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Response of pepper plants grown under high temperature to some safety compounds and reflect of that on fruit yield and its quality and minimizing the Physiological infection by sunburn.

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Abstract

Two field experiments were carried out at Kaha Vegetable Station, Qalubia Governorate, Egypt, during the two late summer seasons of 2015/2016 to study the influence of foliar application with some safety compounds, i.e. Kaolin (Aluminum silicate) at 2 % and 4% /l, Silica gel at 1% and 2% /l, Purshade at 5 and 8 cm^3 /l., Lithovit at 0.5 and 0.75 g/l. comparing with the control (tap water), the foliar application treatments started after three weeks from transplanting and repeated four times during the growth season every three weeks by intervals. The obtained results, showed that, plant length and number of branches per pepper plant were significantly responded to the all treatments of foliar spray with Lithovit, Purshade, Silica gel or Kaolin at the two levels respectively, while, number of leaves/ plant and plant dry weight did not show responses except silica gel at 1% / l during the two seasons and, Purshade at 5 cm^3 / l at the second season on plant dry weight only. Moreover, the all foliar spray treatments led to obvious incerement in the total fruit yield and its types, inspite of some of it's not reach to significant level. The superior treatments which produced the highest yield with best quality were foliar spray with Lithovit at 0.75 g/l, Purshade at 5 cm^3 /l, Kaolin at 4%/l then Silica at gel 2% /l respectively. The highly significant lowest percentages from sunscald fruit at the two seasons were obtained from Lithovit at 0.75 g/l, then Silica gel at 2%/l, then Purshade 5 cm^3 /l in descending order respectively. The fruit contents from Ca, Mg and N significantly responded to the all treatments while the highest values from vitamin C were obtained from Purshade 8 at cm^3 /l, Lithovit at 0.5 g/l, and Silica gel at 2% /l respectively. It can recommended under heat stress condition by adding foliar spraying pepper plants with any one of Lithovit at 0.75 g/l or Purshade at 5 cm^3 / l or Kaolin at 4%/l or Silica gel at 2%/l respectively to obtain highest pepper fruit yield with best quality and protect the fruit from sunburn injury.

Key Words: Kaolin (Aluminum silicate) Silica gel Soluble SiO_2 sunscald sunburn

Introduction

Sweet pepper (*Capsicum annuum* L.) is the third member of the family Solanaceae. Pepper is the most widely grown and popular vegetable crop in the world, as well as one of the most important vegetable fruit crops in Egypt for fresh consumption and exportation. Under the Egyptian climate conditions, which characterized with high temperature during summer period which consider the main growing season of pepper. Pepper plant and its fruits were affected with sunscald if the plants and fruits expose to high temperature and produce low fruit quality and infected with Sunburn as a result of high solar radiation causes large economic losses in the fruits and vegetables grown in arid and semiarid regions of the world. The first sunburn necrosis is happened in the skin, peel, or fruit tissue causing skin tissue death specially in the exposed side of the fruit to sunward. The critical injury of fruit tissue exposed to high temperature or direct sunshine varies according to position of the fruits on the plant and the degree of maturity as well as drought degree either in the soil or in air condition. The second type of sunburn injury is brown sunburn tissue, **(Davenport *et al*., 1969).** It can reduce heat injury on fruit tissues by different treatments such as, foliar sprays by using some reflecting materials which may reduce transpiration through three different ways: reduce the absorption of radiant energy or thereby reduce leaf temperatures and transpiration rates; form thin transparent films which reduce the transpiration rate from the leaves, and finally prevent the stomata from still opening or quick opening, thus decreasing the loss of water vapor from the leaves. The serous injury can happen under the condition of high temperature and strong light, because the sunburn increase strongly as result of the interaction of high temperature and strong light **(Glenn *and Erez* 2002, and Schrader *et al*., 2003)**.The high temperature stresses is one of biotic stresses that limit plant growth and survival its. The morphological symptoms of heat stress include scorching of leaves and twigs, leaf senescence and abscission, inhibition shoot and root growth **(Wahid and Shabbir 2005)** for that., Several investigates reported that, spraying particle film from aluminum silicate (kaolin) or silica gel induced reduction on the injury of the high temperature on apple fruit thereby reducing sunburn and improving the development of red coloring of the fruit **(Mahmoud *et al*., 2010)** The reflective film treatments were 1 , 2 and 3% kaolin clay or 0.5, 1 and 1.5% Silica gel. Results of this study revealed that reflective films sprayed on apple trees increased significantly the leaf area and level of light reflected

from the leaves, while decreased the percentages of fruit sunburn **(Mahmoud *et al*., 2010).**

In addition., anther investigates indicated that, silicon affect positively on several plants which led to inhancing plant growth and crop quality, stimulates photosynthesis, reduces transpiration rate, and enhances plant resistance to a series of both abiotic and biotic stresses such as water deficiency and chemical stresses, nutrient imbalances, metal toxicities, diseases pests problems (**Cherif *et al*., 1992 ; Hodson and Sangster, 1999; Liang *et al*., 2001; Lu and Cao, 2001; Ma and Takahashi, 2002; McAvoy and Bible, 1996; Savvas *et al*., 2002 Seebold *et al*., 2001; Zhou *et al*., 2002;**). Although Si is important for plant growth, it had abundance roles in the soils compared to other elements (**Ma and Takahashi, 2002)**. Recently, there has been an increased interest for sustainable crop production, and Si can contribute to that direction with its prophylactic properties and promotion the plant vigor. **Okuda and Takahashi (1965)** suggested that a large amount of Si was important to promote the growth of rice (Oryza sativa) and improve the grain yield. They tested different concentrations of SiO_2 (0, 5, 20, 60, and 100 ppm). The application of SiO_2 at 60 and 100 ppm increased the top length, stem number, dry weight and grain yield of the rice. The same researchers also found that when silicon acid was applied to barley (Hordeum vulgare L.) increased the percentage of ripening panicles and the grain yield. Maize (Zea mays L.) also responds positively to Si supplements. Leaf growth, aerial root occurrence, ear development, leaf system constitution, stem development, lodging resistance, nutrient absorbing ability, grain number, and dry matter accumulation after silking were improved by Si fertilizer application (**Zhou *et al*., 2002**). According to these researchers Si fertilizer should be applied as a base-fertilizer to maize. **Ren *et al.* (2001)** found that the Si application increased yield of maize by 8.6%, increased utilization rate and absorbing ability of nutrients. In addition The fertilization with Si increased the commercial productivity of tomato plants and reduced the occurrence of cracked fruits **(**Josué **C Marodin *et al. 2014)***

It can by using another organic compounds such as Purshade, which showed important role on reducing solar radiation injuries, moreover Purshade reduces solar stress in crops by protecting the foliage and fruits from damaging caused by ultraviolet (UV) and infrared (IR) radiation, while still allowing photosynthesis to occurrence. Engineered with advanced reflectance technology and based on calcium carbonate which consider a highly reflective mineral, Purshade has been shown to reduce sunburn damage and minimize overall heat stress. Purshade effectively reflects harmful UV and IR radiation away from plants. Concerning the effect of it as an antitranspirants treatment, in this concern, **El-Sayed (1991)** decided that spraying snap bean cv. Giza 3 plants with 2 or 3 % of pinolene (as an antitranspirant) increased plant height and fresh weight of snap bean plants. **Csizinszky (1996)** by using Vapor Gard (di-1p-menthane) antitranspirant at 9.35 L/ ha, sprayed either weekly or biweekly during the first 10 weeks of the season on tomato and bell pepper increased dray matter in shoots. As regard to treating tomato plants with Stanes and Greenmiracle which consider as antitranspirant compounds and Purshade as antitranspirations treatments, in this respect, **Amor *et al*. (2010)** pointed out that spraying the mentioned antitranspirants could significantly improve drought tolerance in sweet pepper plants. Purshade treatment increased the leaves content from total chlorophyll (SPAD unit), nitrogen, phosphorus and potassium (%) of tomato plants (**Abdel-Aziz and Gaafar 2012).**

Regarding to another compound which consider as anti-sunburn stress it was found that Lithovit compound contain active and important macro and microelements which consider a natural intensified Co_2 foliar fertilizer for indoor/outdoor uses, it is a top-quality natural technological product created by tribodynamic activation and micronization to levels of 10-20 microns. Lithovit can considerably increase the photosynthesis rate, since one of the essential factors limiting photosynthesis outdoors is the lower natural co_2 content of the air. **Byan(2014)** reported that lithovit foliar spray on snap bean and soil treatment with sap material gave the highest values of green pod characters as well as strong vegetative growth.

This study was initiated to evaluate the effect of some reflective films materials (as an safety compounds) on fruit yield and its quality components i. e., early, mid, late and total fruit yields, protect pepper plants and fruits against sunburn injury and enhance fruit mineral composition of sweet pepper plants grown under high temperature conditions.

Material and Methods

Two field experiments were carried out at Kaha Vegetable Station, Qalubia Governorate, Egypt, during the two late summer seasons of 2015/2016 to study the effect of foliar application by some natural and active compounds unti high temperature stress, i.e., kaolin (2 and 4%/l),silica gel (1 and 2%/ l), Purshade (5 and 8 cm^3 / l), Lithovit (0.5 and 0.75 g/l) comparing with the control (tap water), and the reflection of that on vegetative growth, yield components, i.e., early, mid, late and the total fruit yields (ton/ fed) minimize, sunburn fruit percentage and enhancing some chemical contents in fruits of pepper plants grown under high temperature at the late summer season.

The mechanical and chemical analysis of the experimental soil at Kaha are analyzed according to the methods described by **Black (1965)** as shown in **Table (1)**

Table 1. Physical and chemical properties of the experiment soil at Kaha Vegetable Station during the late summer season of 2015 and 2016**.**

Components	2015	2016
Soil texture	Clay loam	Clay loam
PH	8.08	8.09
E.c (ds / m)	3.39	3.47
N ppm	110	107
P ppm	49	46
K ppm	103	102

Sweet pepper (*Capsicum annuum* L. cv. California Wonder.) seeds were sown in the nursery on 3rd and 5th of March, respectively in 2015 and 2016 seasons, in seedling trays (209 cell) under unheated greenhouse conditions. Pepper seedlings were transplanted on 5th and 7th of April, in the both seasons, respectively.

The treatments of this experiment were arranged in randomized complete block design with three replicates. Each plot area was 8.4 m^2 (the plot consists of three rows each row was 0.7 m wide and 4 m long) with a spacing of 35 cm between the plants.

All materials were delivered in fine mist using hand pressure sprayer equipped with a fine nozzle. A guard row was left between each two experimental units to avoid drift sprays.

This experiment included eight treatments, and the control, names of the nutritional materials and its composition are shown in **Table (2)**.

Table 2. Names of nutritional compounds and its composition used in this study as foliar spray on pepper plants during the two late summer seasons of 2015 and 2016.

Nutritional names and its used levels	**Composition**
1-Kaolin(Aluminum Silicate) at 2%/l **2- -Kaolin(Aluminum Silicate) at 4%/l**	Aluminum silicate ($(Al_2O_7Si_2)$, $Si_2$48.8ml/g + Al_2 O_7.7%)).
3-Silica gel at 1%/l **4- Silica gel at 2%/l**	Soluble SiO_2
5-Purshade at 5 cm /l **6- Purshade at 8 cm /l**	62.5% $CaCo_3$ +37.5% organic forms.
7-Lithovit at 0.5 g/l **8- Lithovit at 0.75 g/l**	80.2% $CaCo_3$, 4.6%$MgCo_3$,0.2 %K_2O,0.75% Fe.
9- The control treatment	Spray only with tap water

The foliar spray treatments started after 21 days from transplanting and repeated every 21 days by intervals four times during the growing season (before the first picking).

Field environmental conditions: The metrological data for the experimental area obtained from Central Laboratory of Agricultural Climate (CLCA), Agricultural Research Center (ARC), the values were calculated and expressed as monthly interval means during the two growing seasons as shown in

Table 3. Maximum air temperature of Qalubia governorate region during the summer seasons of 2015 and 2016**.**

Months	Max. air Temperature Cº	
	2015	2016
April	38.8	40.7
May	44.3	46.3
June	39.3	44
July	38.9	38.4
August	43.5	39.5
Mean	40.96	41.78

Data recorded:

I- Vegetative growth parameters : Three plants were chosen randomly from each treatment plot in as a representative sample at the flowering stage (after 65 days from transplanting) in order to determine the following:

I.1. plant height cm

I.2. leaves number /plant

I.3. branches number /plant

I.4.Plant dry weight: A random sample of other three plants from each plot was taken and dried at 70 Cº till constant weight and the dry weight of whole plant was determined using the standard methods as illustrated by **A.O.A.C (1990).**

II. Fruit yield and its characteristics:

Fruit yield and its components were determined as: Five sweet pepper fruits were randomly taken from each yield type, i.e. early, mid and the late to determine the following data:

II.1.Total fruit yield

II.1.1.Early fruit yield (ton/fed) as the first and second pickings,

II.1.2. Mid yield (ton/fed) pickings no., three, four,five and the sex

II.1.3.Late fruit yield (ton/fed) pickings no., seven, eight nine and ten

II.1.4.Total fruit yields (ton/fed) were estimated from the all pickings.

II.2. Fruit characteristics

II.2.1. Fruit length (cm),

II.2.2. Fruit diameter (cm),

II.2.3. Average fruit weight (g) and

II.2.4. Dry matter percent in fruit 100g from early, mid and late fruits yield, fruits were taken and dried at 70 Cº till constant weight and the dry weight was determined.

II.3. Number Sunscald fruits as a percentage: It was determined as the number of the sunscald affected fruits at the total number fruits and calculated according to the formula:

$$\text{Sunscald fruits yield}\% = \frac{\text{No. Sunscald affected fruits}}{\text{Total fruits number}} \times 100$$

III. Some chemical properties in pepper fruits:

III.1. Nitrogen, magnesium and calcium

Total nitrogen, magnesium and calcium were determined in dry fruits on the basis of dry weight according to the methods described by **Bremner and Mulvaney (1982), Chapman and Pratt (1961) and Olsen and Sommers(1982)** respectively .

III.2. Total ascorbic acid

Total ascorbic acid: (Vitamin C mg/100g fresh weight) content was determined using 2, 6 dichlorophenol indophenols, method as described by **Ranganna(1979)**

Statistical analysis:

All data were subjected to the statistical analysis of variance and treatment means were compared according to the Least Significant Differences (L. S. D. at 5 % level) test method as described by **Snedecor and Cochran (1980)**.

Results and Discussion

I. Vegetative growth characters:

Vegetative growth characters determined as plant height, number of leaves and branches/plant as well as plant dry weight of pepper plants grown under high temperature condition and sprayed with some compounds unti high temperature, data in **Table 4** revealed that, all different sprayed treatments i. e.; kaolin (2 and 4% / l),silica gel (1 and 2% / l), Purshade (5 and 8 cm^3 / l), Lithovit (0.5 and 0.75 g / l) recorded significant differences increases on vegetative growth characters i. e.; plant length, number of branches / plant as well as dry weight of plant while the increment of number leaves/plant especially during the first season did not reach to the significant level, under of all concentrations when compared with the control in this resect**. Zakher (2017)** assumed that foliar spray with different treatments i.e., 1 to 3% aluminum silicate induced significant increases on tomato growth in the both seasons of the study. However, foliar spray with 2% was more effective than the others on vegetative growth of tomato plants. Meanwhile, the effect of silicon on plant growth may refer to that Si enhance the growth, improve protection against pathogens (**Greger *et al*., 2011**) and maintain of photosynthetic activity which that is one of the factors for increasing dry matter production (**Agurie *et al*., 1992**). In this respect **Pilon *et al.* (2013**) found that silicon application increased leaf area, specific leaf area, pigment concentration (chlorophyll a and carotenoids) and photosynthesis of potato. Silica has a role "analogous to lignin in that it is a compression-resistant structural component of cell walls" (**Epstein, 1994**). Also reported that Si content in the plant tissue decrease the transpiration rate and increases stem thickness and strength. Plants supplied with silicon are more resistant to water stresses, and less prone or lodging caused by wind (**Hodson and Sangster, 1999**). Silicon has also been reported to have increase resistance to stresses caused by deficiencies and toxicities of nutrients and metals, pH and pesticides. (**Ma and Takahashi, 2002**), mentioned also that, silicon can play an important role on plant growth and crop production by preventing nutrient inbalances. The improved vegetative growth evidenced as plant height, number of branches, chlorophyll content, number of leaves, and stem diameter per plant showed that used purshade treatment, led to reduction about one temperature degree inside the plant foliage less than open field **(Zakher and Abdrabbo, 2014)**. Sprayed Lithovit on snap bean plants gave the highest values of vegetative growth parameters, i.e., plant length, number of leaves/plant and leaf area **Byan, (2014)**.

Table 4. Effect of spraying pepper plants with Kaolin, Silica gel, Purshade and Lithovit on plant growth parameters during the two late summer seasons of 2015 and 2016**.**

Treatments	Plant length (cm)		Number of branches/plant		Number of leaves/plant		Plant dry weight(g)	
	2015	2016	2015	2016	2015	2016	2015	2016
Kaolin 2%/L	32.67	34.00	5.33	5.67	118.7	111.3	14.26	12.6
Kaolin 4%/L	34.0	35.00	5.67	5.00	128.3	124.7	14.77	13.6
Silica gel 1%/L	33.67	37.33	6.00	6.33	140.3	147.0	16.55	15.6
Silica gel 2%/L	31.67	34.67	6.33	5.67	126.3	128.7	13.70	14.3
Purshade 5 Cm^3 /L	37.00	36.33	5.67	6.67	121.0	137.7	13.47	15.6
Purshade 8 Cm^3 /L	35.33	32.00	7.33	7.67	127.0	128.0	13.25	13.7
Lithovit 0.5 g/L	35.33	36.33	6.67	7.00	107.3	115.0	11.30	12.8
Lithovit 0.75 g/L	32.00	35.00	6.00	6.33	123.0	120.3	12.77	12.8
Control	29.67	30.67	4.67	4.67	104.0	95.3	11.73	10.6
L.S.D at level 0.05	3.38	2.39	0.57	1.06	47.4	44.7	5.2	4.7

II. Fruit yield and its characters:

The influence of spraying pepper plants with some unti-stress materials on fruit yield and its components, i. e; early yield, mid yield, late yield as well as the total fruits yield, in addition fruit characters are shown in **Tables 5, 6 and 7**

Data illustrated in **Table 5** show obviously that, application of different levels of treatments i.e., Kaolin, Silica gel, Purshade and Lithovit did not induce significant increases on fruit length at the early yield, while most of the treatments showed positive response on either fruit length or fruit diameter at the fruits obtained from mid yield or late yield, it is notice that lithovit at 0.5 and 0.75 g/l, purshade at 5 cm^3 /l then kaolin were the favorable treatment on fruit characters inspite of did not reach to significant level on some characters. All treatments showed positive response on fresh fruit weight that, the fresh fruit weight as shown in **Table 6**, as a general, the all treatments induced obvious increment but not reach to the significant level, it is notice also that using Lithovit at 0.75 g / l and purshade 5 cm^3 /l gave favorable significant, but in the first season not reach to the significant level expect at kaolin 2%/ l. The fruit dry weight not reach to the significance level by using the mentioned materials.

Table 5: Effect of spraying pepper plants with Kaolin, Silica gel, Purshade and Lithovit on fruit length and diameter at yield types characters during the two late summer seasons of 2015 and 2016.

Treatments	Fruit length cm						Fruit diameter cm					
	Early yield		Mid yield		Late yield		Early yield		Mid yield		Late yield	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Kaolin 2%/L	5.46	5.63	6.37	6.70	6.33	5.70	4.45	4.55	6.47	6.13	5.20	4.83
Kaolin 4% /L	5.28	5.64	6.50	6.87	6.00	5.33	3.89	4.37	6.40	6.30	5.70	4.97
Silica gel 1%/L	5.08	5.46	6.80	7.13	5.43	5.60	4.31	4.14	6.60	6.30	5.10	4.50
Silica gel 2%/L	5.72	5.57	6.40	6.27	6.10	5.83	4.41	4.49	6.10	6.07	5.03	4.80
Purshade5 Cm^3 /L	5.13	5.20	7.03	7.07	6.13	5.93	4.22	4.44	6.83	6.53	5.97	6.00
Purshade 8 Cm^3 /L	5.78	5.26	5.97	6.13	5.27	5.20	4.68	4.56	6.27	5.57	5.23	5.23
Lithovit 0.5 g/L	5.31	5.27	6.73	6.57	5.33	5.57	4.49	4.82	5.87	5.83	5.33	5.70
Lithovit 0.75 g/L	5.33	5.14	7.60	7.57	5.83	5.67	4.61	4.04	6.80	6.70	5.93	5.90
Control	5.21	5.20	6.30	6.10	5.23	5.03	4.07	4.07	5.83	5.47	4.23	4.63
L.S.D at level 0.05	1.02	0.77	0.83	0.65	1.16	0.72	0.56	0.68	0.48	0.52	0.9	0.87

Table 6. Effect of spraying pepper plants with Kaolin, Silica gel, Purshade and Lithovit on average fruit weight at different yield types during the two late summer seasons of 2015 and 2016.

Treatments	Average Fresh fruit weight (g)						Dry fruit weight(g)/100g					
	Early yield		Mid yield		Late yield		Early yield		Mid yield		Late yield	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Kaolin 2%/L	50.99	46.34	67.20	67.47	52.87	53.43	7.47	7.23	8.23	8.17	8.30	8.30
Kaolin 4%/L	39.85	36.16	59.26	59.46	49.03	47.81	7.30	7.47	7.97	7.90	8.13	8.10
Silica gel 1%/L	34.23	30.42	77.82	84.76	41.70	46.18	7.57	7.93	8.30	8.23	7.40	8.27
Silica gel 2%/L	36.84	39.78	65.64	63.57	51.68	51.55	7.30	7.40	7.90	8.03	8.10	8.10
Purshade5 Cm^3 /L	34.75	33.59	84.82	83.10	56.45	54.60	8.13	8.23	8.47	8.53	8.67	8.63
Purshade 8 Cm^3/L	41.44	37.2	62.50	63.81	46.56	47.17	8.53	8.33	8.67	8.60	8.67	8.63
Lithovit 0.5 g/L	41.73	44.36	62.08	64.63	50.05	49.79	8.13	8.57	8.47	8.53	8.60	8.60
Lithovit 0.75 g/L	46.59	32.33	84.89	83.01	54.24	54.46	7.60	7.33	8.17	8.13	8.30	8.13
Control	30.31	32.84	60.64	60.75	44.59	43.58	7.07	6.97	7.87	7.83	7.93	7.77

The data in **Table 7** as general show that all treatments used at its two levels led to obvious increment in the all fruit yield types, i.e early, mid, late and total yields but in some cases the increment did not reach to the significant level. In other meaning it can said, the favorable significant treatment on the early yield was obtained by spraying the plants using lithovit at 0.75g / l then purshade at 5 cm^3/ l, while in the mid yield or the late yield the treatment by using lithovit at 0.75g/L then purshade at 5 cm^3 / l then silica gel or kaolin were the best respectively. The highest total fruit yield was obtained from the treatment of spraying pepper plants with Lithovit at 0.75 g / l then the treatment of purshade at 5· cm^3 / l the same trend was found about the reflective film treatments of 1, 2 and 3% kaolin; 0.5, 1 and 1.5% Silica gel, on apple trees **(**Mahmoud ***et al.*** **2010).** These results also might be attributed to the favorable temperature as a result of the role of the used materials, i.e., Kaolin, Silica gel, Purshade and Lithovit effect during the period of growth and reproduction process which reduced plant transpiration rate and thus water uptake, and improved water use and moisture availability in the soil which might have increased various physiological processes, better plant nutrient uptake, higher rates of photosynthesis, which might reflect on more number of fruits and higher fruit weight (**Ngouajio *et al.*, 2007**). In addition, **Byan(2014)**. Reported that spraying snap bean plant with Lithovit increased pod yield by about 50% and reduced water requirement as the physiological role of Lithovit increasing photosynthesis rate and this led to yield increases and also to Lithovit contents from some essential microelements, i. e., Mg, Fe and K_2O, as a important

macro element moreover role of Lithovit to encourage the plants to keep the stomata closed longer time under drought condition, all of that influence positively on plant physiological processes which that reflect in the fruit yield.

Concerning to the effect of the materials used in this study, i. e., Kaolin, Silica gel, Purshade and Lithovit at two levels, on the sunscald fruits percentage, the data in **Table 7** illustrate that, all treatments induced significant protection from sunburn injury on pepper fruits, comparing to the control. The lowest values of number sunscald fruits % were obtained from Lithovit at 0.5 g/ l (7.2 & 6.89 %) then silica gel at 2 % (10.9 &11.78 % from the total no. fruits) then purshade at 5 cm^3 /l (15. 6 & 14.16 % from the no. of fruits) comparing the control (28.5 & 28.7 % from the no. of fruits) as average of the two seasons respectively. The obtained results are similar of that obtained from, **Glenn *and Erez(* 2002), Mahmoud *et al*.(2010)** on apple, **Zakher (2017)** on tomato. It is obvious that, Lithovit 0.5 g/l then silica gel 2 % then purshade 5 cm^3 / l were the most favorable treatments to minimize the percentage of sunscald fruits, and this may be due to the role of these compounds causing positive reflection of infrared as well as ultraviolet radiation and reduce transpiration rate, in addition increase plant foliage, whereas all this led to highly protection for the fruits against heat stress as well as sunburn injury in fury as mentioned by several investigators.

Table 7. Effect of spraying pepper plants with Kaolin, Silica gel, Purshade and Lithovit on early , mid , later ,total yield and sunscald fruits % during the two late summer seasons of 2015 and 2016.

Treatments	Early yield t/f		Mid yield t/f		Later yield t/f		Total yield t/f		Fruit sunscald %	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Kaolin 2%/L	1.59	1.64	5.52	4.9	1.80	2.08	8.9	8.59	23.12	24.21
Kaolin 4% /L	1.63	1.80	4.51	5.35	1.92	2.44	8.1	9.6	22.87	22.88
Silica gel 1%/L	1.56	2.09	4.90	5.6	2.46	2.44	8.92	10.13	13.73	14.03
Silica gel 2%/L	1.42	1.84	3.51	4.78	2.10	2.05	6.99	8.67	10.90	11.78
Purshade5 Cm^3 /L	1.98	2.3	6.37	6.10	3.19	2.93	11.54	11.33	15.60	14.16
Purshade 8 Cm^3 /L	1.45	1.89	5.41	5.53	1.93	1.96	8.78	9.39	21.78	21.34
Lithovit 0.5 g/L	1.75	2.02	5.71	5.57	2.18	2.28	9.65	9.83	7.2	6.89
Lithovit 0.75 g/L	2.06	2.45	7.21	7.50	2.83	2.68	12.11	12.64	23.28	23.38
Control	1.32	1.49	4.79	4.37	1.65	1.80	7.76	7.67	28.52	28.68
L.S.D at level 0.05	0.45	0.6	2.15	1.17	0.71	0.50	2.16	1.62	3.61	3.73

III. Some Fruit chemical contents:

Effect of spraying pepper plants with reflective film from kaolin, silica gel, Purshade and Lithovit on some minerals, i. e., (Ca, Mg, N) as well as vit. C contents in pepper fruit are shown, in Table (8). The data revealed that, all reflected films used in this study increased Ca, N, Mg elements as well as Vit. C contents in pepper fruit as compared with the control in both seasons. Furthermore, the Lithovit 0.5g / l or silica gel 2 % significantly increased the contents of fruit flesh with Ca and Mg comparing with the control in both seasons, purshade 8 cm^3/ l increased VC in the both seasons, while kaolin 4%/l was not affected on VC content in both seasons. These obtained results are in agreement with those obtained by other investigators **Schupp *et al*. (2002)** on apple , **Jia *et al*. (2011)** on some crops i. e., showed that silicon material increase vitamin C and soluble solids of strawberry and eggplant.

Table 8. Effect of spraying pepper plants with Kaolin, Silica gel, Purshade and Lithovit on fruit mineral Contents of pepper during the two late summer seasons of 2015 and 2016.

Treatments	Ca%		Mg%		N%		V.C (mg/100g)	
	2015	2016	2015	2016	2015	2016	2015	2016
Kaolin 2%/L	25.13	24.74	5.01	4.91	2.48	2.58	92.5	95.0
Kaolin 4%/L	25.16	25.06	5.23	5.28	2.28	2.22	105.0	105.8
Silica gel 1%/L	25.68	25.67	5.18	5.22	2.6	2.6	128.3	127.5
Silica gel 2%/L	25.99	26.12	5.71	5.98	1.89	2.03	114.2	116.7
Purshade5 Cm^3 /L	25.38	25.14	5.18	5.28	2.67	2.77	103.3	105.0
Purshade 8 Cm^3 /L	25.16	24.95	5.21	5.16	2.62	2.51	152.3	150.0
Lithovit 0.5 g/L	26.68	26.49	5.84	5.95	2.45	2.51	137.5	139.3
Lithovit 0.75 g/L	24.62	24.29	5.29	5.21	2.4	2.47	109.2	110.8
Control	23.14	23.18	4.75	4.54	2.03	2.10	97.5	97.5
L.S.D at level 0.05	0.30	0.49	0.17	0.31	0.15	0.18	23.2	24.9

Conclusion

According to the obtained results, it can recommended by spraying pepper plants grown under late summer under high temperature condition, which expose to high temperature injury, with any one of the favorable material such as Lithovit 0.75 g/ l, purshade 5 cm^3 / l, kaolin 4%/ l or silica gel 1%/ l respectively which showed highly protection against heat stress injury and increased fruit yield as well as its quality with low percentage from number of sunscald fruits , whereas, the plants in this period expose to heat stress and sunburn injury on the fruits causing reduction on fruit yield and its quality .

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استجابة نباتات الفلفل المنزرع تحت ظروف الحرارة المرتفعة لبعض المركبات الامنة وانعكاس ذلك على محصول الثماروجودته وتقليل الاصابة الفسيولوجية بلفحة الشمس .

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اجريت التجربة بمزرعة الخضر بقها– محافظة القليوبيه خلال الموسم الصيفى المتأخر لعامى 2015 / 2016 لدراسة تأثير الرش ببعض المواد الآمنه مثل الكاولين (سليكات الالومنيوم) 2 %، 4 % ،سليكا جيل بمعدل 1 % ، 2 % ، بيورشاد 5 ، 8 سم / للتر ، لثيوفيت 0.5 ، 0.75 جرام / للتر و الكنترول (ما ء صنبور) و تم الرش الورقى بعد 3 أسابيع من الشتل و كرر كل 3 أسابيع لعدد 4 رشات (حتى بداية الجمع) .واوضحت النتائج المتحصل عليها انه بوجه عام ادت كل المعاملات المستخدمة فى الرش الى زياة معنويه فى طول النبات و عدد الافرع / نبات بينماعدد الاوراق على النبات و المادة الجافه له لم تظهر استجابه للرش لكل المعاملات فيما عدا الرش بمركب سيلكا جيل 1 %، ومركب البيورشاد 5سم / لتر حيث اظهرت زيادة معنوية فى المادة الجافه بالنبات فقط . وقد ادى الرش بكل المعاملات المذكوره الى زيادة و اضحه فى المحصول الكلى للثمار و انواعه المحصول المبكر والمتوسط والمتأخر بالرغم من ان بعض الزيادات لم تصل الى مستوى المعنويه وكانت افضل المعاملات و ذلك فى انتاج اعلى محصول بمواصفات جيدة هو الرش بمركب ليثوفيت 0.75 جرام / للتر يليه بيوشاد 5 سم / لتر، كاولين 4% يليه سليكا جيل 2% بالتوالى . كما ان اقل نسبه من الاصابه بلفحة الشمس على الثمار تم الحصول عليها خلال الموسمين من الرش بمركب ليثوفيت0.75 جرام/ لتر ثم سليكا جيل 2 %/ لتر ثم مركب بيورشاد 5 سم / للتر على التوالى كما ادت جميع معاملات الرش بالمواد المذكوره الى زيادة محتوى الثمار من كل من الكالسيوم – الماغنسيوم و النيتروجين و كانت اعلى التركيزات من فيتامين سى فى الثمار الناتجة من النباتات التى تم رشها بمركب بيورشاد 8 سم / لتر يليه لثيوفيت 0.5 جرام / لتر ثم سليكا جيل 1%/ لتر . وعلى ضوء ذلك يمكن التوصيه تحت ظروف الاجهاد الحرارى (حراره مرتفعه) استخدام الرش الورقى لنباتات الفلفل اى من مركب لثيوفيت 0.75 جرام / لتر او بيورشاد 5 سم / لتر او كاولين 4 %/ لتر او سليكا جيل 2 %/ لتر على التوالى طبقا لاهمها للحصول على اعلى محصول من الثمار بمواصفات جيدة واقل نسبة اصابه بلفحة الشمس للثمار.