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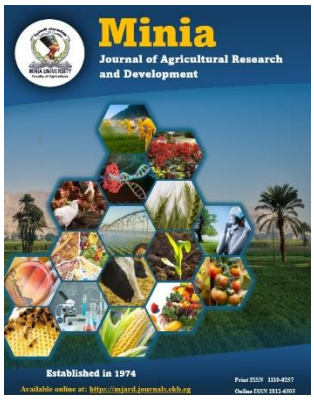

Role of Some Stimulants Materials for Improve Growth, Yield and Quality of Color Sweet Pepper Hybrids Under Plastic Houses Conditions

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ABSTRACT

Growth, yield, and quality for two hybrids of color sweet pepper as influenced by some stimulant materials i-e chitosan with concentration (250 ppm), melatonin with (50 ppm) and potassium silicate with (2000 ppm) in addition to control. were studied. The experiments were carried out in two successive seasons 2021/ 2022 and 2022/ 2023 at the farm and laboratories of the Horticulture Department Faculty of Agriculture Minia University, El Minia Governorate, Egypt, under plastic house conditions. The experiment was laid out as CRBD in the split plots design where the two hybrids were done out in the main plot and the stimulant materials were distributed in a subplot with three replicates. The results revealed that most growth parameters, yield, and its components such as average fruit weight and the number of fruits/plant in addition to some fruit quality i-e fruit wall thickness were improved significantly after spraying these materials compared to control plants (those plants which sprayed with water). Among these materials spraying plants with potassium silicate improved the number of fruits/plant, number of branches/plant, fresh weight of plant, and total yield. While spraying with melatonin had improved the average fruit weight, average fruit length, and dry weight of the plant, on the other hand spraying with chitosan had improved the average plant height.

Keywords: Sweet pepper, hybrids, chitosan , melatonin , potassium silicate.

INTRODUCTION

In Egypt plastic houses became very important for early vegetable production, and save water, consumption, and saving significant amounts of fertilizer.During the last years had rapid changes in the technology used to produce plants under protected cultivations. Plastic houses, heating systems, automatic watering and nutrition systems have been developed and transformed for better plant growth.

Peppers, scientifically known as *(Capsicum annuum L.,)* come in a wide variety of sweet and spicy varieties that are

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enjoyed in many different ways around the globe. **(Blanco-Ríos et al. 2013) , (Xavier & Van Zonneveld et al. 2015), and (Perez-Galvez 2016)** all rank the genus Capsicum among the top five most extensively cultivated species globally. Vitamins, flavonoids, carotenoids, and phenolic chemicals are just a few examples of the many antioxidants found in fruits and vegetables. According to **(Cong-Cong et al. 2017), (Singh et al. 2017), (and Rodrigues et al. 2019),** bell peppers are among the most consumed fresh vegetables because of their attractive color, delicious flavor, and high nutritional content. It has been established in human diet that peppers contain a high concentration of phytochemicals, including antioxidants, vitamin C, and carotenoids **(Martínez et al., 2007; Matsufuji et al., 2007and Sun et al., 2007).**In addition to their many other uses, peppers enhance the flavor, aroma, and color of food while also having medicinal, nutritional, and antioxidant effects.

There is a natural polysaccharide called chitosan or chitin. Crabs, shrimp, fungus, and insect exoskeletons all contain it naturally in their cell walls **(Katiyar et al., 2015).** By enhancing the morpho-physiological characteristics and reducing the harmful effects of abiotic stresses through the stress transduction pathway, it is useful in agriculture **(Hidangmayum et al., 2019).** different plants have shown improved tolerance to stress after prenous administration of chitosan **(Kim et al., 2005; Al-Tawaha et al., 2006; Balal et al., 2017).**

According to **(Murch, Krishna Raj, and Saxena 2000),** melatonin,(N-acetyl1-5-methoxtryptamine) which is an indolamine that has been methoxylated, can be produced by plants. While melatonin's (MEL) exact physiological roles in plants are still up for debate, new evidence points to a few possible roles **(Tan et al., 2012).** Studies have documented that MEL is as a potent free-radical scavenger in plants **(Paredes et al., 2009; Tan et al., 2012 and Wang et al., 2012).** Furthermore, MEL is engaged in root and leaf development promotion, and it may also have a role in regulating circadian rhythms and photoperiodic reactions **(Kolar and Machakova, 2005: Arnao & Hernández-Ruiz, 2007 and Sarropoulou et al., 2012**) and leaves **(Okazaki et al.,2010 and Wang et al.,2013) .** The positive impacts of MEL on human health are a contributing factor to the growing interest in plant MEL among scientists. According to research by **Reiter, Manchester, and Tan (2005) and Iriti, Varoni, and Vitalini (2010),** the absorption of melatonin from plants increases blood antioxidant capacity.

According to **Raij et al. (1973),** potassium silicate (PSi) is an advantageous nutrient for many plant species, particularly grasses. Typically, the impact of silicon is associated with enhancing plant resistance mechanisms and reducing pest and disease populations. Deposition of silica under the leaf epidermis triggers the generation of phenols, which in turn stimulates phytoalexin production, decreases lodging, reduces transpiration, and boosts photosynthetic capacity; these effects on yield are related to physical defense mechanisms **(Kornd et al., 2004).** Current studies focus on finding effective ways to deliver Si through the leaves, as well as feasible alternatives to fertilization that use smaller amounts of PSi to activate the beneficial effects of this nutrient. Because of this, it is important to investigate the benefits of this method, which include reduced fertilizer waste (due to the fact that foliar fertilization involves directing tiny amounts of nutrients to the leaves), easier application, lower costs, and the use of high-

quality fertilizers that are free of contaminants and easily soluble in water.

This study aims to improve the qualitative growth and productivity of colored sweet pepper plants in the plastichouse via:

1) Improving growth and yield in addition to fruit quality of colored sweet peppers under stressful conditions inside the plastic house by using some materials that play this role.
2) Discover which of these materials have the ability to increase the capability of sweet pepper plants against to the adverse conditions inside the plastichouse.

MATERIAL AND METHODS

This study was carried out during the two successive winter seasons of 2021/2022 and 2022/2023 in an unheated plastic house. This experiment was conducted at the research farm and laboratories of the Horticulture Department, and Food Science Department Faculty of Agriculture, Minya University, Minya Governorate, Arab Republic of Egypt.

An analysis of the experiment soil was conducted, and its chemical in the first and second season are shown in Table 1

Table (1): Chemical properties of soil characterization of the experimental site in in the first and second season.

First season (2021/2022)										
PH	EC		Cations (meq/l)			K	Anions (meq/l)			
	dSm-1	ppm	Ca	Mg	Na	ppm	Cl	CO3	HCO3	SO4
7.4	0.148	95	0.18	0.12	0.43	13	0.54	0.00	0.19	0.004
Second Season (2022/2023)										
PH	EC		Cations (meq/l)			K	Anions (meq/l)			
	dSm-1	ppm	Ca	Mg	Na	ppm	Cl	CO3	HCO3	SO4
7.2	0.153	98	0.15	0.11	0.48	12	0.60	0.00	0.15	0.003

This study was conducted on two hybrids i.e.; yellow (Disco)and red (Radden), the characteristic of these hybrids is shown in Table (2). This study aimed to evaluate the effect of some materials that react as antioxidants and antitranspiration on growth, yield, yield components, and chemical composition of color sweet Pepper plants (*Capsicum annuum L*).

Table (2): Some economic characters and description for Yellow Disco hybrid and Red Radden hybrid (purchased feom Green seed Company).

Characters & description	Disco	Radden
Country of origin	Netherlands	Netherlands
Fruit length	9 (cm)	9 (cm)
Fruit color	Yellow	Red
Fruit shape	Long type with fruit chambers	Long type with fruit chambers
Flower color	White	White
Variety	F1 hybrid (sweet pepper)	F1 hybrid (sweet pepper)
Maturity	80-85 day	85-90 day

Experiment soil inside the plastichouse was prepared as follows:

Plastichouse was 40 meters long, 8.5 meters wide, and 3.25 meters high. The plastic cover was a locally treated P.V.C sheet of 5 meters in width and 200 microns in thickness:

1- Disposing of previous crop and waste.

2- Irrigating the land to encourage weed seeds to germinate.

3- Plowed the land well, taking into account changing the depth of plowing from one season to another.

4- Combing and leveling the land.

5- Adding organic and chemical fertilizers as following :.

Compost was added at a rate of 2000 kg (6 kg/m²). While, chemical fertilizers were added per one plastichouse at the rate of 40 kg (120 gm/m²) ammonium nitrate (33.5%), 50 kg (150 gm/m²) superphosphate (15.5% p2o5), and 25 kg (75 gm/m²) of Sulphur (agricultural Sulphur) and applied as broadcast and mixed with the soil. Then the soil was pulverized and formed into eight rows, each row 40 m long and 1 m wide. Transplants of sweet pepper plants were planted in the plastichouse on September 20th in both seasons.

Planting was done on both sides of each row in hills spaced 60 cm apart as a single plant per hill. The area of each experimental unit equal 10 m^2.

Three weeks after transplanting, the recommended drip irrigation fertilization program (fertigation) was used according to the Ministry of Agriculture fertilization of sweet pepper plants in plastichouse under middle Egypt condition.

Experimental design:

Treatments were arranged in three replicates using a Split plot in a complete randomized Block design. Where, the sweet pepper hybrids i-e(Disco) and (Radden) were distributed in the main plots and the antioxidant and antitranspiration i-e (chitosan), (melatonin) and (potassium silicate) were distributed in a sub plot.

Use foliar spraying method of chitosan (250ppm), melatonin (50ppm), and potassium silicate (2000ppm),in addition to the control plants which were sprayed with distilled water.

The preparation of antioxidant and antitranspiration substances solutions were as follows:

Preparation of aqueous solutions of chitosan:

Chitosan powder was added (0.25 gm) to 1 liter of distilled water, with 5 ml of acetic acid was added, and dissolved to obtain the required concentration (250 ppm).

Preparation of aqueous solutions of melatonin:

Five tablets of melatonin with a concentration of 10 mg were added and dissolved in 5 ml of 95% ethanol alcohol, then dissolved in one liter of distilled water to obtain the required concentration (50 ppm).

Preparation of aqueous solutions of Potassium silicate:

Four ml of pure potassium silicate was added to one liter of distilled water, stirring well to obtain the required concentration (2000 ppm).

Spraying time and method:

Two times of spraying the stimulant materials were applied. The first one was after 35 days from transplanting and the second one was after two weeks from the first one.

Twenty liters of each material with its concentration which mentioned before was sprayed for each treatment. The plant was sprayed completely with this solution from the bottom to the top of the plant.

Data Recorded

I- Vegetative growth characters:

Plant height (cm): The stem of 3 random plants was measured from the plant base (soil surface) to its top using a meter trip measuring tape after 3 months from transplanting.

Number of branches per plant: It was measured by counting the number of branches per plant in 3 random plants in each replicate after 90 DAT.

Plant fresh weight (g): It was measured in 3 random plants after the end of the experiment.

Plant dry weight (g): It was measured in 3 random plants after the end of the experiment in the oven and dried at 70°c until constant weight.

Chlorophyll-a, b:

Chlorophyll A and B make up the total Chlorophyll content. It was measured by adding 5 ml of acetone (95%) to 0.5 g of fresh new leaves of 3 random plants, after that the samples were analyzed using a spectrophotometer at wavelengths of 662 and 644 respectively after four weeks. The results were calculated according to the use of the following equations:

Chlorophyll A = (9.784 ×E662) – (0.99 × E 644) = mg/L

Chlorophyll B = (21.426 ×E644) – (4.65 × E 662) = mg / L

Where E = optical density of the given wavelength.

$$\text{Concentration (mg\g. F.W.)} = \frac{\text{mg\L} \times \text{dilution}}{\text{weight} \times 100}$$

II- Characters of fruits and yield

Mature sweet pepper fruits were harvested after 80 days for the yellow hybrid and 90 days for the red hybrid. Samples of three plants were collected randomly from each experimental unit and classified to determine the following studied traits.

Fruit length (cm): It was measured by Vernier Caliper

Fruit weight(g): It was measured by digital scale

Fruit wall thickness (mm): It was measured by Vernier Caliper

Number of chambers per fruit: It was measured by counting the number of chambers per fruit in 5 random fruits in each replicate after harvest.

Number of fruits per plant: It was measured by counting the number of fruit per plant in each collection in 3 random plants in each replicate at harvest

Total yield (kg): It was calculated as the average plant yield multiplied by the number of plants per experimental unit and converted to yield /m^2

RESULTS

1. Effect of spraying Chitosan, Melatonin and Potassium silicate on plant growth parameters:

1.1. Plant height (cm):

Data presented in table (3) show that both hybrids of color sweet pepper significantly different from each other, in their plant height in both seasons. Whereas,

the hybrid ("radden" red color). Showed taller plants (100.2 and 108.7 cm) in comparison with hybrid ("disco "yellow color) which showed (92.7 and 103.2 cm) in the first and second seasons respectively. These results agree with those obtained by **(Chartzoulakis and Klapaki, 2000) and (Geleta and Labuschagne, 2004)** who found that the different hybrids of pepper differed in their plant height when grown under the same conditions. These differences between the hybrids depended on the genetic differences between them.

Regarding the effect of spraying pepper plants with different substances. Data in the same table show that all substances except potassium silicate in the first season and chitosan in the second season increased significantly plant height in comparison with control plants in both seasons. Among these substances data in the same table (3) showed that the best one was chitosan in the first season which showed (103.1 cm) and melatonin in the second season which showed (112.2 cm), while the lowest one was (control) which showed the lowest values of plant height (89.8 and 99 cm) in the first and second season respectively. These results agree with those obtained by (**Shehata *et al.*, 2018 and Pereira *et al.*, 2019)** who reported that the height of pepper plants increased with spraying stimulant materials.

Regarding the interaction effects data in table (3) show that these interactions were significant in both seasons and the best treatment was when growing the hybrid ("radden" red color) and spraying it with (melatonin) this observation was obtained in both seasons, while the lowes one was when grown the hybrid ("disco" yellow color) with water control plants.

Table (3): Effect of spraying Chitosan, Melatonin and Potassium silicate on Plant height (cm) in colord sweet peeper hybrids .

Hybrids / Treatment	First season(2021/2022)					Second season(2022/2023)				
	Control	Chitosan	Melatonin	Potassium silicate	Mean	Control	Chitosan	Melatonin	Potassium silicate	Mean
H1 RED Radden	96.3	103.3	104.6	96.7	100.2	100.7	107.7	124.3	102	108.7
H2 YELLOW Disco	83.3	102.9	100	84.6	92.7	97.3	101.7	100	113.7	103.2
Mean	89.8	103.1	102.3	90.6		99	104.7	112.2	107.8	
LSD 5%	A= 4.72	B= 9.10	AB= 2.46			A= 3.46	B= 6.97	AB= 5.34		

1.2. Number of branches per plant:

The two hybrids of sweet pepper differed significantly in their number of branches/plant as shown in table (4). Where, the ("radden "red color hybrid) was superior in its number of branches/plant compared with ("disco" yellow color hybrid) in first season and the revers was obtained in the second season. ("disco" yellow color hybrid) was superior in second season compared with the ("radden" red color hybrid). These results were observed in both seasons and in harmony with those obtained by **(Malik *et al.*, 2011)** who found that the sweet pepper hybrids differ significantly in number of branches per plant.

Also, the number of branches/plant of color sweet pepper hybrids increased significantly after spraying the plants with stimulant compared to control plants in both seasons as shown in the same table (4). Among the these materials, potassium silicate in the first season and chitosan in the second season (5.9 and 5) were the best materials to obtain the higher value in number of branches per plant as data shown in table (4). These results are in harmony with those obtained by **(Hassan *et al.*, 2021)** who observed that the number of branches per plant of pepper plants was increased after spraying plants with potassium silicate.

Regarding the interaction effect data show that these effects were significant in both seasons. The best treatment which showed the highest value number of branches per plant was observed when spraying the ("radden" red color hybrid) with potassium silicate in the first season and spraying the yellow hybrid with chitosan in the second season.

Table (4): Effect of spraying Chitosan, Melatonin and Potassium silicate on Number of branches/plant in colord sweet peeper hybrids.

Hybrids / Treatment	First season(2021/2022)					Second season(2022/2023)				
	Control	Chitosan	Melatonin	Potassium silicate	Mean	Control	Chitosan	Melatonin	Potassium silicate	Mean
H1 RED Radden	4.6	4.8	5.3	6.3	5.25	3.3	4.2	3.4	3.4	3.58
H2 YELLOW Disco	4.6	5.6	5	5.6	5.2	4.1	5.8	5.3	4.3	4.88
Mean	4.6	5.2	5.15	5.95		3.7	5	4.35	3.85	
LSD 5%	**A= 0.04**	**B= 0.56**	**AB= 0.28**			**A= 0.81**	**B= 0.71**	**AB= 0.31**		

1.3. Plant fresh weight (g):

Data illustrated in the table (5) show that the two hybrids of color sweet pepper differ significantly in their plant fresh weight in both seasons. The higher values of average fresh weight/plant (288 and 286.7 g/ plant) in the first and second seasons respectively were observed with hybrid ("disco" yellow color) and the lower values (179.8 and 184.7 g/plant) in the first and second seasons respectively was obtained from the hybrid ("radden" red color). The plant fresh weight of the pepper plant also differed depending on the hybrid as reported by **(Singh *et al.*, 2011).**

After spraying pepper plants with stimulant materials, the plant's fresh weight had increased significantly except for chitosan in both seasons compared with control plants as data obtained in the same table (5).

Both potassium silicate and melatonin were the best two materials, which show the highest values of plant fresh weight with insignificant differences between their mean values in both seasons, whereas, potassium silicate was the best one in the first season and gave the highest plant fresh weight equal (252.8 g/plant). While melatonin was the best one in the second season and gave the highest average fresh weight equal

(251.2 g/plant) in the second season. According to previous studies spraying pepper plants with the same growth regulators led to an increase in its plant fresh weight as reported by **(Shehata *et al.,* 2018)** and **(Youssif *et al.,* 2018).**

Table (5): Effect of spraying Chitosan, Melatonin and Potassium silicate on Plant fresh weight (g) in colord sweet peeper hybrids.

Hybrids / Treatment	First season(2021/2022)					Second season(2022/2023)				
	Control	Chitosan	Melatonin	Potassium silicate	Mean	Control	Chitosan	Melatonin	Potassium silicate	Mean
H1 RED Raden	162.7	182.5	190.5	183.7	179.8	145.5	200.5	213	180	184.75
H2 YELLOW Disco	263.7	266.2	300.2	322	288	288.5	266.2	289.3	302.8	286.7
Mean	213.2	224.3	245.3	252.8		217	233.3	251.2	241.4	
LSD 5%	A= 68.04	B= 23.09	AB= 11.12			A= 64.13	B= 18.19	AB= 8.65		

The interaction between hybrids and antitranspiration materials was significant, in both seasons, The best treatment was gained after spraying the ("radden" yellow hybrid) with potassium silicate in both seasons. While the lowest one was after spraying the ("disco" red color hybrid) with water (control plants), in both seasons.

1.4. Plant dry weight (g):

The two hybrids differed significantly in their plant dry weight/plant in both seasons as data shown in table (6). The ("disco" yellow color hybrid) was significantly higher in its plant dry weight (g) and show (75 and 73.8 g) in first and second seasons as data shown in the same table (6). The differences between sweet pepper hybrids are also observed by **(Chartzoulakis and Klapaki, 2000) and (Jadczak *et al.,* 2010).**

Spraying colored sweet pepper plants with antioxidant materials led to an increase significantly in its plant dry weight (g) in both seasons except for chitosan in both seasons in comparison with control plants (these plants which were sprayed with water) in both seasons. Both melatonin and potassium silicate showed the highest values of plant dry weight (g) in both seasons, whears the differences between their mean values were insignificant in both seasons. Many studies reported that plant dry weight of pepper was increased after being sprayed with melatonin and potassium silicate as reported by **(Kotb *et al.,* 2018); (Youssif *et al.,* 2018) and (Hassan *et al.,* 2021).**

Among the interactions, the highest plant dry weight (g) of colored sweet pepper was obtained from the ("disco" yellow color hybrid) when sprayed with melatonin in the both seasons.

Table (6): Effect of spraying Chitosan, Melatonin, Potassium silicate on Plant dry weight (g) in colord sweet peeper hybrids.

Hybrids / Treatment	First season(2021/2022)					Second season(2022/2023)				
	Control	Chitosan	Melatonin	Potassium silicate	Mean	Control	Chitosan	Melatonin	Potassium silicate	Mean
H1 RED Raden	45.5	49.2	49.7	46.7	47.8	33.3	53.3	56.7	46.6	47.5
H2 YELLOW Disco	65.3	66.8	83.4	84.5	75	69.5	68.6	80	77.1	73.8
Mean	55.4	58	66.5	65.6		51.4	61	68.4	61.8	
LSD 5%	A= 17.13	B= 6.95	AB= 3.96			A= 16.55	B= 8.81	AB= 2.93		

2. Effect of spraying Chitosan, Melatonin and Potassium silicate on chemical characteristics:

2.1. Chlorophyll A:

The results presented in table (7) indicate that the highest concentration of chlorophyll A was with the ("disco" yellow color hybrid) which showed the highest values (2.810 and 2.911) in the first and second seasons respectively with significant differences in comparison with the ("radden" red color hybrid),only in the first season. These results were observed in both seasons and in harmony with those obtained by **(Malik *et al.*, 2011)** who, found that the sweet pepper hybrid are significantly different in its content of chlorophyll A.

The spraying materials, showed insignificant differences were obtained between all treatments and control plants in both seasons**.**

Also, there was a significant effect for the interaction treatments on chlorophyll A in both seasons. The best treatment was observed with sowing the ("radden" red color hybrid) and spraying it with potassium silicate in the first season, and sowing the ("disco" yellow color hybrid), and spraying it with potassium silicate in the second season.

Table (7): Effect of spraying Chitosan, Melatonin, Potassium silicate on Chlorophyll A mg/l in colord sweet peeper hybrids.

Hybrids / Treatment	First season(2021/2022)					Second season(2022/2023)				
	Control	Chitosan	Melatonin	Potassium silicate	Mean	Control	Chitosan	Melatonin	Potassium silicate	Mean
H1 RED Raden	2.874	2.522	2.757	2.905	2.764	2.907	2.887	2.807	2.937	2.885
H2 YELLOW Disco	2.806	2.773	2.802	2.860	2.810	2.927	2.851	2.920	2.944	2.911
Mean	2.840	2.647	2.779	2.883		2.917	2.869	2.863	2.940	
LSD 5%	A= 0.0416	B= N.S	AB= 0.0562			A= 0.0528	B= N.S	AB= 0.0562		

2.2. Cholorophyll B:

Results in table (8) showed that the average quantity of chlorophyll B differed significantly among the two hybrids,in both seasons. Wherase, ("radden" red color hybrid) was superior and showed the highest values (4.821 and 4.323) in the first and second seasons respectively of leaf content of chlorophyll B. A comparison with the content of chlorophyll B in a leaf of ("disco" yellow color hybrid) was showed the lowest values (3.978 and 3.443) in first and second seasons. These results agree with those obtained by **(Malik *et al.,* 2011)** who, found that the sweet pepper hybrid showed significant differences in its content of chlorophyll B**.**

Also, data in the same table (8) showed that the color sweet pepper plant differed significantly in its content of chlorophyll B after spraying it with antitranspiration materials. The quantity of chlorophyll B was increased significantly after spraying pepper plants with these materials in comparison with control plants, in both seasons. Among these materials, both melatonin and potassium silicate were the best materials in the first season, and chitosan and potassium silicate in the second season with insignificant differences between their mean values in this character. Chlorophyll B was differed also after stimulants pepper plants with some materials such as **(Al-Kahtani *et al.,* 2020); (Hassan *et al.,* 2021) and (Altaf *et al.,* 2023).**

All the interaction effects were significant in both seasons and the best treatment was when sowing ("radden" red color hybrid) and sprayed it with chitosan and melatonin in the first and second seasons respectively.

Table (8): Effect of spraying Chitosan, Melatonin, Potassium silicate on [chlorophyll B mg/l] in colord sweet peeper hybrids.

Hybrids / Treatment	First season(2021/2022)					Second season(2022/2023)				
	Control	Chitosan	Melatonin	Potassium silicate	Mean	Control	Chitosan	Melatonin	Potassium silicate	Mean
H1 RED Raden	3.752	5.502	5.272	4.757	4.821	3.215	4.710	4.765	4.603	4.323
H2 YELLOW Disco	2.695	3.989	4.492	4.741	3.978	2.913	3.558	3.090	4.210	3.443
Mean	3.223	4.744	4.882	4.749		3.064	4.134	3.928	4.406	
LSD 5%	A= 0.461	B= 0.308	AB= 0.397			A= 0.421	B= 0.352	AB= 0.318		

3. Effect of spraying Chitosan, Melatonin and Potassium silicate on yield and it's components and fruit quality:

3.1. Average length/fruit (cm):

The average length/fruit for ("radden" red color hybrid) was higher significantly and show (9.3 and 9.2 cm) in first and second seasons in comparison with the fruit length of ("disco" yellow color hybrid) which show (8.7 and 8.6 cm) in first and second seasons as data shown in table (9). Also, some sweet pepper hybrids differed in their average length/fruit as reported by

(Dinu *et al.*, 2008) and (Pimenta *et al.*, 2016). Treated sweet pepper plants with stimulant materials led to an increase its fruit length significantly in comparison with control plants (Those plants treated with water only) as data shown in table (9) and these results were observed in both seasons. The melatonin showed the best in its effects to increase average length/fruit on both seasons when compared with the control treatment. Increasing fruit length after spraying plants with melatonin was reported by **(Abd El-Aziz *et al.*, 2021)**.

The interactions data in the same table showed that after spraying the ("raden "red hybrid) with potassium silicate in the first season and melatonin in the second season, these treatments led to obtaining the highest significantly value of average length/fruit with insignificant difference between their mean values. On the other hand, the lowest values of average length/fruit were observed with ("disco" yellow hybrid) after spraying its plants with water (control plants) in both seasons, as data in the same table show.

Table (9): Effect of spraying Chitosan, Melatonin and Potassium silicate on Average fruit length (cm)/plant in colord sweet peeper hybrids.

Hybrids / Treatment	First season(2021/2022)					Second season(2022/2023)				
	Control	Chitosan	Melatonin	Potassium silicate	Mean	Control	Chitosan	Melatonin	Potassium silicate	Mean
H1 RED Raden	9	9	9.3	9.8	9.3	8.5	9.5	9.6	9.1	9.2
H2 YELLOW Disco	7.1	8.6	9.7	9.3	8.7	8.4	8.4	8.9	8.7	8.6
Mean	8.1	8.8	9.5	9.5		8.4	8.9	9.3	8.9	
LSD 5%	A= 0.38	B= 0.65	AB= 0.53			A= 0.38	B= 0.45	AB= 0.15		

3.2. Average weight/fruit (g):

Results in table (10) show that the average weight/fruit differed significantly among the two hybrids. Where the hybrid ("radden" red) was superior and showed the highest value of average weight/fruit (235.3 and 248.6 g) in the first and second seasons respectively in comparison with the second hybrid ("disco" yellow) which showed a lower value of average fruit weight (210.6 and 239.7 g) in the first and second seasons respectively. These results agree with those obtained by **(Geleta and Labuschagne, 2004); (Jadczak *et al.*, 2010)** and **(Mahmoud and El-Eslamboly, 2015)**. Who found that the average weight/ fruit of pepper plants differed according to different hybrids.

Also, data in the same table (10) showed that the average weight/fruit of pepper plants differed significantly as affected by different sources of spraying materials, in both seasons. All stimulant materials showed an improvement in this character when compared with control plants as data shown in table (10). These results reveal the highest average fruit weight (241.9 and 268.3 g) from spraying pepper plants with melatonin material (50 ppm) in the first and second seasons respectively. The lowest value of average weight/fruit (178.1 and 213.4 g) was observed with those plants which sprayed with distilled water (control plants) in the first and second seasons respectively. These results are in harmony with those obtained

by **(Wang *et al.*, 2022)** who observed that the average fruit weight of pepper plants was increased after spraying plants with melatonin.

The interaction effect data in the same table (10) showed that the interactions were significant in both seasons. The highest value of average weight/fruit was obtained when ("radden" red hybrid) sweet pepper plants were sprayed with potassium silicate in the first season. While in the second season ("radden" red hybrid) sprayed with melatonin was the best treatment. while the lowest one was obtained from the hybrid ("disco" yellow color) with water control plants in both seasons.

Table (10): Effect of spraying Chitosan, Melatonin and Potassium silicate on Average fruit weight (g) in colord sweet peeper hybrids.

Hybrids / Treatment	First season(2021/2022)					Second season(2022/2023)				
	Control	Chitosan	Melatonin	Potassium silicate	Mean	Control	Chitosan	Melatonin	Potassium silicate	Mean
H1 RED Raden	180	236	247.6	277.42	235.3	215.8	253.3	276.1	249.3	248.6
H2 YELLOW Disco	176.3	234.8	236.3	195	210.6	210.9	243.1	260.5	244.2	239.7
Mean	178.1	235.4	241.9	236.2		213.4	248.2	268.3	246.7	
LSD 5%	A= 15.53	B= 37.74	AB= 19.32			A= 7.83	B= 12.92	AB= 13.14		

3.3. Fruit wall thickness(mm):

Data presented in table (11) show that the values of fruit wall thickness were significantly higher in ("radden" red color hybrid) when compared with the yellow one in the first season. These results are in harmony with those obtained by **(Jadczak *et al.*, 2010); (Mahmoud and El-Eslamboly, 2015) and (Pimenta *et al.*, 2016).**

Also, experiment data show that spraying sweet pepper plant hybrids with stimulant materials led to a significant increase in fruit wall thickness in comparison with control plants in both seasons, except with chitosan in the first season only. Among these materials, melatonin was the best in its effects to improve and increase fruit wall thickness of colored sweet pepper hybrids followed by potassium silicate with insignificant differences between their mean values in both seasons. These results are in harmony with those obtained by **(Kamal, 2013)** who found that the fruit wall thickness of sweet pepper plants had increased after being sprayed with potassium silicate.

All, interactions between the two factors of experimental factors were significant in the second season only and the best treatment was when using the ("radden" red color hybrid) and spraying it with potassium silicate but with insignificant differences when spraying with melatonin.

3.4. Number of chambers per fruit:

Data in table (12) indicate that this character did not show any significant effect to hybrids or treatments or their interactions in both seasons.

Table (11): Effect of spraying Chitosan, Melatonin and Potassium silicate on [Fruit wall thickness (mm)/plant] in colord sweet peeper hybrids.

Hybrids / Treatment	First season(2021/2022)					Second season(2022/2023)				
	Control	Chitosan	Melatonin	Potassium silicate	Mean	Control	Chitosan	Melatonin	Potassium silicate	Mean
H1 RED Raden	4	3.3	4.7	4.5	4.12	3.7	4.9	5.2	5.2	4.75
H2 YELLOW Disco	3.3	3.7	4	4	3.75	4.1	4.9	5.1	5.1	4.80
Mean	3.65	3.50	4.35	4.25		3.90	4.90	5.15	5.15	
LSD 5%	A= 0.24	B= 0.52	AB= NS			A= N.S	B= 0.65	AB= 0.21		

Table (12): Effect of spraying Chitosan, Melatonin and Potassium silicate on Number of chambers per the fruit of colord sweet peeper hybrids.

Hybrids / Treatment	First season(2021/2022)					Second season(2022/2023)				
	Control	Chitosan	Melatonin	Potassium silicate	Mean	Control	Chitosan	Melatonin	Potassium silicate	Mean
H1 RED Raden	4	3.8	4	4	4	3.7	3.8	3.7	3.7	3.7
H2 YELLOW Disco	3.8	3.8	4	4	3.9	4	4	4	4	4
Mean	3.9	3.8	4	4		3.8	3.9	3.8	3.8	
LSD 5%	A= NS	B= NS	AB= NS			A= NS	B= NS	AB= NS		

3.5. Number of fruits/plant:

Recorded data in table (13) show that the number of fruits/plant of sweet pepper plant was higher significantly with (“radden“ red color hybrid) in comparison with (“disco“ yellow color hybrid) in both seasons. The (“radden“ red color hybrid) show (11.52 and 10.96) in comparison with (“disco“ yellow color hybrid) which shows (7.9 and 10.35) as the number of fruits/plant in the first and second seasons respectively. The differed in number of fruits produced by a single plant was obtained according to cultivar or hybrid differed as reported by **(Geleta and Labuschagne, 2004); (Shrestha *et al.*, 2011)** and **(Singh *et al.*, 2011)**.

Spraying sweet pepper plants with different stimulant materials ,the number of fruits/plant had increased significantly as compared with control plants according to data shown in table (13). Potassium silicate was the best one of these materials in their effect on the number of fruits of color sweet pepper in both seasons. Number of fruits/plant was differed also after stimulants pepper plants with some materials as reported by **(Lee *et al.*, 2004); (Kamal, 2013)** and **(Al-Kahtani *et al.*, 2020).**

Regarding the interaction effect on this trait data in table (13) show that all interactions effects were significant, in both seasons. The best treatment to obtain the highest number of fruit/plant in both seasons was after spraying color sweet pepper plants ("radden" red color hybrid) with potassium silicate in both seasons.

Table (13): Effect of spraying Chitosan, Melatonin and Potassium silicate on the number of fruit/plant in colord sweet peeper hybrids.

Hybrids / Treatment	First season(2021/2022)					Second season(2022/2023)				
	Control	Chitosan	Melatonin	Potassium silicate	Mean	Control	Chitosan	Melatonin	Potassium silicate	Mean
H1 RED Raden	10	10.7	11.2	14.2	11.52	10.3	10.2	10.5	12.83	10.96
H2 YELLOW Disco	7	8.7	8.1	7.8	7.9	8.7	11.7	11.0	10.0	10.35
Mean	8.5	9.7	9.65	11		9.5	10.95	10.75	11.4	
LSD 5%	A= 2.1	B= 1.16	AB= 0.85			A= 0.60	B= 0.83	AB= 0.79		

3.6. Total yield (kg/m^2):

The performance of color sweet pepper hybrids that were investigated revealed that the genotypes had a substantial influence on the average yield kg/m^2 as shown in table (15). The higher weight of yield/m^2 was observed with the ("radden" red color hybrid) which showed (6.9 and 5.6 kg/m^2) in the first and second seasons respectively. However, significant differences was obtained in the first season only. The differences between sweet pepper hybrids were also observed by **(Dinu *et al.*, 2008) and (Singh *et al.*, 2011).**

All foliar treatments significantly increased the yield of color sweet pepper hybrids compared to control plants as data show in the same table (14). The increment percentage for one square meter ranged from 13% to 25% and 17% to 32% compared to control in the first and second seasons respectively.

Among the, three substances the best one was potassium silicate which showed higher values of total yield per square meter (6.4 and 6.05 kg/m^2) in the first and second seasons followed by melatonin with insignificant differences between them in the second season. These results are in harmony with those obtained by **(Nada *et al.*, 2020); (Hassan *et al.*, 2021) and (Korkmaz *et al.*, 2021)**.

The interactions between hybrid and spraying materials showed significant effects on both seasons. The best treatment to obtain the highest yield/m^2 was when sowing ("radden" red color hybrid) and spraying it with potassium silicate in both seasons.

Table (14): Effect of spraying Chitosan, Melatonin, Potassium silicate on [average [total yield (kg)/m^2] in colord sweet peeper hybrids.

Hybrids / Treatment	First season(2021/2022)					Second season(2022/2023)				
	Control	Chitosan	Melatonin	Potassium silicate	Mean	Control	Chitosan	Melatonin	Potassium silicate	Mean
H1 RED Raden	5.4	6.7	7	8.4	6.9	4.7	5.2	5.8	6.6	5.6
H2 YELLOW Disco	4.3	4.9	4.7	4.4	4.6	4.5	5.6	5.5	5.5	5.3
Mean	4.85	5.8	5.85	6.4		4.6	5.4	5.65	6.05	
LSD 5%	A= 0.60	B= 0.54	AB= 0.49			A= N.S	B= 0.55	AB= 0.44		

DISCUSSION

The pepper plant hybrid (“radden“ red color hybrid) under investigation was found to differ significantly in most growth characteristics such as plant height, number of branches/plant (in first season), and chlorophyll B, Also in yield and its components such as the average length/ fruit, average weight /fruit, number of fruits/plant, fruit wall thickness and total yield (kg/m^2) in comparison with (“disco“ yellow color hybrid) one ,which showed higher values of plant fresh weight, plant dry weight, number of branches/plant (in second season) and chlorophyll A as compared with (“radden“ red color hybrid) one. The fluctuant in data obtained from season to the anther may be as result of the changes in the environmental conditions

Also, these differences may depend on the genetically differed between the two hybrids and the reaction for this genetically differed with environmental conditions and soil characters.

These genetic differences between the two hybrids may be a result of a switch on and off for some genes whose role is controlled by biotic and abiotic stress in conditions of plant growth inside greenhouse conditions. Many investigators demonstrated the influence that the genes exert on physiological processes by controlling the mechanism of the synthesis of enzymes.

In addition, our study found that compared to plants sprayed with water alone, colored sweet pepper hybrids sprayed with antitraspiration or antioxidant substances i.e chitosan, melatonin, and potassium silicate exhibited significant improvements in nearly all growth characteristics measured by yield, component addition, and quality parameters. It is possible that the effects of these compounds on plant growth and production are connected to the observed improvements in growth characteristics and increases in yield and its components following spraying. While chitosan is known to improve morpho-physiological parameters and reduce the harmful effects of abiotic stresses through the stress transduction pathway, it has also been shown to increase plant tolerance to a number of stresses, improve growth characteristics, and increase the germination rate of numerous plants in previous studies **(Kim et al., 2005; Al-Tawaha et al., 2006; Balal et al., 2017).**

The function of melatonin has now been suggested Research by **Tan et al. (2012). Tan et al. (2012), Wang et al. (2012), and Paredes, Korkmaz, Manchester, Tan & Reiter (2009)** all found that MEL is a powerful free-radical scavenger in plants. Furthermore, MEL has been found to promote root and leaf growth **(Aranao & Hernández-Ruiz, 2007; Sarropoulou, Therios & Dimassi-Theriou, 2012),** and it may also play a role in the regulation of circadian rhythms and photoperiodic reactions **(Kolar & Machakova, 2005).** The positive impacts of MEL on human health are a contributing factor to the growing interest in plant MEL among scientists.

According to **Raij et al. (1973),** potassium silicate is an advantageous nutrient for many plants, particularly grasses. Typically, the impact of silicon is associated with enhancing plant resistance mechanisms and reducing pest and disease populations. The formation of phenols, which boosts phytoalexin production, minimizes lodging, reduces transpiration, and increases photosynthetic capacity, as well as the impacts on yield, are all connected to physical defensive mechanisms involving the deposition of silicate under the leaf epidermis.

REFERENCES

Abd El-Aziz, M, H; Soliman, M. A. and Ennab, H. A. (2021) Effect of Potassium Silicate and Chelated Calcium Sprays on Yield, Quality and Storage of Peach Fruits Cv. "Dessert Red". Menoufia J. Plant Prod.,: 119 – 135

Alkahtani, M., Attia, K. and Hafez,Y. (2020) Chlorophyll fluorescence parameters and antioxidant defense system can display salt tolerance of salt acclimated sweet pepper plants treated with chitosan and plant growth promoting rhizobacteria. Agronomy,10, 1180, 1 of 20

Al-Tawaha, A. M., Seguin, P., Smith, D. L., Beaulieu, C. (2006) Foliar application of elicitors alters isofl avone concentrations and other seed characteristics of field-grown soybean. Can. J. Plant Sci. 86, 677–684.

Altaf, M., Hao,Y. and Shu, H. (2023). Melatonin enhanced the heavy metal-stress tolerance of pepper by mitigating the oxidative damage and reducing the heavy metal accumulation. Journal of Hazardous Materials 454, 131468.

Arnao, M. B. and Hernández-Ruiz, J. (2007). Melatonin promotes adventitious- and lateral root regeneration in etiolated hypocotyls of Lupinus albus L. Journal of Pineal Research, 42, 147–152.

Balal, R. M., Shahid, M. A., Javaid, M. M., Iqbal, Z., Liu, G. D., Zotarelli, L.and Khan, N. (2017) Chitosan alleviates phytotoxicity caused by boron through augmented polyamine metabolism and antioxidant activities and reduced boron concentration in *Cucumis sativus* L. Acta Physiol. Plant., 39, 31.

Blanco-Ríos, A. K., Medina-Juárez, L. A., González-Aguilar, G. A., and Gámez- Meza, N. (2013) Antioxidant activity of the phenolic and oily fractions of different sweet bell peppers. Journal of the Mexican Chemical Society, 57(2), 137–143.).

Chartzoulakis, K., and Klapaki, G. (2000). Response of two greenhouse pepper hybrids to NaCl salinity during

different growth stages. Scientia horticulturae, 86(3), 247-260.

Cong-Cong, X., Bing, W., Yi-Qiong, P., Jian-Sheng, T., and Tong, Z. (2017). Advances in extraction and analysis of phenolic compounds from plant materials. Chinese Journal of Natural Medicines, 15, 721.

Dinu, M., Savescu, P., and Pintilie, I. (2008). Comparative study between new hybrids of sweet pepper cultivated in unheated greenhouse from Almaj-Dolj County. Bulletin of the University of Agricultural Sciences & Veterinary Medicine Cluj-Napoca. Horticulture, 65(1).

Gomaa, M. A., Kandil, E. E., Zen El-Dein, A. A. M. and Abou-Donia, M. E. M. (2021) Increase maize productivity and water use efficiency through application of potassium silicate under water stress. Scientific Reports | 11:224

Hassan, S. M., El-Bebany, A. F., Salem, M. Z. and Komeil, D. A. (2021) Productivity and Post-Harvest Fungal Resistance of Hot Pepper as Affected by Potassium Silicate, Clove Extract Foliar Spray and Nitrogen Application. Plants, 10, 662: ₱1-17

Hidangmayum, A., Dwivedi, P., Katiyar, D. and Hemantaranjan, A. (2019) Application of chitosan on plant responses with special reference to abiotic stress. Physiol. Mol. Biol. Plants, 25, 313–326.

Iriti, M., Varoni, E. M., and Vitalini, S. (2010). Melatonin in traditional Mediterranean diets. Journal of Pineal Research, 49, 101–105.

Jadczak, D., Grzeszczuk, M. and Kosecka, D. (2010). Quality characteristics and content of mineral compounds in fruit of some cultivars of sweet pepper *[Capsicum annuum L.]*. Journal of Elementology, 15(3), 509-515.

Kamal, A. M. (2013) Influence of irrigation levels, antitranspirants and potassium silicate on growth, fruit yield and quality of sweet pepper plants **(Capsicum annuum l.)** grown under drip irrigation. J. Plant Production, Mansoura Univ., 4 (11): 1581 – 1597.

Katiyar, D.; Hemantaranjan, A.; Singh, B.(2015) Chitosan as a promising natural compound to enhance potential physiological responses in plant: A review. Indian J. Plant Physiol., 20, 1–9.

Khosravi, S., Haghighi, M. and Mottaghipisheh, J. (2023) Effects of melatonin foliar application on hot pepper growth and stress tolerance. Plant Stress 9 100192.

Kim, H. J., Chen, F., Wang, X. and Rajapakse, N. C. (2005) Efect of chitosan on the biological properties of sweet basil*(Ocimum basilicum L.).* J. Agric. Food Chem. 53, 3696–3701.

Kolar, J., and Machakova, I. (2005). Melatonin in higher plants: Occurrence and possible functions. Journal of Pineal Research, 39, 333–341.

Kornd¨orfer, G., Pereira, H. S., Vidal, A. A. and Camargo, M. S. (2004). Fontes de sil´ıcio para a cultura do arroz [Silicon sources for rice]. Scientia Agr´ıcola, 61: 35–42.

Korkmaz, A., Deger,O. and Szafranska, K .(2021) Melatonin effects in enhancing chilling stress tolerance of pepper. Scientia Horticulturae 289 110434.

Kotb, H. M., Hegazi, H. H, Ghoneim, I. M and Feleafel, M. N. (2018) Effect of

water regime, pruning system and potassium silicate on dry mass production of sweet pepper plants grown in calcareous soil under greenhouse. Alex. J. Agric. Sci. 63,.(2), p 105-118.

Lee, J. S., Seo, S.T. and Wong, T. C. (2004) Effect of Potassium Silicate Amendments in Hydroponic Nutrient Solution on the Suppressing of Phytophthora Blight *(Phytophthora capsici)* in Pepper. The Plant Pathology Journal 20 (4) p.277-282.

Mahmoud, A. M., and El-Eslamboly, A. (2015). Production and evaluation of high yielding sweet pepper hybrids under greenhouse conditions. American-Eurasian Journal of Agricultural & Environmental Sciences, 15(4), 573-580.

Malik, A., Chattoo, M., Sheemar, G., and Rashid, R. (2011). Growth, yield and fruit quality of sweet pepper hybrid SH-SP-5 *(Capsicum annuum L.)* as affected by integration of inorganic fertilizers and organic manures (FYM). Journal of Agricultural Technology, 7(4), 1037-1048.

Matsufuji, H., Ishikawa, K., Nunomura, O., Chino, M., and Takeda, M. (2007). Antioxidant content of different coloured sweet peppers, white, green, yellow, orange and red *(Capsicum annuum L.).* International Journal of Food Science & Technology, 42, 1482–1488.

Martínez, S., Curros, A., Bermúdez, J., Carballo, J., and Franco, I. (2007). The composition arnoia peppers *(Capsicum annuum L.)* at different stages of maturity. International Journal of Food Science & Technology, 58, 150–161.

Mourya, V. K, Inamdar, N. (2008) Chitosan-modifications and applications: Opportunities galore. Reactive and Functional Polymers. 68, p1013-1051

Murch, S. J., KrishnaRaj, S., and Saxena, P. K. (2000). Tryptophan is a precursor for melatonin and serotonin biosynthesis in in vitro regenerated St. John's wort *(Hypericum perforatum L. cv. Anthos)* plants. Plant Cell Reports, 19, 698–704.

Okazaki, M., Higuchi, K., Aouini, A., and Ezura, H. (2010). Lowering intercellular melatonin levels by transgenic analysis of indoleamine 2,3-dioxygenase from rice in tomato plants. Journal of Pineal Research, 49, 239–247.

Paredes, S. D., Korkmaz, A., Manchester, L. C., Tan, D. X., & and Reiter, R. J. (2009). Phytomelatonin: A review. Journal of Experimental Botany, 60, 57–69.

Pereira, A. I. A., Guimarães, J. J., Costa, J. V. and Cantuário, F. S. (2019) Growth of sweet pepper plants submitted to water tensions in soil and potassium silicate doses. Hortic. bras., Brasília,.37,.(1):p 82-88

Pimenta, S., Menezes, D., Neder, D. G., Melo, R. A., Araujo, A. L., and Maranhão, E. A. (2016). Adaptability and stability of pepper hybrids under conventional and organic production systems. Horticultura Brasileira, 34, 168-174.

Raij, B. V., and Camargo, O. A. (1973). S´ılica sol´uvel em solos [Soluble silicon in soils]. Bragantia 32: 223–231.

Reiter, R. J., Manchester, L. C., and Tan, D. X. (2005). Melatonin in walnuts:

Influence on levels of melatonin and total antioxidant capacity of blood. Nutrition (Burbank, Los Angeles County, Calif), 21, 920–924.

Rodrigues, C. A., Nicácio, A. E., Jardim, I. C. S. F., Visentainer, J. V., and Maldaner, L. (2019). Determination of phenolic compounds in red sweet pepper *(Capsicum annuum L.)* using a modified QuEChERS method and UHPLC-MS/ MS analysis and its relation to antioxidant activity. Journal of the Brazilian Chemical Society, 30, 1229–1240.

Sarropoulou, V. N., Therios, I. N., and Dimassi-Theriou, K. N. (2012). Melatonin promotes adventitious root regeneration in in vitro shoot tip explants of the commercial sweet cherry rootstocks CAB-6P *(Prunus cerasus L.)*, Gisela 6 *(P. cerasus _ P. canescens)*, and MxM 60 (P. avium _ P. mahaleb). Journal of Pineal Research, 52, 38–46.

Shehata, S. A., Saad, M., El, M., Saleh, M. A. and Atala, S. A. (2018) Effect of Foliar spray with Potassium Silicate on Growth, Yield, Quality and Storability of Cucumber Fruits. Annals of Agric. Sci., Moshtohor. 56(2) 385 – 396

Shrestha, S. L., Luitel, B. P., and Kang, W. H. (2011). Heterosis and heterobeltiosis studies in sweet pepper *(Capsicum annuum L.).* Horticulture, Environment, and Biotechnology, 52, 278-283.

Singh, A. K., Singh, B., and Gupta, R. (2011). Performance of sweet pepper (Capsicum annum) varieties and economics under protected and open field conditions in Uttarakhand. Indian Journal of Agricultural Sciences, 81(10), 973-975.

Singh, B., Singh, J. P., Kaur, A., and Singh, N. (2017). Phenolic composition and antioxidant potential of grain legume seeds: A review. Food Research International, 101, 1.

Sun, T., Xu, Z., Wu, T. C., Janes, M., Prinyawiwatkul, W., and No, H. K. (2007). Antioxidant activities of different colored sweet bell peppers *(Capsicum annuum L.).* Journal of Food Science, 72, 98–102.

Tan, D. X., Hardeland, R., Manchester, L. C., Korkmaz, A., Ma, S., Rosales-Corral, S., et al. (2012). Functional roles of melatonin in plants, and perspectives in nutritional and agricultural science. Journal of Experimental Botany, 63, 577–597.

Van Zonneveld, M., Ramirez, M., Williams, D. E., Petz, M., Meckelmann, S., Avila, T., Bejarano, C., Rios, L., Pena, K., Jager, M., Libreros, D. Amaya, K., and Scheldeman, X. (2015). Screening genetic resources of Capsicum peppers in their primary center of diversity in Bolivia and Peru. PLoS One, 10(9), e0134663.

Wang, P., Yin, L., Liang, D., Li, C., Ma, F., and Yue, Z. (2012). Delayed senescence of apple leaves by exogenous melatonin treatment: Toward regulating the ascorbate–glutathione cycle. Journal of Pineal Research, 53, 11–20.

Wang, P., Sun, X., Li, C., Wei, Z., Liang, D., and Ma, F. (2013). Long-term exogenous application of melatonin delays drought-induced leaf senescence in apple. Journal of Pineal Research, 54, 292–302.

Wang L., Shen X., Chen X., Ouyang Q., Tan X. and Tao N. (2022) Exogenous

application of melatonin to green horn pepper fruit reduces chilling injury during postharvest cold storage by regulating enzymatic activities in the antioxidant system. Plants 11:2367.

Xavier, A. A. O., and Perez-Galvez, A. (2016). Peppers and chilies. In B. Caballero, P. M. Finglas, & F. Toldra (Eds.), Encyclopedia of food and health (p. 301). Kidlington.

Youssif, N. E. E., Osman, H. S. M., Salama, Y. A. M. and Zaghlool, S. A. M. (2018) Effect of Rice Straw and Applications of Potassium Silicate, Potassium Humate and Seaweed Extract on Growth and Some Macronutrients of Sweet Pepper Plants Under Irrigation Deficit. Arab Universities Journal of Agricultural Sciences p755-773
storage. *Fermentation*, *8*(12), 668.

الملخص العربي

دور بعض المواد المحفزة في تحسين نمو وإنتاجية وجودة هجن فلفل الألوان الحلو تحت ظروف البيوت البلاستيكية

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قسم البساتين كلية الزراعة جامعة المنيا

أجريت تجربتان حقليتان تحت ظروف البيت البلاستيكي بمزرعة قسم البساتين بكلية الزراعة جامعة المنيا خلال موسمين 2021/ 2022 و 2022/ 2023. أجريت التجارب لدراسة تأثير رش بعض مضادات النتح ومضادات الأكسدة في تحسين النمو والمحصول وجودة الثمار لهجن الفلفل الالوان تحت ظروف الزراعات المحمية. رتبت معاملات التصميم التجريبي في ثلاث مكررات باستخدام نظام القطع المنشقة في تصميم القطاعات كاملة العشوائية. حيث وزعت هجين الفلفل الحلو هجين احمر (رادن) وهجين (اصفر) ديسكو في القطع الرئيسية ووزعت مضادات الأكسدة ومضادات النتح (شيتوزان)، (ميلاتونين)، (سيليكات البوتاسيوم) في القطع فرعية تحت ظروف الصوب البلاستيكية.

ويمكن تلخيص نتائج هذه التجارب على النحو التالي:

تأثير الهجين (الهجين الأحمر اللون رادن) كان متفوقاً في ارتفاع النبات، عدد الأفرع/نبات، الكلوروفيل ب، متوسط وزن الثمرة، المحصول الكلي (كجم/م^2) ، عدد الثمرة/نبات، سمك جدار الثمرة، ومتوسط طول الثمرة. وفي نفس الوقت تفوق (الهجين الأصفر اللون ديسكو) في متوسط الوزن الطازج/نبات، والوزن الجاف/نبات، والكلوروفيل أ.

تأثير مواد الرش أظهرت نتائج البحث أن رش نبات الفلفل الالوان الهجين بأي من هذه المواد المضادة للأكسدة له تأثير ايجابي ومعنوي في تحسين مؤشرات نمو النبات وزيادة كل من المحصول ومكوناته بالإضافة إلى صفات جودة الثمار مقارنة بالكنترول. كان لمادة الشيتوزان تأثير إيجابي في تحسين ارتفاع النبات وعدد الأفرع/نبات والكلوروفيل ب من مؤشرات النمو. وفي الوقت نفسه، كان الميلاتونين متفوقا. لقد حسن متوسط الوزن الطازج/نبات، الوزن الجاف/نبات، ارتفاع النبات، والكلوروفيل ب لمؤشرات النمو ومتوسط وزن الثمرة، المحصول الكلي (كجم/م^2) ، ومتوسط طول الثمرة لمكونات المحصول. في المقابل تفوقت سيليكات البوتاسيوم حسن في متوسط الوزن الطازج/نبات، والوزن الجاف/نبات، وعدد الأفرع/نبات كلوروفيل أ وكلوروفيل ب في مؤشرات النمو ومتوسط وزن الثمرة وسمك جدار الثمرة والمحصول الكلي (كجم/م^2) ومتوسط طول الثمرة لمكونات المحصول