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EFFECT OF SOME STIMULANTS AS FOLIAR APPLICATION ON GROWTH, YIELD AND FRUIT QUALITY OF CUCUMBER UNDER PLASTIC HOUSE CONDITIONS

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ABSTRACT: During the 2018/2019 and 2019/2020 winter seasons, this experiment was conducted under plastic houses conditions in Fayoum Governorate Egypt, to investigate the effects of some stimulants on cucumber growth, yield and fruit quality of cucumber (*Cucumis sativus* L.) Barracuda F1 hybrid. This experiment included nine treatments as follows: Spraying with tap water (control), sodium selenate (NaSel) at 2,4 and 6mg/l, humic acid (HA) at 1, 2 and 3 g/l, potassium silicate (KSil at 4 and 6 ml/l. These treatments were arranged in a randomized complete block design with three replicates ,Spraying cucumber plants with HA at 3 g/l or KSil at 6 ml/l increased dry weight of leaves, branches and shoots/plant, chlorophyll a, b and total (a+b), number of fruits/plant, average fruit weight, yield/plant and yield /m^2. Foliar spray with KSil at 6 ml /l increased TSS, Vit. C, DM% and K contents in fruits, whereas HA at 2 and 3 g /l or KSil at 4 or at 6 ml /l increased fruit length. It can be concluded that cucumbers are highly responsive to foliar applications of potassium silicate and humic acid, followed by selenium spraying, and the yield can be increased by 58.64 % and 48.79 %, respectively, by spraying with potassium silicate at 6 ml/l and humic acid at 3 g/l (average two seasons).

Key words: Cucumber, humic acid, potassium silicate, sodium selenate, foliar application, dry weight, yield, fruit quality.

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is the fourth most important vegetable crop after tomato, cabbage, and onion **(Tatlioglu, 1993**). Due to its short life cycle, cucumber is the most popular crop grown under protected conditions. In regulated conditions, parthenocarpic and gynoecious cucumber cultivars have a higher potential for producing a large fruit load, leading in a high harvest index. Plants with a high harvest index will make better use of the limited growing space available in a growth chamber (**Meena *et al.*, 2017)**.

Humic compounds are classified as organic fertilizers since they contain a variety of minerals that are essential for plant growth, such as nitrogen, phosphorus, potassium and some elements such as zinc, ferric, copper and magnesium. **(Ajalli *et al.*, 2013)**.. Humates appear to have a particularly beneficial influence on nutrient availability, according to earlier research. As a result, the use of humates was investigated as a way to promote both nutritional balance and plant vigour **(Boehme *et al.*, 2005).**

Some authors reported that spraying plant with humic acid significantly enhanced plant growth **(El-Desuki, 2012; El-Nemr *et al.*, 2012** on cucumber), leaf pigments **(Unlu *et al.*, 2011** on cucumber), early and total yield **(Unlu *et al.*, 2011; Shafeek *et al.*, 2016; El-Hamady *et al.*, 2017** and **Meena *et al.*, 2017** on cucumber) and fruit quality **(Al-Madhagi,2019** on cucumber).

Selenium is a component that resembles sulphur. Selenium is an essential element with significant plant nutrition effects. It is beneficial

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for plant growth particularly under stress conditions (**Feng, 2013**). Selenium protects plants from various stress factors particularly drought, salinity and UV radiation (**Hajiboland and Keivanfar, 2012**). Although selenium is not a required element for plant growth, it has been shown to boost plant growth. Selenium is a microelement that has antioxidant, anticancer and antiviral properties that are beneficial to human and animal health. There is no proof that it is required for plant growth **(Lyons *et al.*, 2004).**

Treated plants with selenium improved dry weight **(Yassen *et al.*, 2011** on potato and **Abul-Soud and Abd-Elrahman, 2016** on eggplant**),** leaf pigments (**Haghighi *et al.* 2016** on cucumber), productivity (**El-Hamady *et al.*, 2017** on pepper , **Shalaby and Ramadan, 2017** on lettuce and **Ghazi, 2018** on eggplant) and fruit quality (**Belal, 2020** on tomato and **Shalaby *et al.*, 2021** on cucumber).

After absorption by plants, silicon is deposited in the walls of epidermal cells, which contributes significantly to stem strength. In plants, silicon is not a very mobile element **(Epstein, 1999)**. Silicon's role in plant biology is to alleviate a variety of stressors, both biotic and a biotic. It is also known to improve plant drought tolerance by maintaining plant water balance, photosynthetic activity, leaf erectness, and xylem vessel structure under high transpiration rates (**Epstein, 2001**).

Spraying plants with potassium silicate enhanced dry weight (**Dawa *et al.*, 2017; Shehata *et al.*, 2018** on cucumber**)** leaf chlorophyll (**Abd El-Gawad *et al.* 2017** on potato), yield and its components (**Gorecki and Danieski-Busch, 2009; Abd-Alkarim *et al.*, 2017; Shehata *et al.*, 2018** on cucumber, and **Abd-Elaziz *et al.*, 2019** and **Salama *et al.*, 2019** on squash) and fruit quality (**Soundharya *et al.*, 2019** on tomato and**, Nada 2020** on Strawberry).

The major goal of this study was to see how certain stimulants, such as humic acid, selenium, and silicon, affectes cucumber growth, productivity and fruit quality under plastic houses conditions.

MATERIALS AND METHODS

During the 2018/2019 and 2019/2020 winter seasons, this experiment was conducted under plastic houses conditions in Fayoum Governorate Egypt, to investigate the effects of some stimulants on cucumber growth, yield, and fruit quality (*Cucumis sativus* L.) cv. Barracuda F_1 hybrid. This experiment included nine treatments as follows: Spraying with tap water (control), sodium selenite at 2,4 and 6 mg/l, humic acid at 1, 2 and 3 g/l, potassium silicate at 4 and 6 ml /l. These treatments were arranged in a randomized complete block design with three replicates.

The area of each plot was $5m^2$ (5 m long and 1 m width) with 20 plants. Seeds of cucumber cv. Barracuda F1 hybrid were sown in the nursery on 7th and 10th November and seedlings were transplanted in the greenhouse on 12th and 14th December in the 1st and 2nd seasons, respectively. The plastic houses were 40 m long and 8.5 m wide (340 m^2) and were divided into 6 beds, each 1 m wide and 40 m long. Seedlings were planted on two sides of each bed at 50 cm apart. One side was used for the samples to measure vegetative growth and the other side was used for yield determination. Cucumber plants were sprayed three times at 15 day intervals with different concentrations of all stimulants beginning three weeks after transplanting utilizing a hand-held sprayer.

All plots received the recommended rate of N, P and K (150 kg. N, 75 kg. P_2O_5 and 150 kg. K_2O/feddan), respectively as ammonium sulphate (20.5%N), calcium super phosphate (15.5% P_2O_5) and potassium sulphate (48 % K_2O). The normal agricultural practices in the experiment were carried out as commonly followed in the district.

Data Recorded

Dry weight

Random sample of three plants were randomly taken at 75 days after planting from every experimental unit to measure dry weight of different plant parts, i.e., leaves, branches and shoot (leaves + branches) dry weight/plant after dried in oven at 70°C till constant weight.

Photosynthetic pigments

Ten discs samples from the fourth upper leaf of the plant tip from every experimental unit were randomly taken at 75 days after planting in both seasons to determine chlorophyll a, b and total chlorophylls as well as carotenoides according to the method described by **Wettestein (1957**).

Total fruit yield

Cucumber fruits from every experimental unit at marketable stage were harvested twice weekly. At harvest time, the number of fruits/ plant, average weight of fruit and yield (kg/ plant) as well as per square meter were recorded.

Fruit quality

Five fruits were randomly taken from every experimental unit of all pickings to measure the physical and chemical characters of the fruits in both seasons as follows:

Fruit length (cm) and, fruit diameter (cm). Total soluble solids percentage (TSS) were determined by using a hand refractometer**.** Vitamin C (Ascorbic acid) was measured by titration with iodide potassium according to the method of **Ranganna (1986)** and calculated as mg vitamin C/ 100 ml juice.**for** Fruit dry matter measurement, randomly fruit samples of 100 g of fresh weight were dried in oven at 105° C till the constant weight then the percentage of fruit dry matter was calculated. Nitrogen, phosphorus, and potassium were determined on the basis of dry matter according to the methods described by **Bremner and Mulvaney (1982), Olsen and Sommers (1982) and Jackson (1970**), respectively.

Statistical Analysis

Collected data were subjected to proper statistical analysis of variance according to **Snedecor and Cochran (1980)** and the differences among treatments were compared using Duncans' multiple range test (**Duncan, 1958**), where means had different letters were statistically significant, and those means followed by the same letter were statistically insignificant.

RESULTS AND DISCUSSION

Dry Weight

The obtained results in Table 1 indicate that humic acid (HA), sodium selenate (Na_2seo_3) and potassium silicate (k_2o_3si) at different rates increased dry weight of leaves, branches and shoot dry weight/plant of cucumber at 75 days after planting compared to control (spraying with water), spraying cucumber plant with HA at 3 g/l and KSil at 6 ml/l increased dry weight/ of leaves , branches and shoots/plant. Sodium selenate at 2, 4 and 6 ml/l gave the lowest values of dry weight compared to HA at 1, 2 and 3 ml / l and KSil at 4 and 6 ml/l in both seasons.

The increases in dry weight of shoots/ plant were about 65.1 and 60% for KSil at 6 ml/l, 61.2 and 54.9% for HA at 3 g /l over the control in the 1st and 2nd seasons, respectively.

This increment in dry weight of cucumber plants may be due to the role of potassium on plant nutrition and enhancing the translocation of assimilates and protein synthesis. Silicon addition to plants reduced the inhibition effect on cucumber growth and photosynthesis, also the improving effect of silicon seemed to be due to increasing root hydraulic conductance of the plants (**Shi *et al*., 2016**).

Humic substances had a beneficial effect on plant physiology. It was noted that it had direct effects on cell membrane permeability, respiration, nucleic acid, biosynthesis, ion absorption, hormone and enzyme activity (**Chen and Schnitzer, 1978**). The indirect effect of the humic acid provides minerals and biochemical substances, increases the microorganisms which carries trace elements and growth promoters **(Unlu *et al*., 2011).**

Similar trained due to sprayeing humic acid to cucumber were obtained by **El-Desuki(2012) and El-Nemr *et al*.,(2012**), also spraying plants with potassium silicate significantly increased all parameters of dry weight, in this concern, (**Dawa *et al*., 2017 and Shehata *et al*. 2018** on cucumber) came the similar results.

Photosynthetic Pigments

Spraying with some stimulants (HA, Na_2seo_3 and k_2o_3si) at different rates increased the concentrations of chlorophyll a, b, total chlorophyll a+b and carotenoides in leaf tissues at 75 days after planting compared to control (sprayed with water) in both seasons as show in Table 2. Foliar spray with HA at 3 g/l followed by HA at 2 g/l increased the concentration of chlorophyll a, b and total (a+b), whereas spraying with Na_2seo_3 at 2 mg/l increased the concentration of carotenoides in leaf tissues at 75 days after planting.

Table 1. Effect of foliar spray with some stimulants on dry weight of different organs at 75 days after planting of cucumber plants during 2018/2019 and 2019/2020 seasons under plastic house conditions

Treatments	Dry weight of leaves (g)	Dry weight of branches (g)	Dry weight pf shoots (g)	Relative increases in shoot dry weight (%)
		2019 season		
Spraying with water (control)	14.59 g	13.66 e	28.25 f	100.0
HA at 1 g/l	21.29 d	16.64 c	37.93 c	134.3
HA at 2 g/l	24.61 c	18.20 b	42.81 b	151.5
HA at 3 g/l	26.94 a	18.60 b	45.54 a	161.2
NaSel at 2 mg/l	17.56 f	14.00 e	31.56 e	111.7
NaSel at 4 mg/l	17.95 f	15.00 d	32.95 d	116.6
NaSel at 6 mg/l	18.84 e	15.02 d	33.86 d	119.9
KSil at 4 ml /l	25.60 b	18.26 b	43.86 b	155.3
KSil at 6 ml /l	27.37 a	19.27 a	46.64 a	165.1
		2020 season		
Spraying with water (control)	15.63 e	12.82 f	28.45 f	100.0
HA at 1 g/l	21.14 c	15.86 d	37.00 c	130.1
HA at 2 g/l	23.19 b	17.42 c	40.61 b	142.7
HA at 3 g/l	25.62 a	18.46 b	44.08 a	154.9
NaSel at 2 mg/l	18.95 d	13.29 f	32.24 e	113.3
NaSel at 4 mg/l	18.77 d	14.77 e	33.54 de	117.9
NaSel at 6 mg/l	20.57 c	14.43 e	35.00 d	123.0
KSil at 4 ml /l	25.60 a	18.67 b	44.27 a	155.6
KSil at 6 ml /l	26.01 a	19.52 a	45.53 a	160.0

HA= humic acid, NaSel= Sodium selenate and KSil= potassium silicate.
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 2. Effect of foliar spray with some stimulants on leaf pigments (mg/g DW) at 75 days after planting of cucumber plants during 2018/2019 and 2019/2020 season under plastic house conditions

Treatments	Chlorophyll a	Chlorophyll b	Chlorophyll a+b	Carotenoides
		2019 season		
Spraying with water (control)	2.65 h	1.18 ef	3.83 de	1.52 c
HA at 1 g/l	3.12 e	1.35 d	4.47 c	1.79 b
HA at 2 g/l	3.48 b	1.70 b	5.18 b	1.56 c
HA at 3 g/l	3.62 a	1.82 a	5.44 a	1.48 c
NaSel at 2 mg/l	2.71 gh	1.07 g	3.78 e	2.03 a
NaSel at 4 mg/l	2.74 g	1.08 fg	3.82 de	2.09 a
NaSel at 6 mg/l	2.84 f	1.20 e	4.04 d	2.07 a
KSil at 4 ml /l	3.25 d	1.43 d	4.68 c	1.34 d
KSil at 6 ml /l	3.39 c	1.56 c	4.95 b	1.38 d
		2020 season		
Spraying with water (control)	2.57 f	1.08 d	3.65 e	1.62 d
HA at 1 g/l	3.21 d	1.40 c	4.61 c	1.74 c
HA at 2 g/l	3.55 ab	1.65 a	5.20 ab	1.78 c
HA at 3 g/l	3.59 a	1.74 a	5.33 a	1.59 d
NaSel at 2 mg/l	2.67 f	1.09 d	3.76 e	2.07 a
NaSel at 4 mg/l	2.80 e	1.17 d	3.97 d	1.97 b
NaSel at 6 mg/l	2.84 e	1.13 d	3.97 d	2.01 ab
KSil at 4 ml /l	3.34 c	1.42 c	4.76 c	1.48 e
KSil at 6 ml /l	3.46 bc	1.55 b	5.01 b	1.42 e

HA= humic acid , NaSel= Sodium selenate and KSil= potassium silicate.

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.

Humic acid may be caused an enhancement in the synthesis of the chlorophyll and/or delayed chlorophyll degradation in the two different types of leaves, primary and lateral shoot leaves (**Nardi *et al.*, 2002**). Also, humic substances may inhibit the biosynthetic pathway of chlorophyll, stimulate the degradative pathway of chlorophyll **(Yang *et al.*, 2004**). Silicon can mitigate K deficiency stress, because it increases the levels of chlorophyll and antioxidant compounds (carotenoides). This favors photosynthesis rates and decreases transpiration, thereby increasing the efficiency of water use and dry matter production **(Ma, 2004)**.

These results are in harmony with those obtained by **Haghighi *et al*. (2016**) on cucumber regarding humic acid effect and **Abd El-Gawad *et al*. (2017)** on potato as for potassium silicate effect .

Early Yield and its Components

Foliar spray with humic acid at 3 g/l and KSil at 6 ml/l increased the number of early fruits/plant, average early fruit weight, early yield/plant and early yield/m^2 in both seasons, followed by spraying with HA at 2 g /l (Table 3).

The increases in early yield/m^2 were about 65.52 and 49.08% for HA at 3 g/l and 76.31 and 59.48% for KSil at 6 ml/l and 56.26 and 35.69% for HA at 2g /l over the control in the 1st and 2nd seasons, respectively.

Total Yield and its Components

Spraying cucumber plants grown under plastic house conditions with HA, Na_2seo_3 and k_2o_3si at different rates increased yield and its components compared to control in both seasons (Table 4). Also, HA at 3 g/l and k_2o_3si at 6 ml /l increased number of fruits/plant, average fruit weight, yield/plant and total yield/m^2, followed by HA at 2g/l and k_2o_3si at 4 ml/l in both seasons.

The increases in total yield/m^2 were about 43.40 and 39.83% for HA at 2 g/l, 48.79 and 58.64% for HA at 3 g/l, 42.12 and 53.09% for KSil at 4 ml /l and 54.42 and 59.45 % for KSil at 6 ml/l over the control in the 1st and 2nd seasons, respectively.

Humic acid led to increase the permeability of plant membranes, promote the uptake of nutrients, reduce impacts of disease and stimulate plant growth all of this led to increase yield of fruits. Also the stimulative effect of humic acid may be due to: 1-Enhancing productivity via increasing the vegetative growth parameters and female flowers which reflects on cucumber yield. 2- Enhancement of cell division and cell enlargement. These results are in conformity with the findings of **Khalil *et al.* (2011**) on cucumber.

Silicon may enhance soil fertility and uptake of water and other nutrient elements, improve disease and pest resistance and plant growth, photosynthesis and yield (**Samuels *et al.*, 1993**). Also, foliar spray with potassium silicate of cucumber plants increased yield which was enhanced with the number of fruits per plant (**Gorecki and Danieski-Busch, 2009**).

These findings were in accordance with those obtained by **Unlu *et al.* (2011), Shafeek *et al*. (2016), El-Hamady *et al*. (2017)** and **Meena *et al.* (2017)** on cucumber. All reported that spraying cucumber with humic acid significantly enhanced all components of yield, *i.e.*, number of fruits/plant, average fruit weight and total yield. Also, spraying with potassium silicate recorded the best values for increasing yield and its components, in this regard **(Gorecki and Danieski-Busch, 2009; Abd-Alkarim *et al.*, 2017; Shehata *et al*., 2018** on cucumber and **Abd-Elaziz *et al*., 2019; Salama *et al*., 2019)** on squash. Moreover, Se foliar applications improved all parameters of yield than unsprayed plants (**El-Hamady *et al*., 2017** on pepper, **Shalaby and Ramadan (2017)** on lettuce and Ghazi 2018 on eggplant).

Fruit Quality

Shape (Tables 5, 6 and 7) foliar spray with KSil at 6 ml/l increased TSS, Vit C, DM% and K contents with no significant differences with KSil at 4 ml /l with respect to TSS, Vit C and K contents in the 1st season, whereas HA at 2 and 3 g /l and KSil at 4 and 6 ml /l increased fruit length.

Potassium silicate is a source of highly soluble potassium and silicon so it is used in agricultural production system primarily as a silicon amendment source and has utilized of supplying small amounts of potassium help to improve the quality of yield (**Talebi *et al.*, 2015**).

Table 3. Effect of foliar spray with some stimulants on early yield of cucumber plants during 2018/2019 and 2019/2020 season under plastic house conditions

Treatments	Number of fruits / plant	Avege fruit weight (g)	Yield / plant (kg)	Yield / (kg/m^2)	Relative increases in early yield (%)
			2019 season		
Spraying with water (control)	16.76 e	48.35 f	0.810 h	1.621 h	0.00
HA at 1 g/l	19.16 c	59.91 c	1.148 d	2.296 d	41.64
HA at 2 g/l	20.71 b	61.15 bc	1.266 c	2.533 c	56.26
HA at 3 g/l	20.96 b	64.01 a	1.342 b	2.683 b	65.52
NaSel at 2 mg/l	17.44 de	49.06 f	0.856 g	1.711 g	5.55
NaSel at 4 mg/l	17.62 d	50.47 e	0.889 f	1.779 f	9.75
NaSel at 6 mg/l	18.05 d	52.34 d	0.945 e	1.889 e	16.53
KSil at 4 ml /l	20.31 b	62.24 b	1.264 c	2.528 c	55.95
KSil at 6 ml /l	22.00 a	64.95 a	1.429 a	2.858 a	76.31
			2020 season		
Spraying with water (control)	17.950 c	48.48 f	0.870 d	1.740 e	0.00
HA at 1 g/l	19.020 bc	53.29 d	1.014 c	2.027 d	16.49
HA at 2 g/l	20.880 ab	56.53 c	1.180 b	2.361 c	35.69
HA at 3 g/l	21.610 a	60.03 b	1.297 a	2.594 b	49.08
NaSel at 2 mg/l	18.520 c	49.86 ef	0.923 cd	1.847 e	6.15
NaSel at 4 mg/l	18.330 c	50.53 e	0.926 cd	1.852 e	6.44
NaSel at 6 mg/l	18.140 c	51.24 e	0.929 cd	1.859 e	6.84
KSil at 4 ml /l	21.310 a	60.45 b	1.288 a	2.576 b	48.05
KSil at 6 ml /l	22.210 a	62.47 a	1.387 a	2.775 a	59.48

HA= humic acid , NaSel= Sodium selenate and KSil= potassium silicate.

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 4. Effect of foliar spray with some stimulants on yield and its components of cucumber plants during 2018/2019 and 2019/2020 seasons under plastic house conditions

Treatments	Number of fruits/plant	Avege fruit weight (g)	Yield/ plant (kg)	Yield (kg/ m^2)	Relative increases in total yield (%)
			2019 season		
Spraying with water (control)	48.90 e	69.07 g	3.378 g	6.755 g	00.00
HA at 1 g/l	56.23 c	79.87 d	4.491 d	8.982 d	32.97
HA at 2 g/l	59.53 ab	81.36 c	4.843 c	9.687 c	43.40
HA at 3 g/l	60.23 ab	83.44 b	5.026 b	10.051 b	48.79
NaSel at 2 mg/l	48.43 e	70.08 g	3.394 g	6.788 g	00.49
NaSel at 4 mg/l	50.10 e	72.10 f	3.612 f	7.224 f	06.94
NaSel at 6 mg/l	52.98 d	74.78 e	3.962 e	7.924 e	17.31
KSil at 4 ml /l	58.50 b	82.05 c	4.800 c	9.600 c	42.12
KSil at 6 ml /l	61.43 a	84.90 a	5.215 a	10.431 a	54.42
			2020 season		
Spraying with water (control)	50.38 d	68.83 f	3.468 f	6.935 e	0.00
HA at 1 g/l	52.85 c	76.13 d	4.023 d	8.047 c	16.03
HA at 2 g/l	57.98 b	83.62 c	4.848 c	9.697 b	39.83
HA at 3 g/l	60.05 a	91.61 a	5.501 a	11.002 a	58.64
NaSel at 2 mg/l	50.93 d	68.92 f	3.510 f	7.020 e	1.23
NaSel at 4 mg/l	51.43 cd	69.26 f	3.562 f	7.124 de	2.73
NaSel at 6 mg/l	53.08 c	72.19 e	3.832 e	7.664 cd	10.51
KSil at 4 ml /l	59.50 ab	89.22 b	5.309 b	10.617 a	53.09
KSil at 6 ml /l	60.03 a	92.10 a	5.529 a	11.058 a	59.45

HA= humic acid, NaSel= Sodium selenate and KSil= potassium silicate

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 5. Effect of foliar spray with some stimulants on fruit length and diameter of cucumber during 2018/2019 and 2019/2020 seasons under plastic house conditions

Treatments	Fruit length (cm)	Fruit diameter (cm)
	2019 season	
Spraying with water (control)	12.89 b	3.19 a
HA at 1 g/l	14.69 a	3.42 a
HA at 2 g/l	14.79 a	3.70 a
HA at 3 g/l	14.97 a	3.74 a
NaSel at 2 mg/l	13.54 b	3.22 a
NaSel at 4 mg/l	13.46 b	3.37 a
NaSel at 6 mg/l	13.59 b	3.40 a
KSil at 4 ml /l	15.24 a	3.81 a
KSil at 6 ml /l	15.44 a	3.62 a
	2020 season	
Spraying with water (control)	12.23 d	3.06 a
HA at 1 g/l	13.89 b	3.40 a
HA at 2 g/l	14.01 b	3.73 a
HA at 3 g/l	14.84 a	3.86 a
NaSel at 2 mg/l	13.11 c	3.08 a
NaSel at 4 mg/l	13.09 c	3.27 a
NaSel at 6 mg/l	13.96 b	3.49 a
KSil at 4 ml /l	14.99 a	4.00 a
KSil at 6 ml /l	14.81 a	4.00 a

HA= humic acid , NaSel= Sodium selenate and KSil= potassium silicate

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 6. Effect of foliar spray with some stimulants on TSS, Vit C and DM (%)of cucumber fruits during 2018/2019 and 2019/2020 seasons under plastic house conditions

Treatments	TSS	Vitamin C (mg /100 ml juice)	Dry matter (%)
		2019 season	
Spraying with water (control)	3.33 g	6.28 e	4.22 f
HA at 1 g/l	3.55 f	7.26 b	4.26 ef
HA at 2 g/l	3.67 e	7.24 b	4.30 ef
HA at 3 g/l	3.72 e	7.31 b	4.36 e
NaSel at 2 mg/l	4.04 d	6.37 e	4.35 e
NaSel at 4 mg/l	4.23 c	6.55 d	4.58 d
NaSel at 6 mg/l	4.56 b	6.80 c	5.27 c
KSil at 4 ml /l	4.77 a	8.03 a	5.42 b
KSil at 6 ml /l	4.82 a	8.17 a	5.58 a
		2020 season	
Spraying with water (control)	3.37 h	6.22 e	4.14 f
HA at 1 g/l	3.52 g	6.92 c	4.22 f
HA at 2 g/l	3.77 f	7.00 c	4.22 f
HA at 3 g/l	3.77 f	7.06 c	4.32 e
NaSel at 2 mg/l	4.03 e	6.30 e	4.44 d
NaSel at 4 mg/l	4.40 d	6.26 e	4.78 c
NaSel at 6 mg/l	4.66 c	6.56 d	5.39 a
KSil at 4 ml /l	4.77 b	8.02 b	5.15 b
KSil at 6 ml /l	4.94 a	8.28 a	5.33 a

HA= humic acid , NaSel= Sodium selenate and KSil= potassium silicate

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 7. Effect of foliar spray with some stimulants on N, P and K contents in fruit of cucumber during 2018/2019 and 2019/2020 seasons under plastic house conditions

Treatments	N (%)	P (%)	K (%)
		2019 season	
Spraying with water (control)	1.32 e	0.286 g	2.33 f
HA at 1 g/l	1.78 bc	0.494 b	2.88 c
HA at 2 g/l	1.85 ab	0.497 b	2.90 c
HA at 3 g/l	1.87 a	0.532 a	3.00 b
NaSel at 2 mg/l	1.43 d	0.314 f	2.56 e
NaSel at 4 mg/l	1.48 d	0.311 f	2.59 e
NaSel at 6 mg/l	1.48 d	0.350 e	2.73 d
KSil at 4 ml /l	1.72 c	0.445 d	3.18 a
KSil at 6 ml /l	1.75 c	0.485 c	3.23 a
		2020 season	
Spraying with water (control)	1.25 d	0.288 e	2.31 e
HA at 1 g/l	1.73 b	0.447 b	2.65 d
HA at 2 g/l	1.79 ab	0.462 b	2.76 cd
HA at 3 g/l	1.91 a	0.489 a	2.97 ab
NaSel at 2 mg/l	1.39 cd	0.314 d	2.59 d
NaSel at 4 mg/l	1.48 c	0.330 cd	2.64 d
NaSel at 6 mg/l	1.51 c	0.342 c	2.89 bc
KSil at 4 ml /l	1.75 b	0.443 b	3.09 a
KSil at 6 ml /l	1.76 b	0.453 b	3.10 a

HA= humic acid , NaSel= Sodium selenate and KSil= potassium silicate

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.

Similar results were obtained by **Al-Madhagi (2019)** on cucumber as for humic acid effect, **Belal 2020** on tomato and **Shalaby *et al*. (2021)** on cucumber as for selenium effect and **Soundharya *et al*. (2019)** on tomato and **Nada 2020** on Strawberry as for potassium silicate.

Conclusion

Based on the findings, it can be concluded that cucumbers are highly responsive to foliar applications of potassium silicate and humic acid, followed by selenium spraying, and that yield can be increased by 58.64 percent and 48.79 percent, respectively, by spraying potassium silicate at 6 ml/l and humic acid at 3 g/l (average two seasons).

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تأثير الرش الورقي ببعض المحفزات علي النمو والمحصول وجودة ثمار الخيار تحت ظروف البيوت البلاستيكية

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أجري هذا البحث خلال شتاء موسمي 2019/2018، 2020/2019 تحت ظروف البيوت البلاستيكية بمحافظة الفيوم، مصر. وذلك لدراسة تأثير بعض المحفزات علي النمو والمحصول وجودة ثمار الخيار صنف باراكودا هجين جيل اول. وقد اشتملت هذه التجربة علي 9 معاملات كالتالي الرش بالماء (معاملة المقارنة)، سيلنات الصوديوم بتركيز (2، 4، 6) ملليجرام/لتر، حمض الهيومك بمعدل 1، 2 ، 3 جرام/لتر، سيلكات البوتاسيوم بتركيز (4، 6) ملليلتر/لتر، وقد وزعت المعاملات في قطاعات كاملة العشوائية وفي ثلاث مكررات، وسجلت معاملة رش الخيار بحمض الهيومك بمعدل 3 جرام /لتر والرش بسلكات البوتاسيوم بمعدل 6 ملليلتر/لتر زيادة في كلا من الوزن الجاف للأوراق والافرع والوزن الجاف الكلي للعرش لكلورفيل أ،ب ولكلورفيل الكلي أ+ب، وعدد الثمار على النباتات، متوسط وزن الثمرة ومحصول النبات/المتر مربع. سجل الرش بسليكات البوتاسيوم بمعدل 6ملليلتر/لتر زيادة في محتوي الثمار من المواد الصلبة الذائبة الكلية وفيتامين ج نسبة المادة الجافة ومحتوي الثمار من البوتاسيوم. بينما سجلت معاملات الرش بحممض الهيومك بتركيز 2، 3 جرام/لتر، أو سليكات البوتاسيوم 4 و 6ملليلتر/لتر زيادة في طول الثمرة، ويمكن التوصية بأن للخيار استجابة عالية للرش بكل من سليكات البوتاسيوم أو حمض الهيومك ويليهما الرش بالسيلنيوم. وكانت الزيادة في المحصول بنسبة 58,64%، 48,79% بالرش بسليكات البوتاسيوم بتركيز 6 ملليلتر/لتر أو حمض الهيومك بمعدل 3 جرام/لتر علي التوالي (متوسط الموسمين).

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