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Response Of Growth, And Pod Yield Of Sugar Pea To Some Eco- Friendly Compounds

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ABSTRACT

The present study was conducted at the experimental farm, El-Kassasein Research Station, Ismailia Governorate, Egypt, during the two successive winter seasons of 2022/2023 2023/2024, to investigate the effects of natural foliar applications, i.e., Salicylic acid, Ascorbic acid, Citric acid, Aloe vera extract and Borpota fertilizer on growth parameters and pod yield of sugar snap pea cultivar "Sugar Snap".

This experiment included 11 treatments which arranged in a randomized complete block design (RCBD) with three replicates.

The foliar application of 11 treatments as follows:

Control (sprayed with tap water only), Salicylic acid 100 mg L^{-1} (ppm), Salicylic acid 200 mg L^{-1} (ppm), Ascorbic acid 100 mg L^{-1} (ppm), Ascorbic acid 200 mg L^{-1} (ppm), Citric acid 100 mg L^{-1} (ppm), Citric acid 200 mg L^{-1} (ppm), Aloe vera extract 20 ml/l, Aloe vera extract 40 ml/l, Borpota 1 ml/l and Borpota 2 ml/l.

The obtained results regarding that all the foliar studied treatments significantly increased growth parameters, i.e., plant height, both number of branches and leaves, and pod yield of sugar pea, i.e., average pod weight, number of pod/ plant, pod yield / plant, pod yield / feddan, pod length, and pod diameter. These results indicated that foliar application of ascorbic acid (vitamin c) at 200mgl^{-1}, being the most effective of all vegetative growth characters, and pod yield and its components of sugar pea. These treatments followed by the treatments of salicylic acids, citric acid, Aloe vera extract and borpota at high concentration fertilizer, respectively.

***Conclusively,** it can be concluded that using the bio- stimulants substrates (ascorbic acid, salicylic acid, citric acid, Aloe vera extract and borpota fertilizer increased the vegetative growth characters of plants, and pod yield and its components of sugar pea pods.*

Key words: Sugar pea – growth – pod yield -bio- stimulants substrates- borpota fertilizer.

INTRODUCTION

Sugar pea is a significant addition to Egypt's vegetable crop, supporting local market and export purposes. There are two genotypes: snow pea and sugar snap pea. Snow pea, also known as *Pisum sativum* var. macrocarpon, are edible-podded due to their lack of cross fibres in the pod wall. They can be consumed whole, unlike garden peas. Snow peas, also known as "mange-tout" in England and France, are a botanical cultivar or subspecies of *Pisum sativum*. The snow pea pod is flat and consumed before string formation and pea enlargement (Burt, 2008).

The sugar snap pea, also known as snap pea, is a legume originating from a crossbreeding between a snow pea and an unusual pea variety with thick walls. Its pods have thick walls and a pleasant sweetness. Harvested at a more advanced stage of maturity, the sugar snap pea has a fully rounded shape (Beckingham, 2001 and Burt, 2008). Its pods contain beneficial nutrients like dietary fiber, folic acid, vitamin C, iron, manganese, riboflavin, vitamin B6, magnesium, phosphorus, potassium, vitamin A, and vitamin K. (Chauhan and Sharma, 2021).

Existing agricultural methods confront enormous difficulties in maintaining food supply and quality in the face of global warming and its far-reaching effects (Sachdev *et al.*, 2021). The intricate interaction of changing climate conditions has intensified abiotic stresses on plants across the world, including drought, salt, high temperatures, and lack of nutrients (Chaudhry and Sidhu, 2022). In addition, ecosystems and soil health have been further compromised due to chemical inputs, thus there has to be immediate effort to find sustainable agricultural alternatives (Yang *et al.*, 2020). Using Bio-stimulants as natural compounds impact plant nutrition, enhance water absorption and influence of plant growth and biomass generation, and increase both primary and secondary metabolism. (Chojnacka, 2024)

Salicylic acid (SA) is a naturally occurring plant hormone functions as an endogenous signal molecule in the resistance of plants to environmental stresses (Sofy *et al.*, 2020), and when applied SA has been found to improve various characteristics of pea plants, including pod number per plant, seed weight, pod length, pod width, pod yield per plant, and pod yield per hectare, under both irrigated and water-deficit conditions (Soni *et al*., 2021). SA also enhances particular biological processes involved in plant growth (Basit *et al.*, 2018), so the study discovered that applying salicylic acid to cowpea plants resulted in the most significant effects. This treatment enhanced vegetative growth, including plant height, number of compound leaves per plant, fresh weight and dry weight of shoots per plant, Additionally, it increased productivity, photosynthetic pigments, and the concentrations of nitrogen, phosphorus, and potassium of leaves (Azoz and El-Taher,2018)

Also, Vitamins and antioxidants are classified as bio-regulators or hormone precursors. When added in small amounts, that enhancing plant growth and development, and may affect the energy metabolic process (Mostafa *et al*., 2015); ascorbic acid (ASA) and citric acid (CA) act as antioxidants and anti-stress agents, as well as signaling molecules in some plant physiological and defense mechanism (El-Kobisy *et al*., 2005)

Ascorbic acid plays an important role in various activities, including photosynthesis, cell wall development and expansion, resistance to environmental stresses, and production of ethylene, gibberellins, anthocyanin, and hydroxyl proline (Saha *et al.,* 2020). Ascorbic acid, when used as a foliar treatment, improves the resistance of cowpea plants to NaCl stress by stimulating the growth of roots and shoots, increasing the weight of fresh and dry plant material, and enhancing the levels of chlorophyll pigments and carotenoids (Mir and Somasundaram, 2021). Additionally, applying Ascorbic acid as a foliar treatment has positive effects on growth and development of French bean and resulted in the highest yield per plant, as documented by (Saha *et al*. 2020). Citric acid (CA) plays a crucial role in various signal transduction systems, maintaining the stability and function of membranes, activating transporter enzymes, facilitating metabolism, and facilitating the translocation of carbohydrates (Smirnoff, 1996). Also (Mallhi *et al.,* 2019) showed that application of CA may mitigate the decrease in germination, mineral uptake, hormone balance, and overall growth and productivity caused by Pb-induced stress.

Likewise, Plant extracts, such as Aloe vera leaf extract, is one of the various types of bio-stimulants (Bulgari *et al.,* 2019; Nephali *et al*., 2020). belongs to the Liliaceae family. It is an evergreen perennial herb that grows mostly in tropical and subtropical climates, and its leaf produces yellow latex gel (Surjushe *et al.,* 2008). ALE has a high concentration of auxins, gibberellins, salicylic acid, lignin, antioxidants, phenols, flavonoids, amino acids, vitamins, macro- and micronutrients, and polysaccharides (Chatterjee *et al*., 2013). Scientific research has verified that using aloe vera extract stimulates the process of seed germination and enhances the growth of plants throughout both the vegetative and flowering stages (Lindsey *et al*., 2002 and Wilson 2020) especially had the most significant impact on eggplant.

Plants of the leguminous family require boron in order to enhance the efficiency of nitrogen fixation. Furthermore, B is essential for the development and stability of cell walls, maintains the structural and functional properties of biological membranes, facilitates the transportation of sugar or energy to the growing sections of plants, and has a good impact on pollination and seed production. (Sutulienė *et al.,* 2023), moreover boron enhances the uptake of K^+ ions and stimulates the activity of ATPase enzymes located in the cell membrane, resulting in the hyperpolarization of the plasma membrane. It enhances the opening and closing of stomata (Pal *et al*., 2023). It was reported

that the growth, yield, and seed production of various pea cultivars are greatly increased by foliar application of boron number of leaves on a plant (120.8), the height of the plant (103.5 cm), the number of main branches (13.1), the number of pods/ plant (16.6), the length (11.1 cm), the diameter (13.8 mm), and the number of seeds (Ullah *et al.*,2024*)*

Therefore, this study aims to investigate the effects of several bio-stimulants *i.e.*, salicylic acid, ascorbic acid, citric acid, aloe vera extract, and boron as a foliar spray on growth, pod yield of sugar pea (*Pisum sativum* var. saccharatum) *cv.* Sugar snap. These substances are eco-friendly and can be applied to plants to improve nutritional efficiency, abiotic stress tolerance, and crop quality traits.

MATERIALS AND METHODS

The present study was conducted at the experimental farm, El-Kassasein Research Station, Ismailia Governorate, Egypt, during the two successive winter seasons of 2022/2023 2023/2024, to investigate the effects of natural foliar applications, *i.e*., Salicylic acid, Ascorbic acid, Citric acid, Aloe vera Extract and Borpota on vegetative growth, and pod yield, of sugar snap pea cultivar "Sugar snap". Representative samples were collected randomly from the experimental soil before sowing at 0-30 cm depth to determine some physical and chemical properties of the soil according to the method described by Chapman and Pratt (1982).

Table (1): the physical and chemical properties of the experimental soil

Physical properties			Chemical properties		
Items	2023	2024		2023	2024
Sand (%)	90.5	95.6	Organic matter (%)	0.03	0.08
Silt (%)	4.7	1.6	Available K (ppm)	55	66
Clay	4.8	4.7	Available p (ppm)	5.7	6.8
Field capacity	6.8	7.2	Available N (%)	5.9	6.3
Wilting point	2.5	2.6	Calcium carbonate (%)	0.28	0.26
Available water	4.5	4.5	pH	8.1	8.1
Water holding capacity	13.9	14.6			

The experimental design and treatments:

Seeds of sugar peas were obtained from Horticulture Research Institute, Agriculture Research Centre, Giza, Egypt. Seeds were inoculated directly before sowing with root nodules bacteria (*Rhizobium leguminosarum*) and sown, two seeds per hill (two seeds / hill) on one side and sown on October 18 th and 22 th in the first and the second seasons, respectively. This experiment

included 11 treatments which arranged in a randomized complete blocks design (RCBD) with three replicates. The experimental unit area was 10.5 m^2 (3 ridges, 5m length and 0.7 m width) and one row was left between each two plots without treating as a guard row.

The agricultural practices for sugar pea production were followed according to the Egyptian Ministry of Agriculture recommendations. the foliar application of 11 treatments as follow:

1. Salicylic acid 100 mg L^{-1} (ppm)
2. Salicylic acid 200 mg L^{-1} (ppm)
3. Ascorbic acid 100 mg L^{-1} (ppm)
4. Ascorbic acid 200 mg L^{-1} (ppm)
5. Citric acid 100 mg L^{-1} (ppm)
6. Citric acid 200 mg L^{-1} (ppm)
7. Aloe vera extract 20 ml/l
8. Aloe vera extract 40 ml/l
9. Borpota 1 ml/l
10. Borpota 2 ml/l
11. Control (sprayed with tap water only)

Antioxidants:

Antioxidants (ascorbic acid, salicylic acid and citric acid) were obtained from El-Gomhoria Company for Chemicals, Egypt.

Salicylic acid Application

SA was initially submerged in pure ethanol and then gradually added to the water (ethanol/water, 1/1000, v/v) according to Stevens *et al*.,(2006).

Borpota: Obtained from the Ministry of Agriculture and Land Reclamation, Giza, Egypt, which contains of boron, potassium oxide and Amino acid.

Table (2): The chemical analysis of Borpota

Contents	Units	Value
Boron	%	15
Potissum oxide	%	5
Amino acid	%	2

Aloe vera leaves Extract Preparation

Aloe vera leaves were collected from cultivated plants, separated from the plant, cleaned to eliminate dirt, air-dried, and subsequently sliced into pieces. The chopped leaves were then crushed either manually or using an electric juicer. The gel was separated from the solid components by straining it through a cheesecloth or fine screen to remove the fibrous component. Bejar *et al*. (2020). The aloe vera solution was kept at a temperature of 5°C in a refrigerator until it was utilized to prevent the oxidation of phenolic compounds.

Table (3): The chemical analysis of Aloe vera leaf extract.

Characters	Units	Cont.
GA_3	mg g^{-100}	15.00
IAA	mg g^{-100}	0.63
ABA	mg g^{-100}	3.06
Ascorbic acid	mg g^{-1}	154.64
Protein	%	3.70
Polysaccharide	%	90
Minerals	Units	Values
N	mg g^{-100}	82.65
P	mg g^{-100}	7.95
K	mg g^{-100}	57.14
Fe	Ppm	766.11
Zn	Ppm	166.87
Mn	Ppm	478.88
Ca	mg g^{-100}	37.00
Cu	Ppm	42.73
Mg	mg g^{-100}	15.55
Na	mg g^{-100}	48.27

The foliar treatments were applied three times, the first one at 15 days after sowing and repeated at 15-day, intervals (15, 30and 45 days from sowing).

The mineral and phytohormone levels in the Aloe vera leaf extract were analysed following the procedure presented by Nandi *et al*., (1990**),** specifically focusing on gibberellic acid (GA3), indole-3-acetic acid (IAA), and abscisic acid (ABA). However, the mineral content and sugar percentage were determined by Rawe (1966)**.** In addition, the analysis of various chemical components was conducted according to the criteria provided by A.O.A.C (2012**)** for protein determination (Saad *et al*., 2015**).**

Data recorded were as follows:

At 50 days after sowing, five plants from each experimental unit were randomly taken for determining the following data:

Plant height (cm):

Plant height was measured as the average height in centimetres of the marked plants. The measurement started from the surface of ground to the plant stem apex.

Number of leaves/plant:

Number of leaves was calculated as average number of leaves on the marked plants.

Number of branches/plant:

Number of branches was calculated as an average number of branches on the marked plants.

Plant fresh weight (g):

Plant fresh weight was determined in grams as the average weight of five plants (leaves and Stems) from each unit area.

Plant dry weight (g):

Plant dry weight was determined in grams by drying five plants from each unit area in an oven with driven hot air at 70 C^o for constant weight, and then the average dry weight per plant was calculated.

Green pod yield and its components:

At the proper maturing stage, green pods of each treatment were harvested, counted and weighed in each harvest and the following parameters were determined:

Number of pods/plant: The number of all harvested pods per plot was divided by the number of plants per plot.

Average weight of green pod (g):

It was expressed as the mean weight of 20 green pods from each unit in grams.

Green pod length (cm):

It was expressed as the mean length of 20 green pods from each unit in centimetres

Green pod diameter (mm):

It was expressed as the mean diameter of 20 green pods from each unit in millimetres, and measured by veneer calliper.

Green pod thickness (mm):

It was expressed as the mean thickness of 20 green pods from each unit in millimetres, measured by veneer calliper.

Green pod yield/plant (g):

It was calculated by dividing the total pod yield per unit area by the number of plants per plot.

Total green pod yield (ton/fed.):

It was calculated from all harvested pods per unit area and then calculated as ton per fed.

Statistical analysis

All obtained data were subjected to the statistical analysis of variance and treatment means were compared using least significant difference (LSD) method described by Snedecor and Cochran (1989) at 5 % significance level. The statistical analyses were performed using SAS Computer Software program (SAS, 2004).

RESULTS AND DISCUSSION:

Vegetative growth characters:

Data presented in Tables (4 and 5) study the effect of bio-stimulants and borpota fertilizer on vegetative growth characters of sugar pea.

Table (4): Effect of foliar application with some natural substances on vegetative growth characters of sugar pea in the two seasons of 2022/2023 and 2023/2024 at 50 days after sowing

Treatments	Plant height (cm)		No of branches/ plant		No of leaves/plant	
	2022/2023	2023/2024	2022/2023	2023/2024	2022/2023	2023/2024
Control	60.10 c	58.26 b	1.47 e	1.62 f	22.78 e	26.20 c
CA 100 ppm	63.83 cb	71.20 ab	2.12 de	2.58 de	28.38 dc	28.90 cb
CA 200 ppm	69.33 a	78.33 a	3.14 ab	3.62 ab	31.39 b	36.53 a
AVE 20 ml/l	62.23 c	65.46 ab	2.01 de	2.36 fe	25.16 e	28.00 c
AVE 40 ml/l	68.95 a	77.53 a	2.93 cab	3.58 cab	30.62 cb	36.25 a
Borpota 1 ml/l	63.75 cb	68.63 ab	2.04 de	2.41 e	27.93 d	28.43 cb
Borpota 2 ml/l	67.76 ab	75.23 ab	2.58 cdb	3.20 cdb	29.69 dcb	34.76 ab
ASA 100 ppm	64.33 cb	74.00 ab	2.45 cd	2.83 cde	29.52 dcb	30.76 cab
ASA 200 ppm	71.55 a	80.00 a	3.14 ab	3.95 ab	31.88 ab	36.53 a
SA 100 ppm	63.83 cb	73.16 ab	2.13 de	2.60 de	28.71 dc	29.53 cb
SA 200 ppm	71.80 a	80.43 a	3.29 a	4.25 a	34.10 a	37.20 a
LSD (0.05)	4.5273	17.276	0.6675	0.7554	2.565	6.6434

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

CA (Citric acid), AVE (aloe vera leaf extract), ASA (Ascorbic acid), SA (salicylic acid).

Table (5): Effect of foliar application with some natural substances on fresh and dry weight/plant of sugar pea in the two seasons of 2022/2023 and 2023/2024 at 50 days after sowing

Treatments	Plant fresh weight (g)		Plant dry weight (g)	
	2022/2023	2023/2024	2022/2023	2023/2024
Control	86.700 g	99.250 d	16.197 e	16.920 d
CA 100 ppm	118.103 ef	118.900 c	22.107 dc	23.983 cb
CA 200 ppm	133.623 c	154.667 ab	26.420 b	30.660 ab
AVE 20 ml/l	110.450 f	102.000 d	19.597 de	21.600 cd
AVE 40 ml/l	128.403 cd	150.000 b	24.627 bc	29.820 ab
Borpota 1 ml/l	117.187 ef	102.833 d	20.157 d	21.923 cd
Borpota 2 ml/l	127.987 cd	148.333 b	24.520 bc	29.757 ab
ASA 100 ppm	123.063 ed	146.583 b	22.773 dc	29.110 ab
ASA 200 ppm	149.277 b	155.750 ab	27.245 b	34.480 a
SA 100 ppm	123.063 ed	141.500 b	22.463 dc	25.903 cb
SA 200 ppm	158.350 a	166.400 a	30.840 a	34.837 a
LSD (0.05)	8.3051	15.052	3.5829	6.9264

Means followed by the same letter within a column are not significantly different at 0.05 level of probability according to Dunken multiple range test.
CA (Citric acid), AVE (aloe vera leaf extract), ASA (Ascorbic acid), SA (salicylic acid)

The bio-stimulants (salicylic acid, ascorbic acid, citric acid and Aloe vera leaf extract) and borpota fertilizer caused an increase in the studied vegetative growth characters, *i.e.*, plant height, both number of branches and leaves, plant fresh and dry weight. The treatments of foliar spray with salicylic acid or ascorbic acid at 200 ppm, being the most effective treatments on the all studied vegetative growth characters of sugar pea. These treatments followed by the treatments of citric acid, aloe vera leaf extract and borpota fertilizer, respectively.

Regarding the vital role of bio-stimulants on growth of legumes vegetable crops, Ahmad *et al*. (2023) indicated that salicylic acid is an organic substance used to promote plant growth, it can be activating several enzymes in the seeds to germinate and promote the plant growth within contains many enzymes such as phenylalanine ammonia – lyase, nitrite reductase and glucanase which enhances plant growth. Hellal *et al.* (2021) concluded that ascorbic acid plays a very important role in the synthesis of oxalate and tartrate in addition to being an antioxidant and cofactor for enzymes consequently, increased and promote the plant growth and many physiological, biochemical processes. Lindsey *et al.* (2002) and Raka (2017) confirmed that citric acid is a vital organic acid act as an enzyme co-factor in plants, important for the respiratory cycle and other physiological processes and then increased plant growth. Khater *et al.* (2020) illustrated that Aloe vera extract contains some of

the enzymes, vitamins, amino acid and auxins which helps to speed germination, vegetative growth of plants.

Respecting the role of borpota fertilizer, which contains boron, Alk (2015) demonstrated that boron has an important role in transporting the manufactured materials for products of the carbon metabolism process to the active growth areas in the plant, especially the meristematic cell division and elongation and then increased the plant growth. As well as, borpota fertilizer contains of potassium nutrient, that has a vital role in mechanical of open and close the stomata, and translocate the carbohydrates and increased plant growth (Abu Dahi and Al- younis ,1988). These results are in confirming with the findings of Janda *et al.* (2007), Beltagi (2008), El tohamy *et al.* (2013), Ahmad *et al*. (2014) and Abdou *et al*. (2022) who worked with salicylic acid, ascorbic acid, citric acid, aloe vera extract and boron, respectively.

Pod yield and its components:

Data in Tables (6 and 7) explain that bio-stimulants and Borpota fertilizer gave the highest value in pod yield and its components, i.e., number of pod / plant, average pod weight, pod length, pod diameter, pod thickness, pod yield / plant and total pod yield / feddan. The treatments of ascorbic acid and / or salicylic acid at (200 ppm), being the most effective on pod yield and its components, which promote and encourage many enzymes to activate the metabolism processes for building and translocating the compounds in storage organs parts and then increased the plant yield (Sathishkumar *et al*., 2020, and Hellal *et al*., 2021 with salicylic acid and ascorbic acid on pea plants). These results are followed by the treatments of citric acid, Aloe vera leaf extract and borpota fertilizer, respectively on pod yield and its components of sugar pea. These results are true in both growing seasons.

The bio-stimulants of both citric acid and aloe vera leaf extract, and borpota fertilizer have an important role in increasing pod yield and its components that contains many substances to promote and enhance the biological and biochemical processes in different parts of plant and then increased the yield and its components (El-Tohamy *et al*., 2013; Abdou *et al*., 2022 and Rashid and Mosleh, 2022) , who worked with citric acid , Aloe vera extract and boron fertilizer on legumes plants , respectively. Similar findings were obtained by El -Afifi *et al*. (2017), Kater *et al*. (2020), El-Mahdy *et al*. (2021), Hellal *et al.* (2021) and Rashid and Mosleh (2022), they worked with salicylic acid, citric acid, Aloe vera extract, and borpota fertilizer, respectively.

Conclusively, it can be concluded that (salicylic acid, ascorbic acid, citric acid and Aloe vera leaf extract) the bio-stimulants caused an increase in plant growth characters and pod yield and its components as well as borpota fertilizer of sugar pea cv. sugar snap.

Table (6): Effect of foliar application with some natural substances on pod yield and its components of sugar pea in the two seasons of 2022/2023 and 2023/2024 at maturity stage

Treatments	Average pod weight (g)		Pod yield/ plant (g)		Total pod yield (ton/fed.)	
	2022/2023	2023/2024	2022/2023	2023/2024	2022/2023	2023/2024
Control	4.98 e	3.64 f	125.52 e	133.20 g	7.39 e	6.85 f
CA 100 ppm	5.60 cde	4.80 de	145.27 cd	167.48 fe	8.59 cd	8.40 de
CA 200 ppm	6.63 ab	5.85 cab	190.80 b	206.73 b	11.28 b	9.59 c
AVE20 ml/l	5.33 de	3.74 f	137.82 d	137.85 g	8.15 d	7.12 f
AVE40 ml/l	6.49 ab	5.62 cdb	154.58 c	194.35 c	9.14 c	8.75 d
Borpota 1 ml/l	5.40 de	4.33 fe	143.64 cd	159.96 f	8.49 cd	8.26 e
Borpota 2 ml/l	6.33 cab	5.49 cdb	146.38 cd	177.93 d	8.65 cd	8.74 d
ASA 100 ppm	6.09 cdb	5.23 cdeb	145.70 cd	171.91 de	8.61 cd	8.47 de
ASA 200 ppm	7.07 a	6.80 a	205.36 a	232.46 a	12.15 a	11.85 a
SA 100 ppm	6.04 cdb	4.91 cde	145.55 cd	171.12 de	8.60 cd	8.42 de
SA 200 ppm	7.04 a	6.14 ab	202.28 a	213.52 b	11.96 a	10.91 b
LSD (0.05)	0.8254	0.9569	11.236	8.4562	0.6665	0.3746

*Means followed by the same letter within a column are not significantly different at 0.05 level of probability according to Duncan multiple range test. CA (Citric acid), AVE (aloe vera leaf extract), ASA (Ascorbic acid), SA (salicylic acid)

Table (7): Effect of foliar application with some natural substances on the physical pod characters of sugar pea in the two seasons of 2022/2023 and 2023/2024 at maturity stage

Treatments	No of pods/ Plant		Pod length (cm)		Pod diameter (mm)		Pod thickness (mm)	
	2022/2023	2023/2024	2022/2023	2023/2024	2022/2023	2023/2024	2022/2023	2023/2024
Control	21.66 e	25.53 g	6.63 e	6.25 c	11.73 d	13.16 c	6.55 g	6.76 f
CA 100 ppm	28.00 d	32.91 ef	7.06 cde	6.73 cab	13.23 cd	14.16 cab	7.79 edf	8.20 de
CA 200 ppm	51.30 a	54.66 ab	7.81 ab	7.19 a	14.68 cab	15.06 a	8.55 bc	9.40 b
AVE20 ml/l	26.16 de	30.00 gf	6.72 e	6.37 cb	12.08 d	13.26 cb	7.18 gf	7.46 ef
AVE40 ml/l	45.81 b	42.83 cd	7.69 ab	7.11 a	14.63 cab	15.06 a	8.36 dc	9.26 bc
Borpota 1 ml/l	27.54 d	32.58 ef	6.95 de	6.71 cab	13.12 cd	13.40 cb	7.34 ef	7.56 ef
Borpota 2 ml/l	41.57 bc	44.50 c	7.52 cab	7.04 a	14.39 cab	14.60 ab	8.34 dc	8.80 dbc
ASA 100 ppm	39.45 c	42.00 cd	7.51 cab	6.96 ab	13.70 cb	14.33 cab	8.03 edc	8.33 dec
ASA 200 ppm	54.11 a	60.16 a	8.03 a	7.27 a	15.46 a	15.30 a	10.12 a	11.03 a
SA 100 ppm	37.91 c	37.16 ed	7.30 cdb	6.74 cab	14.25 cab	14.46 cab	8.22 dc	8.80 dbc
SA 200 ppm	52.31 a	54.66 ab	7.89 a	7.22 a	15.13 ab	15.16 a	9.06 b	9.50 b
LSD (0.05)	4.8287	6.7223	0.5208	0.6439	1.5971	1.3369	0.6987	0.9719

*Means followed by the same letter within a column are not significantly different at 0.05 level of probability according to Duncan multiple range test.
CA (Citric acid), AVE (aloe vera leaf extract), ASA (Ascorbic acid), SA (salicylic acid).

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إستجابة نمو وإنتاجية قرون البازلاء السكرية لبعض المحفزات الصديقة للبيئة

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** . قسم التربة والمياه ،كلية الطب البيطري والزراعة -جامعة الزاوية، ليبيا

أجريت هذه الدراسة في المزرعة التجريبية، بمحطة بحوث القصاصين، محافظة الإسماعيلية، مصر، خلال موسمي الشتاء المتتاليين ٢٠٢٢/٢٠٢٣ ٢٠٢٣/٢٠٢٤، لدراسة تأثير التسميد الورقي الطبيعي، (حمض الساليسيليك وحمض الأسكوربيك وحمض الستريك ومستخلص الصبار) وسماد البوربوتا على صفات النمو ومحصول قرون البازلاء السكرية صنف (Sugar snap)

تضمنت هذه التجربة ١١ معاملة بنظام القطاعات الكاملة العشوائية (RCBD) في ثلاث مكررات. اشتملت التجربة علي ١١ معاملة كايلي:

المقارنة (رش بماء الصنبور فقط)، حمض الساليسيليك ١٠٠ ملجم / لتر- ،حمض الساليسيليك ٢٠٠ ملجم / لتر) ، حمض الأسكوربيك ١٠٠ ملجم / لتر)، حمض الأسكوربيك ٢٠٠ ملجم / لتر ، حمض الستريك ١٠٠ ملجم / لتر، حمض الستريك ٢٠٠ ملجم / لتر ، مستخلص الصبار ٢٠ مل/لتر، مستخلص الصبار ٤٠ مل/لتر، بوربوتا ١ مل/لتر ثم بوربوتا ٢ مل/لتر.

أمكن تلخيص النتائج التي تم الحصول عليها على النحو التالي؛

أدت جميع المعاملات الورقية المدروسة إلى زيادة كبيرة في قياسات النمو، أي ارتفاع النبات، وعدد الأفرع وعدد الأوراق، ومحصول القرون للبازلاء السكرية ومكوناتها وهي ؛ متوسط وزن القرون، عدد القرون/نبات، محصول القرون/نبات، محصول القرون/فدان، طول القرون، وقطر القرون.

أشارت هذه النتائج إلى أن الرش الورقي بحمض الأسكوربيك (فيتامين ج) بالمعدل الأعلي هو الأكثر فعالية في جميع صفات النمو الخضري، ومحصول القرون ومكوناته في البازلاء السكرية وتبعت هذه المعاملات معاملات حمض الساليسيليك وحمض الستريك ومستخلص الصبار وسماد البوربوتا بالمعدل الأعلي أيضا ، على التوالي.

التوصية: يمكن التوصية باستخدام المحفزات الحيوية (حمض الأسكوربيك وحمض الساليسيليك وحمض الستريك ومستخلص الصبار وسماد البوربوتا أدى إلى زيادة صفات النمو الخضري للنباتات ومحصول القرون ومكوناته في قرون البازلاء السكرية.

الكلمات المفتاحية: البازلاء السكرية – النمو – محصول القرون –المحفزات الحيوية – سماد البوربوتا