with aqueous solutions of different treatments three times at 20, 30 and 40 days after sowing. Each experimental unit received two litters solution using spreading agent (super film) in all treatment by hand sprayer. The untreated plants (control) were sprayed with tap water.

Vit. E and SA were obtained from El- Gomhouria Chemicals Company, while, super Vigro-X was obtained by Arabian Group for Agriculture Service, Giza , Egypt.

The composition of super Vigro-X was poly Saccharides at 2 %, L-free amino acid at 15 %, acetic acid at 3 % , saponin compound at 2 %, ploy ethylene at 1%, potassium and nitrogen at 3.1 %.

All plots received equal amounts of N,P and K at the rate of 150 kg ammonium sulphate (20.5% N), 120 kg triple superphosphate (37% P_2O_5) and 115 kg potassium sulphate (48 - 52% K_2O) per feddan. One - third of these fertilizers was added at soil preparation. The other two thirds were added at 20 and 40 days after sowing. All the other normal agricultural treatments of growing pea plants were practiced.

Data recorded: Samples of ten plants from each experimental unit were randomly taken at 55 days after sowing, and the following data were recorded.

Vegetative growth characters: Plant height (cm), both number of leaves and branches/plant were estimated. The plants (leaves+ branches) were oven dried at 70 ºC till constant weight, and the shoot dry weight/plant (g) was recorded.

Chemical analyses:

Photosynthetic pigments: Ten discs samples from the fourth upper leaf of the plant tip from every experimental unit were randomly taken after 55 days after sowing in both seasons, to determine chlorophyll a and b as well as total chlorophylls were calculated, according to the method described by Wettestein (1957).

Proline amino acid content and oxides enzyme activity (mg/g FW/1hour) were determined in shoots at 55 days after sowing in both seasons according to Bates (1973) and Loukili *et al*. (1999).

Nitrogen, phosphorus and potassium contents: were determined in the dry matter of shoots (leaves+ branches) at 55 days after sowing in both seasons according to the methods described by Bremner and Mulvaney (1982), Olsen and Sommers (1982) and Jackson (1970), respectively.

Yield and its components:

Green pods of each plot were harvested at maturity stage, counted and weighed in each harvest. Ten green pods were randomly taken from the 2nd harvest for each experimental unit and the following data were recorded:

Average green pod weight (g), pod length (cm), 100-seed weight (g). Individual plant yield (g): It was calculated by dividing total weight of green pods/plot by number of plants/plot and total yield/feddan.

Pod quality:

Total sugars (%) were determined according to Forsee (1938). Total soluble solids percentage (TSS %) was determined in green seeds in the second harvest by Carl Zeis Refractometer. Vit.C content was determined in green seeds as the method mentioned in A.O.A.C. (2005). Total protein percentage in dry green seeds: It was determined by multiplying nitrogen content by 6.25 in both seasons.

Statistical analysis

The collected data were subjected to statistical analysis of variance according to Snedecor and Cochran (1980) and means separation were done according to Duncan (1955).

RESULTS AND DISCUSSION

Plant Growth

Morphological traits

It is obvious from data in Table (3) that spraying pea plant grown in clay soil with high fertility (Table 1) with all tested treatments had positive effect on plant growth than control (unsprayed) pea in both seasons. However, the compound treatment ones especially with the treatment included three sprayed materials (Vit. E + super Vigor-X + SA gave the tallest plants and recorded the maximum values of both number of leaves and branches /plant as well as shoot dry weight / plant , followed by the spraying with Vit. E+ super Vigro X in both seasons.

The increases in shoots dry weight / plant were about 42.5 and 52.8 % for spraying with Vit. E + super Vigor-X + SA followed by 29.0 and 40.3 % for spraying with Vit. E+ super Vigro X and 28.1 and 36.1 % for super Vigro X +SA % over control (unsprayed) plants in the 1st and 2nd seasons, respectively.

The pea plant's dry weight dominance may be due to plant height rise, number of leaves / plant, and number of branches / plant. Furthermore, 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 pea plants (Gardener *et al.*, 1985). Vitamin's positive action on pea growth could be due to its important role in protecting plant cells from senescence and various disorders, as well as enhancing cell division, the biosynthesis of natural hormones such as IAA and ethylene, nutrient and water absorption, photosynthesis, plant pigment and protein production, amino acids and plant metabolism. These important functions of vitamins surely reflected on enhancing growth (Samiullah *et al.*, 1988). The major compounds of super Vigro –X were amino acids at 15 %, potassium and nitrogen at 3.1 %, in this regard, the promoting effect of amino acids on growth of pea might be attributed to their positive action on protecting plants from oxidative stress, enhancing the biosynthesis of proteins through polymerization of amino acids, ethylene, GA_3, IAA, cytokinins, plant pigments, and organic foods (Davies, 1982).

The obtained data are in good harmony with those reported by El -Shraiy and Hegazi (2009) on pea as for salicylic acid, Salib *et al.* (2012) for super Vigro-X, Shafeek *et al.* (2014) on snap bean for Vit.E.

Table 3. Effect of foliar spray with some substances on plant growth of pea during early summer seasons of 2018 and 2019

Treatments	Plant height (cm)		Number of leaves / plant		Number of branches / plant		Shoot dry weight (g)		Relative increases in shoot dry weight (%)	
	2018 season	2019 season	2018 season	2019 season	2018 season	2019 season	2018 season	2019 season	2018 season	2019 season
Unsprayed (Control)	25.16 e	22.31 g	18.08 e	17.40 f	1.15 f	1.24 f	4.38 f	4.24 g	00.0	00.0
Vitamin E (Vit.E)	38.48 c	40.13 d	22.01 d	22.01 d	1.74 d	1.74 cd	4.94 d	5.37 e	12.8	26.7
Super Vigro X	38.04 c	40.71 cd	24.70 c	24.70 bc	1.45 e	1.45 e	5.30 c	5.46 de	21.0	28.8
Salicylic acid (SA)	33.62 d	32.15 f	21.88 d	19.89 e	1.36 e	1.35 ef	4.65 e	5.05 f	06.2	19.1
Vit. E+ Super Vigro X	43.01 b	44.87 b	25.72 b	25.72 b	2.09 b	2.09 b	5.65 b	5.95 b	29.0	40.3
Super Vigro X +SA	39.18 c	41.94 c	24.32 c	24.32 c	1.97 c	1.65 d	5.61 b	5.77 c	28.1	36.1
Vit. E+ SA	37.75 c	38.00 e	24.37 c	25.37 bc	1.65 d	1.87 c	5.47 bc	5.55 d	24.9	30.9
Vit. E+ Super Vigro X+ SA	47.78 a	48.08 a	29.53 a	29.53 a	2.29 a	2.29 a	6.24 a	6.48 a	42.5	52.8

Vitamin E (Vit.E) at 150 ppm , super Vigro-X at 1 ml/l and salicylic acid (SA) at 150 ppm

Values having the same alphabetical letter(s) did not significantly differ at the 0.05 level of significance, according to Duncan's multiple range test.

Photosynthetic pigments

It is clear from data in Table 4 that spraying pea plants with Vit. E, super Vigro-X and SA singly or in combinations had significant effect on leaf pigments of pea in both early summer seasons than control (untreated) plants.

In general, spraying pea plants with super Vigro-X was the most effect than Vit.E or SA. However , the highest concentrations of chlorophyll a, chlorophyll b and total chlorophylls as well as carotenoides in leaf tissues of pea were obtained with the plants which sprayed with Vit.E.+ super Vigro-X+ SA, followed by spraying with Vit. E+ super Vigro-X in both growing seasons.

Salicylic acid may be associated with enhancement of photosynthesis which increased chlorophyll content (Bideshki *et al.*, 2013). Also, Vit. E are believed to protect chloroplast membranes from photo oxidation and help to provide an optimal environment for the photosynthetic machinery.

These results are harmony with those obtained with El-Bassiouny *et al.* (2005) on faba bean and El-Tohamy, and El-Greadly (2007) for Vit. E.

Table 4. Effect of foliar spray with some substances on photosynthetic pigments (mg/g DW) in leaf tissues of pea during early summer seasons of 2018 and 2019

Treatments	Chlorophyll a		Chlorophyll b		Total chlorophyll (a+b)		Total carotenoides	
	2018 season	2019 season	2018 season	2019 season	2018 season	2019 season	2018 season	2019 season
Unsprayed (Control)	1.52 e	1.82 e	0.75 d	0.72 d	2.27 g	2.54 f	1.23 f	1.28 g
Vitamin E (Vit.E)	2.25 cd	2.29 d	1.18 bc	1.29 b	3.43 de	3.58 d	1.83 c	1.79 de
Super Vigro X	2.32 bc	2.58 c	1.22 b	1.30 b	3.54 cd	3.88 c	1.67 de	1.84 cd
Salicylic acid (SA)	2.16 d	2.29 d	1.09 c	1.03 c	3.25 f	3.32 e	1.54 e	1.65 ef
Vit. E+ Super Vigro X	2.46 b	2.89 b	1.46 a	1.34 b	3.92 b	4.23 b	2.11 b	2.12 b
Super Vigro X +SA	2.41 b	2.44 cd	1.21 b	1.34 b	3.62 c	3.78 c	1.80 cd	1.99 bc
Vit. E+ SA	2.22 cd	2.34 d	1.09 c	1.03 c	3.31 ef	3.37 e	1.60 e	1.52 f
Vit. E+ Super Vigro X+ SA	2.71 a	3.26 a	1.55 a	1.59 a	4.26 a	4.85 a	2.31 a	2.35 a

Vitamin E (Vit.E) at 150 ppm , super Vigro-X at 1 ml/l and salicylic acid (SA) at 150 ppm
Values having the same alphabetical letter(s) did not significantly differ at the 0.05 level of significance, according to Duncan's multiple range test.

Proline amino acid content and oxides enzyme activity

Data in Table 5 show the effect of different substances material had significant effect on proline amino acid and oxides enzyme activity in leaves of pea than control (untreated) plants in both early summer seasons.

Table 5. Effect of foliar spray with some substances on proline amino acid and Oxides enzyme activity in shoots of pea during early summer seasons of 2018 and 2019

Treatments	Proline amino acid (mg/g DW)		Oxides enzyme activity (mg/g FW/1hour)	
	2018 season	2019 season	2018 season	2019 season
Unsprayed (Control)	36.37 a	32.11 a	25.37 a	27.58 a
Vitamin E (Vit.E)	16.60 b	15.83 c	18.05 c	17.32 d
Super Vigro X	15.66 bc	17.76 b	19.01 b	20.10 b
Salicylic acid (SA)	12.22 e	13.97 d	16.05 d	16.45 d
Vit. E+ Super Vigro X	14.21 cd	14.01 d	16.73 d	18.90 c
Super Vigro X +SA	12.85 de	13.32 d	12.72 e	14.70 e
Vit. E+ SA	7.05 f	9.18 e	9.22 g	9.77 f
Vit. E+ Super Vigro X+ SA	7.10 f	9.57 e	10.18 f	10.05 f

Vitamin E (Vit.E) at 150 ppm , super Vigro-X at 1 ml/l and salicylic acid (SA) at 150 ppm
Values having the same alphabetical letter(s) did not significantly differ at the 0.05 level of significance, according to Duncan's multiple range test.

Spraying pea plants with Vit. E+ SA gave the lowest concentration of proline amino acid in shoots (7.05 and 9.18 mg/g DW) and oxides enzyme activity (9.22 and 9.77 mg/g FW/1hour), followed by spraying with Vit. E+SA+ super Vigro-X (7.10 and 9.57 mg/g DW) for proline amino acid and (10.18 and 10.05 mg/g FW/1hour) for oxides enzyme activity in the 1st and 2nd seasons, respectively. On the other hand, control (unsprayed) plants recorded the highest values of proline in shoots (36.37 and 32.11 mg/g DW) and oxides enzyme activity (25.37 and 27.58 mg/g FW/1hour) in shoots in the 1st and 2nd seasons, respectively.

The rise in proline amino acid in crops cultivated at elevated temperatures could be one of the earliest metabolic reactions caused in the transduction pathway that connects physiological perception reactions at the cellular level (Hassanein *et al.*, 2012). These results are similar to Naji and Devaraj (2011) who found that peroxidase isozyme activity in horse gram increase under heat stress. SA sprays are very effective against abiotic and biotic stresses, foliar sSA 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).

These results are consistent with the work of Shalaby and Ramadan (2017) on lettuce.

Nitrogen , phosphorus and potassium contents

It is obvious from the data in Table 6 that, spraying pea plants with Vit. E, super Vigor-X and SA individually, or in combinations had significant effect on N and K contents in shoots , but did not significant effect on P in shoots as compared to control (unsprayed) plants in both seasons. The maximum contents of N and K in shoots were recorded with the combination between Vit.E+SA + super Vigro-X with no significant differences between all substances materials regarding N contents in shoots in both seasons, while the minimum values were recorded with unsprayed plants in both seasons.

Results are in harmony with those obtained with Marzauk, *et al*. (2014) on faba bean as for Vit. E , Ramadan (2015) for Vigor-X and El-Saadony *et al.* (2017) on pea for SA .

Table 6. Effect of foliar spray with some substances on N, P and K contents in shoots of pea during early summer seasons of 2018 and 2019

Treatments	N (%)		P (%)		K(%)	
	2018 season	2019 season	2018 season	2019 season	2018 season	2019 season
Unsprayed (Control)	1.83 c	2.04 c	0.27 a	0.26 a	0.95 f	1.02 f
Vitamin E (Vit.E)	2.70 ab	2.87 ab	0.34 a	0.36 a	1.77 c	1.76 cd
Super Vigro X	2.71 ab	2.96 ab	0.35 a	0.36 a	1.67 d	1.70 d
Salicylic acid (SA)	2.54 b	2.68 b	0.33 a	0.32 a	1.15 e	1.26 e
Vit. E+ Super Vigro X	2.98 ab	3.07ab	0.36 a	0.33 a	1.95 b	1.99 b
Super Vigro X +SA	2.93 ab	2.91ab	0.34 a	0.34 a	1.93 b	1.96 b
Vit. E+ SA	2.67 ab	2.93 ab	0.38 a	0.38 a	1.86 bc	1.87 bc
Vit. E+ Super Vigro X+ SA	3.06 a	3.16 a	0.39 a	0.35 a	2.11 a	2.22 a

Vitamin E (Vit.E) at 150 ppm , super Vigro-X at 1 ml/l and salicylic acid (SA) at 150 ppm
Values having the same alphabetical letter(s) did not significantly differ at the 0.05 level of significance, according to Duncan's multiple range test.

Yield and Its Components

The obtained results in Table (7) revealed that the maximum values for yield / plant and total yield/feddan were recorded with spraying pea plants with Vit.E., super Vigro-X and SA and Vit. E+ super Vigro X. while, the lowest values for the above parameters were detected with the control (unsprayed) plants.

On the other side, when calculated the increasing percent of the total yield over the control (unsprayed plants) due to applied treatments, the results showed that all applied treatments increased the yield than the control treatment.

The increment percentage ranged between 6.6-55.5 in the 1st season and 23.8-72.2 % in the second one among the applied treatments. The maximum increment of the total yield over the control were about 55.5 and 72.2 % for spraying with Vit.E., super Vigro-X and SA and 53 and 66 % for Vit. E+ super Vigro-X in the 1st and 2nd seasons, respectively.

Vit. E, super Vigro-X and SA induced thermo-tolerance in pea plants during growing season from Feb. to May (Table 2).

As for green pod characteristics , data in Table (8), indicated that sprayed pea plants with all material substances had significant effect on average pod weight , length and 100 seed weight than control (unsprayed) in both seasons, however, spraying pea plants with Vit.E., super Vigro-X and SA and Vit. E+ super Vigro-X recorded the highest values of average pod weight, length of pod and 100 seed weight in both growing seasons. Unsprayed plants recorded the lowest values of all pod characteristics in both seasons.

The increase in total yield was directly due to the increase in plant growth (Table 3), high photosynthesis capacity expressed in leaf pigments (Table 4), highest contents of N and K (Table 6) and high average pod weight (Table 8).

Similar results were obtained by El-Tohamy, and El-Greadly (2007) on bean , Marzauk, *et al*. (2014) on faba bean , Shafeek *et al*. (2014) on snap bean for Vit. E., Helal (2006) and Ramadan (2015) for super Vigor-X and Shafeek *et al*. (2014), Abdel Azem *et al*. (2015) and Rady *et al*. (2015) for salicylic acid.

Table 7. Effect of foliar spray with some substances on yield and its components of pea during early summer seasons of 2018 and 2019

Treatments	Yield / plant (g)		Total yield /fed. (ton/fed.)		Increases in total yield (%)	
	2018 season	2019 season	2018 season	2019 season	2018 season	2019 season
Unsprayed (Control)	32.40 e	30.51 f	2.268 e	2.136 e	000	000
Vitamin E (Vit.E)	42.69 c	40.60 d	2.988 d	2.842 cd	31.7	33.1
Super Vigro X	46.10 b	44.74 c	3.227 b-d	3.132 bc	42.3	46.6
Salicylic acid (SA)	34.53 d	37.77 e	2.417 e	2.644 d	06.6	23.8
Vit. E+ Super Vigro X	49.57 a	50.64 ab	3.470 ab	3.545 a	53.0	66.0
Super Vigro X +SA	47.29 b	48.87 b	3.310 a-c	3.421 ab	45.9	60.2
Vit. E+ SA	44.12 c	43.14 c	3.090 cd	3.020 c	36.2	41.4
Vit. E+ Super Vigro X+ SA	50.37 a	52.56 a	3.526 a	3.679 a	55.5	72.2

Vitamin E (Vit.E) at 150 ppm , super Vigro-X at 1 ml/l and salicylic acid (SA) at 150 ppm

Values having the same alphabetical letter(s) did not significantly differ at the 0.05 level of significance, according to Duncan's multiple range test.

Table 8. Effect of foliar spray with some substances on pod traits of pea during early summer seasons of 2018 and 2019

Treatments	Average pod weight (g)		Average pod length (cm)		100 seed weight (g)	
	2018 season	2019 season	2018 season	2019 season	2018 season	2019 season
Unsprayed (Control)	5.06 c	4.63 e	5.56 d	5.66 d	18.28 f	17.65 f
Vitamin E (Vit.E)	5.73 a-c	5.70 c	6.86 b	6.70 b	30.77 d	31.92 d
Super Vigro X	5.76 a-c	5.72 bc	6.83 b	6.40 bc	31.44 d	33.25 b-d
Salicylic acid (SA)	5.18 bc	5.21 d	6.23 c	6.13 c	27.46 e	28.85 e
Vit. E+ Super Vigro X	6.07 a	6.29 a	7.33 a	7.36 a	33.80 b	34.87 ab
Super Vigro X +SA	5.94 ab	6.11 ab	7.26 a	7.36 a	33.10 bc	33.61bc
Vit. E+ SA	5.96 ab	5.85 bc	7.06 ab	6.80 b	31.81 cd	32.32 cd
Vit. E+ Super Vigro X+ SA	6.33 a	6.29 a	7.33 a	7.46 a	35.26 a	35.81 a

Vitamin E (Vit.E) at 150 ppm , super Vigro-X at 1 ml/l and salicylic acid (SA) at 150 ppm

Values having the same alphabetical letter(s) did not significantly differ at the 0.05 level of significance, according to Duncan's multiple range test.

Pod quality

The obtained data in Table (9) reveal that total sugars, TSS, Vit. C and total protein were affected by all material substances in both seasons. The highest values of total sugars, TSS and total protein in pods were obtained with spraying plants with the treatment included the three examined materials (Vit.E., super Vigro-X and SA), followed by the treatment included the two examined materials (super Vigro-X and SA) in both seasons. As for Vit. C, the highest values were recorded with spraying plants with Vit. E in both seasons. On the contrary, the lowest values of all pod quality parameters were recorded with unsprayed plants in both seasons.

The beneficial effect of salicylic acid on pod quality 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 development (Arberg, 1981).

In this regard, Shabana, *et al*. (2015) reported that spraying sweet pepper plants with SA or Vit. E at 50 ppm significantly increasing the most fruit quality compared with untreated control treatment.

Finally, it could be concluded that, spraying pea plants cv Master B grown in clay soil with Vit. E at 150 ppm + super Vigro-X at 1 ml/L + SA at 150 ppm three times at 20 , 30 and 40 days after sowing gave the highest values of plant growth , leaf chlorophyll pigments, N,P and K contents (%) in shoots and yield and its components as well as best pod quality of pea under early summer conditions.

Table 9. Effect of foliar spray with some substances on pod quality of pea during early summer seasons of 2018 and 2019

Treatments	Total sugars (%)		TSS (brix)		Vit. C (mg/100 g FW)		Total protein (%)	
	2018 season	2019 season	2018 season	2019 season	2018 season	2019 season	2018 season	2019 season
Unsprayed (Control)	6.26 f	6.34 f	6.69 e	7.18 e	15.11 f	16.14 f	13.85 d	13.59 d
Vitamin E (Vit.E)	7.55 e	7.63 de	9.47 d	9.40 d	33.75 a	33.84 a	17.12 bc	17.11 c
Super Vigro X	7.42 e	7.49 e	9.60 cd	9.87 bc	32.96 bc	32.81 bc	16.98 bc	16.98 c
Salicylic acid (SA)	7.92 d	7.84 d	9.81 bc	9.74 c	30.13 e	29.54 e	16.59 c	16.89 c
Vit. E+ Super Vigro X	8.15 c	8.14 c	9.91 b	9.95 bc	32.37 c	32.29 c	17.40 bc	18.28 b
Super Vigro X +SA	8.49 b	8.55 b	10.21 a	10.00 b	32.96 bc	31.19 d	18.21 b	18.51 b
Vit. E+ SA	8.30 c	8.44 b	9.65 b-d	10.00 b	30.83 d	30.68 d	16.73 c	16.93 c
Vit. E+ Super Vigro X+ SA	8.69 a	8.98 a	10.30 a	10.43 a	33.56 ab	33.16 ab	19.80 a	19.74 a

Vitamin E (Vit.E) at 150 ppm , super Vigro-X at 1 ml/l and salicylic acid (SA) at 150 ppm
Values having the same alphabetical letter(s) did not significantly differ at the 0.05 level of significance, according to Duncan's multiple range test.

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تأثير بعض المواد المحفزة على الإنتاجية وجوده القرون فى البسلة تحت ظروف الزراعة الصيفية المبكره

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أجريت تجربتان حقليتان خلال موسمى صيف المبكر ٢٠١٨ ، ٢٠١٩ وذلك بمزرعة التجارب الزراعية – محطة بحوث الجميزة – محافظة الغربية – مصر وذلك بهدف دراسة تأثير الرش ببعض المواد المحفزه مثل فيتامين هـ بتركيز ١٥٠ جزء فى المليون محفز النموسوبر فيجرو – أكس بتركيز ١ ملليتر/ لتر ، حمض الساليسيلك بتركيز ١٥٠ جزء فى المليون منفردا أو فى توليفات ثنائيه أو فى توليفات ثلاثيه على نمو النبات ، الصفات البيوكيمائيه ومحصول وجودة القرون فى البسله صنف ماستر ب وقد أوضحت النتائج أن رش البسله بالمعامله التى تشتمل على الثلاث مواد (فيتامين هـ + محفز النمو سوبر فيجرو – أكس + حمض الساليسيلك) ثلاث مرات الاولى بعد ٢٠ ، ٣٠، ٤٠ يوم من الزراعة قد سجلت أعلى القيم لكل من ارتفاع النبات ، كل من عدد الاوراق والافرع للنبات ، الوزن الجاف للعرش ، صبغات الكلوروفيل فى الورقة ، محتوى العرش من النيتروجين والفوسفور والبوتاسيوم ، المحصول ومكوناته ,افضل جودة لقرون البسله ، ومحتوى العرش من الحمض الأمينى البرولين ونشاط انزيم الأوكسيبز. وقد سجلت هذه المعامله زياده فى المحصول الكلى حوالى ٦٣,٨ % (متوسط الموسمين) عن معامله عدم الرش . بينما جاءت معامله الرش بمخلوط من محفز النمو سوبر فيجرو – أكس + حمض الساليسيلك) فى المرتبه الثانيه فى هذا الخصوص.