Effect of cultivar and potassium silicate and the interaction between them on the percentage of NPK, the percentage of calcium, the content of capsaicin and the content of protein in the fruits

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Abstract

The experiment was conducted in a field in Al-Azzawiya region - Al-Musayyib district (40 km) north of the center of Babylon province, during the spring agricultural season 2022 within the longitude 44.07° and latitude 32.76°. The experiment included two factors, the first being two cultivars of sweet pepper, the first being the imported cultivar, California Wonder, and the second being the local cultivar. The second factor was the use of two concentrations of potassium silicate (3.5) ml. L^{-1} in addition to the control treatment,The experiment was conducted using a randomized complete block design, according to the split plot system, with three replicates. The items were placed in the main plot and sprayed with potassium silicate in the system sub-plot. Means were compared using the Least Significant Difference test.L.S.D. at the probability level of 0.05. The results of the table showed that the imported cultivar California Wonder achieved a significant superiority over the local cultivar in traits of phosphorus 0.47%, potassium 1.24%, calcium 0.54% in fruits. Nitrogen 1.60%, phosphorus 0.62%, potassium 0.79% in leaves and protein 9.32% in fruits. While the local cultivar achieved the highest percentage of nitrogen 1.46% and the fruit content of vitamin C 117.10 mg.100g $^{-1}$ fresh weight, the two cultivars also achieved a significantly excelled in the fruit content of carbohydrates 2.91% and capsaicin 0.29gm.100g $^{-1}$ .Also achieved spraying treatment at a concentration of 5 ml. L^{-1} with potassium silicate had a significantly excelled in the percentage of phosphorus 0.47%, potassium 1.30%, calcium 0.55% in fruits, and the fruit content of vitamin C reached 117.75 mg. 100g-1 fresh weight, nitrogen 1.65%, phosphorus 0.64%. Potassium 1.83%, calcium 0.80% in the leaves and capsaicin 0.30 g. L^{-1} excelled in nitrogen in fruits 1.46%,Carbohydrates 3.02% and protein 9.37%. Also, the bi-interaction was achieved between the imported cultivar California Wonder and spray at a concentration of 5 ml / L.It excelled in the proportion of phosphorus in fruits 0.49%, the percentage of potassium in fruits 1.34%, the percentage of calcium in fruits 0.56%,The percentage of nitrogen in the leaves is 1.70%, the percentage of phosphorus in the leaves is 0.65%, the percentage of potassium in the leaves is 1.85%, the percentage of calcium in the leaves is 0.83%, and the percentage of capsaicin in the fruits is 0.30 g. Also, the local cultivar and spray at a concentration of 5 ml / L achieved a significant superiority in the fruit content of vitamin C 118.03 mg. 100g^{-1} fresh weight ,While the imported cultivar California Wonder with spraying at a concentration of 3 ml.L^{-1} achieved a significantly excelled in the fruit content of protein 9.45%.

Key word: sweet pepper, cultivar, potassium silicate

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Introduction

Capsicum annuum L. is a herbaceous plant native to Central and South America. Sweet pepper is one of the plants that are grown in 116 countries around the world. Asian countries account for 59% of the total cultivated area worldwide. It is the third crop in the Solanaceae family in terms of economic importance after Tomatoes and Potatoes (Perry, 2012)Iraq is one of the sweet pepper-producing countries, but in recent years there has been a decrease in productivity. In the year 2020, the production of the pepper plant reached 46,498 tons, with a productivity of 8.77 tons. ha^{-1} with a cultivated area of 21189 dunums (Central Statistical Organization, 2020.) Pepper cultivars differ from each other in morphological and biological traits.Therefore, these cultivars are subject to genetic factors, and this in turn affected the production efficiency, so he called on the researchers to study this difference, and pay attention to it in order to find cultivars that have morphological traits that are resistant to the surrounding conditions, and give a distinct crop in terms of quantity and quality. cultivars from different sources were introduced to study the extent of Adapting it to our local conditions and meeting the taste of the local consumer (Okra, 2018). Zughair (2013) indicated that during the study of two cultivar of hot pepper, the Syrian cultivar Albarra and the Dutch Cayenne De Cayenne, the results showed the superiority of the Albara cultivar in the leaf content of chlorophyll, nitrogen,The average fruit weight and yield, and the cultivar de Cayenne excelled in plant height, percentage of dry matter in the leaves, the percentage of potassium in the leaves and the content of vitamin C in the fruits. Ahmed et al. (2022)showed during their study of some pepper cultivars(Chillina, Parbirian, Champion and Hyffa) showed The results showed that the Chillina cultivar was excelled in the second place in increasing the yield and its quality, as well as the Parbirian cultivar in increasing the morphological characteristics of the pepper plant, while the results showed that the Champion cultivar gave the lowest values for the number of fruits, the yield and its components.Boyhan et al. (2019) indicated that there is a paucity of information on pepper production. A full randomized group designed experiment of 13 pepper cultivars was evaluated in 2016 and 2017. Total yield, graded yield and early yield were the main factors of concern. Therefore, an analysis was coundected. Data separately for each year .The results also showed the superiority of the five highest yield cultivars: Aristotle X3RO, Gridiron, King Arthur, Flavorburst, and Blitz. Except for Flavorburst, while Aristotle X3RO, Flavorburst, Touchdown, Islander and Gridiron cultivars excelled. By giving the largest early harvest in 2017.Waleed (2017) showed during his study on the potato plant that spraying the potato plant with four concentrations of potassium silicate (0, 1.0, 1.5, and 2.0) g/l showed that the concentration was 2 g/L. It had a significant effect on increasing the percentage of some elements in the fruits, such as nitrogen to 1.88 and 2.05%, phosphorus to 0.42 and 0.43%, potassium to 3.88 and 3.95%, and the fruit content of vitamin C, which amounted to 19.4 and 19.7 mg. $100gm^{-1}$, compared with control plants. As the percentage of nitrogen decreased to 1.50 and 1.71%, phosphorus to 0.34 and 0.35%, potassium to 3.54 and 3.58%, and the vitamin C content of fruits reached 13.2 and 13.7 mg. $100g^{-1}$ for the seasons 2014 and 2015, respectively. El-Bassiony et al (2010) showed that spraying sweet pepper plants with two different sources of potassium, potassium oxide at a concentration of 2 and 4 ml/L and potassium humate at a concentration of 4 g/L led to a significant increase in the chemical traits . Spraying with potassium humate at a concentration of 4 gm/L gave the highest percentages of nutrients such as nitrogen, phosphorous and potassium, which amounted to 1.73%, 0.71% and 2.46%, respectively, for the 2009 season, as for the 2010 season. It achieved nitrogen 1.77 and potassium 2.53%, while the element phosphorus was not affected by spraying with potassium humate. This study aimed to investigate the effect of foliar spraying of potassium silicate on the chemical

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and qualitative traits of the fruits of two sweet pepper cultivars.

Materials and Methods

The experiment was conducted in a field in the Al-Azzawiya region - Al-Musayyib district (40 km) north of the center of Babylon province, during the spring agricultural season 2022 within the longitude 44.07° and latitude 32.76° .To study the effect of spraying with anti-transpiration potassium silicate on some chemical and qualitative indicators of two cultivars of sweet pepper. The land designated for cultivation has been prepared after removing the growing plants and bushes, then carrying out the tillage , smoothing and leveling process well and homogeneously in a perpendicular manner.Soil samples were taken from the field before planting in a random manner and from different regions with depths ranging from 0-30 cm, then they were air-dried, ground and passed through a sieve with a diameter of 2 mm .It was analyzed to find out some of the chemical and physical traits of the field soil, and the results of the analysis are shown in Table (1 .)The distance between one terrace and another was 5.1 meters, leaving a distance of 1 meter between the experimental units as a buffer to prevent confusion between the treatments, while leaving a buffer distance at the beginning and end of each sector, and the drip irrigation system was used in the process of irrigation the plants.The seeds were sown in the plastic house on 1/30/2022 in cork dishes filled with peat moss as a medium for planting seeds in one of the private nurseries affiliated with the project sub-district in Al-Musayyib District, Babylon province, with one seed per eye inside the greenhouse, while providing the appropriate conditions for the growth of seedlings. Before transferring the seedlings to the permanent field, and when they reached the stage of formation of the third true leaf, they were hardened for a period of 7 days, by removing the seedlings outside the plastic house daily in the morning, exposing them to sunlight and returning them in the evening, while reducing the number of irrigations through thirsting the plants, by increasing the period between one iraagation and another (Wanted et al 1989). After the seedlings reached the stage of four true leaves, they were transferred in the afternoon to the field on 3/23/2022. Planting took place inside the terraces with 12 seedlings per experimental unit distributed on both sides of the line alternately, the distance between one line and another 50 cm and between one plant and another 50 cm. Service, irrigation and control operations were carried out as recommended (Al-Sabaylah and Al-Tarwanah, 2007). The drip irrigation system was used twice during the week in the early stag

seedling and then according to the plant's need and environmental conditions

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.Table 1: Physical and chemical properties of field soil before cultivation*

values	Units	Traits
7.52	---	pH
3.0	$DS.m^{-3}$	Electrical conductivity EC
1.13	%	organic matter
13.4	$mg.kg^{-1}$	available nitrogen
2.53		available phosphorous
128.87		available Potassium
1.13	$g.cm^{-3}$	bulk density
200	$g.kg^{-1}$	the sand
560		silt
240		clay
Clay siltly	Texture	

*The analysis was conducted in the Graduate Studies Laboratory, College of Agriculture - Al-Qasim Green University

The experiment involved two factors

The first factor: the use of two cultivars of sweet pepper, which are (the imported cultivar, California Wonder, and the local cultivar)

The second factor: it included spraying with three concentrations of potassium silicate (0, 3, 5) ml. L^{-1} Using potassium silicate containing 10% potassium and 25% silica

The plants were sprayed in the morning until the degree of complete wetness, with the addition of Al-Zahi as a dispersant material, at an average of 1 ml. $10L^{-1}$, (Kamal, 2013) As the first spraying was after 25 days of seedlings in the permanent field on 4/17/2022, with six sprays, and it was between one spray and another two weeks.The experiment was conducted as a factorial experiment ((3 × 2) with three replications within the split plot system. The cultivars were distributed on the main plot, and three concentrations of spraying potassium silicate were added to the sub-plot (Al-Rawi and Khalafallah, 2000)With three replicates in each replicate 6 experimental units, thus the number of experimental units is (18) units, the plants of the experimental unit were collected separately and the following measurements were made on them:Percentage of nitrogen, phosphorus, potassium and calcium in leaves and fruits, percentage of carbohydrates in fruits, vitamin C, capsin and protein in fruits .Means were compared using the Least Significant Difference (L.S.D.) test at the probability level of 0.05 (Al-Sahoki and Wahib, 1990). The 2012-Genstat program was used in the statistical analysis.

Results and discussion

The results in Table (3) indicate that the imported cultivar California Wonder achieved a significantly excelled on the local cultivar in the percentage of phosphorus in fruits, 0.47%.The percentage of potassium in the fruits was 1.24% and calcium 0.54%, while the local cultivar excelled the imported cultivar California Wonder in the percentage of nitrogen in the fruits, amounting to 1.46% and the fruit content of vitamin C, which amounted to 117.10 mg. $100gm^{-1}$ fresh weight. The California Wonder cultivar, achieved the highest rate of carbohydrates, amounting to 2.91%, which did not differ significantly from the local cultivar in giving the same rate As for the treatment of spraying with potassium silicate, it had a significant effect on the studied indicators, where the spraying at a concentration of 5 $ml.L^{-1}$ achieved a significantly excelled in the percentage of phosphorus in the fruits 0.47%, the percentage

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of potassium in the fruits 1.30%, calcium 0.55% and vitamin C reached 117.75 mg. $100g^{-1}$ fresh weight,While the local cultivar excelled on the imported cultivar, California Wonder, in the percentage of nitrogen in the fruits, which amounted to 1.46%, while the spraying treatment with a concentration of 3 $ml.L^{-1}$ achieved the highest rate of nitrogen in the fruits, which amounted to 1.50%, and carbohydrates 3.02%.It is noted from the results in Table (3) that the bi-interaction between the cultivar and the treatment of spraying with potassium silicate had a significant effect on the studied traits, as it achieved the bi-interaction between the imported cultivar California Wonder and the treatment of spraying at a concentration of 5 $ml.L^{-1}$.Significantly excelled in the percentage of phosphorus in fruits 0.49, the percentage of potassium in fruits 1.34 and calcium 0.56%. Also, the imported cultivar California Wonder, with two spraying treatments at a concentration of 3 ml and 5 $ml.L^{-1}$, achieved a significantly excelled in the percentage of nitrogen in fruits amounted to 1.51%.The treatment of the bi-interaction between the local cultivar and spraying at a concentration of 3 ml / L achieved the highest rate of carbohydrate content of fruits, which amounted to 3.04%. While the bi-interaction between the local cultivar and the spraying treatment at a concentration of 5 ml / liter achieved a significantly excelled in trait of the fruit content of vitamin C, which amounted to 118.03 mg. $100g^{-1}$ fresh weight. The reason for this discrepancy in the table between the California and local cultivars may be due to the genetic difference of the two cultivars and the interaction of the genetic makeup of these cultivars with the environmental conditions, and this enabled the plant to absorb a large amount of nutrients in a larger way, which was reflected in the increase in the vital processes within the plant and thus an increase in the dry weight of the vegetative body and to an increase in the percentage of chlorophyll in the leaves, which was positively reflected in the increase in the processes of photosynthesis, which caused an increase in the production of food compounds that eventually contributed to an increase in the vegetative system. This is consistent with what Shaker (2022) indicated or, spraying the leaves of plants with two concentrations of potassium silicate caused a significant increase in all growth traits , and these results coincide with the results of spraying tomato plants with five types of anti-transpiration agents, including potassium silicate at a concentration of 2 $g.l^{-1}$, which produced a significant effect in increasing plant growth traits when applying a spray. leaves with potassium silicate may be due to its stimulation of growth, As the presence of potassium, which is an important element in crop production, especially in its role in reducing the negative impact of salt and oxidative stress (Hafez, 2021).Silicon, which is soluble in water, plays an effective role in the formation of sugars, starch and proteins, cell division and growth, seed size and quality, all of which lead to improving the growth characteristics of plants (Abd-Elbaky, 2018). As for the bi-interaction between the treatments, spraying the leaves with potassium silicate at a concentration of 5 ml. L^{-1} significantly increased the studied growth indicators. The above results also confirm what was previously indicated on the role of dual application in changing and improving plant traits. It was noted that the double application of two cultivars of sweet pepper with anti-transpiration (potassium silicate) led to an improvement in growth, physiological properties, nutrient absorption and productivity of pepper plants in soil affected by salinity (Shaker, 2022).These results agree with what was mentioned previously, that spraying sweet pepper plants with potassium silicate at a concentration of 5 ml. L^{-1} caused an increase in the content of calcium and capsaicin in fruits compared to control plants, and this is consistent with what was mentioned by (Al-Abedi, 2022).These results are consistent with the findings of (Abu El-Azm and Youssef, 2015) when spraying tomato plants with five types of anti-transpiration agents, including potassium silicate, consisting of 11% silicon and 60% K2O at a concentration of 2 $g.l^{-1}$. 68.30 cm, the number of leaves to 47.29 leaves. Plant-1, the leaf area

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to 44.89 cm^2, $leaf^{-1}$, and the number of fruits to 36.19 fruits. $Plant^{-1}$And the weight of the fruits to 163.72 g. Fruit $^{-1}$, and the yield of one plant is 5.98 kg. $plant^{-1}$, compared with plants of the control treatment without spraying, in which the plant length decreased to 60.22 cm, the number of leaves to 41.71 leaves, plant-1, the leaf area to 37.67 cm^2. leaf-1, the number of fruits to 31.1 fruits, $plant^{-1}$, and the weight of the fruits to 151.63 gm. $Fruit^{-1}$The yield of one plant is 4.70 kg. plant-1 . While Jufri (and Sulistyono, 2016) observed that foliar feeding with anti-transpiration at a concentration of 2 ml. L^{-1} had a positive effect on most of the parameters of the pepper plant.As (Manea, 2017) showed, the use of synthetic fertilizers causes long-term problems for the environment. Therefore, it is important to develop an appropriate strategy for the agricultural application of alternative types of fertilizers.And he showed in his experiment on the study of organic fertilizers and urea solution on the growth and yield of cabbage, which led to giving the best response in plant growth, increasing the yield and its quality, as well as increasing the nutrients.

Table (3) The effect of cultivar and potassium silicate and the interaction between them on the percentage of NPK in the fruits, the percentage of calcium in the fruits, the content of the fruits of capsaicin and the content of the fruits of protein

Carbohydrate content of fruits (%)	Fruit content of vitamin C mg. 100 g^{-1} fresh weight	Percentage ofCalcium in fruits (%)	Percentage of potassium in fruits (%)	Percentage of phosphorous in fruits (%)	The percentage of nitrogen in fruits (%)	treatments
2.91	116.63	0.54	1.24	0.47	1.41	A1 (California Wonder)
2.91	117.10	0.51	1.17	0.43	1.46	A2 (local)
0.10	0.92	0.013	0.02	0.004	0.16	L.S.D.
2.72	115.62	0.49	1.09	0.42	1.33	C0 potassium silicate (0ml.L^{-1})
3.02	117.22	0.53	1.23	0.45	1.50	C1 Potassium Silicate (3ml.L^{-1})
2.99	117.75	0.55	1.30	0.47	1.48	C2 potassium silicate (5ml.L^{-1})
0.05	0.27	0.012	0.02	0.05	0.09	L.S.D
						interaction
2.73	115.50	0.51	1.09	0.44	1.23	A1C0
2.99	116.93	0.55	1.28	0.47	1.51	A1C1
3.02	117.46	0.56	1.34	0.49	1.51	A1C2
2.71	115.75	0.48	1.09	0.39	1.43	A2C0
3.04	117.52	0.52	1.18	0.43	1.48	A2C1
2.97	118.03	0.53	1.26	0.46	1.47	A2C2
0.09	0.70	0.015	0.02	0.006	0.14	L.S.D

The results of Table (4) indicate that the imported cultivar California Wonder achieved a significantly excelled on the local cultivar in the percentage of nitrogen in the leaves 1.60%, the percentage of phosphorous in the leaves 0.62%, the percentage of potassium in the leaves 1.76%, calcium in the leaves 0.79%The protein in the fruits was 9.32%, and

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the imported cultivar California Wonder had a significantly excelled in the fruits' capsaicin content of 0.29 g. 100gm-1, which did not differ significantly on the local cultivar, which gave the same rate of fruit content of capsaicin.As for the treatment of spraying with potassium silicate, it had a significant effect on the studied indicators, where spraying with a concentration of 5 $ml.L^{-1}$ achieved a significantly excelled in the percentage of nitrogen in the leaves 1.65%, the percentage of phosphorous in the leaves 0.64%, the percentage of potassium in the leaves 1.83%, calcium in the leaves 0.80 % and capsaicin in fruits 0.30 g. $100g^{-1}$,While the spraying treatment with a concentration of 3 $ml.L^{-1}$ achieved the highest rate of fruit content of protein, which amounted to 1.50%.It is noted from the results of Table (3) that the bilateral interaction between the cultivar and the treatment of spraying with potassium silicate had a significant effect on the studied traits. The leaves are 0.65%, the percentage of potassium in the leaves is 1.85%, and the calcium in the leaves is 0.83%. The imported cultivar, California Wonder, was also achieved with a spray treatment at a concentration of 3 $ml.L^{-1}$.Significantly excelled in the fruit content of protein amounted to 9.45%, as well as the treatment of bi-interaction between the imported cultivar California Wonder Walrush with a concentration of 5 ml.l-1 in giving the highest rate of fruit content of capsaicin, which amounted to 0.30 g. 100gm-1, which did not differ significantly with the treatment of bi-interaction between the local cultivar and the two spraying treatments at a concentration of 3 and 5 $ml.L^{-1}$.Significantly excelled in giving the same rate of capsaicin. The reason may be due to the environmental factors that significantly affect the characteristics of the plant, as temperatures exceeding the optimal limits lead to a reduction in the growth rate of the plant and then negatively affect the trait of the plant. High temperatures are among the interesting factors due to global climate change and its adverse effects on Quality and productivity of food crops (Damatta et al., 2010.(the stresses are for a long time, then they inhibit plant growth or lead to its complete death (Al-Muhareb et al., 2015). From what was mentioned above, the harmful effect of high temperatures in all stages of plant growth,So it became necessary for us to explain the techniques that can be used to withstand high temperatures, including the use of anti-transpiration compounds, which are compounds that form a thin, shiny, biodegradable waxy layer on the surface of the leaves that reduces transpiration and partially closes the stomata .and that some anti-transpiration substances have an effect on the process of carbon metabolism of the plant, as they work to reduce the stomata openings, causing a decrease in the permeability of CO2 gas, which is the determining factor for the process of carbon metabolism and then is reflected in some indicators of the plants under study (Weller and Ferree, 1978.(These results are consistent with what was indicated by (Kamal, 2013) in his experiment that spraying sweet pepper plants with potassium silicate at a concentration of 1.5 kg. feddan-1 caused an increase in the vitamin C content of fruits amounting to 112.6 mg. 100 gm-1 fresh weight compared to plants sprayed with water only. which gave 104.9 mg.100g-1 fresh weight. The pepper plant is also one of the stressful crops for the soil, which needs the availability of nutrients in the soil (Al-Mohareb et al., 2015).Its phenotypic and physiological taits constituted an obstacle in ways of increasing its growth, productivity, and tolerance to different environmental conditions, which led to the attention being drawn towards the use of various agricultural technologies to achieve the desired aims .The use of anti-transpiration agents is one of the agricultural techniques that in turn leads to reducing water loss and plant tolerance to high temperatures. Potassium silicate (K2SiO3) is considered a chemical compound that is degradable on the surface of the leaves and has importance in reducing the transpiration process by controlling the movement of the stomata and closing them partially (Al-Abedi 2022)As it is an important additional source of potassium when added to leaves, it helps in enzymatic activity, building proteins, photosynthesis, stomata movement, and water

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relations, while silicate contributes to increasing the hardness, strength, and elasticity of plant cell walls (Hounsome, 2008)With the lack of studies on the application of anti-transpiration using potassium silicate and the study of its effect on the specifications of the sweet pepper plant locally and globally in its characteristics for that, and the stresses are considered as physiological conditions caused by some factors that lead to an imbalance in the plant, i.e. the occurrence of natural and chemical changes caused by the surrounding conditions (Gaspar et al., 2002)The use of anti-transpiration agents is one of the agricultural techniques that in turn lead to plant tolerance to high temperatures, the most important of which is potassium silicate, which are biodegradable chemical compounds on the surface of the leaves to reduce transpiration and control the movement of stomata and their partial closure (Al-Abedi, 2022).

Table (4) The effect of cultivar and potassium silicate and the interaction between them on the percentage of NPK in the leaves, the percentage of calcium in the leaves, the content of the fruits of capsaicin and the content of the fruits of protein

Carbohydrate content of fruits (%)	Fruit content of vitamin C mg. 100 g^{-1} fresh weight	Percentage of Calcium in fruits (%)	Percentage of potassium in fruits (%)	Percentage of phosphorous in fruits (%)	The percentage of nitrogen in fruits (%)	treatments
9.32	0.29	0.79	1.76	0.62	1.60	A1 (California Wonder)
9.15	0.29	0.74	1.75	0.59	1.54	A2 (local)
0.03	0.005	0.008	0.034	0.004	0.02	L.S.D.
9.05	0.27	0.71	1.65	0.56	1.50	C0 potassium silicate (0ml.L^{-1})
9.37	0.29	0.78	1.79	0.62	1.56	C1 Potassium Silicate (3ml.L^{-1})
9.28	0.30	0.80	1.83	0.64	1.65	C2 potassium silicate (5ml.L^{-1})
0.04	0.006	0.006	0.036	0.009	0.01	L.S.D
						interaction
9.12	0.26	0.72	1.64	0.58	1.51	A1C0
9.45	0.29	0.81	1.78	0.64	1.59	A1C1
9.38	0.30	0.83	1.85	0.65	1.70	A1C2
8.99	0.28	0.69	1.66	0.54	1.49	A2C0
9.28	0.30	0.76	1.80	0.59	1.53	A2C1
9.17	0.30	0.76	1.80	0.63	1.65	A2C2
0.05	0.008	0.008	0.044	0.011	0.02	L.S.D

We conclude that the imported cultivar California Wonder outperformed the local cultivar in most of the studied traits, and that spraying with a concentration of 5 $ml.l^{-1}$ achieved the best results, and the interaction between the imported cultivar California Wonder and spraying with a concentration of 5 $ml.l^{-1}$ achieved an increase in the studied indicators.

References

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Abd-Elbaky, A., El- Abeid, S., and Osman, N. .2018. Effect of Integration between Vascular Arbuiscular Mycorrhizal Fungi and Potassium Silicate Supplementation on Controlling Onion White Rot. Egyptian Journal of Phytopathology, 46(1), 125-142.

Abu El-Azm, N. A. I and Youssef, S. M. S. 2015. Spraying potassium silicate and sugar beet molasses on tomato plants minimizes transpiration, relieves drought stress and rationalizes water use. Middle East J. , 4(4): 1047-1064.

Ahmed, I. H.M., E. F.Ali, A. A.Gad , A.Bardisi, A. M.El-Tahan, O.A.Abd Esadek, M. T.El-Saadony, A. S.Gendy. 2022. Impact of plant growth regulators spray on fruit quantity and quality of pepper (*Capsicum annuum* L.) cultivars grown under plastic tunnels. Saudi Journal of Biological Sciences, (4) (29): 2291-2298.

Al-Abedi, Ahmed Hazem Urgent. 2022. Response of growth, yield and content of active compounds of sweet pepper Capsicum annuum L. to treatment with nano-treated organic fertilizer and potassium silicate. Master's degree, College of Agriculture, University of Kufa.

Al-Anzi, Rua'a Wahb Abd al-Rahim, Ali Abadi Manea al-Musawi, and Raja' Abd al-Razzaq Abay al-Anbaki. 2022. The effect of mycorrhiza on the vegetative growth characteristics and the quantitative and qualitative yield of two sweet pepper cultivars, Capsicum annuum L.. PhD thesis, College of Agriculture - Al-Qasim Green University - Republic of Iraq.

Al-Enezi, Roua Wahb Abdel-Rahim. 2020. Evaluation of growth and yield of two table beet cultivars under Beta vulgaris L. system by the effect of organic and chemical fertilization. Master's thesis, College of Agriculture, Al-Qasim Green University. The Republic of Iraq.

Al-Muhareb, Muhammad Zaidan Khalaf, Fadel Hussein Al-Sahhaf, and Alaa Saleh Aati. 2015. The effect of irrigation levels and organic matter on the qualitative characteristics of cayenne pepper under protected cultivation system. Al Furat Journal of Agricultural Sciences, 7(1):95-84.

Al-Rawi, Khashaa Mahmoud, and Abdul-Aziz Muhammad Khalaf Allah. 2000. Design and Analysis of Agricultural Experiments (Revised Edition), University of Mosul. Ministry of Higher Education and Scientific Research, Republic of Iraq.

Al-Sabaila, Huimel and Muhammad Al-Tarwana, 2007. Technical guide to broccoli production. and the cultivation of agriculture. National Center for Agricultural Research and Extension. Horticultural export development project and technology transfer. Jordan.

Al-Sahoki, Medhat and Karima Muhammad Wahib. 1990. Applications in the design and analysis of experiments. Ministry of Education and Scientific Research - University of Baghdad.

Al-Taie, Faza Mahmoud. 2007. Effect of Vegetarian-Shrub Mycorrhizal fungi (VAM) on the growth of corn and soybean crops. College of Science - University of Mosul. Journal of Al-Rafidain Sciences, 18 (2): 8-15

Boyhan, G. E. , C. McGregor, S. OConnell, J. Biang and D. Berle .2019. A Comparison of 13 Sweet Pepper Cultivars under an Organic Farming System. 30(1):1-9.

central Statistical Organization. 2020. Cultivated area and average

ISSN 2072-3857

production of vegetable crops at the level of . The Ministry of Planning. The Republic of Iraq.

Damatta, F.M., A. Grandis, B.C. Arenque and M.S. Buckeridge. 2010. Impacts of climate changes on crop physiology and food quality. Food Research International, 43(7): 1814-1823.

El-Bassiony, A. M.; Z. F. Fawzy; E. H. El-Samad and Riad, G. S. 2010. Growth, yield and fruit quality of sweet pepper plants (*Capsicum annuum* L.) as affected by potassium fertilization. Journal of American Science, 6(12): 722–729.

Gaspar, T.; T. Franck; B. Bisbis; C. Kevers; L. Jouve; J. F. Hausman and Dommes , J.2002. Concepts in plant stress physiology. Application to plant tissue cultures. Plant Growth Regulators, 37: 263–285.

Hafez, E.M., Osman, H.S., El-Razek, U.A.A., Elbagory, M. Omara, A.E.D., Eid, M.A. and Gowayed, S. M. .2021. Foliar-Applied Potassium Silicate Coupled with Plant Growth- Promoting Rhizobacteria Improves Growth, Physiology, Nutrient Uptake and Productivity of Faba Bean (Vicia Faba L.) Irrigated with Saline Water in Salt-Affected Soil. Plants 2021, 10, 894.

Hajji, N., D. Wannes, M.-A. Jabri, K. Rtibi, H. Tounsi, A. Abdellaoui, and S. Hichem .2020. Purgative/laxative actions of *Globularia alypum* aqueous extract on gastrointestinal-physiological function and against loperamide-induced constipation coupled to oxidative stress and inflammation in rats. https://doi.org/10.1111/nmo.13858.

Hounsome, N. W.; B.Y. Hounsome ; D. L. Tomos and Edwards-Jones.G. H. 2008. Plant metabolites and nutritional quality of vegetables. J. Food Sci, 73(4): 48-65.

Jufri, A. F and Sulistyono, E . 2016. b. Effects of Dry Spirulina platensis and Anti-transpirant on growth and yield of Chili Pepper (*Capsicum annuum* L.). Indonesian Journal of Agronomy, 44(2): 170-175.

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 Prod. Mansoura Univ. , 4(11): 1581-1597.

Manea, A. .2017. Fertilizer Type on Cabbage Growth and Yield. Al_Qasim Green University. International Journal of Vegetable Science. .23(11): 567-574.

matlob, Adnan Nasser, Izz al-Din Sultan Muhammad, and Karim Salih Abdoul. 1989. Vegetable production, the first part - Dar Al-Kutub Foundation for Printing and Publishing - Ministry of Higher Education and Scientific Research / Iraq

Okra, A., 2018. A study of the morphological and productive characteristics of some Capsicum annuum L hybrids under protected agricultural conditions. Tishreen University Journal for Research and Scientific Studies - Biological Sciences Series, Volume (40), Issue 2.

Shaker, Ziad Iyad. 2022. The role of organic and biofertilization in the growth and productivity of three cultivars of cayenne pepper and their capsaicin content. Master's thesis, College of Agriculture, University of Kufa. The Republic of Iraq.

Waleed, A. 2017 . effect of irrigation water level and potassium silicate foliar application rate on drip irrigated-

ISSN 2072-3857

potato growth, yield and quality. Current Science International ,6(4):940-954.

Weller, S. C. and Ferree ,D.C. 1978. Effect of a pinolene –base antitraspirant on fruit growth, net photosynthesis, transpiration and shoot growth of Golden Delicious Apple trees. J. Amer. Soc. Horti . Sci., 103(1) : 17-19.

Zughair, Nawal Mahdi Hamoudo Ali Adnan. 2013. Effect of selected fertilizer treatments on the growth and yield of two cultivars of cayenne pepper. Capsicum annuum L under unheated greenhouse conditions. Basra Journal of Agricultural Sciences, Vol. 26 (1) 58-69.

ISSN 2072-3857