Middle East Journal of Agriculture Research
Volume: 10 | Issue: 04| Oct. – Dec.| 2021

EISSN: 2706-7955 ISSN: 2077-4605
DOI: 10.36632/mejar/2021.10.4.99
Journal homepage: www.curresweb.com
Pages: 1454-1463

Effect of Foliar Application with some Organic Acids on Growth and Productivity of summer squash Plants (*Cucurbita pepo* L.)

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Received: 10 Nov. 2021 **Accepted:** 20 Dec. 2021 **Published:** 30 Dec. 2021

ABSTRACT
Two field experiments were carried out during the summer seasons of 2020 and 2021, to study the effects of foliar application with various organic acids, i.e., ascorbic, salicylic, citric and fulvic acids as well as the binary combination between them on vegetative growth parameters, chemical constituents, total fruit yield, and fruit quality of squash plants cv. galaxy 555. This experiment included eleven treatments, (T1- Ascorbic at 0.5 g/L, T2- Salicylic at 0.5g, T3- citric at 0.5g, T4-Fulvic at 0.5g, T5- Ascorbic at 0.5 g/L + Salicylic at 0.5g, T6- Ascorbic at 0.5 g/L + citric at 0.5g, T7- Ascorbic at 0.5 g/L + Fulvic at 0.5g, T8- Salicylic at 0.5g+ citric at 0.5g, T9- Salicylic at 0.5g+ Fulvic at 0.5g, T10- citric at 0.5g + Fulvic at 0.5g and T11- Control). Results show that all foliar applications with organic acids treatments when used either singly or combined on squash plants, significantly, increased all vegetative growth characters (plant height, number of leaves/plant, plant fresh weight, plant dry weight and leaf area), chemical constituents (Total chlorophyll, N, P, K), yield and its components (Early yield per plant, number of fruits per plant and total yield per plant) and fruit quality's characters (Average fruit weight, fruit length and fruit diameter) comparing to non-treated plants during both seasons. Obtained results indicate that foliar spray of ascorbic at 0.5 g/L+ salicylic at 0.5g (T5) or ascorbic at 0.5 g/L + citric at 0.5g (T6) is the most effective on vegetative growth characters, the chemical composition of leaves, fruit yield and quality of squash plants.

Keywords: squash, salicylic acid, ascorbic acid, foliar application, sex ratio, summer temperature

1. Introduction
Summer Squash (*Cucurbita pepo* L.) belongs to the Cucurbitaceae family, which is one of the most popular vegetable crops for human nutrition in Egypt and worldwide (Abd El-All *et al.,* 2013). According to statistics of the Ministry of Agric, Egypt, 2020, the cultivated area of Squash in Egypt is 49966 feddan with a total production of 414806 tons and an average of 8.302 tons per fed. The summer Squash has various health benefits to humans as well as medicinal potential. Summer squash fruits are very low in calories (19 Kcal/100 g), moisture (94.8 g), and edible portion (94%), and have large amounts of fiber (0.8 g) (Tamer *et al.,* 2010).

Over the past years, there was a connection between organic acid metabolisms with plant tolerance to environmental stress. Organic acids consider also as key components in mechanisms that some plants use to cope with nutrient deficiencies (Lo´pez-Bucio *et al.,* 2000). Organic acids (OA) are more diverse in their role in plant stress toleration and are more efficient comparing other acids, like amino acids. It is one of the most important applications that are used in combating climate change and sustainable food production (Panchal *et al.,* 2021). Ascorbic acid, salicylic acid, citric acid and fulvic acid are among the important organic acids for the plant. Salicylic acid is one of the phenolic compounds that are necessary in the biosynthesis of lignin, which is one of the most important components of the cell wall as well as

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phenolic compounds, especially phytoalexin which play important role in the chemical protection of the plant against germs, insects and herbivorous (AL-Khafaji, 2014). Salicylic acid at a concentration of 50 ppm improved plant growth and development, increased resilience to abiotic stressors in many plants (Azooz *et al.,* 2011), and protected plants from oxidative injury (Moosavi, 2012). Salicylic acid helps protect nucleic acids and prevents protein crash, it also impacts certain genes associated with the protein that is responsible for vital and non-vital stress (Amanullah *et al.,* 2010). Plant growth factors such as plant height, dry matter, chlorophyll, carbohydrate contents, and yield characteristics, were increased by SA foliar spray (Khan *et al.,* 2010; AL-Rubaye *et al.,* 2016 and Abd-Elaziz *et al.,* 2019). AsA is one of the most important Metabo that serve as antioxidants. It also has active biological activities in plants, as a donor/ acceptor in electron transport and as and as enzyme co-factor (Conklin, 2001 and Shalata and Neumann, 2001). AsA is currently considered as a plant growth regulator due to its effect on cell division, differentiation, and various growth factors (Amin *et al.,* 2007). It increases the content of DNA and acts as a co-enzyme in the enzymatic reactions as well as involved in photosynthesis and respiration (Mazher *et al.,* 2011 and Salama *et al.,* 2014). Citric acid is one of the organic acids present in tricarboxilic acid cycle or malic acid conversion to citric acid. Most studies emphasized the significance of foliar-applied CA in terms of its vital effects on metabolic and physiological activities such as cell elongation and division, leading to raises in the plant biomass and photosynthesis process in numerous plant species (Fayed, 2010). Maksoud *et al.* (2009) reported that the CA in its effect is similar to the influence of auxin in increasing the evolution, flowering, and fruiting of fruit trees. Mandour *et al.* (2009) stated that the foliar spray with citric acid on strawberry cv. Festival at 2 g/L increased the yield components, plant height, number of leaves per plant, shoot dry weight, fruit physical and chemical quality standards and decreased the weight loss and decay percentage. Fulvic acid, plays an active role in the increasing of the permeability for the cellular membrane which made water and nutrient absorption more effective in the plant, which helps the movement of metals and their transfer in the plant. Enzyme activation is also an important characteristic, this can be explained by the presence of a group of alkaloids in the humic acid that acts as a receptor for hydrogen, at the same time, oxygen is an encouraging factor and chemical agent for oxidation and redox processes. Humic acids entered the plant at the early stages of their development as a multiple phenol supplement, which acts as a chemical breathing agent that increased the plant vital efficiency. In addition to that, the enzymatic system becomes more efficient, the root system develops, cell division and dry material increases, (Meena *et al.,* 2017, Shafeek *et al.,* 2016) found significant increases in the studied traits in cucumber and *Cucurbita pepo* plants.

Therefore, the destination of this work is to examine the effects of spray application with various organic acids, i.e., ascorbic, salicylic, citric and fulvic acids on vegetative growth parameters, chemical constituents, total fruit yield, and fruit quality of squash plants.

2. Materials and Methods

The experiments were accomplished during the summer seasons of 2020 and 2021, in a private farm, at Moshtohor village, Kalyobiya Governorate, Egypt, under open field conditions to test the effect of spray application with various organic acids, i.e., ascorbic, salicylic, citric and fulvic acids as well as the binary combination between them on growth parameters, chemical constituents, total fruit yield, and fruit quality of squash plants cv. galaxy 555. The soil in the experimental site was clay texture. The soil mechanical and chemical properties are shown in Table (1). Chemical analysis was determined according to Black *et al.* (1982), while physical analysis was approximated according to Jackson (1973).

Table 1: Soil analysis in the experimental farm.

Mechanical			**Textural Class**	**pH (1-2.5 Soil : water suspension)**	**Ec: Soil paste 1:1 ds/m**		**Organic matter**
Sand	**Silt**	**Clay**	**Clay**	8	1.3		2.3%
25%	19.9%	55.1%					
Soluble Anions and Cations							
Anions (meq./L)				**Cations (meq./L)**			
CO_3^{--}	**HCO_3^{--}**	**Cl^-**	**SO_4^{--}**	**Ca^{++}**	**Mg^{++}**	**Na^+**	**K^+**
1.4	2.0	3.4	0.80	2.50	1.20	1.27	1.23
Available macro and micro elements (mg/kg)							
N	**P**	**K**	**Fe**	**Mn**	**Zn**		**Cu**
25	11	177	24.3	9.4	7.6		3.6

The experimental field was ploughed and pulverized. Then, the soil was ridged into rows one-meter width and divided to plots. Seeds were sown in the field on 1th week of June during the 2020 and 2021 seasons at 0.5 m apart and 1 m width of the ridge on one side of the rows. This experiment included eleven treatments, which were foliar applications with ascorbic, salicylic, citric and fulvic acids as well as the binary combining between them as follows:

T1- Ascorbic at 0.5 g/L
T2- Salicylic at 0.5g
T3- Citric at 0.5g
T4- Fulvic at 0.5g
T5- Ascorbic at 0.5 g/L + Salicylic at 0.5g
T6- Ascorbic at 0.5 g/L + Citric at 0.5g
T7- Ascorbic at 0.5 g/L + Fulvic at 0.5g
T8- Salicylic at 0.5g+ Citric at 0.5g
T9- Salicylic at 0.5g+ Fulvic at 0.5g
T10- Citric at 0.5g+ Fulvic at 0.5g
T11- Control

The design of this experiment was a factorial experiment in a complete randomized block design with 11 treatments and 3 replicates. The experimental plot was 12 m in length and 1 m width (area=12 m^2) and the plants spacing in the same row was 0.5 m. Plants were sprayed with treatments three times (3, 5 and 7 weeks from planting) during the growing seasons. The agrarian practices such as irrigation, insect and disease control were done according to the recommendation of the Ministry of Agriculture.

The recorded data
Vegetative growth parameters: After 75 days from planting, the plant height (cm), number of leaves per plant, leaf area (cm^2), plant fresh weight (g) and plant dry weight (g) were measured.
Yield and its components: At the harvesting time, fruit length (cm), fruit diameter (cm), average fruit weight (g), number of fruits per plant and fruit yield per plant (kg) were calculated.
Chemical constituents: Chlorophyll content meter measurement in the field with units SPAD. Leaves total nitrogen (N) (Pregl, 1945), phosphorus (P) (John, 1970), potassium (K) (Brown and Lilleland, 1946) were estimated in the dry matter of leaves.

Statistical Analysis
Analyzed and studied the data and has a comparison of calculations averages by using test Duncan and moral level of 0.05, and used a statistical system ready Genstat as reported by Gomez and Gomez (1984).

3. Results and Discussion
3.1. Vegetative growth characters:
Results of vegetative growth characters, i.e., plant height (cm), number of leaves/plant, plant fresh weight (g), plant dry weight (g) and leaf area (cm^2) influenced by foliar application with various organic acids, i.e., ascorbic, salicylic, citric and fulvic acid as well as the combination between every two of them are given in Table (2). All foliar applications with organic acids treatments when used singly or in combination on squash plants, significantly, increased all vegetative growth characters compared to non-treated plants during both seasons. The maximum plant height (121.0 and 91.7cm), number of leaves/plant (57.3 and 47.0), plant fresh weight (2776.7 and 1983.3 g), plant dry weight (515.3 and 375.5 g) and leaf area (927.2 and 724.7 cm^2) in 1st and 2nd seasons, respectively were recorded in plants applied with ascorbic at 0.5 g/L+salicylic at 0.5g/L (Treatment T5). However, the minimum plant height (66.7 and 66.7cm), number of leaves/plant (35.0 and 34.7), plant fresh weight (966.7 and 883.3), plant dry weight (116.9 and 116.5 g) and leaf area (332.4 and 355.5 cm^2) in 1st and 2nd seasons, respectively were recorded under control. The superiority of T5 treatment may be due to the combining effect of both salicylic acid and ascorbic acid to their ability to improve the effectiveness of the immune of antioxidants in plants. Salicylic acid has a positive effect upon the endogenous phytochromes especially the growth

promoters such as auxins, gibberellins and cytokinins which promote cell division and cell enlargement (Mady 2014). Salicylic acid may be estimated for root growth and improves the quality and quantity of the protein also improves the plant resistance against stress conditions (Canakci S. and O. Munzuroglu, 2007). In addition to salicylic acid plays an important role in the physiological activity of the plant like photosynthesis through its effect on the function of stomata and the rate of transpiration and breathing passages in cucumber (Shalata and Neumann, 2001). Salicylic acids have a role in increasing the chlorophyll pigment and carotene and accelerating the photosynthesis process and increase the activity of some important enzymes, in addition to increas the plant hormone levels like auxins and cytokines because of treatment with salicylic acid so it will lead to increased vegetative growth (Abdulwahed *et al.,* 2012).

Table 2: Effect of spray application with some organic acids on the vegetative growth traits of summer squash plants during two seasons of 2020 and 2021.

Traits / Treatments	Plant height (cm)		Number of leaves/plant		Plant fresh weight (g)		Plant dry weight (g)		Leaf area (cm^2)	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T1- Ascorbic at 0.5 g/L	66.3c	69.0cd	43.7cd	45.7ab	1193.3b	1143.3cd	267.5b	265.7a	695.7c	579.0bd
T2- Salicylic at 0.5g	85.3bc	75.0bd	40.7cd	36.0de	850.0b	600.0d	163.9bc	128.3b	395.9ef	304.7g
T3- Citric at 0.5g	75.0bc	68.3d	42.0cd	40.7ac	843.3b	733.3d	144.3bc	135.7b	503.4de	435.3efg
T4-Fulvic at 0.5g	83.3bc	73.3cd	41.0cd	43.7ac	783.3b	766.7d	142.0bc	120.0b	486.5e	462.7def
T5- Ascorbic at 0.5 g/L+Salicylic at 0.5g	121.0a	91.7a	57.3a	47.0a	2776.7a	1983.3a	515.3a	375.5a	927.2a	724.7a
T6- Ascorbic at 0.5 g/L+Citric at 0.5g	100.0ab	90.0ab	55.0ab	42.0ac	2316.7a	1690.0ab	405.0a	292.4a	887.6ab	703.0ab
T7- Ascorbic at 0.5 g/L+Fulvic at 0.5g	91.7bc	85.0ac	45.7bd	39.3ce	1200.0b	1440.0bc	255.2bc	288.0a	756.4bc	653.2ac
T8- Salicylic at 0.5g+ Citric at 0.5g	92.7bc	95.0a	50.7ac	42.0ac	683.3b	726.7d	141.3bc	147.2b	494.2e	457.1def
T9- Salicylic at 0.5g+ Fulvic at 0.5g	81.7bc	85.0ac	42.0cd	42.7ac	826.7b	866.7d	125.3bc	148.0b	711.5c	566.1ce
T10- Citric at 0.5g+ Fulvic at 0.5g	78.3bc	68.3d	40.7cd	40.7ac	976.7b	866.7d	175.1bc	152.0b	645.4cd	475.8def
T11- Control	66.7c	66.7d	35.0d	34.7e	966.7b	883.3d	116.9c	116.5b	332.4f	355.5fg

Meanwhile, AsA had a clear effect on the growth of squash plants and the production of biomass. Ascorbic acid application (vitamin-c) to plants stimulates their growth due to their main role as coenzymes also play other independent roles in the processes of biochemical for plants, repairing the harmful impacts of unfavorable conditions (El-Kobisy *et al.,* 2005). Several experiments have confirmed that AsA has a great role in improving plant tolerance to salt stress (Athar *et al.,* 2008). Moreover, the useful impacts of ascorbic acid (AsA) are a significant part of the abiotic stress reaction in plant cells (Rady and Hemida, 2016 and Rady *et al.,* 2018). AsA could influence of endogenous phytohormones specially the growth promoters such as Auxins, cytokinins and gibberellins (Mady, 2009). The presented results in this study are in harmony, more or less, with those of Yildirim *et al.,* (2008); Elwan and EL-Shatoury, (2014); Abd El-Mageed *et al.,* (2016); AL-Rubaye and Atia (2016); Omar (2017) and Abd-Elaziz *et al.,* (2019).

Chemical constituents

Results in Table 3 reveal that total chlorophyll and NPK% of summer squash leaves as affected by the spray application of various organic acids treatments, i.e., ascorbic, salicylic, citric and fulvic acid as well as the combination between every two of them during the seasons of 2020 and 2021. Concerning total chlorophyll, the highest readings values were recorded when plants treated with salicylic, ascorbic,

citric, fulvic acids and / or their combination without significant among them compared to untreated plants during the 2020 and 2021seasons.
This may be due to the main role of organic acids (salicylic, ascorbic, citric and / or fulvic acids) on increasing activity, rate and pigments of photosynthetic, in leaves (Amin *et al.,* 2007; Mady, 2009 and Wei *et al.,* 2009).

Table 3: Effect of spray application with some organic acids on the chemical constituent's traits of summer squash plants during two seasons of 2020 and 2021.

Traits / Treatments	Nitrogen (%)		Phosphorus (%)		Potassium (%)		Total chlorophyll (SPAD)	
	2020	2021	2020	2021	2020	2021	2020	2021
T1- Ascorbic at 0.5 g/L	1.32ac	1.26ac	0.47bc	0.41b	3.79c	4.95ab	34.37a	37.51a
T2- Salicylic at 0.5g	1.52ab	1.28ac	0.51ac	0.51a	4.67ab	4.12ab	33.23a	36.33a
T3- Citric at 0.5g	1.37ac	1.47ac	0.41cd	0.44ab	4.09ac	4.40ab	36.50a	39.96a
T4- Fulvic at 0.5g	0.99d	1.17bd	0.32de	0.33c	3.03d	3.44bc	33.10a	36.07a
T5- Ascorbic at 0.5 g/L+Salicylic at 0.5g	1.49ab	1.63a	0.61a	0.53a	4.85a	4.38a	35.47a	39.05a
T6- Ascorbic at 0.5 g/L+Citric at 0.5g	1.48ab	1.43ac	0.47bc	0.49ab	4.48ac	4.42ab	34.07a	37.37a
T7- Ascorbic at 0.5 g/L+Fulvic at 0.5g	1.44ac	1.16bd	0.47bc	0.48ab	4.40ac	3.77bc	34.57a	37.61a
T8- Salicylic at 0.5g+ Citric at 0.5g	1.58a	1.52ab	0.48bc	0.52a	4.74ab	4.68ab	35.60a	39.07a
T9- Salicylic at 0.5g+ Fulvic at 0.5g	1.20cd	1.05cd	0.57ab	0.44ab	4.07bc	3.43bc	33.97a	36.86a
T10- Citric at 0.5g+ Fulvic at 0.5g	1.28bc	1.38ac	0.41cd	0.42b	3.89c	4.16ab	35.97a	39.32a
T11- Control	0.97d	0.83d	0.27e	0.31c	2.84d	2.63c	28.17b	30.53b

The obtained results reported that the lowest content of N (0.97 and0.83 %), P (0.27 ans 0.31%) and K (2.84 and 2.63) in leaves were obtained from untreated plants (T11) in first and second seasons, respectively. While, the highest percentages of N (1.58 and 1.63%) were obtained when plants treated with salicylic at 0.5g+ citric at 0.5g (T8) in the first season and ascorbic at 0.5 g/L+ salicylic at 0.5g (T5) in the second one. In this respect, the highest percentages of P (0.61 and 0.53 %) and K (4.85 and 4.38%) were obtained when plants treated with ascorbic at 0.5 g/L+ salicylic at 0.5g (T5) in both seasons.
This may be attributed to the role of organic acids especially salicylic, ascorbic and citric acids to stimulate plant growth, the absorption and transport of nutrients, membrane permeability, the rate of growth and photosynthesis (Basra *et al.,* 2007). Add to that salicylic acid is an internal growth regulator involved in regulating physiological processes in plants, contribute to modifying activity of enzymes antioxidant, improves the process of photosynthesis, nutrient uptake, the activity of phenolic antioxidants and many vital metabolic compounds (Khandaker *et al.,* 2011). Where it works as an antidote oxidative contributes to scavenge of free roots and thus protect cell membranes and thus gets the absorption and transport of nutrients better (Mady, 2009), As well as the important functions in protecting the nucleic acids and protein to prevent crashes (Amanullah *et al.,* 2010). In this concern, Grown (2012) reported the stimulatory effect of SA on concentration of nutrition elements and yield components and attributed these findings to the effect of salicylic acid on many biochemical and physiological processes that were reflected on improving vegetative growth and active translocation of photosynthesis products from source to sink. These results agree, more or less, with those reported by Elwan and EL-Shatoury (2014); AL-Rubaye, 2015; AL-Rubaye and Abdul-Rassoland (2016) and Abd-Elaziz *et al.,* (2019) on squash, Pramod Kumar *et al.,* 2010 and Omar (2017) on cucumber and Abd-Elaziz *et al.,* (2019) on squash.

3- Yield and fruit number

Data in Table 4 present that all treated plants recorded the highest significant means of early yield per plant, number of fruits per plant and total yield per plant compared to untreated plants (control) during the 2020 and 2021seasons. Where, foliar application with ascorbic, salicylic and/ or citric and combinations; affected significantly ($p \leq 0.05$) all studied characteristics of the tested squash cultivar. Whereas, the lowest significant average values for all yield characters of squash fruits were derived from untreated plants compared to treated plants during both seasons. Generally, summer squash plants treated with the combined treatment, i.e., ascorbic at 0.5 g/L + salicylic at 0.5g (T5) and/ or ascorbic at 0.5 g/L + citric at 0.5g (T6) recorded the highest mean of early yield (1260, 1211 and 1480, 1198 g. per plant), number of fruits (1211, 19.3 and 18.3, 17.0 per plant) and total yield (3001, 2664 and 3012, 2623 per plant), respectively in both seasons. In the present study, increasing of squash fruit yield was achieved due to foliar application with ascorbic, salicylic and/ or citric and their combinations might be attributed to the increase of vegetative growth parameters as reported earlier and reflected on the yield and fruit number per plant, due to it is effect on cell division, differentiation and increases nucleic acids content in the enzymatic reactions by which proteins, carbohydrates metabolized and interested in photosynthesis (Mazid *et al.,* 2011 and Youssef *et al.,* 2017). The present results are in correspondence with those obtained by Elwan and EL-Shatoury (2014); Abd El-Mageed *et al.,* (2016); Rubaye and Atia (2016); Omar (2017) and Abd-Elaziz *et al.,* (2019).

Table 4: Effect of spray application with some organic acids on the yield traits of summer squash plants during two seasons of 2020 and 2021.

Traits / Treatments	Early yield / plant (g)		Number of fruits/ plant		Total yield / plant (g)	
	2020	2021	2020	2021	2020	2021
T1- Ascorbic at 0.5 g/L	638bc	557bc	13.3ce	13.0b	1859bc	1660bc
T2- Salicylic at 0.5g	769b	223cd	16.0bc	11.0bc	1795bc	1003cd
T3- Citric at 0.5g	285cd	143cd	11.3df	10.0bc	1187cd	930d
T4-Fulvic at 0.5g	107d	47d	9.3f	8.7c	920d	833d
T5- Ascorbic at 0.5 g/L+Salicylic at 0.5g	1260a	1211a	19.3a	16.7a	3001a	2664a
T6- Ascorbic at 0.5 g/L+Citric at 0.5g	1480a	1198a	18.3ab	17.0a	3012a	2623a
T7- Ascorbic at 0.5 g/L+Fulvic at 0.5g	782b	678b	14.3cd	13.0b	2028b	2018ab
T8- Salicylic at 0.5g+ Citric at 0.5g	380bd	251bd	13.0ce	11.3bc	1240cd	1059cd
T9- Salicylic at 0.5g+ Fulvic at 0.5g	190d	220cd	10.3ef	10.0bc	1058d	1113cd
T10- Citric at 0.5g+ Fulvic at 0.5g	262cd	267bd	10.7ef	11.0bc	1257cd	1180cd
T11- Control	407bd	207cd	12.0df	10.3bc	1420bd	1120cd

4. Fruit quality's characters

Results postulated in Table (5) reveal that all treated plants showed the highest significant average values of average fruit weight, fruit length and fruit diameter characters compared to untreated plants during both seasons, except fruit diameter in first the season. However, plants that were treated with ascorbic acid singly or combined with salicylic /or citric, led to the highest average values for fruit quality traits during both seasons. In addition, plants treated with ascorbic at 0.5 g/L+salicylic at 0.5g (T5) recorded higher average values of average fruit weight (155.3 and 160.0 g), fruit length (17.5 and 16.6 cm) and fruit diameter (3.5 and 3.8 cm) compare to control treatment which recorded low average values of average fruit weight (116.7 and 108.3 g), fruit length (12.5 and 12.5 cm) and fruit diameter (3.7 and 3.5 cm) in the first and second season, respectively.

In terms of fruit shape index, during the first season the highest average values were obtained from plants sprayed with Ascorbic at 0.5 g/L+Salicylic at 0.5g (T5), Ascorbic at 0.5 g/L+ citric at 0.5g (T6) and/or ascorbic at 0.5 g/L+fulvic at 0.5g. Compared to the control treatment. While in the second season, the highest average values were obtained from plants sprayed with citric at 0.5g+ fulvic at 0.5g (T10). These results are in agreement with those illustrated by Omar (2017) and Abd-Elaziz *et al.,* (2019) who indicated that foliar application with SA resulted in a significant increase in fruit length and diameter of cucumber compared to control plants.

Table 5: Effect of spray application with some organic acids on the fruit quality traits of summer squash plants during two seasons of 2020 and 2021.

Traits / Treatments	Average fruit weight (g)		Fruit length (cm)		Fruit diameter (cm)		Fruit shape index	
	2020	2021	2020	2021	2020	2021	2020	2021
T1- Ascorbic at 0.5 g/L	139.3ab	125.3ab	14.7a	13.7ac	3.8a	3.6ab	3.9ab	3.8c
T2- Salicylic at 0.5g	108.3bc	90.0b	11.0c	12.1bc	3.9a	3.0bd	2.8b	4.1c
T3- Citric at 0.5g	104.3c	93.3b	11.0c	14.3ac	3.8a	2.6de	2.9b	5.5b
T4-Fulvic at 0.5g	98.3c	96.7b	10.8c	13.0bc	3.6a	3.0ce	3.0b	4.4bc
T5- Ascorbic at 0.5 g/L + Salicylic at 0.5g	155.3a	160.0a	17.5a	16.6a	3.5a	3.8a	4.9a	4.3bc
T6- Ascorbic at 0.5 g/L + Citric at 0.5g	165.7a	155.7a	17.9a	16.4ab	3.7a	3.8a	4.8a	4.3bc
T7- Ascorbic at 0.5 g/L + Fulvic at 0.5g	140.0ab	155.0a	16.4a	15.4ac	3.4a	4.0a	4.8a	3.9c
T8- Salicylic at 0.5g + Citric at 0.5g	95.0c	92.7b	10.4c	11.8c	3.7a	3.1bd	2.9b	3.8c
T9- Salicylic at 0.5g + Fulvic at 0.5g	102.7c	106.7b	11.6c	12.8bc	3.6a	3.3bc	3.3b	3.9c
T10- Citric at 0.5g + Fulvic at 0.5g	117.7bc	106.7b	12.5bc	17.1a	3.8a	2.5e	3.3b	6.8a
T11- Control	116.7bc	108.3b	12.5bc	12.5c	3.7a	3.5ac	3.4b	3.6c

4. Conclusion

Obtained results indicate that foliar spray of Ascorbic at 0.5 g/L+ Salicylic at 0.5g (T5) or Ascorbic at 0.5 g/L + citric at 0.5g (T6) being the most effective on vegetative growth characters, the chemical composition of leaves, fruit yield and quality of squash plants.

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