Journal of Plant Production

Journal homepage & Available online at: www.jpp.journals.ekb.eg

Using Some Safe Materials to Mitigate Climate Changes on Productivity and Fruit Quality of Watermelon under Conditions of New Valley Governorate

Cross Mark

Ali, M. A. M.[1*]; M. H. Z. El-Dekashey[2]; Shereen Y. Attallah[2] and Rehab A. Mostafa[1]

[1]Horticulture Department, Faculty of Agriculture, New Valley University, Egypt.
[2]Vegetable Department, Faculty of Agriculture, Assiut University, Egypt.

ABSTRACT

This work was conducted at a private Farm in El-Kasr city, El-Dakhla Oasis, New Valley Governorate, during 2022 and 2023 seasons to study the effect of two sowing dates (1st and 20th February), foliar spray with some safe materials, i.e., salicylic acid (SA) at 0.5 and 1.0 mM, ascorbic acid (AsA) at 50 and 100 ppm, and potassium silicate (KSil) at 4 and 8 ml/l, beside untreated control, and the interaction between them on growth, yield and fruit quality of watermelon (cv. Aswan F1). The interaction between sowing watermelon on 20th Feb. and foliar spray with KSil at 8 ml/l recorded the highest values of vegetative growth parameters and dry weight/plant, nitrogen, phosphorus and potassium % in leaves and average fruit weight, fruit quality, i.e., total soluble solids, total and reducing sugars, lycopene concentration and ferric reducing antioxidant power assay. While the interaction between sowing on 20th Feb. and spraying plants with AsA at 50 ppm gave the highest total yield/faddan without significant differences in the interaction between sowing at the same date and spraying plants with KSil at 8 ml/l in both seasons. The relative increase in total yield/faddan were about 71.96 and 70.93% for the interaction between sowing on 20th Feb. and spraying plants with KSil at 8 ml/l and 73.83 and 72.40% for the interaction between sowing on 20th Feb. and spraying plants with AsA at 50 ppm over sowing date on 1st Feb. and (spraying plants with distilled water) in the 1st and 2nd seasons, respectively.

Keywords: Watermelon, sowing date, salicylic acid, ascorbic acid, potassium silicate.

INTRODUCTION

Watermelon (*Citrullus lanatus* L.) belongs to family cucurbitaceae. It is a popular dessert vegetable with year round availability. Watermelon global consumption is greater than that of any of the cucurbit family member (Baba *et al.*, 2014).

The total harvested area in Egypt amounting to 31501 ha, produced about 1025289 ton with an average of 32.55 ton/ha of watermelon fruits during 2022 season (FAOSTAT, 2022).

Watermelon native to the tropical and sub-tropical areas is particularly sensitive to cold stress. Cold stress can cause stunted plant growth, wilting, necrotic lesions on leaves and increased susceptibility to diseases witch pathogens and can result in yield reduction (Korkmaz and Dufault, 2002).

The current impacts of climate change are threatening agricultural production globally. Climate change demand a substantial increase in agricultural production to ensure food Safe (Bouabdelli *et al.*, 2022). Early harvesting is one of the important criteria for obtaining better prices in the market for higher profitability.

There were significant differences between sowing dates on plant growth, yield and its components and fruit quality of many cucurbit crops (El-Shabrawy and Hatem, 2008 on watermelon; Mohamed, 2011 and Moursy *et al.*, 2014 on squash; Khaled, 2016 on bottle gourd; Mousa, 2017 on watermelon and Abdel-Aleim *et al.*, 2023 on cucumber).

In this concern, there is an urgent need to improve agricultural practices to ensure that crop production is balanced with environmental sustainability. Under climate changes the production of vegetable crops may be improved by using various novel agricultural practices, i.e., suitable new cultivars, modification of sowing date, as well as spraying growth stimulants. Growth stimulants like potassium silicate, ascorbic acid, and salicylic acid have drawn attention recently because they are thought to be among the most crucial components of management strategies to improve horticultural crops' capacity to withstand a biotic stress, as well as their uptake and efficiency of nutrients, and overall crop quality, especially when stressed (Salama *et al.*, 2019).

Salicylic acid (SA) is a naturally occurring phenolic compound. It is play an important role in the regulation of plant growth, development, ripening, and defense responses. In addition to its defense responses, SA plays an important role in the response to abiotic stresses, including drought, low temperature, and salinity stresses (Miura and Tada, 2014). Salicylic acid increase drought tolerance and avoids the deleterious effect of water stress (Shehata *et al.*, 2020). Recent studies have revealed that exogenous SA can enhance cold stress tolerance mechanisms in different plant species (Duan *et al.*, 2022). In addition, spraying plants with salicylic

[*] **Corresponding author.**
E-mail address: Mohamed.ali@agr.nvu.edu.eg
DOI: 10.21608/jpp.2024.294375.1345

acid improved plant growth, yield and fruit quality (Abd-Elaziz *et al*., 2019 on squash; Nada and Abd El-Hady, 2019 and Akshata *et al.*, 2023 on cucumber).

Ascorbic acid (AsA) is the most abundant antioxidant compound essential for various biological functions in plants (Chaturvedi *et al.,* 2022). It also plays an important role in cell division and expansion, osmotic adjustment, and hormone biosynthesis, processes that are essential to plant growth and development. According to (Kamal *et al.,* 2017) revealed that exogenously applied AsA can alleviate the adverse effects of various abiotic stresses.

In this regard, spraying with ascorbic acid significantly enhanced plant growth, productivity and fruit quality of many cucurbit crops (Naz *et al*., 2016 on cucumber; Youssef *et al*., 2017 on squash; Abdel-Wahab, 2018 on cucumber; Mohamed *et al*., 2021 on squash).

In agricultural production systems, potassium silicate (KSil) is a useful supply of highly soluble silicon and potassium. By enhancing plant resistance to biotic and abiotic challenges, including disease infections and pests, salt, drought, high temperature, and nutrient imbalance, it has a significant impact on the growth, production, and fruit quality of watermelon (Ma, 2004).

Some authors showed that spraying with potassium silicate significantly enhanced growth, yield and fruit quality of some cucurbit plants (Shehata, 2018 on cucumber; Shehata and Abdelgawad, 2019 on squash; Wehedy, 2019 on watermelon and Qassem *et al*., 2022 on cucumber.

This study was conducted with the aim of reaching the most appropriate sowing time and foliar spraying with safe materials to obtain high productivity and the best quality of fruits under the conditions of El-Dakhla Oasis in New Valley Governorate.

MATERIALS AND METHODS

This work was conducted at a private farm in El-Kasr city, located at El-Dakhla Oasis district (25”41’33° N, 28”51’51° E, altitude 616 m), New Valley Governorate, during 2022 and 2023 seasons to study the effect of two sowing dates (1st and 20th February), foliar spray with some safe materials; salicylic acid (SA), ascorbic acid (AsA) and potassium silicate (KSil) and the interaction between them on growth, productivity and fruit quality of watermelon (cv. Aswan F1), witch supplied by SAKATA Company, Japan and obtained from Gaara Seeds Company.

Physical and chemical analysis of experimental soil according to the methods of Page *et al.* (1982), as the average of the 2022 and 2023 seasons, are shown in (Table 1).

Table 1. Physical and chemical analysis of experimental soil.

Soil properties		Soil properties		Soil properties	
Physical analysis	**Values**	**Chemical analysis**	**Values**	**Soluble anions**	**Values**
Coarse sand (%)	4.95	SP (%)	11.95	Cl^- (meq/L)	5.40
Fine sand (%)	75.11	$CaCO_3$ (%)	5.88	HCO_3 (meq/L)	1.00
Silt (%)	13.09	Soluble cations	Values	Available nutrients	Values
Clay (%)	6.85	Na^+ (meq/L)	11.02	N (ppm)	42.25
Textural class	Sandy	K^+ (meq/L)	1.10	P (ppm)	5.39
Chemical analysis	Values	Ca^{2+} (meq/L)	2.50	K (ppm)	87.70
E.C. (dsm^{-1} 1:2.5)	1.28	Mg^{2+} (meq/L)	0.75		
pH (1:2.5 w/v)	8.14				
Organic matter (%)	0.62				

The average temperature and relative humidity (RH %) in two growing seasons 2022 and 2023 were determined according to Meteorological Station of El-Dakhla Oasis, New Valley Governorate, Egypt, and shown in (Table 2).

Table 2. Meteorological data during the two growing seasons 2022 and 2023.

Month	Temperature degree (ºC)		Relative humidity (%)	
	2022 season	**2023 season**	**2022 season**	**2023 season**
1-10 Feb.	14.00	13.60	47.00	45.00
11-20 Feb	15.40	15.30	46.00	43.00
21-28 Feb	17.10	17.80	39.00	41.00
1-10 March	21.10	22.90	31.00	28.00
11-20 March	15.80	20.60	35.00	33.00
21-31 March	19.00	21.40	28.00	35.00
1-10 April	31.30	24.70	15.00	29.00
11-20 April	26.80	25.00	23.00	30.00
21-30 April	29.10	27.00	21.00	26.00
1-10 May	28.40	27.30	22.00	27.00
11-20 May	31.10	29.00	20.00	25.00
21-31 May	30.40	32.10	22.00	23.00
1-10 June	32.70	35.20	22.00	22.00
11-20 April	32.90	33.40	24.00	26.00
21-30 June	32.80	32.40	25.00	27.00

This experiment included 14 treatments which were the combinations between two sowing dates (1st February and 20th February) and 6 treatments with some safe materials as foliar spray; SA at 0.5 and 1.0 mM, AsA at 50 and 100 ppm and KSil at 4 and 8 ml/l, beside untreated control (sprayed plants with distilled water).

These treatments were arranged in a split plot design with three replicates. Sowing dates were randomly arranged in the main plots and some safe materials were randomly distributed in the sub plots. The plot area was 12.0 m^2, with two ridges of 4.0 m long and 1.5 m width and the distance between two plants on the same ridge was 0.5 m apart. Seeds were sowed directly in the soil at two sowing dates (1st and 20th February) during both seasons.

Plants were sprayed with different safe materials four times, starting at the fourth true leaf stage (45 days from sowing dates in both seasons), and repeated three times with an interval of 10 days. Each plot received 0.4, 0.6, 0.8, and 1.0 liter of aqueous solution at the first, second, third, and forth foliar applications, respectively, and used a spreading agent (reflecting materials). In addition, control plants were sprayed with the same quantity of distilled water. Potassium silicate (FTE Silika) contained 30% SiO_3 and 20% K_2O; SA, AsA, and KSil were obtained from El-Gomhouria Company, Egypt.

During soil preparation a mixture of 20 m^3 poultry manure (FYM) plus 200 kg calcium super phosphate

(15.5% P_2O_5), 100 kg ammonium sulphate (20.6% N), 100 kg potassium sulphate (50% K_2O), and 75 kg sulfur per feddan. Other rates of N, P, and K fertilizers were added weekly, and other agricultural practices for watermelon, such as irrigation, weed control and pest control, were carried out according to the recommendations of the Ministry of Agriculture, Egypt.

Data recorded:

1- Vegetative growth characters:

Representative samples, five plants were randomly taken from each plot at 90 days from sowing in both seasons, before fruit harvesting to estimate the following characteristics from chosen plants: Vine length (cm), number of branches per plant, and leaf area (cm^2), which was determined as the fifth leaf number (fully expanded leaf) from the plant top for five plants, according to the formula of (Almeida, 2013). Also, plant parts such as vine, branches, leaves, and root were dried at 70 °C until they reached a constant weight, and then the plant dry weight (g) was determined.

2- Chemical constituents of leaves:

The amounts of nitrogen, phosphorus, and potassium in leaves were measured at 90 days from sowing dates in both seasons using the techniques outlined by A.O.A.C. (2019).

3- Yield:

Ripe fruits were harvested three times, starting at 125 and 98 days from sowing dates 1st Feb. and 20th Feb., respectively, in both seasons, and the average fruit weight (kg) and total yield (ton/feddan) were determined.

4- Fruit quality:

Ripened fruits (5 fruits per plot) were sampled for laboratory analysis, and the edible portion of the fruit, was analyzed for: Total soluble solids (TSS) were determined using a refractometer. Lycopene concentration was determined as mg/100g FW) according to Ranganna (1977).

Total soluble sugar and reducing sugars were determined in dried flesh of fruits according to the method described by Sadasivam and Manickam (1996) and Naguib (1964), respectively. Ferric Reducing Antioxidant Power (FRAP) was determined in flesh fruits according to Benzie and Strain (1996).

Statistical analysis:

Data were subject to the statistical analysis of ANOVA, and the entries means were compared according to the least significant differences (LSD) at 5% levels, as reported by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1. Vegetative growth characters:

Effect of sowing date:

There were significant differences between the two sowing dates concerning all plant growth parameters of watermelon plants grown in El-Kasr city, El-Dakhla Oasis in both seasons (Tables 3-6). The highest values of these traits, i.e., vine length (366.50 and 375.36 cm), number of branches per plant (11.24 and 11.43), leaf area (197.96 and 203.32 cm^2), and plant dry weight (192.81 and 196.48 g) were obtained by late sowing date 20th February compared with early sowing 1st February in both seasons. The relative increases in total dry weight per plant were about 35.16 and 34.83% for sowing date on 20th February over early sowing 1st February in the 1st and 2nd seasons, respectively.

This may be due to summer vegetables such as watermelon are sensitive to low temperature, especially blew 15°C throughout plant development, i.e., seed germination, vegetative growth and reproduction. Under low temperatures, many seeds may do not germinate or germinate irregularly and plants grow differentially with delayed plant formation leading to variability in crop development. During later stages, plant growth and development are extremely retarded that either limit or lead to no flower and fruit production (Foolad and Lin, 2000).

In this connection higher vegetative growth of the 20th Feb. sowing date might be due to the prevailing suitable temperature (Table 2) and better meteorological conditions compared with 1st Feb. early sowing date. Also, the increase in leaf area may be due to availability of higher light intensity and temperature resulting in production of more active leaves and also affecting leaf physiology which finally increased leaf photosynthesis (Watako, 2015).

Similar results were obtained by El-Shabrawy and Hatem (2008) on watermelon; Iqbal *et al.* (2019) on Bitter ground and Abdel-Aleim *et al.* (2023) on cucumber.

Effect of foliar spray with some safe materials:

All safe materials as foliar spray had increased all plant growth parameters of watermelon plant at 90 days after sowing in both seasons as compared to control treatment (Tables 3-6).

Spraying plants with KSil at 8 ml/l significantly increased vine length (363.36 and 374.62 cm), number of branches per plant (10.72 and 11.11), and plant dry weight (181.04 and 184.65 g), while spraying with AsA at 50 ppm gave the highest value of leaf area (202.34 and 207.90 cm^2) at 90 days after sowing in both seasons. There were no significant differences between spraying with KSil at 8 ml/l and SA at 0.05 mM as for vine length in both seasons, KSil at 8 ml/l and AsA at 50 ppm as for number of branches per plant and leaf area in both seasons. The relative increases in total dry weight per plant due to spraying with KSil at 8ml/l were about 17.63 and 17.58% over the control in the 1st and 2nd seasons, respectively.

This increment in dry weight of watermelon plants (Table 6) could be attributed to the role of potassium on plant nutrition and the enhancement of assimilate translocation and protein synthesis. Silicon addition to plants reduced the inhibitory effect on watermelon growth and photosynthesis, also the improving effect of silicon seemed to be due to increasing root hydraulic conductance of the plants (Shi *et al.*, 2016).

This may be due to the role of silicon that improves plant development and growth through promoting several desirable physiological processes (Desoky *et al*., 2021) in addition, deposited in the walls of epidermal cells after absorption by plants, contributes considerably to stem strength (Shehata *et al.*, 2018). Also, the positive effect of AsA on root length and leaf area per leaves may be due to its role in enhancing the efficiency of photosynthesis, cell expansion and cell division (Naz *et al.,* 2016). However, application of vitamins to plants may enhance plant growth by acting as growth regulators under normal conditions and/or produce hormones and vitamins such as IAA, thiamine, riboflavin and biotin, in addition fixing nitrogen which might stimulates plant growth due to enhancing root development (Oertli, 1987).

Similar results were obtained by Hegazi *et al.* (2015) on squash and Omar (2017) on cucumber who noticed that plant foliar spray with silicon caused an increase in the vegetative growth.

Effect of the interaction:

The interaction between sowing dates (1st and 20th February) and spraying with (SA, AsA, and KSil) at different concentrations had significant effect on all plant growth characters of watermelon as compared to control plants during 2022 and 2023 seasons (Tables 3-6).

The findings demonstrated that in both seasons, planting of watermelon on 20th Feb. and spraying with KSil at 8 ml/l scored the highest values of vine length (389.39 and 398.56 cm), number of branches per plant (11.67 and 12.00), leaf area (206.48 and 212.80 cm^2), and total dry weight (205.93 and 209.74 g) in the 1st and 2nd seasons, respectively.

There were no significant differences between the interaction on 20th Feb. and spraying with KSil at 8 ml/l and with AsA at 50 ppm for vine length, number of branches per plant and leaf area in both seasons. The relative increases in total dry weight per plant due to the interaction between planting watermelon on 20th Feb. and spraying with KSil at 8 ml/l were about 59.97 and 59.77% over planting on 1st Feb. and treated with distilled water in the 1st and 2nd seasons, respectively.

Table 3. Effect of sowing date, foliar application with some safe materials and the interaction between them on vine length (cm) of watermelon plants in the two growing seasons.

Sowing date (A)	Safe materials (B)							Mean (A)
	Control	SA (0.5 mM)	SA (1.0 mM)	AsA (50 ppm)	AsA (100 ppm)	KSil (4 ml/l)	KSil (8 ml/l)	
	2022 season							
1st Feb.	292.89	340.11	321.78	330.67	298.56	319.00	337.33	320.05
20th Feb.	341.67	375.78	360.56	381.89	350.44	365.78	389.39	366.50
Mean (B)	317.28	357.94	341.17	356.28	324.50	342.39	363.36	
	A (F test): **		B ($LSD_{0.05}$) = 7.82		AB ($LSD_{0.05}$) = 11.04			
	2023 season							
1st Feb.	304.17	354.72	327.00	342.50	315.11	335.89	350.69	332.87
20th Feb.	349.17	384.00	369.28	392.28	358.72	375.50	398.56	375.36
Mean (B)	326.66	369.36	348.13	367.38	336.91	355.69	374.62	
	A (F test): **		B ($LSD_{0.05}$) = 11.88		AB ($LSD_{0.05}$) = 16.76			

Ns, * and ** means that non-significant, significant at 5 % and 1 % levels of probability, respectively.
Feb. = February, control = sprayed with distilled water, SA = Salicylic acid, AsA = Ascorbic acid and KSil = potassium silicate.

Table 4. Effect of sowing date, foliar application with some safe materials and the interaction between them on branches number of watermelon plants in the two growing seasons.

Sowing date (A)	Safe materials (B)							Mean (A)
	Control	SA (0.5 mM)	SA (1.0 mM)	AsA (50 ppm)	AsA (100 ppm)	KSil (4 ml/l)	KSil (8 ml/l)	
	2022 season							
1st Feb.	8.67	9.67	9.00	9.89	8.78	9.56	9.78	9.33
20th Feb.	10.66	11.44	11.00	11.89	10.78	11.22	11.67	11.24
Mean (B)	9.67	10.56	10.00	10.89	9.78	10.39	10.72	
	A (F test): **		B ($LSD_{0.05}$) = 0.61		AB ($LSD_{0.05}$) = 0.86			
	2023 season							
1st Feb.	9.22	10.00	9.56	10.44	9.33	9.89	10.22	9.81
20th Feb.	10.89	11.78	11.44	12.22	11.11	11.56	12.00	11.43
Mean (B)	10.06	10.39	10.50	11.33	10.22	10.72	11.11	
	A (F test): *		B ($LSD_{0.05}$) = 0.48		AB ($LSD_{0.05}$) = 0.68			

Ns, * and ** means that non-significant, significant at 5 % and 1 % levels of probability, respectively.
Feb. = February, control = sprayed with distilled water, SA = Salicylic acid, AsA = Ascorbic acid and KSil = potassium silicate.

Table 5. Effect of sowing date, foliar application with some safe materials and the interaction between them on leaf area (cm^2) of watermelon plants in the two growing seasons.

Sowing date (A)	Safe materials (B)							Mean (A)
	Control	SA (0.5 mM)	SA (1.0 mM)	AsA (50 ppm)	AsA (100 ppm)	KSil (4 ml/l)	KSil (8 ml/l)	
	2022 season							
1st Feb.	159.60	185.19	180.37	194.60	168.31	175.54	191.96	179.37
20th Feb.	181.07	204.79	197.94	210.08	191.64	193.74	206.42	197.96
Mean (B)	170.33	194.90	189.16	202.34	179.98	184.64	199.19	
	A (F test): **		B ($LSD_{0.05}$) = 7.01		AB ($LSD_{0.05}$) = 9.90			
	2023 season							
1st Feb.	164.73	190.32	184.88	200.20	174.45	180.29	197.71	184.66
20th Feb.	186.20	210.08	203.23	215.60	196.47	198.88	212.80	203.32
Mean (B)	175.47	200.20	194.06	207.90	185.46	189.58	205.26	
	A (F test): **		B ($LSD_{0.05}$) = 8.49		AB ($LSD_{0.05}$) = 11.99			

Ns, * and ** means that non-significant, significant at 5 % and 1 % levels of probability, respectively.
Feb. = February, control = sprayed with distilled water, SA = Salicylic acid, AsA = Ascorbic acid and KSil = potassium silicate.

Table 6. Effect of sowing date, foliar application with some safe materials and the interaction between them on dry weight (g) of watermelon plants in the two growing seasons.

Sowing date (A)	Safe materials (B)							Mean (A)
	Control	SA (0.5 mM)	SA (1.0 mM)	AsA (50 ppm)	AsA (100 ppm)	KSil (4 ml/l)	KSil (8 ml/l)	
	2022 season							
1st Feb.	128.73	148.17	137.05	150.26	134.99	143.18	156.15	142.65
20th Feb.	179.08	197.97	187.59	202.02	183.54	193.53	205.93	192.81
Mean (B)	153.90	173.07	162.32	176.14	159.26	168.36	181.04	
	A (F test): **		B (LSD 0.05) = 2.58		AB (LSD 0.05) = 3.63			
	2023 season							
1st Feb.	131.27	151.01	140.72	154.38	137.93	145.21	159.56	145.72
20th Feb.	182.82	201.83	191.53	205.54	186.94	196.92	209.74	196.48
Mean (B)	157.04	176.42	166.13	179.95	162.45	171.06	184.65	
	A (F test): **		B (LSD 0.05) = 3.88		AB (LSD 0.05) = 5.47			

Ns, * and ** means that non-significant, significant at 5 % and 1 % levels of probability, respectively.
Feb. = February, control = sprayed with distilled water, SA = Salicylic acid, AsA = Ascorbic acid and KSil = potassium silicate.

2. Chemical constituents of leaves:

Effect of sowing date:

Obtained data in (Tables 7-9) show that there were significant differences between the two sowing dates in nitrogen, phosphorus, and potassium content in watermelon leaves. Planting watermelon seeds on 20th Feb. gave the higher values of nitrogen (2.77 and 2.97%), phosphorus (0.307 and 0.340%) and potassium contents (2.09 and 2.31%) in the 1st and 2nd seasons, respectively. In this respect Esho and Saeed (2017) on summer squash reported that planting date 10th August gave a highest K content in leaves than 31th August planting date.

Effect of foliar spray with some safe materials:

The contents of nitrogen, phosphorus, and potassium in watermelon leaves at 90 days from the sowing date were significantly affected by different foliar spray treatments compared to control treatment in both seasons (Tables 7-9).

It has been found that spraying plants with KSil at 8 ml/l significantly increased and recorded the highest values for N (2.79 and 2.96%), P (0.309 and 0.340%), and K content (2.13 and 2.33%) in the 1st and 2nd seasons, respectively, followed by spraying with AsA at 100 ppm in both seasons. While, the lowest values for N, P, and K respectively (2.35 and 2.45%), (0.263 and 0.275%) and (1.66 and 1.68%) were obtained from control treatment (spraying plants with distilled water) in both seasons.

Silicon is not considered an essential element for plant growth, its beneficial role in plant nutrition is well known (Epstein, 1999). Plants absorb silicon as monosilicic acid (H_2SiO_4), which builds up in leaf epidermal cells more than in any other cell type (Currie and Perry, 2007).

Similar results were found by Kim *et al.* (2015) on watermelon; Shehata and Abdelgawad (2019) and El-Shoura (2020) on squash. They demonstrated that KSil application increased leaf chemical content. On the other side, Emara (2019) came up with similar results for SA. They showed that spraying tomato plants with SA significantly increased N, P, and K contents of the plants compared to unsprayed plants.

Effect of the interaction:

Data in Tables (7-9) showed that the interaction significantly affected N, P, and K in contents in leaves in both seasons. The highest values of nitrogen (2.94 and 3.15%), phosphorus (0.326 and 0.361%), and potassium (2.32 and 2.59%) were obtained with the interaction between sowing date on 20th Feb. and spraying plants with KSil at 8 ml/l. While, the lowest values (2.21 and 2.26%), (0.250 and 0.255%), and (1.54 and 1.51%) for N, P, and K were when sowing on 1st Feb. and spraying plants with distilled water (control) in the 1st and 2nd seasons, respectively.

Growth stimulants like KSil, AsA, and SA have drawn attention recently because they are thought to be among the most crucial components of management strategies to improve horticultural crops' capacity to withstand abiotic stress, as well as their uptake and efficiency of nutrients, and overall crop quality, especially when stressed (Salama *et al*., 2019).

Table 7. Effect of sowing date, foliar application with some safe materials and the interaction between them on nitrogen content (%) in leaves of watermelon plants in the two growing seasons.

Sowing date (A)	Safe materials (B)							Mean (A)
	Control	SA (0.5 mM)	SA (1.0 mM)	AsA (50 ppm)	AsA (100 ppm)	KSil (4 ml/l)	KSil (8 ml/l)	
	2022 season							
1st Feb.	2.21	2.27	2.55	2.39	2.62	2.45	2.64	2.45
20th Feb.	2.49	2.70	2.84	2.76	2.91	2.79	2.94	2.77
Mean (B)	2.35	2.49	2.69	2.57	2.77	2.62	2.79	
	A (F test): **		B (LSD 0.05) = 0.05		AB (LSD 0.05) = 0.05			
	2023 season							
1st Feb.	2.26	2.41	2.69	2.49	2.73	2.56	2.78	2.56
20th Feb.	2.64	2.89	3.07	2.95	3.12	2.99	3.15	2.97
Mean (B)	2.45	2.65	2.88	2.72	2.92	2.78	2.96	
	A (F test): **		B (LSD 0.05) = 0.09		AB (LSD 0.05) = 0.13			

Ns, * and ** means that non-significant, significant at 5 % and 1 % levels of probability, respectively.
Feb. = February, control = sprayed with distilled water, SA = Salicylic acid, AsA = Ascorbic acid and KSil = potassium silicate.

Table 8. Effect of sowing date, foliar application with some safe materials and the interaction between them on phosphorus content in leaves (%) of watermelon plants in the two growing seasons.

Sowing date (A)	Safe materials (B)							Mean (A)
	Control	SA (0.5 mM)	SA (1.0 mM)	AsA (50 ppm)	AsA (100 ppm)	KSil (4 ml/l)	KSil (8 ml/l)	
	2022 season							
1st Feb.	0.250	0.258	0.280	0.266	0.288	0.270	0.292	0.272
20th Feb.	0.275	0.298	0.312	0.307	0.322	0.310	0.326	0.307
Mean (B)	0.263	0.278	0.296	0.287	0.305	0.290	0.309	
A (F test): **		B ($LSD_{0.05}$) = 0.006			AB ($LSD_{0.05}$) = 0.009			
	2023 season							
1st Feb.	0.255	0.271	0.306	0.275	0.312	0.286	0.320	0.289
20th Feb.	0.295	0.332	0.352	0.337	0.356	0.345	0.361	0.340
Mean (B)	0.275	0.301	0.329	0.306	0.334	0.315	0.340	
A (F test): **		B ($LSD_{0.05}$) = 0.004			AB ($LSD_{0.05}$) = 0.007			

Ns, * and ** means that non-significant, significant at 5 % and 1 % levels of probability, respectively.
Feb. = February, control = sprayed with distilled water, SA = Salicylic acid, AsA = Ascorbic acid and KSil = potassium silicate.

Table 9. Effect of sowing date, foliar application with some safe materials and the interaction between them on potassium content in leaves (%) of watermelon plants in the two growing seasons.

Sowing date (A)	Safe materials (B)							Mean (A)
	Control	SA (0.5 mM)	SA (1.0 mM)	AsA (50 ppm)	AsA (100 ppm)	KSil (4 ml/l)	KSil (8 ml/l)	
	2022 season							
1st Feb.	1.54	1.61	1.81	1.70	1.90	1.73	1.93	1.74
20th Feb.	1.79	1.97	2.15	2.06	2.27	2.09	2.32	2.09
Mean (B)	1.66	1.79	1.98	1.88	2.08	1.91	2.13	
A (F test): **		B ($LSD_{0.05}$) = 0.08			AB ($LSD_{0.05}$) = 0.11			
	2023 season							
1st Feb.	1.51	1.69	1.95	1.73	1.99	1.82	2.06	1.82
20th Feb.	1.86	2.16	2.44	2.27	2.52	2.32	2.59	2.31
Mean (B)	1.68	1.92	2.19	2.00	2.26	2.07	2.33	
A (F test): **		B ($LSD_{0.05}$) = 0.08			AB ($LSD_{0.05}$) = 0.12			

Ns, * and ** means that non-significant, significant at 5 % and 1 % levels of probability, respectively.
Feb. = February, control = sprayed with distilled water, SA = Salicylic acid, AsA = Ascorbic acid and KSil = potassium silicate.

3. Yield:

Effect of sowing date:

As shown in Tables (10 and 11) there was significant difference between the two sowing dates concerning average fruit weight and total yield per faddan of watermelon plants.

Sowing watermelon seeds on 20th Feb. gave significantly higher value of average fruit weight (6.50 and 6.68 kg) and total yield (35.61 and 35.88 ton/faddan.) in the 1st and 2nd seasons, respectively.

The relative increases in total yield per faddan were about 57.63 and 56.47% for sowing date on 20th Feb. over early sowing 1st Feb. in the 1st and 2nd seasons, respectively.

The increments in yield of watermelon may be due to the increases in the vegetative growth characters (Table 3-5), dry weight per plant (Table 6), mineral contents (Tables 7-9) and also due to the increase in fruit number and average fruit weight (Table 10).

Cucurbit crop yield depend on the presence of optimal temperatures for foliage and fruit growth and for pollination. Higher fruit weight at the end of February sown crop might be due to increased dry matter and greater translocation of photosynthates along with metabolites from source to sink. Irvin and Micheal (1995) in their studies on influence of environmental factors on cucumber concluded that, high nocturnal temperatures are conducive to assimilate translocation into reproductive sinks, thereby enhancing the fruit growth rate.

Our findings are consistent with those of Khaled (2016) on bottle gourd; Mousa (2017) on watermelon and Abdel-Aleim *et al.* (2023) on cucumber.

Effect of foliar spray with some safe materials:

Data recorded in (Tables 10 and 11) show the effect of spraying with some safe materials on yield and its components of watermelon plants in both growing seasons 2022 and 2023. It has been found that foliar application with some safe materials significantly affected these traits as compared to control treatment in both seasons. Whereas, the highest value of average fruit weight (6.64 and 6.79 kg) was produced by potassium silicate at 8 ml/l without significant differences between spraying with AsA at 50 ppm (6.43 and 6.60 kg) and the lowest value for this trait (5.28 and 5.42 kg) was obtained from control in the 1st and 2nd seasons, respectively.

As for total yield per faddan, the highest value of total yield (30.28 and 30.57 ton/faddan) was produced by ascorbic acid at 50 ppm in the 1st and 2nd seasons, respectively with no significant differences with spraying by KSil at 8 m/l (30.22 and 30.56 ton/feddan) in the 1st and 2nd seasons, respectively. While, the lowest value for this trait (27.64 and 27.95 ton/feddan) was obtained from control in both seasons, respectively.

The increases in total yield per faddan were about 9.51 and 9.37 for AsA at 50 ppm and 9.29 and 9.33% for KSil at 8 ml/l over control treatment (spraying with distilled water) in the 1st and 2nd seasons, respectively.

The increments in total yield of watermelon may be due to the increases in the vegetative growth characters (Table 3-5), dry weight per plant (Table 6), N, P, and K contents (Tables 7-9) and also due to the increase in fruit number and average fruit weight (Table 10).

This outcome was consistent with studies by Youssef *et al.* (2017) on squash and Abdel-Wahab (2018) on cucumber, which discovered that spraying ascorbic acid on the plants increased overall yield. Moreover, this findings may be due to the fact that ascorbic acid plays an important role in increasing fruit yield and one of the essential ingredients necessary in plants to increase the cell division and increase the effectiveness some of enzymes which consists of photosynthesis and breathing (Eifediyi and Remison, 2009), consequently controlling the timing of flowering and aging and increasing the fruit.

Effect of the interaction:

Data revealed that the interaction between sowing date and spraying with some safe materials significantly increased average fruit weight and total yield per faddan than control treatment in both seasons (Tables 10 and 11). The highest value of average fruit weight (7.25 and 7.40 kg) recorded when sowing on 20th Feb. and spraying with KSil at 8 ml/l. While, the lowest value (4.80 and 4.94 kg) recorded when sowing on 1st Feb. and sprayed with water in the 1st and 2nd seasons, respectively.

However, the highest value of total yield (37.20 and 37.43 ton/faddan) was recorded by the interaction between planting on 20th Feb. and spraying with AsA at 50 ppm without significant difference with the interaction between planting at the same date and spraying with KSil at 8 ml/l (36.80 and 37.11 ton/faddan) in the 1st and 2nd seasons, respectively. While, the lowest value of total yield per faddan (21.40 and 21.71 ton/faddan) was recorded when sowing on 1st Feb. and spraying with distilled water in both seasons, respectively.

The increases in total yield per faddan were about 71.96 and 70.93% for the interaction between sowing on 20th Feb. and spraying with KSil at 8 ml/l and 73.83 and 72.40% for the interaction between sowing on 20th Feb. and spraying with AsA at 50 ppm over sowing date on 1st Feb. and spraying with distilled water in the 1st and 2nd seasons, respectively.

Table 10. Effect of sowing date, foliar application with some safety materials and the interaction between them on average fruit weight (kg) of watermelon plants in the two growing seasons.

Sowing date (A)	Safety materials (B)							Mean (A)
	Control	**SA (0.5 mM)**	**SA (1.0 mM)**	**AsA (50 ppm)**	**AsA (100 ppm)**	**KSil (4 ml/l)**	**KSil (8 ml/l)**	
				2022 season				
1st Feb.	4.80	5.73	5.16	5.84	4.95	5.39	6.03	5.41
20th Feb.	5.75	6.81	6.20	7.02	6.00	6.50	7.25	6.50
Mean (B)	5.28	6.27	5.68	6.43	5.48	5.95	6.64	
	A (F test): **		B ($LSD_{0.05}$) = 0.216		AB ($LSD_{0.05}$) = 0.306			
				2023 season				
1st Feb.	4.94	5.86	5.32	5.99	5.11	5.55	6.17	5.56
20th Feb.	5.90	7.01	6.36	7.20	6.18	6.69	7.40	6.68
Mean (B)	5.42	6.44	5.84	6.60	5.65	6.12	6.79	
	A (F test): **		B ($LSD_{0.05}$) = 0.109		AB ($LSD_{0.05}$) = 0.150			

Ns, * and ** means that non-significant, significant at 5 % and 1 % levels of probability, respectively.
Feb. = February, control = sprayed with distilled water, SA = Salicylic acid, AsA = Ascorbic acid and KSil = potassium silicate.

Table 11. Effect of sowing date, foliar application with some safety materials and the interaction between them on total yield (ton/faddan) of watermelon in the two growing seasons.

Sowing date (A)	Safety materials (B)							Mean (A)
	Control	**SA (0.5 mM)**	**SA (1.0 mM)**	**AsA (50 ppm)**	**AsA (100 ppm)**	**KSil (4 ml/l)**	**KSil (8 ml/l)**	
				2022 season				
1st Feb.	21.40	23.07	22.24	23.36	21.80	22.62	23.64	22.59
20th Feb.	33.90	36.23	35.58	37.20	34.49	35.08	36.80	35.61
Mean (B)	27.65	29.64	28.91	30.28	28.14	28.85	30.22	
	A (F test): **		B ($LSD_{0.05}$) = 0.86		AB ($LSD_{0.05}$) = 1.21			
				2023 season				
1st Feb.	21.71	23.39	22.60	23.71	22.15	22.95	24.01	22.93
20th Feb.	34.19	36.50	35.88	37.43	34.78	35.30	37.11	35.88
Mean (B)	27.95	29.94	29.24	30.57	28.46	29.13	30.56	
	A (F test): **		B ($LSD_{0.05}$) = 0.52		AB ($LSD_{0.05}$) = 0.73			

Ns, * and ** means that non-significant, significant at 5 % and 1 % levels of probability, respectively.
Feb. = February, control = sprayed with distilled water, SA = Salicylic acid, AsA = Ascorbic acid and KSil = potassium silicate.

4. Fruit quality:

Effect of sowing date:

Data recorded in (Tables 12-17) show that, there were significant differences between two sowing dates on fruit quality of watermelon fruits, i.e., TSS, total sugars, reducing and non reducing sugars, lycopine concentration and ferric reducing antioxidant power (FRAP) assay in fruits in both seasons. Sowing watermelon on 20th Feb. significantly increased TSS contents (11.29 and 11.42 brix), total sugars (9.75 and 10.42%), reducing sugars (6.61 and 6.87%), non reducing sugars (3.15 and 3.56%), lyconene concentration (7.63 and 7.91 mg/100g FW) and FRAP (31.82 and 31.12 mM/100g FW) against TSS contents (10.78 and 10.89 brix), total sugars (9.26 and 9.57%), reducing sugars (6.20 and 6.41%), non reducing sugars (3.07 and 3.16%), lyconene concentration (7.26 and 7.48 mg/100g FW) and FRAP (30.41 and 29.75 mM/100 g FW) for planting on 1st Feb. in the 1st and 2nd seasons, respectively. These results are in harmony with those of Mousa (2017) on watermelon and Abdel-Aleim *et al.* (2023) on cucumber.

Effect of foliar spray with some safe materials:

The effect of foliar spray with SA, AsA and KSil at different concentrations had significant effect on fruit quality of watermelon fruits compared to control treatment in both seasons are presented in (Tables 12-17). Spraying watermelon plants with KSil at 8 ml/l significantly increased TSS contents (11.50 and 11.67 brix), total sugars (9.77 and 10.47%), reducing sugars (6.63 and 6.88%), lyconene concentration (7.66 and 7.95 mg/100g FW) and FRAP (31.95 and 31.23 mM/100 g FW) against TSS contents (10.52 and 10.64 brix), total sugars (9.12 and 9.29%), reducing sugars (6.09 and 6.27%), lyconene concentration (7.15 and 7.34 mg/100g FW) and FRAP (29.98 and 29.37 mM/100g FW) for control treatment in the 1st and 2nd seasons, respectively. However, there were significant differences between spraying KSil at 8 ml/l and SA at 1.0 mM for TSS in both seasons and FRAP in the 1st season, KSil at 8 ml/l and AsA at 100 ppm for total, reducing sugars and FRAP in both seasons and non reducing in the 2nd seasons.

Despite popular belief that watermelon is made up of only water and sugar, watermelon is actually considered a nutrient dense food, a food that provides a high amount of vitamins, minerals and antioxidants for a low amount of calories. Therefore, working to increase these components in watermelon fruits is extremely important because watermelon is one of the most popular foods in human nutrition due to its large nutritional content (Olayinka and Etejere, 2018).

These results are agreed with Shehata and Abdelgawad (2019) and Salama *et al*. (2019) on squash; Wehedy *et al*. (2019) on watermelon; Qassem *et al*. (2022) on cucumber as for potassium silicate; Abdel-Wahab (2018) on cucumber and Mohamed *et al*. (2021) on squash as for ascorbic acid.

Effect of the interaction:

Data recorded in (Tables 12-17) show the effect of interaction between sowing date and spraying with some safe materials had significantly increased all watermelon fruit quality during 2022 and 2023 seasons.

The interaction between sowing date on 20th Feb. and spraying with KSil at 8 ml/l significantly increased and gave the maximum values of TSS (11.80 and 12.02 brix), total sugars (10.0 and 10.83%), reducing sugars (6.82 and 7.08%), lyconene concentration (7.83 and 8.14 mg/100g FW) and FRAP (32.65 and 31.83 mM/100g FW) in the 1st and 2nd seasons, respectively. In the same time there were no significant differences with this interaction and the same sown date and spraying with SA at 1.0 mM for TSS, AsA at 100 ppm for total sugars, reducing sugars, lycopine concentration and FRAP) assay in the both seasons. On the other hand, the lowest values of all fruit quality traits were recorded with the interaction between sown date on 1st Feb. and spraying with water in both seasons.

In agricultural production systems, potassium silicate is a useful supply of highly soluble silicon and potassium. By enhancing plant resistance to biotic and abiotic challenges including disease infections and pests, salt, drought, high temperature, and nutrient imbalance, it has a significant impact on fruit quality of watermelon (Ma, 2004).

Table 12. Effect of sowing date, foliar application with some safety materials and the interaction between them on TSS content (brix) of watermelon fruit in the two growing seasons.

Sowing date (A)	Safety materials (B)							Mean (A)
	Control	SA (0.5 mM)	SA (1.0 mM)	AsA (50 ppm)	AsA (100 ppm)	KSil (4 ml/l)	KSil (8 ml/l)	
	2022 season							
1st Feb.	10.32	10.68	10.89	10.56	10.74	11.08	11.20	10.78
20th Feb.	10.72	11.10	11.68	10.96	11.44	11.32	11.80	11.29
Mean (B)	10.52	10.89	11.28	10.76	11.09	11.20	11.50	
	A (F test): NS		B (LSD 0.05) = 0.43		AB (LSD 0.05) = 0.60			
	2023 season							
1st Feb.	10.41	10.79	11.00	10.69	10.82	11.17	11.32	10.89
20th Feb.	10.88	11.29	11.73	11.12	11.50	11.41	12.02	11.42
Mean (B)	10.64	11.04	11.37	10.91	11.16	11.29	11.67	
	A (F test): *		B (LSD 0.05) = 0.37		AB (LSD 0.05) = 0.52			

Ns, * and ** means that non-significant, significant at 5 % and 1 % levels of probability, respectively.
Feb. = February, control = sprayed with distilled water, SA = Salicylic acid, AsA = Ascorbic acid and KSil = potassium silicate.

Table 13. Effect of sowing date, foliar application with some safety materials and the interaction between them on total sugars (%) of watermelon fruit in the two growing seasons.

Sowing date (A)	Safety materials (B)							Mean (A)
	Control	SA (0.5 mM)	SA (1.0 mM)	AsA (50 ppm)	AsA (100 ppm)	KSil (4 ml/l)	KSil (8 ml/l)	
	2022 season							
1st Feb.	8.90	9.08	9.39	9.17	9.50	9.25	9.54	9.26
20th Feb.	9.34	9.60	9.85	9.73	9.96	9.78	10.00	9.75
Mean (B)	9.12	9.34	9.62	9.45	9.73	9.52	9.77	
	A (F test): **		B (LSD 0.05) = 0.17		AB (LSD 0.05) = 0.23			
	2023 season							
1st Feb.	8.91	9.16	9.86	9.38	10.02	9.53	10.11	9.57
20th Feb.	9.67	10.28	10.63	10.36	10.71	10.47	10.83	10.42
Mean (B)	9.29	9.72	10.24	9.87	10.37	10.00	10.47	
	A (F test): **		B (LSD 0.05) = 0.16		AB (LSD 0.05) = 0.22			

Ns, * and ** means that non-significant, significant at 5 % and 1 % levels of probability, respectively.
Feb. = February, control = sprayed with distilled water, SA = Salicylic acid, AsA = Ascorbic acid and KSil = potassium silicate.

Table 14. Effect of sowing date, foliar application with some safety materials and the interaction between them on reducing sugars (%) of watermelon fruit in the two growing seasons.

Sowing date (A)	Safety materials (B)							Mean (A)
	Control	SA (0.5 mM)	SA (1.0 mM)	AsA (50 ppm)	AsA (100 ppm)	KSil (4 ml/l)	KSil (8 ml/l)	
	2022 season							
1st Feb.	5.94	6.02	6.30	6.12	6.38	6.16	6.44	6.20
20th Feb.	6.24	6.49	6.70	6.59	6.77	6.64	6.82	6.61
Mean (B)	6.09	6.26	6.50	6.36	6.58	6.40	6.63	
	A (F test): **		B (LSD 0.05) = 0.11		AB (LSD 0.05) = 0.15			
	2023 season							
1st Feb.	6.09	6.23	6.55	6.31	6.60	6.39	6.67	6.41
20th Feb.	6.44	6.79	6.98	6.82	7.04	6.90	7.08	6.87
Mean (B)	6.27	6.51	6.77	6.56	6.82	6.65	6.88	
	A (F test): **		B (LSD 0.05) = 0.10		AB (LSD 0.05) = 0.14			

Ns, * and ** means that non-significant, significant at 5 % and 1 % levels of probability, respectively.
Feb. = February, control = sprayed with distilled water, SA = Salicylic acid, AsA = Ascorbic acid and KSil = potassium silicate.

Table 15. Effect of sowing date, foliar application with some safety materials and the interaction between them on non reducing sugars (%) of watermelon fruit in the two growing seasons.

Sowing date (A)	Safety materials (B)							Mean (A)
	Control	SA (0.5 mM)	SA (1.0 mM)	AsA (50 ppm)	AsA (100 ppm)	KSil (4 ml/l)	KSil (8 ml/l)	
	2022 season							
1st Feb.	2.96	3.06	3.09	3.05	3.12	3.09	3.10	3.07
20th Feb.	3.10	3.11	3.15	3.14	3.19	3.14	3.18	3.15
Mean (B)	3.03	3.08	3.12	3.10	3.16	3.12	3.14	
	A (F test): *		B (LSD 0.05) = 0.23		AB (LSD 0.05) = 0.33			
	2023 season							
1st Feb.	2.82	2.93	3.31	3.07	3.43	3.14	3.44	3.16
20th Feb.	3.23	3.49	3.65	3.55	3.67	3.57	3.75	3.56
Mean (B)	3.02	3.21	3.48	3.31	3.56	3.35	3.59	
	A (F test): *		B (LSD 0.05) = 0.16		AB (LSD 0.05) = 0.22			

Ns, * and ** means that non-significant, significant at 5 % and 1 % levels of probability, respectively.
Feb. = February, control = sprayed with distilled water, SA = Salicylic acid, AsA = Ascorbic acid and KSil = potassium silicate.

Table 16. Effect of sowing date, foliar application with some safety materials and the interaction between them on lycopene (mg/100g FW) of watermelon fruit in the two growing seasons.

Sowing date (A)	Safety materials (B)							Mean (A)
	Control	SA (0.5 mM)	SA (1.0 mM)	AsA (50 ppm)	AsA (100 ppm)	KSil (4 ml/l)	KSil (8 ml/l)	
	2022 season							
1st Feb.	7.04	7.09	7.35	7.17	7.45	7.20	7.49	7.26
20th Feb.	7.26	7.53	7.71	7.64	7.79	7.66	7.83	7.63
Mean (B)	7.15	7.31	7.53	7.41	7.62	7.43	7.66	
	A (F test): **		B (LSD 0.05) = 0.12		AB (LSD 0.05) = 0.17			
	2023 season							
1st Feb.	7.20	7.30	7.59	7.39	7.68	7.42	7.75	7.48
20th Feb.	7.48	7.85	8.02	7.89	8.08	7.92	8.14	7.91
Mean (B)	7.34	7.57	7.81	7.64	7.88	7.67	7.95	
	A (F test): **		B (LSD 0.05) = 0.12		AB (LSD 0.05) = 0.16			

Ns, * and ** means that non-significant, significant at 5 % and 1 % levels of probability, respectively.
Feb. = February, control = sprayed with distilled water, SA = Salicylic acid, AsA = Ascorbic acid and KSil = potassium silicate.

Table 17. Effect of sowing date, foliar application with some safety materials and the interaction between them on ferric reducing antioxidant power (FRAP) assay (mM/100g FW) of watermelon fruit in the two growing seasons.

Sowing date (A)	Safety materials (B)							Mean (A)
	Control	SA (0.5 mM)	SA (1.0 mM)	AsA (50 ppm)	AsA (100 ppm)	KSil (4 ml/l)	KSil (8 ml/l)	
	2022 season							
1st Feb.	29.51	30.02	30.64	30.15	31.06	30.28	31.24	30.41
20th Feb.	30.45	31.39	32.14	31.77	32.44	31.91	32.65	31.82
Mean (B)	29.98	30.70	31.39	30.96	31.75	31.09	31.95	
	A (F test): *		B (LSD 0.05) = 1.13		AB (LSD 0.05) = 1.59			
	2023 season							
1st Feb.	28.93	29.18	30.14	29.43	30.35	29.60	30.63	29.75
20th Feb.	29.81	30.89	31.43	31.03	31.63	31.22	31.83	31.12
Mean (B)	29.37	30.04	30.79	30.23	30.99	30.41	31.23	
	A (F test): **		B (LSD 0.05) = 0.52		AB (LSD 0.05) = 0.73			

Ns, * and ** means that non-significant, significant at 5 % and 1 % levels of probability, respectively.
Feb. = February, control = sprayed with distilled water, SA = Salicylic acid, AsA = Ascorbic acid and KSil = potassium silicate.

CONCLUSION

From the foregoing results, under the same conditions, it could be recommended that planting watermelon on 20th February and using potassium silicate as a foliar application at 8 ml/l or ascorbic acid at 50 ppm to obtain high plant growth, good productivity, and the best fruit quality of watermelon.

REFERENCES

A.O.A.C. (2019). Official Methods of Analysis of AOAC INTERNATIONAL. 21st Edition, AOAC International, Washington DC.

Abdel-Aleim, A.A.; Abdelwahed, A.H.M.; Awad, A.H. and Helaly, A.A. (2023). Effect of planting dates on growth and productivity of cucumber hybrids under the conditions of Minia Governorate. Al-Azhar J. of Agri. Res., 48(1): 239-250.

Abd-Elaziz, S.A.; Alkharpotly, A.A.; Yousry, M.M. and Abido, A.I.A. (2019). Effect of foliar application with salicylic acid and potassium silicate on squash plants (*Cucurbita pepo* L.) yield and quality. Fayoum J. Agric. Res. and Develop., 33(1): 1-29.

Abdel-Wahab, A. (2018). Effect of pruning and spraying of ascorbic acid on growth, fruits yield and quality and some physiological attributes of cucumber. J. Hort. Sci. Ornam. Plants, 10(3): 104-109.

Akshata, A.; Shalini, M.; Vasanthi, B.G. and Mallikarjuna, G.A.P. (2023). Effect of foliar application of salicylic acid (SA) along with micronutrients (Boron & Zinc) on growth and yield of Parthenocarpic cucumber (*Cucumis sativus* L.). Bio. Forum–An Inter. J., 15(11): 436-442.

Almeida, R.A. (2013). Aspectos germinativos de duas cultivares de melancia em diferentes doses de composto orgânico. Catolé do Rocha: Universidade Estadual da Paraíba. 23p.

Baba, M.D.; Yelwa, J.M. and Sanchi, I. (2014). Comparative profitability analysis of watermelon and pepper production in Danko-Wasagu Local Government Area of Kebbi State, Nigeria. Review of Knowledge Economy, 1(3): 39-47.

Benzie, F. and Strain, J. (1996). The ferric reducing ability of plasma (FRAP) as a measure of antioxidant power: the FRAP assay. Analytical Biochemistry, 239(1): 70-76.

Bouabdelli, S.; Zeroual, A.; Meddi, M. and Assani, A. (2022). Impact of temperature on agricultural drought occurrence under the effects of climate change. Theor. Appl. Climat., 148(1): 191-209.

Chaturvedi, S.; Khan, S.; Bhunia, R.K.; Kaur, K. and Tiwari S. (2022). Metabolic engineering in food crops to enhance ascorbic acid production: crop biofortification perspectives for human health. Physiol. Mol. Biol. Plants, 28(4): 871-884.

Currie, H.A. and Perry, C.C. (2007). Silica in plants: Biological, biochemical and chemical studies. Ann. Bot., 100(7): 1383-1389.

Desoky, E.M.; Mansour, E.; El-Sobky, E.S.; Abdul-Hamid, M.I.; Taha, T.F.; Elakkad, H.A. (2021). Physio-biochemical and agronomic responses of faba beans to exogenously applied nano-silicon under drought stress conditions. Front. Plant Sci., 12: 1-13.

Duan, X.; Zhu, Z.; Yang, Y.; Duan, J.; Jia, Z. and Chen, F. (2022). Salicylic acid regulates sugar metabolism that confers freezing tolerance in Magnolia wufengensis during natural cold acclimation. J. Plant Growth Regul., 41(10): 227-235.

Eifediyi, E.K. and Remison, S.U. (2009). Effect of time of planting on the growth and yield of five varieties of cucumber (*Cucumis sativus* L.). Report and Opinion, 1(5): 81-90.

El-Shabrawy, R.A. and Hatem, A.K. (2008). Effect of sowing date and plant distribution system on growth and yield of Gurma watermelon (*Citrullus lanatus* var. colocynthoides). J. Agric. Sci. Mansoura Univ., 33(6): 4397-4407.

El-Shoura, A.M. (2020). Effect of foliar application with some treatments on summer squash (*Cucurbita pepo* L.) tolerance to high temperature stress. Middle East J. Agri. Res., 9(2): 468-478.

Emara, A.M.A. (2019). Effect of water irrigation levels and some foliar applications on tomato growth, yield and fruit quality under drip irrigation system. Ph. D. Thesis, Fac. Agric., Mansoura Univ., Egypt.

Epstein, E., (1999). Silicon. Annu. Rev. Plant Physiol. Plant Mol. Biol., 50: 641-664.

Esho, K.B. and Saeed, S.H. (2017). Effect of planting Date and Humic on the flowering growth N, P and K concentration of three summer squash cultivars (Cucurbita pepo L.). Al-Furat J. of Agri. Sci., 9(2): 76-95.

FAOSTAT (2022). Food and Agriculture Organization of the United Nations. Data available at http://www.fao.org/faostat/en/#data/QC.

Foolad, M.R. and Lin, G.Y. (2000). Relationship between cold tolerance during seed germination and vegetative growth in tomato: germplasm evaluation. J. Amer. Soc. Hort. Sci., 125(6): 679-683.

Gomez, K.A. and Gomez, A.A. (1984). Statistical procedure for Agric. Res. 2nd ed. John Wiley and Sons Inc. New York, 680 p.

Hegazi, A.Z.; Ismaiel, A.Y. and Anany, T.G. (2015). Improving growth and seed yield of squash by foliar applications with moringa leaf extract, ascorbic acid or benzyladenine. Egypt. J. Hort., 42(1): 577-588.

Iqbal, R.; Ashraf, M.I.; Sajad, S. and Murtaza, M. (2019). Effect of different sowing times on the growth, quality and yield of bitter gourd (*Momordica charantia* L.) under low tunnel in Punjab. J. Hortic. Arboric. 2(5): 0095-0098.

Irvin, E.W. and Michael, K. (1995). Environmental effects on seed dry weight and carbohydrate composition as related to expansive growth of cucumber (*Cucumis sativus* L.) fruit. Sci. Hort., 64(1-2): 21-31.

Kamal, M.A.; Saleem, M.F.; Shahid, M.; Awais, M.; Khan, H.Z. and Ahmed, K. (2017). Ascorbic acid triggered physiochemical transformations at different phonological stages of heat-stressed Bt cotton. J. Agro. and Crop Sci., 203(3): 1-9.

Khaled, S. (2016). Effect of location and planting date on bottle gourd (*Lagenaria siceraria* L.) productivity at desert soils. Egyptian J. Desert Res., 66(2): 351-372 .

Kim, Y.S.; Kang, H.J.; Kim, T.I.; Jeong, T.G.; Han, J.W.; Nam, S.Y. and Kim, K.I. (2015). Effects of water soluble potassium silicate by soil drenching application on watermelon (*citrullus lanatus* var. lanatus). Prot. Hort. and Plant Fact., 24(3): 235-242.

Korkmaz, A. and Dufault R.J. (2002). Short-term cyclic cold temperature stress on watermelon yield. Hort. Sci., 37(3): 487-489.

Ma, J.F. (2004). Role of silicon in enhancing the resistance of plants to biotic and abiotic stresses. Soil Sci. and Plant Nutr., 50(1): 11-18.

Miura, K. and Tada, Y. (2014). Regulation of water, salinity, and cold stress responses by salicylic acid. Front. Plant Sci., 5: 1-12.

Mohamed, A.S.; Saleh, S.A.; Darwish, S.N. and Halawa, S.S. (2021). Effect of foliar application with some organic acids on growth and productivity of summer squash plants (*Cucurbita pepo* L.). Middle East J. Agric. Res., 10(4): 1454-1463.

Mohamed, M.A. (2011). Effect of planting dates on infestations with certain pests and yield parameters of squash plants Egypt. J. Agric. Res., 89(4): 1353-1362.

Moursy, F.S.; Sadek, I.I.; Heggi, M.A.M. and Farag, A.A. (2014). Comparing four different squash hybrids on growing degree days (GDD) Bases. Researcher, 6(7): 97-111.

Mousa, E.A.M. (2017). Effect of planting dates on major insect pests and yield of watermelon seeds (*Citrullus lanatus*.) in Kafr El-Sheikh Governorate. Egypt. Acad. J. Biolog. Sci., 10(8): 1-8.

Nada, M.M. and Abd El-Hady, M.A.M. (2019). Influence of salicylic acid on cucumber plants under different irrigation levels. J. Plant Production, Mansoura Univ., 10(2): 165-171.

Naguib, M.I. (1964). "Modified Nelsons solution". Effect of sevin on the carbohydrates and nitrogen metabolism during germination cotton seeds. Ind. J. Biol., 2: 149-152.

Naz, H.; Akram, N.A. and Ashraf, M. (2016). Impact of ascorbic acid on growth and some physiological attributes of cucumber (*Cucumis sativus*) plants under water-deficit conditions. Pak. J. Bot., 48(3): 877-883.

Oertli, J.J. (1987). Exogenous application of Vitamins as regulators for growth and development of plants. A review. J. Plant Nutr. Soil Sci., 150: 375-391.

Olayinka, B.U. and Etejere, E.O. (2018). Proximate and chemical compositions of watermelon (*Citrullus lanatus* (Thunb.) Matsum and Nakai cv Red and cucumber (*Cucumis sativus* L. cv Pipino). Inter. Food Res. J., 25(3): 1060-1066.

Omar, A.A.A. (2017). Improving the fruit yield and quality of the grafted cucumber plants grown under high polyethylene tunnels. M. Sc. thesis, Fac. Agric. Mansoura Univ., Egypt.

Page, A.L.; Miller, R.H. and Keeney, D.R. (1982). Methods of soil analysis. Part II Chemical and Microbiological Properties. A. S. A. Madison Wisconsin, USA.

Qassem, M.E.R.; Bardisi, A.; Nawar, D.A.S. and Ibraheem, S.Kh. (2022). Effect of some stimulants as foliar application on growth, yield and fruit quality of cucumber under plastic house conditions. Zagazig J. Agric. Res., 49(1): 9-22.

Ranganna, S. (1977). Manual of analysis of fruit and vegetable products. Tata Mcagaw hill Publishing Company Limited. New Delhi. India.

Sadasivam, S. and Manickam, A. (1996). Biochemical Methods, 2nd Ed. New Age international (P) Limitid Publishers, New Delhi P. 42-43.

Salama, A.R.; Fekry, W.A. and Wahdan, H.M. (2019). Influence of some squash cultivars and growth stimulants on flowering, yield and fruit quality at autumn-winter season under open field conditions. J. Product. Dev., 24(3): 433-460.

Shehata, M.N. and Abdelgawad K.F. (2019). Potassium silicate and amino acids improve growth, flowering and productivity of summer squash under high temperature condition. American-Eurasian J. Agric. And Environ. Sci., 19(2): 74-86.

Shehata, S.A.; Mohamed, M.A. and Attallah, S.Y. (2020). Salicylic acid enhances growth, yield and quality of lettuce plants (Lactuca sativa L.) under drought stress conditions. J. of Plant Production, Mansoura Univ., 11(12): 1581-1586.

Shehata, S.A.; Saad, M.E.M.; Saleh, M.A. and Atala, S.A. (2018). Effect of foliar spray with potassium silicate on growth, yield, quality and storability of cucumber fruits. Annals of Agric. Sci., Moshtohor, 56(2): 385-396.

Shi, Y.; Zhang, Y.; Han W.; Feng, R.; Hu, Y. and Guo, J. (2016). Silicon enhances water stress tolerance by improving root hydraulic conductance in *Solanum lycopersicum* L. Front. Plant Sci., 7: 1-15.

Watako, A.O. (2015). Effect of three covering materials on vegetative growth of cucurbits in Kenya. GARJAS., 4(2): 89-94.

Wehedy, M.R.; Hafez, M.R.; El-Oksh, I.I. and Abou Elyazied, A. (2019). Studies on grafting and some foliar spray treatments on watermelon productivity under north Sinai conditions. Arab Univ. J. Agric. Sci. (AUJAS), Ain Shams Univ., Cairo, Egypt Special Issue, 26(2D): 2253-2263.

Youssef, E.A.E.; El-Baset, M.M.A.; El-Shafie, A.F. and Hussein, M.M. (2017). Study the applications of water deficiency levels and ascorbic acid foliar on growth parameters and yield of summer squash plant (*Cucurbita pepo* L.). Agri. Eng. Int: CIGR J., Special issue: 147-158.

استخدام بعض المواد الآمنة لتخفيف التغيرات المناخية على إنتاجية وجودة ثمار البطيخ تحت ظروف محافظة الوادي الجديد

محمد احمد محمد علي[١] ، محمد حمام زين العابدين الدقيشي[٢] ، شرين يعقوب عطاالله[٢]و رحاب احمد مصطفى[١]

[١]قسم البساتين - كلية الزراعة - جامعة الوادي الجديد - مصر.
[٢]قسم الخضر - كلية الزراعة - جامعة أسيوط - مصر.

الملخص

أجريت هذه الدراسة بمزرعة خاصة في مدينة القصر, واحة الداخلة, محافظة الوادي الجديد خلال موسمي ٢٠٢٢، ٢٠٢٣م, لدراسة تأثير موعدين للزراعة (١ و ٢٠ فبراير) والرش الورقي ببعض المواد الآمنة مثل حامض السالسيليك بتركيز ٠,٥ و١,٠ ميكرومول وحامض الأسكوربيك بتركيز ٥٠ و١٠٠ جزء في المليون وسيليكات البوتاسيوم بتركيز ٤ و٨ مل/لتر بجانب الكنترول غير المعامل، والتفاعل بينهما على النمو والمحصول وجودة الثمار في البطيخ (صنف أسوان F1). التفاعل بين زراعة البطيخ في ٢٠ فبراير والرش الورقي بسليكات البوتاسيوم بتركيز ٨ مل/لتر أعلى قيم لمؤشرات النمو الخضري والوزن الجاف للنبات ومحتوى الأوراق من النيتروجين والفسفور والبوتاسيوم ومتوسط وزن الثمرة وجودة الثمار متمثلة في المواد الصلبة الذائبة الكلية والسكريات الكلية والمختزلة وتركيز الليكوبيين وقوة مضادات الأكسدة. بينما أعطى التفاعل بين الزراعة في ٢٠ فبراير ورش النباتات بحامض الأسكوربيك بتركيز ٥٠ جزء في المليون أعلى محصول كلي للفدان بدون فرق معنوي مع التفاعل بين الزراعة في نفس الموعد ورش النباتات بسليكات البوتاسيوم بتركيز ٨ مل/لتر في كلا الموسمين. بلغت الزيادة النسبية في المحصول الكلي للفدان حوالي ٧١,٩٦ و ٧٠,٩٣٪ للتفاعل بين الزراعة في ٢٠ فبراير ورش النباتات بسليكات البوتاسيوم بتركيز ٨ مل/لتر، ٧٣,٨٣ و٧٢,٤٠٪ للتفاعل بين الزراعة في ٢٠ فبراير ورش النباتات بحامض الأسكوربيك بتركيز ٥٠ جزء في المليون عن الزراعة في ١ فبراير فقط (رش النباتات بالماء المقطر) في الموسمين الأول والثاني على التوالي.

الكلمات الدالة: البطيخ، موعد زراعة، حامض الساليسيليك، حامض الأسكوربيك، سليكات البوتاسيوم.