

INFLUENCE OF PRE-HARVEST POTASSIUM AND SILICON FOLIAR APPLICATION ON QUALITY AND STORABILITY OF SWEET PEPPER

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Abstract

This experiment was carried out in the two successive seasons 2013/ 2014 and 2014/2015 to study the effect of the pre-harvest foliar applications of potassium silicate at concentration of 4 and 8ml/l, potassium thiosulfate at concentration of 1.5 and 3ml/l, and Harvars at concentration of 2.5 and 5ml/l on the quality and storability of sweet pepper fruits (*Capsicum annuum L.*) cv. Sonar. The obtained results showed that spraying sweet pepper plants with potassium silicate or potassium thiosulphate significantly improved fruit quality parameters at harvest time i.e., fruit weight, lightness and hue angle. Concerning storage experiment, the obtained results indicated that sweet pepper fruits received pre-harvest potassium silicate at a concentration of 4 ml/l effectively displayed sweet pepper fruits with glossy and vivid green appearance, maintained TSS%, and reduced the degradation of ascorbic acid content of sweet pepper fruits during storage at 8°C and 95 % RH for 21 days.

Key words: Sweet pepper, potassium foliar applications, storage.

INTRODUCTION

Sweet pepper (*Capsicum annuum L.*) is one of the most important commercial vegetables. However, it is a highly perishable crop with short shelf life. Pepper fruits are rich in vitamins, such as A and C, and are low in calories (Howard *et al.*, 1994). The quality attributes during storage of fresh pepper fruits are affected by water loss, chilling injury, and pathological disorders, which reduce quality and acceptability of fruits. So, it is recommended to store pepper fruits between 7-10 °C and 95% RH to stay in good quality for 2-3 weeks without chilling injury (Sethu *et al.*, 1996, Kader, 2002, and Maalekuu *et al.*, 2002, and smith *et al.*, 2006). Pre-harvest plant nutrition is a major factor effect on fruit and vegetable quality (Sams, 1999). Potassium (K) has been recognized as an important nutrient for crop quality, because it is involved in plants in several metabolic processes such as enzyme activation, osmotic control, and carbohydrate production (Krauss, 2000, and Cong and Hardter, 2001). Silicon (Si) also, plays different roles in plant growth and development; improve soil fertility,

enhance plant resistant to diseases and pests, increase photosynthesis, regulate respiration and increase the tolerance of plant to elements toxicity (Hou *et al.*, 2006). Pre-harvest applications of K and Si during plant growth and fruit development increased fruit weight and chlorophyll content of leaves in strawberry Afifi, (2016). Improved postharvest fruit quality, and increased TSS and ascorbic acid in horticulture crops (Hou *et al.*, 2006), in melons (Jifon *et al.*, 2009), in Sweet pepper (El-Bassiony *et al.*, 2010), in tomato (Lyyakkannu *et al.*, 2011), in Muskmelon (Jifon and Lester 2012), in strawberry Afifi, (2016).

The aim of this work was to investigate the impact of pre-harvest foliar applications of potassium silicate as a source of silicon, and potassium thiosulfate and Harvars as sources of potassium on quality and storability of sweet pepper fruits.

MATERIALS AND METHODS

The field experiment

This experiment was carried out in the two successive seasons 2013/ 2014 and 2014/2015. Sweet pepper seeds (*Capsicum annuum L.*) cv. Sonar from Slwis & Groot Company, Holland, were sowed on 1st day of July in both seasons in a plastic house using seedling trays of 84 cells. The trays were filled with a commercial plastic house transplanting mixture [1 peat moss: 1 vermiculite (v/v)] amended with macro- and micro-nutrients. Sowing was carried out and each cell of the tray had one seed covered with 0.5 cm of the sowing mixture. After 30 days, seedlings were transplanted to a plastic house of an area 540 m² (60 m long × 9 m width × 3 m height). The area of each experimental plot was 10 m² consisted of one row (10 m length with 1 m width). Seedlings were planted on the two sides of each ridge (zigzag pattern) at 50 cm apart. The experiment was laid out in a randomized complete block design with three replicates. The soil texture of the experiment was clay loamy as represented in Table 1.

Agricultural practices as harrowing and pests and diseases control were carried out according to the recommendations of ministry of agriculture for sweet pepper planting.

Table1. The physiochemical properties of the plastic house soil used for sweet pepper planting (average two seasons).

Soil texture	Organic matter (%)	pH	E.C. (dS m ⁻¹)	Available N (ppm)	Available P (ppm)	Available K (ppm)
Clay loamy	1.2	8.22	0.446	42.5	7.65	337

Soil sample was taken from 25 cm soil surface

Soil samples were analyzed by Soil, Water and Environment Res. Inst. Agric. Res. Center. The chemical properties of the soil were determined using the methods described in Association of Official Agriculture Chemists AOAC (1990).

Potassium foliar applications were applied as follow:

1. Potassium silicate K₂SiO₃ 4 ml/l.
2. Potassium silicate K₂SiO₃ 8 ml/l.
3. Potassium thiosulfate K₂S₂O₃ (KTS) 1.5 ml/l.
4. Potassium thiosulfate K₂S₂O₃ (KTS) 3 ml/l.
5. Harvars (60% K₂O) 2.5ml/l.
6. Harvars (60% K₂O) 5 ml/l.
7. Controll (sprayed with tap water).

Potassium silicate (10% K₂O+25% SiO₂) and KTS (36 % K₂O+25%SiO₂) were purchased from El-Gomhoria Co. Egypt. Meanwhile, Harvars (N-P-K, 7: 7: 60), was purchased from Haval Company for Industrial Investments and Chemical Materials, Egypt. Plants were sprayed 4 times during the growing period 15, 30, 45-and 60 days from transplanting.

The obtained data in this experiment were recorded as follows:

Fruit quality parameters

A random sample of 10 fruits from each replicate was taken at harvest to evaluate fruit quality parameters: average fruit weight (g), Skin color measurement was measured using a Minolta Chroma Meter, model CR-200. Calibration was done by a white plate before use. Color changes were quantified by calculating lightness (L) and hue angle in tested samples during storage. hue angle is defined as a color wheel, with pure redness at an angle of 0°, yellow at 90°, pure greenness at 180°, and blue at 270° Xing *et al.*,(2011). Total soluble solids (TSS) % was determined by using a hand Refractometer according to the methods mentioned in A.O.A.C. (2000). Titratable acidity percentage in pepper was measured by titration with 0.1 NaOH and

calculated as citric acid according to AOAC (2000). Ascorbic acid content (as indicator for vitamin C.) was determined (as fresh samples of fruits) by titration method using 2, 6 dicloro phenol indophenol as dicribed in AOAC (2000).

The storage experiment

Sweet pepper fruits were harvested after 70 days from transplanting at a commercial maturity (green stage) and transferred to the laboratory of the Vegetable Handling Department, Horticulture Research Center, within two hours of harvest and kept overnight at 8°C and 90-95% relative humidity (RH). The following morning, the uniform fruits in size, without physical defects or fungal infection from each treatment were selected and placed in carton boxes at the diminutions of 30×35×10cm. Each box contained 2 kg from pepper fruits as one replicate. Nine replicates from each treatment were stored at 8°C and 95 % RH for 21 days. The sample for each treatment was taken at random in three replicates and arranged in a complete randomized design. Samples were evaluated for the changes in the quality parameters at 0 and 7, 14 and 21 days during storage as follows:

1. Weight loss percentage (estimated according to the following equation:

$$\text{Weight loss\%} = \frac{\text{Initial plant weight} - \text{plant weight at sampling date}}{\text{Initial plant weight}} \times 100$$

2. Skin color (lightness and hue angle), Total soluble solids (TSS %), Titrable acidity (TA %), and ascorbic acid content (vitamin C) were measured as described previous in the field experiment.
3. Visual quality of pepper fruits were determined according to the following score system: 9 = excellent, 7 = good, 5 = fair, 3 = poor, and 1 = unusable. Where an average of 5 is fruit in the limit of shelf life. This scale depend on morphological defects such as shriveling (wilting), color change of fruit surface and the pathological disorders.

Statistical analysis

Data of the field experiment and cold storage experiment were statistically analyzed by using MSTAT statistical software and the treatments means were compared by using LSD at 0.05 level of probability according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Fruit quality parameters

Data presented in Table 2 reveal that all tested treatments produced sweet pepper fruit with higher average fruit weight without significant differences among them as compared with fruit sprayed with harvars at concentration of 2.5ml/l or

control, where control plants recorded the lowest average of fruit weight. Such results were in line with the work of Afifi, (2016), for potassium silicate on strawberry, and in a contradiction with the finding of Jifon *et al.* (2009) for potassium thiosulphate on melons. As regard to lightness it is clear from the data that our tested treatments significantly increased the lightness of sweet pepper fruit as compared with control. These results were true in the second season. Meanwhile, no significant differences were observed between control plants and plants treated with Harvars at the concentration of 2.5 or 5 ml/l in the first season. Our results were supported by Jayawardana *et al.*, (2014) who found that foliar application of soluble silicon increase cuticle thickness of capsicum fruit. This in turn gives sweet pepper fruits the shiny appearance. With respect to hue angle, the same Table shows that our tested treatments were succeeded in producing sweet pepper fruit with clear green color without significant effect among them as compared to control. Our obtained results were in agreement with Silva *et al.*, (2013) who investigated that spraying strawberry plants with Si increased the values of chlorophyll reading compared with control, and El-Bassiony *et al.*, (2010) who found an increasing in the content of sweet pepper fruit from chlorophyll as the potassium rate increased. Concerning TSS%, data listed in Table 2 displays that our studied treatments effectively increased TSS% of sweet pepper fruits compared with control in both seasons. These results were in accordance with Afifi, (2016) for potassium silicate on strawberry and Jifon and Laster (2012) for potassium thiosulfate on muskmelon. Moreover, Sweet pepper fruits received potassium silicate at concentration of 4ml/l recorded the highest TSS% as compared with the other treatments. Meanwhile, control fruits recorded the lowest TSS% in both seasons. Regarding acidity % and ascorbic acid content, the obtained data reveal that our treatments hadn't any effect in either acidity % or ascorbic acid content. Such results were in agreement with the finding of Afifi, (2016) regarding the effect of potassium silicate on the acidity of strawberry and disagree with El-Bassiony *et al.*, (2010) regarding the effect of potassium on ascorbic acid content of sweet pepper.

Table 2. Effect of pre- harvest foliar application of potassium and silicon on the quality parameters of sweet pepper fruits during 2013/2014 and 2014/2015 seasons.

Treatments	Season (2013/2014)					
	Fruit weight (g)	Lightness	hue angle	TSS (%)	Acidity (%)	Ascorbic Acid (mg/100g f.w)
Potassium silicate 4ml/l	162.09	33.10	123.04	5.00	0.17	112.44
Potassium silicate 8ml/l	162.23	33.28	122.39	4.66	0.17	112.55
Potassium thiosulfate 1.5ml/l	160.31	33.82	122.05	4.50	0.14	112.08
Potassium thiosulfate 3ml/l	157.57	32.86	122.61	4.33	0.15	112.10
Harvars 2.5ml/l	143.86	31.87	121.89	4.33	0.15	112.13
Harvars 5 ml/l	151.27	31.92	122.51	4.50	0.16	112.43
Control	120.88	31.43	121.95	4.00	0.13	112.25
LSD at 5 % Level	12.77	0.82	0.74	0.33	N.S.	N.S.
Treatments	Season (2014/2015)					
	Fruit weight (g)	Lightness	hue angle	TSS (%)	Acidity (%)	Ascorbic Acid (mg/100g f.w)
Potassium silicate 4ml/l	166.38	32.19	123.11	4.83	0.15	113.55
Potassium silicate 8ml/l	162.09	32.69	122.34	4.66	0.15	113.80
Potassium thiosulfate 1.5ml/l	161.32	33.40	122.23	4.66	0.15	113.01
Potassium thiosulfate 3ml/l	158.88	32.86	122.43	4.33	0.14	113.58
Harvars 2.5ml/l	148.24	32.05	122.32	4.50	0.15	113.80
Harvars 5 ml/l	155.82	32.57	122.54	4.33	0.15	113.76
Control	125.62	31.03	121.80	4.00	0.12	111.70
LSD at 5 % Level	13.03	0.91	1.22	0.32	N.S.	N.S.

Weight loss%

Water loss is one of the most important factors that negatively impact pepper fruit during shipment, storage and marketing (Maalekuu *et al.*, 2002). As shown in Table 3, weight loss % of pepper fruit increased linearly as the storage time increased. This increase may be due to fruit transpiration as reported by Roa *et al.* (2011). In respect to treatments, all pre-harvest treatments significantly reduced weight loss percentage as compared with the control. In addition, sweet pepper fruits received pre-harvest potassium silicate as drenches of 4 and 8 ml/l and potassium thiosulfate as drenches of 1.5 and 3ml/l effectively, controlled weight loss percentage without significant impact between them as compared with the other treatments.

These results were true in both seasons. Such results are in accordance with those reported by Tesfay *et al.* (2011), who pointed out to the role of silicon in maintaining the moisture of avocado fruit and delaying weight loss, and, in agreement with Afifi, (2016), for potassium silicate on strawberry. Also, Tarabih *et al.* (2014) found that silicon might reduce respiration rate of apple fruit and inhibited the physiological processes, which in turn reduces weight loss. In general, the interaction between treatments and storage period was significant and showed that pre-harvest treatment of sweet pepper fruits with potassium silicate displayed the lowest weight loss % during all storage periods at 8°C and 95% RH.

Table 3. Effect of pre-harvest potassium and silicon treatments on weight loss % and lightness of sweet pepper fruits during storage.

Treatments (B)	Weight loss %									
	Season (2013/2014)					Season (2014/2015)				
	Storage periods days (S)									
	0	7	14	21	Mean	0	7	14	21	Mean
Potassium silicate 4ml/l	-	2.39	4.15	5.49	4.01	-	2.19	4.24	5.52	3.98
Potassium silicate 8ml/l	-	2.52	4.39	5.63	4.18	-	2.44	4.43	5.50	4.12
Potassium thiosulfate 1.5ml/l	-	2.86	4.68	5.69	4.41	-	2.65	4.44	5.51	4.20
Potassium thiosulfate 3ml/l	-	2.87	4.78	5.60	4.42	-	2.82	4.76	6.09	4.56
Harvars 2.5ml/l	-	2.79	4.67	6.44	4.63	-	2.34	4.49	6.26	4.36
Harvars 5 ml/l	-	2.74	4.59	6.82	4.72	-	2.34	4.91	6.78	4.68
Control	-	3.56	5.48	7.67	5.57	-	3.40	6.00	7.68	5.69
Mean	-	2.82	4.68	6.19	-	-	2.60	4.75	6.19	-
LSD at 5 % Level	B = 0.43 S = 0.28 B xS = 0.76					B = 0.53 S = 0.35 B xS = 0.93				
Treatments (B)	Lightness									
	Season (2013/2014)					Season (2014/2015)				
	Storage periods days (S)									
	0	7	14	21	Mean	0	7	14	21	Mean
Potassium silicate 4ml/l	33.10	32.64	31.28	30.94	31.99	32.19	31.96	30.83	30.04	31.25
Potassium silicate 8ml/l	33.28	33.26	30.40	28.85	31.45	32.69	32.09	30.77	29.02	31.14
Potassium thiosulfate 1.5ml/l	33.82	32.68	30.72	28.38	31.40	33.40	31.57	30.58	28.10	30.91
Potassium thiosulfate 3ml/l	32.86	31.91	31.32	28.18	31.07	32.86	32.18	30.48	27.29	30.70
Harvars 2.5ml/l	31.87	31.81	30.61	28.57	30.72	32.05	31.03	29.82	27.24	30.03
Harvars 5 ml/l	31.92	31.55	31.07	28.39	30.73	32.57	32.27	29.67	27.19	30.43
Control	31.43	30.41	28.90	28.71	29.87	31.03	29.27	29.00	27.49	29.19
Mean	32.61	32.04	30.61	28.86	-	32.39	31.48	30.16	28.05	-
LSD at 5 % Level	B = 1.58 S = 1.19 B xS = 3.17					B = 1.51 S = 1.14 B xS = 3.03				

Skin color

Data presented in Tables 3 and 4 reflected that a slight decrease in sweet pepper fruits lightness and hue angle was occurred coincided with the storage time prolongation. The decreasing in the lightness may be correlated with water loss which negatively affected on the luminosity of pepper fruits. Meanwhile, the decreasing in hue angle may be attributed to chlorophyll degradation which associated to fruit senescence. Also, the same Table shows that our tested treatments displayed sweet pepper fruits with shiny and vivid green color as compared with the control which exhibited less lightness and less green color. In addition, spraying samples with potassium silicate at concentration of 4 and 8ml/l displayed much better lightness and greenness as compared with other treatments and the control. These results might be attributed to the role of potassium silicate in delaying fruit senescence which in turn displayed the external and the internal color of fruits lighter than control (Afifi, 2016). These results were true in the first season. On the other hand, all studied treatments were more effective in keeping pepper fruits with glossy and vivid green appearance without considerable effects between them in the second season. The interaction between treatments and storage period was significant and indicated that potassium silicate treatment at the two concentrations 4 and 8 ml/l effectively maintained higher lightness and hue angle values of sweet pepper fruits for 21 days storage at 8 °C and 95% RH.

Visual quality

To provide high quality produce, it is required to start from high quality material, i.e., fertilization, production technology system and nutrient, where the best quality of any commodity exists at moment of harvest. From this point, quality cannot be improved, only maintained (Cheisa *et al.*, 2003). The visual quality scale depends on morphological defects such as shriveling (wilting), color changes of fruit surface and the pathological disorders. Wills *et al.* (1998) reported that a bell pepper quality declined after 5% weight loss. Results in Table 4 revealed that visual quality score declined significantly with the prolongation of the storage period without chilling injury or pathological symptoms. This decline may due to water loss which cause shriveling and reduce glossiness and acceptability of pepper fruits (Maalekuu *et al.*, 2002 and Smith *et al.*, 2006).

Table 4. Effect of pre-harvest potassium and silicon treatments on hue angle and visual quality of sweet pepper fruits during storage.

Treatments (B)	hue angle									
	Season (2013/2014)					Season (2014/2015)				
	Storage periods days (S)									
	0	7	14	21	Mean	0	7	14	21	Mean
Potassium silicate 4ml/l	123.04	122.25	122.03	121.23	122.14	123.11	122.16	121.66	121.32	122.06
Potassium silicate 8ml/l	122.39	121.91	121.76	121.43	121.87	122.34	122.25	121.86	121.53	122.00
Potassium thiosulfate 1.5ml/l	122.05	121.03	121.74	121.61	121.60	122.23	122.00	121.90	121.62	121.94
Potassium thiosulfate 3ml/l	122.61	122.37	121.69	120.82	121.87	122.43	122.38	121.88	120.72	121.85
Harvars 2.5ml/l	121.89	121.69	121.43	120.46	121.36	122.32	121.68	121.51	121.28	121.69
Harvars 5 ml/l	122.51	121.50	121.33	120.58	121.48	122.54	121.73	121.63	120.72	121.65
Control	121.95	121.75	120.97	120.63	121.23	121.80	121.09	120.38	119.58	120.71
Mean	122.34	121.79	121.56	120.96	-	122.40	121.89	121.54	120.96	-
LSD at 5 % Level	B = 0.78 S = 0.65 B x S = 1.74					B = 0.62 S = 0.47 B x S = 1.25				
Treatments (B)	Visual quality									
	Season (2013/2014)					Season (2014/2015)				
	Storage periods days (S)									
	0	7	14	21	Mean	0	7	14	21	Mean
Potassium silicate 4ml/l	9.00	9.00	7.00	7.00	8.00	9.00	9.00	7.00	7.66	8.16
Potassium silicate 8ml/l	9.00	9.00	7.00	6.00	7.75	9.00	9.00	7.00	6.33	7.83
Potassium thiosulfate 1.5ml/l	9.00	9.00	7.00	5.33	7.58	9.00	9.00	7.00	6.33	7.83
Potassium thiosulfate 3ml/l	9.00	9.00	7.00	5.00	7.50	9.00	8.33	6.66	5.33	7.33
Harvars 2.5ml/l	9.00	8.00	6.33	5.33	7.16	9.00	8.00	7.00	5.66	7.41
Harvars 5 ml/l	9.00	8.33	6.33	6.00	7.41	9.00	8.33	6.66	5.33	7.33
Control	9.00	6.33	4.33	2.33	5.50	9.00	6.33	4.00	3.33	5.66
Mean	9.00	8.38	6.42	5.28	-	9.00	8.28	6.47	5.71	-
LSD at 5 % Level	B = 0.61 S = 0.46 B x S = 1.22					B = 0.66 S = 0.50 B x S = 1.33				

Concerning treatments, visual quality of sweet pepper was positively affected by potassium and silicon applications. All tested treatments showed higher visual quality score as compared to control. Moreover, sweet pepper fruits received pre-harvest potassium silicate at doses of 4, 8ml/l and potassium thiosulfate at dose of 1.5ml/l displayed better acceptance without significant effect among them as compared with the others. These results are in agreement with Afifi, (2016) for potassium silicate on strawberry, who found that application of potassium silicate maintained the general appearance of fruit by reducing weight loss, decay and maintained the fruit quality. Moreover, Kaluwa *et al.* (2010) found that the main effect of Si application lies in suppression of respiration and ethylene production and enhance shelf life of avocado fruit. In addition, Tesafy *et al.* (2011) reported that treating avocado fruits with silicon lowered electrolyte leakage compared with control and improve quality parameters (mass loss and firmness), possibly due to Si deposition between cell wall and cell membrane, maintaining barrier against solute leakage, and also, Si may enhance activity of chitinases, peroxidase and polyphenol oxidase, and increase formation deposition of callose and hydrogen peroxidase (Shetty *et al.*, 2012). Also, Si application improved strength and rigidity of tissue (Liang *et al.*, 2007).

The interaction between treatments and storage period was significant and indicated that pre-harvest foliar application of sweet pepper fruits with potassium silicate at a concentration of 4 ml/l exhibited pepper fruits with good appearance for 21days Meanwhile, fruits received potassium silicate at doses of 8ml/l or potassium thiosulfate at dose of 1.5ml/l displayed good appearance for 14 days. On the other hand, control treatment reached its limited visual quality score after 7 days of storage at 8°C and 95% RH in both seasons of study.

Total soluble solids (TSS) %

As presented in Table 5, a significant increase was noted in our studied treatments regarding TSS% as the prolongation of the storage period. The increment in TSS% during storage may be attributed to the higher rate of dry matter loss and moisture loss through respiration and transpiration or the inversion of insoluble compounds to soluble substances. These results were observed in both seasons. Similar results were agreed with the findings of Xing *et al.*, (2011) and Roa *et al.* (2011).

In respect to treatments, it is clear from the Table that pre-harvest spraying of sweet pepper with potassium silicate at the concentration of 4 or 8ml/l efficiently maintained higher TSS % as compared with others in the first season. Such results were in accordance with the finding of Stamatakis *et al.*, (2003) on tomato and Tarabih *et al.*, (2014) on apple who found that effect to reducing respiration rate,

ethylene production and vital processes and Afifi, (2016) on strawberry. Meanwhile on the second season no significant difference was detected among our tested treatments and control. The interaction between treatments and storage period showed that the highest values of TSS% were recorded in fruits treated with potassium silicate at the drenches of 4 and 8 ml/l in both seasons after 21 days of storage in 8 °C and 95% RH.

Titrateable acidity (TA)

As shown in Table 5, TA declined as the storage period extended. This result supported by Roa *et al.* (2011). This decline in TA may be due to the consumption of organic acids during respiration process. In respect to treatments, no statistical differences were detected among all tested treatments and the control treatment. The interaction between treatments and storage period was significant and showed that pre-harvest foliar application of potassium silicate at the two drenches kept higher TA% for 14 days in both seasons.

Ascorbic acid content

It is obvious from Table 6 that a progressive decrease in ascorbic acid content was recorded as the storage extended. Such results are in conformity with Xing *et al.* (2011). The same Table indicated that all tested treatments efficiently maintained higher ascorbic acid content compared with the control treatment. This result was in a compliance with Jifon *et al.*, (2009), on muskmelon, Jifon and Laster (2012) on melons and El-Bassiony *et al.*, (2010) on sweet pepper. Moreover, pepper fruits received pre-harvest potassium silicate at a concentration of 4ml/l maintained higher ascorbic acid content (102.33 and 100.95 mg /100g f.w) in both seasons respectively, followed by fruit received potassium silicate at a concentration of 8ml/l (96.78 and 96.2 mg /100g f.w) in both season, respectively. Such results were obtained in both seasons and were in agreement with Afifi, (2016). The interaction between treatments and storage period indicated that sweet pepper fruit received potassium silicate at a concentration of 4 ml/l prevented the loss of ascorbic acid content during 21 days storage at 8 °C and 95% RH.

CONCLUSION

It could be concluded that pre-harvest spraying of sweet pepper plants with potassium silicate or potassium thiosulphate significantly improved fruit quality parameters at harvest. Meanwhile, pre-harvest foliar application of potassium silicate at a concentration of 4 ml/l effectively maintained quality attributes of sweet pepper for 21 days storage at 8 °C and 95% RH.

Table 5. Effect of pre-harvest potassium and silicon treatments on TSS % and acidity of sweet pepper fruits during storage.

Treatments (B)	TSS%									
	Season (2013/2014)					Season (2014/2015)				
	Storage periods days (S)									
	0	7	14	21	Mean	0	7	14	21	Mean
Potassium silicate 4ml/l	5.00	5.00	5.50	5.66	5.29	4.83	5.00	5.00	5.33	5.04
Potassium silicate 8ml/l	4.66	5.00	5.16	5.33	5.03	4.66	5.00	5.16	5.50	5.08
Potassium thiosulfate 1.5ml/l	4.50	4.83	5.00	5.00	4.83	4.66	4.66	5.33	5.33	4.99
Potassium thiosulfate 3ml/l	4.33	4.50	5.00	5.33	4.79	4.33	4.66	5.00	5.16	4.78
Harvars 2.5ml/l	4.33	4.55	5.00	5.00	4.72	4.50	4.66	5.00	5.00	4.79
Harvars 5 ml/l	4.50	4.66	5.00	5.16	4.83	4.33	4.83	5.00	5.33	4.87
Control	4.00	4.83	5.00	5.16	4.74	4.00	4.83	5.00	5.00	4.70
Mean	4.47	4.76	5.09	5.23	-	4.47	4.81	5.07	5.23	-
LSD at 5 % Level	B = 0.28 S = 0.21 B × S = 0.56					B = N.S S = 0.29 B × S = 0.79				
Treatments (B)	Acidity									
	Season (2013/2014)					Season (2014/2015)				
	Storage periods days (S)									
	0	7	14	21	Mean	0	7	14	21	Mean
Potassium silicate 4ml/l	0.17	0.13	0.12	0.08	0.13	0.15	0.14	0.12	0.08	0.12
Potassium silicate 8ml/l	0.17	0.12	0.10	0.08	0.12	0.15	0.12	0.11	0.08	0.12
Potassium thiosulfate 1.5ml/l	0.14	0.13	0.12	0.08	0.12	0.15	0.12	0.11	0.08	0.12
Potassium thiosulfate 3ml/l	0.15	0.13	0.08	0.08	0.11	0.14	0.13	0.08	0.08	0.11
Harvars 2.5ml/l	0.15	0.12	0.08	0.08	0.11	0.15	0.12	0.08	0.08	0.11
Harvars 5 ml/l	0.16	0.12	0.08	0.08	0.11	0.15	0.12	0.08	0.08	0.11
Control	0.13	0.10	0.09	0.08	0.10	0.12	0.09	0.09	0.08	0.10
Mean	0.15	0.12	0.10	0.08	-	0.14	0.12	0.10	0.08	-
LSD at 5 % Level	B = N.S S = 0.01 B × S = 0.05					B = N.S S = 0.01 B × S = 0.05				

Table 6. Effect of pre-harvest potassium and silicon treatments on ascorbic acid content (mg/100g fw) of sweet pepper during storage.

Treatments (B)	Ascorbic acid (mg/100g fw)									
	Season (2013/2014)					Season (2014/2015)				
	Storage periods days (S)									
	0	7	14	21	Mean	0	7	14	21	Mean
Potassium silicate 4ml/l	112.44	103.65	102.90	90.35	102.33	113.55	105.95	94.60	89.70	100.95
Potassium silicate 8ml/l	112.55	99.45	93.60	81.53	96.78	113.80	96.20	94.90	79.90	96.20
Potassium thiosulfate 1.5ml/l	112.08	99.56	94.08	62.40	92.03	113.01	98.21	91.65	59.15	90.50
Potassium thiosulfate 3ml/l	112.10	99.98	94.07	60.45	91.65	113.58	89.30	78.65	63.45	86.24
Harvars 2.5ml/l	112.13	89.37	80.6	68.20	87.57	113.80	91.65	83.03	64.35	88.20
Harvars 5 ml/l	112.43	93.29	85.45	61.75	88.23	113.76	94.78	92.30	68.25	92.27
Control	112.25	87.02	63.70	60.36	80.83	111.70	87.93	65.65	57.18	80.62
Mean	112.28	96.04	87.77	69.29	-	113.31	94.86	85.82	68.85	-
LSD at 5 % Level	B = 2.59 S = 1.96 B × S = 5.19					B = 2.81 S = 2.12 B × S = 5.62				

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تأثير الرش الورقى قبل الحصاد بالبوتاسيوم والسليكون على الجوده والقدرة التخزينيه للفلل الحلو

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أجريت هذه التجربة خلال موسمى ٢٠١٣ / ٢٠١٤ و ٢٠١٤ / ٢٠١٥ فى المزرعة البحثية التابعة لمعهد بحوث البساتين بقها بمحافظة القليوبيه- مصر، وذلك لدراسة تأثير الرش الورقى ما قبل الحصاد لنباتات الفلفل الحلو صنف سونار بتركيزات ٤ و ٨ مل/لتر من سليكات البوتاسيوم، ١،٥ و ٣ مل/لتر من ثيوسلفات البوتاسيوم، ٢،٥ و ٥ مل/لتر من مركب هارفرس الذى يحتوى على ٦٠% بو ٢ أ على صفات الجوده والقدرة التخزينيه لثمار الفلفل الحلو المخزنة على ٨ م° و ٩٥% رطوبة نسبيه لمدة ٢١ يوم. وقد بينت النتائج حدوث تحسن فى وزن الثمرة ولمعان الثمره و كذلك اللون الاخضر للثمرة وقت الحصاد عند رش نباتات الفلفل الأخضر قبل الحصاد بكل من سليكات البوتاسيوم او ثيوسلفات البوتاسيوم. بالنسبه لتجربة التخزين فقد اظهرت النتائج أن معاملة نباتات الفلفل قبل الحصاد وأثناء النمو بسليكات البوتاسيوم بتركيز ٤ مل/لتر أدت إلى احتفاظ الثمار بلون أخضر لامع إلى جانب احتفاظ الثمار بالمواد الصلبة الذائبة والمحتوى من حامض الأسكوربيك لمدة ٢١ يوم من التخزين على ٨ م° و ٩٥% رطوبه نسبيه بصوره افضل بالمقارنه بالكنترول.