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PHYSIOLOGICAL STUDIES ON EGGPLANT(*Solanum melongena* L.): DECREASING THE EFFECT OF SALINITY BY SOME FOLIAR APPLICATION SUBSTANCES ON EGGPLANT.

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ABSTRACT

Two field experiments were carried out at private farm at El-Gammalia district, Dakahlia Governorate, Egypt; during summer seasons of 2013 and 2014 to study the effect of some foliar substances, i.e., yeast extract at 20 m/L, proline at 100 ppm, silicon at 200 ppm, ascorbic acid at 250 ppm, salicylic acid at 250 ppm and selenium at 50 ppm on vegetative growth, flowering, fruit yield and its components and quality of eggplant (*solanum melongena* L.) cv. Black beauty.

The results show that foliar applications gave the highest number of leaves and branches, plant height, fresh and dry weight, leaf area, and stem diameter were obtained in both seasons. Also, treatments resulted the highest in number of flower/plant, number of days to first flowers and the lowest in fruit setting compared with the control in both seasons. Moreover, treatments were the highest in total soluble solids (TSS) and vitamin C (mg/100g fw) and the lowest in titrable acidity (%) in both seasons. Also, treatments were the highest in N, P and K of leaves and N, P, K, Fe, (No_2 + No_3) and protein in both seasons. All foliar applications significantly increased yield characters compared to the control treatment. The superior application was proline followed by yeast extract and silicon in both seasons, respectively.

Keywords: Eggplant, ascorbic acid, salicylic acid, silicon, selenium, proline, yeast extract, growth, flowering, quality and fruit yield.

INTRODUCTION

Eggplant (Solanum melongena L.) is one of the most important crops in the summer season in Egypt. It's fruits contain a considerable amount of carbohydrates, protein, vitamins and some minerals. It is cultivated over the year in Egypt.

The irrigation water sources is one of the most important factors, which may directly affect the plant growth and productivity of plants. Eggplant required large amount of irrigation water, with the increasing water scarcity, the use of drainage water is one of the suggested alternatives for irrigation purpose. This causes some problems related to salinity.

Salinity is a serious environmental constraint to crop production in many parts of the world. It adversely affects plant at all stages of its life cycle. and causes several specific structural changes that disturb plant water balance. Moreover, salt stress has three main effects which, reduces water potential, causes ion imbalance on disturbances in ion homeostasis and toxicity. This altered water status leads to. initial growth reduction and limitation of plant productivity. Thus, growth and development of plants are inhibited due to the occurring defect in metabolism.

Nowadays, great attention has been focused on the possibility of using natural and safe substitutens, to reduce salinity stress in order to improve plant growth, flowering, fruit setting and total yield of vegetable crops plants under saline conditions. Thus, judicious use of special management practices to minimize the adverse effect of salinity on plant growth from the suggested management are using ascorbic acid, salicylic acid, proline, yeast extract, silicon and selenium can be potential practice to alleviate salinity adverse effects.

Proline accumulation is one of the adaptations of plants to salinity. Several functions are attributed to proline accumulation in response to stress. Besides the biophysical effects of proline as an osmo-compatible solute (Tonon *et al.*, 2004). Proline itself may serve also as a nitrogen and carbon source needed in stress recovery (Demiral and Turkan, 2004) and can also act as a scavenger of hydroxyl radicals, avoiding cellular damage provoked by osmotic or salt-induced oxidative stress (Teixeira and Fidalgo, 2009).

Yeast extract is a natural bio-substance suggested to be of useful promotional functions, due to its content of hormones, sugars, amino acids, nucleic acids, vitamins and minerals. Also, It contains a natural growth regulators, especially, cytokinins, which had a stimulative effect on cell division and enlargement moreover, protein and nucleic acids synthesis. The yeast extract also contains tryptophan (Abdel-Latif, 1987) which considered the precursor of IAA (Moor, 1979). Consequently, the application of yeast extract producing more IAA which increasing plant growth and yield.

Among the tools for increasing productivity and quality of eggplant using silicon (Si) application. Although silicon is the second most abundant element both on the surface of the Earth's crust and in soils, it has not yet been listed among the essential elements for higher plants. Like salt in food, which itself is not a nutrient or food item but adds to the taste and palatability. Similarly silicon though not essential confers rigidity and strength to plants, protects them from pests, diseases and abiotic tresses (Vasanthi *et al.*, 2012). Silicon can alleviate biotic and abiotic stresses in several crops, and it has beneficial effects on plants under nonstressed conditions (Pilon *et al.*, 2013).

Ascorbic acid induced enhancement in growth of salt stressed plants coupled with an increase in catalase and peroxidase activity and in increase in superoxide dismutase activity (Dehghan, *et al.*, 2011).

As for Salicylic acid potentiates the generation of reactive oxygen species in photosynthetic tissues during salt and osmotic stresses (Borsani *et al.*, 2001).

Although selenium is not an essential element for plants (Terry *et al.*, 2000), several studies demonstrate that selenium supply may exert diverse beneficial effects, including growth promoting activities (Djanaguiraman *et al.*, 2005). Furthermore, selenium play an important regulatory role in improving the tolerance of plant to stress through increasing chlorophyll content and activating antioxidant enzymes (Shang Qing mao *et al.*, 2005)

In the light of above discussions, present study was designed to investigate the effect of foliar applications of some substances i.e., ascorbic

acid, salicylic acid, silicon, selenium, proline and yeast extract on growth, flowering, chemical composition of leaves and fruits, fruit yield and quality of eggplant.

MATERIALS AND METHODS

Two field experiments were carried out at private farm at El-Gammalia district, Dakahlia Governorate, Egypt; during summer seasons of 2013 and 2014 to study the effect of some foliar applications, i.e., proline at 100 ppm, silicon at 200 ppm, yeast extract at 20 m/L, ascorbic acid at 250 ppm, salicylic acid at 250 ppm and selenium at 50 ppm on vegetative growth, flowering, quality and yield of eggplant grown under saline water.

The physical and chemical analysis of the experimental soil and water are shown in Table 1 and 2.

Table 1: The physical and chemical analysis of the experimental soil.

Soil analysis		2013	2014
A :Mechanical analysis			
Clay (%)		62.3	62.8
Silt (%)		19.8	19.5
Fine sand (%)		15.6	15.5
Coarse sand (%)		2.3	2.2
Texture class		Clay	Clay
OM (%)		1.35	1.42
B : Chemical analysis			
PH		8.5	8.4
E C ds m^{-1}		2.73	2.82
Available (ppm)	N	43.2	41.6
	P	4.23	4.34
	K	355	346
Cations(meq/100gsoil)	Ca^{++}	11.8	12.2
	Mg^{++}	8.6	8.9
	Na^{+}	6.6	6.7
	K^{+}	0.5	0.6
Anions (meq/100gsoil)	CO_3^{-}	-----	-----
	HCO_3^{-}	3.2	3.4
	CL^{-}	16.2	16.7
	SO_4^{-}	7.9	8.1

Table 2: The chemical analysis of the experimental water.

Properties		2013	2014
PH		8.6	8.5
E C ds m^{-1}		5.3	5.5
Anions (meq L^{-1})	CO_3^{-}	-----	-----
	HCO_3^{-}	6.0	6.8
	CL^{-}	30.6	31.3
	SO_4^{-}	16.4	16.9
Cations (meq L^{-1})	Ca^{++}	25.0	25.7
	Mg^{++}	13.0	13.4
	Na^{+}	14.1	14.8
	K^{+}	0.9	1.1

Eggplant seedlings were transplanted on 26 th and 29 th of April in the first and the second seasons, respectively. Seedlings were transplanted at 35 cm apart on one side of ridge.

Seven treatments were arranged in complete randomized blocks, with three replicates. The plot area was 12.4 m^2 and each plot included 3 ridges (ridge was 0. 9 m in width and 4.6 m length). The normal agricultural practices of eggplant production were followed according to the recommendations of Egyptian Ministry of Agriculture. The treatments were arranged as follow:

Foliar application substances:

1- Control (sprayed with tap water).
2- Yeast extract at 20 ml/ L.
3- Silicon in form of (silicic acid ($Si(OH)_4$) at 200 ppm.
4- Ascorbic acid at 250 ppm.
5- Proline at 100 ppm.
6- salicylic acid at 250 ppm.
7- Selenium in form of (sodium salinite (Na_2seo_2)at 50 ppm.

Eggplant plants were sprayed three times, 20,40 and 60 days after transplanting. All above chemicals obtained from El-Gomhoria chemical company.

Data recorded:

a. Vegetative growth:

Three plants were randomly taken from each plot at 70 days after transplanting during both seasons and the following data were recorded: Plant height (cm), number of branches/plant, number of leaves/plant, leaf area (cm^2/plant), fresh and dry weight (g/plant) and stem diameter (cm).

b. Flowering parameters:

Number of flowers per plant, number of days to first flowers and Fruit setting percentage were determined.

c. Fruit yield and its components:

Fruits of each plot were harvested at the proper maturing stage, counted and weighted in each harvest and the following parameters were collected:

Number of fruits/plant, fruit length (cm), fruit diameter (cm), average weight of fruit (kg), dry matter (%),fruit yield/plant (kg), early fruit yield (ton/fed) and total fruit yield (ton/fed.).

c. Fruit quality:

Total soluble solids (TSS) was determined by Carl Zeiss refractometer, vitamin C (mg/100gfw) was determined in juice using 2,6-dichlorophenolindophenol dye (AOAC, 1990) and titrable acidity (%) was determined by the titration method with 0.1 sodium hydroxide using phenolphthalein indicator (AOAC, 1990).

All data were statistically analyzed according to the technique of analysis variance (ANOVA) and Duncan's multible range test (Duncan, 1955) method was used to compare the difference between the means of treatment values to the methods described by Gomez and Gomez, (1984). All statistical analyses were performed using analysis of variance technique by means of Costate Computer Software.

RESULTS AND DISCUSSION

Vegetative growth characters:

Vegetative growth:

Data presented in Tables 3 and 4 show the effect of foliar application substances, i.e., ascorbic acid, salicylic acid, proline, selenium, silicon and yeast extract on plant height, number of leaves, number of branches, stem diameter, fresh weight, dry weigh and leaf area of eggplant.

Data clearly illustrated that all foliar applications significantly increased all studied characters compared with the control. The best application in all studied characters was proline followed by yeast extract and silicon, respectively, in both seasons.

Spraying eggplant plants with ascorbic acid, salicylic acid, proline, selenium, silicon and yeast extract during the two growing seasons corrected the adverse effect of water saline on vegetative growth parameters. The favorable role of treatments of previous substance on stimulation vegetative growth of eggplant plants may be referred to the role played by these compounds on plant bioactivities.

Table 3: Effect of foliar applications of ascorbic acid, salicylic acid, selenium, silicon, proline and yeast extract on plant height, number of leaves, number of branches and stem diameter of eggplant plants during 2013 and 2014 seasons.

Character / Treatment	Plant height (cm)		No. of leaves/plant		No. of branches/plant		Stem diameter (cm)	
	2013	2014	2013	2014	2013	2014	2013	2014
Control	67.65g	61.00g	52.66g	50.33g	7.00f	6.66e	1.27g	1.24g
Ascorbic acid 250 mg/L	86.00d	75.65d	83.00d	77.00d	10.00cd	8.33cd	1.56d	1.44d
Salicylic acid 250 mg/L	79.33e	71.00e	75.66e	68.66e	9.00de	7.66de	1.43e	1.40e
Selenium 50 mg/L	72.02f	66.66f	68.66f	59.33f	7.66ef	7.33de	1.38f	1.33f
Silicon 200 mg/L	91.33c	81.00c	91.33c	84.33c	11.20bc	9.33c	1.63c	1.58c
Proline 100 mg/L	105.00a	98.33a	106.00a	100.33a	13.00a	12.00a	1.85a	1.74a
Yeast extract 20 ml/L	97.363b	86.00b	99.33b	92.33b	12.00ab	10.66b	1.77b	1.70b

*** Values followed by the same letter within a column are not significantly different at the 0.05 % level of probability according to Duncan test.**

These results coincide with those of Abd El-Samad *et al* .(2010) and Talat *et al* (2013) as for proline, Abd-El-All (2009) and Abou El-Khair and Khalil (2014) as for yeast extract and Abou-Baker *et al.* (2011) and Pilon *et al.* (2013) as for Silicon.

Table 4: Effect of foliar applications of ascorbic acid, salicylic acid, selenium, silicon, proline and yeast extract on fresh weight, dry weigh and leaf area of eggplant plants during 2013 and 2014 seasons.

Character / Treatment	Fresh weight (g/plant)		Dry weight (g /plant)		Leaf area / plant (cm^2)	
	2013	2014	2013	2014	2013	2014
Control	574.33g	503.33g	66.00g	64.66g	6518.04 g	6223.37g
Ascorbic acid250 mg/L	722.33d	673.33d	84.00d	82.33d	8603.07d	8533.33d
Salicylic acid 250mg/L	689.00e	611.33e	77.33e	73.33e	7803.30e	7718.68e
Selenium 50 mg/L	613.00f	577.66f	72.66f	70.66f	7198.30f	7002.64f
Silicon200 mg/L	800.33c	715.00c	90.66c	89.66c	9106.35c	9006.05c
Proline100 mg/L	895.00a	837.66a	107.00a	103.33a	9963.64a	9876.36a
Yeast extract20 ml/L	834.66b	775.00b	99.33b	98.00b	9514.61b	9431.32b

Values followed by the same letter within a column are not significantly different at the 0.05 % level of probability according to Duncan test.

As for Proline, the favorable effect of Proline on vegetative growth of eggplant under salt stress may be due it may reduce stomatal opening and reduce transpiration rate (Raghavendra and Reddy., 1987), In addition, Proline play an important role in the osmotic adjustment of the plant under saline conditions (Gilbert, *et al.*, 1998). Furthermore, Proline also has an positive affects various physiological processes that import stress tolerance (Maggio *et al.*, 2002). In addition, The exogenous application of proline improves crop tolerance against salinity and drought by protecting crops from the adverse effects of ROS (Szabados and Savoure., 2009).

Regarding yeast extract, Amer (2004) yeast as a natural source of cytokinins might enhance cell division and cell enlargement so far increasing the leaf surface area as well as enhancing the accumulation of soluble metabolites. Also yeast is natural source of Bs vitamin and most of the essential elements. Also, El-Sherbeny *et al.* (2007) mentioned that enhancement effect of yeast extract might be attributed to its stimulating effect on photosynthetic pigments and improvement of photosynthesis process and enzyme activity which in turn encourage vegetative growth of plants.

Meanwhile, the effect of silicon on plant growth may refer to that Si enhances the growth, improves protection against pathogens (Greger *et al.*, 2011) and maintains of photosynthetic activity and that one of the reasons for increasing dry matter production (Agurie *et al.*, 1992). Further, silicon forms Si-enzyme complexes, which act as protectors and photosynthesis regulators as well as influencing other enzymatic activities (Toresano-Sanchez *et al.*, 2012).In addition, the beneficial effects of silicon are mainly associated with its high deposition in plant tissues, enhancing their strength and, rigidity, increased mechanical strength reduces lodging and pest attack, increases the light-receiving posture of the plant and increasing photosynthesis and hence growth (Prentice and Crooks, 2011).

Also, it was well known that vitamin C evolved a powerful antioxidant effect against ROS oxidative stress and plays important roles in metabolism of bio-assimilates and photosynthesis. Also, it plays a role as a growth factor

associated with cell division and cell elongation, as well as it acts as a co-factor for many enzymes (Lee and Kader, 2000), Ascorbic acid counteracted the adverse effect of salinity on plant growth as well as on some metabolic mechanisms in the plants Shaddad *et al.* (1990).

Regarding salicylic acid it has a beneficial effect for catching the abundant reactive oxygen species (ROS) that cause senescence and loss of plasma membrane permeability and death of cells within plant tissues (Bodannes and Chan, 1979). Also, it plays an essential role in the regulation of plant growth and development (Raskin, 1992).

With respect to the effect of selenium on vegetative growth (Hartikainen, 2002) reported that may be due to its antioxidant function, it may delay plant senescence and promote plant growth and it was effectively used in protein synthesis. Moreover, the growth promoting effect obtained with Se coincided with a marked prevention of lipid peroxidation and a peak of concentration of tochopherols (Vitamin E) which are important antioxidant in plants. Furthermore, under high light conditions Se contributed to defense ability of plants against increased production of oxygen radicals due to enhanced photosynthesis and reduced the lipid pro oxidation irrespective of light conditions. Also, application of selenite at low rates can be used to promote the induction in plants of the antioxidant system, thereby improving stress resistance (Habibi., 2013).

2. Flowering parameters:

The foliar application of some treatments were estimated as the most important factors affecting flowering behavior, each alone or combined with others, under water saline conditions.

The effect of the different foliar applications, ascorbic acid, salicylic acid, proline, selenium, silicon and yeast extract on flowering parameters, number of days to first flowers, number of flowers/plant and fruit set percentage are presented in Table 5.

All aforementioned foliar treatments decreased the number of days to first flowers compared to control (untreated). In addition, all foliar treatments enhanced number of flowers and fruit setting percentage compared with the control in the two studied seasons. The superior treatment was Proline followed by yeast extract and Silicon treatment in Table 5.

However, in salt stressed plants osmotic potential of vacuole decreased by proline accumulation (Yoshiba *et al.* 1997).In addition, proline plays a regulatory role in activity and function of the enzymes catalase, peroxidase and polyphenoloxidase in plant cells and in their participation in development of metabolic responses to environmental factors (Ozturk and Demir 2002).

Concerning, the favorable effect of yeast extract on the formation of flower initiation it might be has an effect on carbohydrates accumulation (Winkler *et al.*, 1962). Furthermore, The promotive effect of yeast extract on plants may be due to its contents of organic substances that play effective roles in improving the growth and initiation of flower formation content (Mohamed and Naguib 2002).

Table 5: Effect of foliar applications of ascorbic acid, salicylic acid, selenium, silicon, proline and yeast extract on number of flowers/plant, Number of days to first flowers and fruit setting percentage of eggplant plants during 2013 and2014seasons.

Character / Treatment	No. flowering/plant		No. days to first flowers		Fruit setting%	
	2013	2014	2013	2014	2013	2014
Control	27.93f	27.46e	45.00a	46.33a	30.06e	30.86b
Ascorbic acid 250 mg/L	32.10d	31.60b	41.66cd	43.33c	33.18c	32.13b
Salicylic acid 250 mg/L	30.98de	30.43c	42.33c	44.00bc	31.81d	31.73b
Selenium 50 mg/L	30.45e	29.26d	43.33b	44.66b	30.85de	31.28b
Silicon 200 mg/L	33.4c	32.36b	41.33d	42.00d	33.50bc	33.66a
Proline 100 mg/L	36.73a	35.36a	39.33f	40.00e	35.58a	34.60a
Yeast extract 20 ml/L	34.90b	34.46a	40.33e	41.33d	34.51ab	33.73a

*** Values followed by the same letter within a column are not significantly different at the 0.05 % level of probability according to Duncan test.**

Chemical composition:

Chemical composition of leaves and fruits :

Results in Tables 6, 7, and 8 declare the effect of foliar application treatments on chemical composition of leaves (N, P and K %) , chemical composition of fruits (N, P , K (%), Fe , No_3,No_2 (ppm) and protein percentage in the two summer seasons of 2013 and 2014.

Data in Table 6 show the effect of foliar application on chemical composition of eggplant leaves, i.e., N, P and K (%). These results indicated that foliar applications (ascorbic acid, salicylic acid, proline, selenium, silicon and yeast extract) had a significant effect on leaves content of N, P and K (%) in both seasons. Same data indicated that the highest content of N, P and K (%) were obtained when eggplant plants sprayed with proline, yeast extract and silicon, respectively and the least content of N, P and K (%) were obtained with the control treatment(untreated one).

Table 6: Effect of foliar applications of ascorbic acid, salicylic acid, selenium, silicon, proline and yeast extract on leaves N, P and K during 2013 and 2014

Character / Treatment	N %		P %		K %	
	2013	2014	2013	2014	2013	2014
Control	2.26d	2.05d	0.307e	0.301d	3.88d	3.47e
Ascorbic acid 250 mg/L	2.52c	2.37bc	0.351c	0.350b	4.33bc	4.34b
Salicylic acid 250 mg/L	2.45c	2.24cd	0.334d	0.329c	4.15cd	4.11c
Selenium 50 mg/L	2.32d	2.17d	0.318e	0.315d	3.89d	3.83d
Silicon 200 mg/L	2.61b	2.42bc	0.357bc	0.354b	4.56ab	4.43b
Proline 100 mg/L	2.82a	2.75a	0.376a	0.373a	4.82a	4.74 a
Yeast extract 20 ml/L	2.65b	2.53b	0.367ab	0.361ab	4.67ab	4.65a

*** Values followed by the same letter within a column are not significantly different at the 0.05 % level of probability according to Duncan test.**

Table 7: Effect of foliar applications of ascorbic acid, salicylic acid, selenium, silicon, proline and yeast extract on fruits N, P and K concentration of eggplants fruits during 2013 and 2014deasons.

Character / Treatment	N%		P%		K%	
	2013	2014	2013	2014	2013	2014
Control	1.24e	1.23f	0.310f	0.302f	3.27e	3.17f
Ascorbic acid 250 mg/L	1.78c	1.75c	0.365cd	0.358cd	3.76c	3.64cd
Salicylic acid 250 mg/L	1.66d	1.55d	0.355de	0.343d	3.62d	3.55 d
Selenium 50 mg/L	1.56d	1.35e	0.342 e	0.324 e	3.52d	3.33 e
Silicon 200 mg/L	1.84c	1.81c	0.376bc	0.366bc	3.85c	3.77bc
Proline 100 mg/L	2.09a	2.05a	0.391 a	0.387a	4.15a	4.06 a
Yeast extract 20 ml/L	1.97b	1.92b	0.387ab	0.376ab	3.98b	3.86 b

*** Values followed by the same letter within a column are not significantly different at the 0.05 % level of probability according to Duncan test.**

Data in Table 7 and 8 showed the effect of foliar application on chemical composition of eggplant fruits, i.e., N, P and K (%).Fe, No_3,No_2 (ppm) and protein (%) .

These results indicated that foliar application substances (ascorbic acid, salicylic acid, proline, selenium, silicon and yeast extract) had a significant effect on leaves content of N, P and K (%).Fe, No_3 and No_2 (ppm) and protein (%) in both seasons. Same data indicated that the highest content of N, P and K (%) were obtained when eggplant plants sprayed with proline, yeast extract and silicon foliar applications, respectively and the least content of N, P and K (%) were obtained with the control (untreated one).

Table 8: Effect of foliar applications of ascorbic acid, salicylic acid, selenium, silicon, proline and yeast extract on fruits Fe, No_3+No_2 and protein concentration of eggplants fruits during 2013 and 2014 seasons.

Character / Treatment	Fe ppm		No_3,No_2 Ppm		Protein %	
	2013	2014	2013	2014	2013	2014
Control	66.37g	65.52g	288g	279f	7.76e	7.30f
Ascorbic acid 250 mg/L	74.57d	73.25d	316d	306c	11.15c	11.00c
Salicylic acid 250 mg/L	72.48e	71.08e	308e	298d	10.38d	9.70d
Selenium 50 mg/L	69.84f	69.05f	295f	289e	9.73d	8.45e
Silicon 200 mg/L	79.54c	77.03c	327c	317b	11.53c	11.33c
Proline 100 mg/L	94.63a	91.35a	345a	334a	13.10a	12.81a
Yeast extract 20 ml/L	86.50b	85.27b	334b	328a	12.31b	12.00b

*** Values followed by the same latter within a column are not significantly different at the 0.05 % level of probability according to Duncan test.**

Fruit quality:

Results in Table 9 declare that the effect of foliar application substances on fruit quality, i.e., ascorbic acid (mg/100gm), total soluble solids (TSS) and titrable acidity (%) in the two summer seasons of 2013 and 2014. silicon and yeast extract) significantly increased fruit quality , i.e., ascorbic acid (mg/100 g) and total soluble solids (TSS) and decreased titrable acidity contents compared with the control in both seasons.

Spraying eggplant plants with proline gave the highest values of total soluble solids (TSS) and vitamin C and recorded the lowest values of titrable

acidity contents followed by yeast extract and silicon in both seasons. On the other hand, control treatment recoded the lowest values of total soluble solids (TSS) and vitamin C and the highest values of titrable acidity contents in both seasons.

Table 9:Effect of foliar applications of ascorbic acid, salicylic acid, selenium, silicon, proline and yeast extract on ascorbic acid, total soluble solids (TSS) and titratable acidity of eggplant fruits during 2013 and 2014 seasons.

Character / Treatment	TSS %		Vit.C (mg/100g)		Acidity%	
	2013	2014	2013	2014	2013	2014
Control	4.06f	3.96e	3.10e	3.03g	0.24a	0.27a
Ascorbic acid 250 mg/L	4.80d	4.50c	3.93c	3.90d	0.18bc	0.20bc
Salicylic acid 250 mg/L	4.63e	4.41cd	3.90c	3.66e	0.21ab	0.21bc
Selenium 50 mg/L	4.50e	4.21d	3.63d	3.53f	0.23a	0.24ab
Silicon 200 mg/L	4.96c	4.71b	4.16b	4.10c	0.17bc	0.18cd
Proline 100 mg/L	5.30a	5.18a	4.50a	4.40a	0.13c	0.15d
Yeast extract 20 ml/L	5.13b	4.85b	4.30b	4.23b	0.16bc	0.17cd

*** Values followed by the same letter within a column are not significantly different at the 0.05 % level of probability according to Duncan test.**

All foliar applications (ascorbic acid, salicylic acid, proline, selenium, These results are in the same line with those reported by Kasraie *et al.* (2012) and El-Sayed. (2013) for proline, Shokr and Abd El-Hamid (2009) and Abou El-Khair and Khalil (2014) for yeast extract and Jia *et al.* (2011) and Toresano *et al.* (2012) for silicon.

In addition, thus treatment with either proline might play an important role in protein synthesis (Abd El-Samad *et al* , 2010). Also, the proline treatment markedly altered the selectivity of Na^+, K^+, $Ca^{++}$and P in both maize and broad bean plants. Spraying with any of either proline restricted Na^+ uptake and enhanced the uptake of K^+, K^+/Na^+ ratio, Ca^{++} and P selectivity in maize and broad bean plants (Abd El-Samad *et al* ., 2010). Further, foliar application of proline was effective on ameliorating the adverse effects of water stress by promoting the uptake and accumulation of essential nutrients such as N, P and K (Ali et al., 2007).

Meanwhile, the proposed functions of accumulated proline are osmoregulation, maintenance of membrane and protein stability, growth, seed germination while carbon and nitrogen serve as an energy store Hare *et al.* (2003). Moreover, the increase in protein percentage under the effect of yeast application could be attributed to the growth hormones produced by yeast Mohamed and Naguib (2002) Furthermore, Hayat (2007) indicated that the positive effect of yeast treatment under water stress conditions may be due to that yeast provided plants with essential nutrients elements required for protein formation. In addition, El-Lethy *et al.* (2011) mentioned that yeast extract pronouncedly increased total phenols, total flavonoids and the antioxidant activity of *Pelargonium graveolens* at both cuttings.

Meanwhile, the possible mechanisms of silicon-improvement of crop quality were summarized in the following aspects: silicon provision, improvement of micro-nutrient supply, coordination of nutrition supply and

enhancement of resistance to stressful conditions (Jia *et al.*, 2011). Moreover, silicon supplementation increased photosynthetic activity and consequently, carbon skeleton production and increased the demand for N for the synthesis of amino acids and other N compounds (Lima Filho and Abdalla, 2008).

Since SA improved the photosynthetic performance of plants under stress conditions (Ananieva *et al.*, 2004), Also, SA treatment diminished changes in phytohormones levels in soybean seedlings under salinity , it prevented any decrease in IAA and cytokinin content and thus reduced stress-induced inhibition of plant growth (Shakirova *et al.*, 2003).

A stimulatory effect of foliar application of selenium on nitrogen assimilation has been reported for barley (Aslam *et al.*, 1990).

Fruit yields and its components:

Data showing the effect of foliar application substances on fruit yield and its components, i .e fruit length, fruit diameter , number of fruits/plant, average fruit weight and fruit dry matter, fruit yield /plant, early fruit yield /plant, fruits yield (ton/fed) and early fruits yield (t/fed). are presented in tables 10 and 11.

Data in Table 10 show the effect of foliar applications of ascorbic acid, salicylic acid, proline, selenium, silicon and yeast extract on fruit length, fruit diameter , average fruit weight and fruit dry matter.

Data showed that all foliar applications (ascorbic acid, salicylic acid, proline, selenium, silicon and yeast extract) significantly increased fruit length, fruit diameter , average fruit weight and fruit dry matter compared to control in both seasons. proline treatments gave the highest values in previous studied characters followed by yeast extract and silicon

Table 10: Effect of foliar applications of ascorbic acid, salicylic acid, selenium, silicon, proline and yeast extract on fruit length, fruit diameter , number of fruits/plant, average fruit weight and fruit dry matter of eggplants fruits during 2013 and 2014 seasons.

Character / Treatment	Fruit length (cm)		Fruit diameter (cm)		Average fruit weight (kg)		Dry matter %	
	2013	2014	2013	2014	2013	2014	2013	2014
Control	8.35g	8.30g	7.25g	7.17g	0.19b	0.18f	7.37g	7.03g
Ascorbic acid 250mg/L	9.79d	9.61d	8.76d	8.66d	0.22b	0.21d	8.85d	8.28d
Salicylic acid 250 mg/L	9.27e	9.17e	8.14e	8.07e	0.21ab	0.20e	8.45e	7.88e
Selenium 50 mg/L	8.95f	8.84f	7.87f	7.77f	0.20b	0.19ef	7.96f	7.46f
Silicon 200 mg/L	10.22c	9.97c	9.10c	9.03c	0.23ab	0.21c	9.26c	8.69c
Proline100 mg/L	11.05a	10.88a	9.88a	9.77a	0.24a	0.23a	10.15a	9.82a
Yeast extract20 ml/L	10.55b	10.31b	9.48b	9.42b	0.23ab	0.22b	9.92b	9.15b

*** Values followed by the same letter within a column are not significantly different at the 0.05 % level of probability according to Duncan test.**

Also, data in Table 11 show the effect of foliar applications (ascorbic acid, salicylic acid, proline, selenium, silicon and yeast extract) on fruit yield /plant, number of fruits/plant, fruits yield (ton/fed) and early fruits yield (ton/fed) compared to control in both seasons. Proline treatments gave the

highest volume in previous studied characters followed by yeast extract and silicon.

These results are harmony with those reported by Kasraie *et al.* (2012) and Kahlaoui *et al.* (2013) as for proline,Abd-El-All (2009) and Abou El-Khair and Khalil (2014) as for yeast extract and Abou-Baker *et al.* (2011), and Crusciol *et al.* (2013) as for silicon.

These increment of yield may be attributed to the bases that all used application had favorable stimulatory effects other than protective role against salt on vegetative growth characters Tables 3 and 4 and enhanced photosynthetic apparatus in partitioning from vegetative growth sinks to reproductive sinks Tables 5,6, 7, 8, 9, 10 and11 under salt conditions Table 2.

Table (11): Effect of foliar applications of ascorbic acid, salicylic acid, selenium, silicon, proline and yeast extract on fruit yield /plant, number of fruits/plant, fruits yield (ton/fed) and early fruits yield (ton/fed) of eggplant plants during 2013 and 2014 seasons.

Character / Treatment	Fruit yield (kg/plant)		No. of fruits/plant		Early fruit yield (ton/fed)		Fruit yield (ton/fed)	
	2013	2014	2013	2014	2013	2014	2013	2014
Control	1.61g	1.58g	8.49g	8.32g	6.08g	5.86g	17.84g	17.62g
Ascorbic acid 250 mg/L	2.12d	2.06d	10.18d	10.08d	7.85d	7.64d	23.59d	22.88d
Salicylic acid 250 mg/L	1.94e	1.89e	9.82e	9.62e	7.20e	7.02e	21.62e	21.03e
Selenium 50 mg/L	1.82f	1.77f	9.28f	9.18f	6.64f	6.54f	20.25f	19.70f
Silicon 200 mg/L	2.37c	2.32c	10.88c	10.81c	8.77c	8.61c	26.32c	25.77c
Proline 100 mg/L	3.08a	2.87a	12.71a	12.15 a	11.43a	10.66a	34.28a	31.88a
Yeast extract 20 ml/L	2.72b	2.59b	11.77b	11.56 b	10.14b	9.52b	30.21b	28.84b

*** Values followed by the same letter within a column are not significantly different at the 0.05 % level of probability according to Duncan test.**

CONCLUSION

For the results of this study, it can be concluded that spraying eggplant. Proline at 100 mg/L, yeast extract at 20 m/L, silicon at 200 mg/L, three times, 20, 40 and 60 days after transplanting, respectively. It could be of some value in improving eggplant vegetative growth, flowering, fruit yield and its components Chemicals under saline water (E.C. 5.3) conditions of summer season at El-Gammalia district and such conditions. Consequently, further research trails should be carried out for improving eggplant tolerance against adverse effect of saline water stress under local condition.

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دراسات فسيولوجية على الباذنجان: تقليل تأثير الملوحة علي الباذنجان بواسطة ببعض معاملات الرش

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أجريت التجربة بمزرعة خاصة فى الجمالية - محافظة الدقهلية– مصر خلال موسمى الزراعة الصيفيين٢٠١٣ و ٢٠١٤ بهدف دراسة تأثير ببعض معاملات الرش (مستخلص الخميرة بتركيز ٢٠ مل/ لتر ، فيتامين سي بتركيز ٢٥٠ جزء فى المليون ،السالسيليك أسيد بتركيز ٢٥٠ جزء في المليون ، البرولين بتركيز ١٠٠ جزء في المليون ، السيلينيوم بتركيز ٥٠ جزء في المليون و السيليكون بتركيز ٢٠٠ جزء فى المليون) على صفات النمو ، الازهار ، ومحصول ومكوناته وجودة الثمار للباذنجان

من خلال هذه النتائج يمكن التوصية بأن رش نباتات الباذنجان بالبرولين ١٠٠ ملجم/لتر أو مستخلص الخميرة ٢٠ مل/لتر أو السيليكون ملجم/لتر ٢٠٠ ملجم/لتر رشا ثلاث مرات بعد ٢٠ يوم من الشتل ثم كل ٢٠ يوم بعد ذلك يؤدى الى تحسين صفات النمو الخضري والزهري والمحصول والمكونات الكيماوية لنبات الباذنجان والتخزين لثمار الباذنجان تحت ظروف الري بمياه مالحة يصل ال EC فيها ٥.٣ للمنطقة في الموسم الصيفي. و بالتالي يجب الاهتمام بإجراء العديد من التجارب التطبيقية من أجل زيادة تحمل محصول الباذنجان الري بمياه مالحة.