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Effect of some Foliar Spray Substances During Growth, Flowering and Chemical Composition of Orange Jasmine Plants Grown under Thermal Stress

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ABSTRACT

It was known that the changes in the climate during the last years negatively affected the plant's production. At this trend, the effect of high temperatures on the orange jasmine plants was studded. To enhance the ability of orange jasmine plants under thermal stress, various foliar spray components such as calcium nitrate, salicylic acid, spirulina algae extract, and potassium silicate different concentrations were tested. The study was conducted throughout two seasons in 2021 and 2022. Generally, the tested spray compounds reduced the effect of high and low-temperature stresses and improved flower productivity of *Murraya paniculata*, L. Salicylic acid at a concentration of 75 mg/l and potassium silicate at 3cm/l were superior most of the other treatments in terms of extending plant height, producing more leaves and flowers, increasing plant weight both fresh and dry and improving the chemical composition of leaves.Spraying the plants by salicylic acid at 75 mg/l or potassium silicate at 3cm/l every month besides using the compound fertilization reduced the thermal stress effects and increased the quantity and quality flowers of *Murraya paniculata*, L.

Keywords: Orange jasmine, antioxidants, nutrients and thermal stress

INTRODUCTION

Orange jasmine,(*Murraya paniculata*, L) is called China box or mock orange. It belongs to the genus *Murraya* which under the citrus family Rutaceae. This family includes some of the most widely planted tropical ornamentals native to South Asia, Southeast Asia and Australia species of evergreen shrub or small tree grows in rainforests and behind beaches. The landscape value of orange jasmine was due to the small white flowers which have a beautiful scent and the leaves are bright green. The leaves are used in Chinese medicine to treat fever, sore throat and cough. (Biswas and Mahbubur Rahman 2022).

Previous studies reported a large number of stressors in the plant may cause its death (Cançado, 2011; El-Baset, 2017) the most important of which is heat stress.

Orange jasmine grows best in temperatures between 25 and 32°C. This is particularly valid in colder climates. Your tropical plants can die from even a light frost. Certain species can experience cellular death in as little as 12 to 24 hours. Cell death can start to happen quickly. As a result of high transpiration demands, elevated temperatures can also harm plants directly by raising their tissue temperatures or indirectly by causing plant-water deficits that ultimately result in death (Howarth, 2005).

The average surface temperature of the entire planet has reportedly risen by approximately 0.6±2°C during the 20th century and is expected to rise by 1.4-5.8°C during this century (Houghton *et al.* 2001).

One of the most significant biotic factors is heat stress, which is defined as a temperature increase that exceeds a threshold and persists for a certain amount of time to harm plant growth and development irreversibly. Heat shock or heat stress is generally defined as a brief increase in temperature of 10–15 ◦C above ambient. The degree, rate, and duration of temperature increase that contribute to heat stress are all complex factors. The high-temperature periods, which can happen during the day or at night, are what determine which specific climate zones exist (Firmansyah and Argosubekti, 2019).

The ability of a plant to develop, grow and produce an economically viable crop in high temperatures is known as heat tolerance. (Bokszczanin*et al.* 2013)

Studies on calcium reducing heat stress in plants have been well-documented. Calcium is an essential nutrient and a secondary messenger that preserves the integrity and structure of membranes and cell walls, controls plant growth and development, and mediates complex responses toward various developmental and environmental cues. (El-Baset, 2017).

Salicylic acid is important increasing the production of heat shock proteins, scavenging reactive oxygen species, protecting the reproductive system and improving photosynthetic efficiency, it gives plants the ability to withstand heat stress. This extends the plant's lifespan by delaying the appearance of ethylene gas. Salicylic acid's impact on plants is greatly influenced by the concentration used, plant species, age, kind of tissues treated, and length of therapy (Sangwan *et al.* 2022).

Rich in proteins, vitamins, minerals, carotenoids, and antioxidants, blue-green algae aids in the plants' adaptation to heat stress and promotes good yields. Salicylic acid is a phenolic compound that promotes photosynthesis and is thought to regulate plant growth. In addition, it was reported that salicylic acid can affect different physiological functions and biochemical reactions and have positive effects on plant

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productivity and quality under heat stress (Mzibra *et al.* 2018). Studies have shown how seaweed extracts affect plants' ability to tolerate stress. (Arioli *et al.* 2015).

Under abiotic stress like salinity, dehydration, metal toxicity, and ultraviolet radiation, it was reported that the silicon made plants more resilient to this condition (Balakhnina and Borkowska, 2013). In addition, the previous data showed that silicon spraying could improve plants' tolerance to heat stress, which improves growth and physiological parameters (Asgharipour and Mosapour, 2016). Potassium silicate that is applied topically to leaves has various advantages, including increasing leaf erectness, photosynthetic efficiency, biomass, yield, and growth of a variety of crops, especially monocotyledonous plants that can store large amounts of silicon in their organs (Shedeed, 2018; Ahmad et al. 2013). Numerous agricultural applications benefit from silicon, including increased growth and yield, improved strength, reduced climatic stress, and impedance to mineral stress (Kandil et al. 2019).

The purpose of the current study was to assess the impact of applying certain substances topically, such as, spirulina algae extract, calcium nitrate, potassium silicate and salicylic acid as antioxidant substances on growth, flowering and chemical composition of Murraya paniculata, L. plants to enhance their production under heat stress condition.

MATERIAL AND METHODS

The current research was conducted during the two successive seasons of 2021 and 2022 at a commercial nursery (El-akhlass Ahmed Shaesha) at Nekyta Village and the Laboratory of the Vegetable and Ornamental Plants Dept., Faculty of Agriculture, Mansoura Univ., Egypt.

Plant material:

Seedlings of orange jasmine plant were brought from a nursery known as Al-Qanater Al-Khairiya in pots of 14 cm the length of the seedlings ranged from 10 to 12 cm and they were planted in pots with a diameter of 25 cm. The pots were supplemented with soil that was a mixture of fully decomposed manure fertilizer into the clay at a ratio of 1 to 3, after a month had passed from the transfer, the foliar spraying of the treatments was done on the day the first of November of each season 2021-2022 and the spraying was repeated with treatments monthly until the completion of flowering shown in Photo (1) in October and harvest. Every two weeks, a basal dose of N, P, and K (20:20:20) compound fertilizer was applied to all plants until eight leaves appeared to end the experiment.

Photo 1. The plant material under study *Murraya paniculata*, L.

Experimental design:

The experiment's thirteen treatments were set up in a randomized complete blocks design with three replicates for each of which treatment, consisting of three plants each:

1. Control (distilled water).
2. Calcium nitrate (50 mg/l).
3. Calcium nitrate (100 mg/l).
4. Calcium nitrate (150 mg/l).
5. Salicylic acid (25 mg/l).
6. Salicylic acid (50 mg/l).
7. Salicylic acid (75mg /l).
8. spirulina algae extract (1cm/l).
9. spirulina algae extract (2cm/l).
10. spirulina algae extract (3cm/l).
11. potassium silicate (1cm/l).
12. potassium silicate (2cm/l).
13. potassium silicate (3cm/l).

Calcium nitrate, salicylic acid and potassium silicate all compounds used have a purity of 98% from (Al-Gomhoreya Co. for Chemical Industries, Mansoura, Egypt), spirulina algae extract from (National Research Center, Egypt).

Note: Every treatment included 12 foliar sprays spaced 30 days apart.

The experimental soil samples were subjected to mechanical and chemical analysis according to (Chapman and Pratt 1978). Table (1) displays the soil analysis data.

The chemical analysis for spirulina algae extract its contents, as shown in Table (2).

The two seasons' average monthly maximum and minimum temperatures at the experimental region is shown in Fig. (1)

Table 1. Examination of the soil both physically and chemically prior to adding any treatments for the experiment

Mechanical analysis		Chemical analysis		Soluble cations and anions	
Coarse sand (%)	1.90	Available N (ppm)	40	Cations (meq/100 g soil)	
Fine sand (%)	29.44	Available P (ppm)	6.29	Ca^{++}	1.80
Silt (%)	36.05	Available K (ppm)	332	Mg^{++}	1.30
Clay (%)	32.61	Organic matter (%)	2.10	Na^{+}	0.96
Texture	Clay loamy	E.C.* %	0.28	K^{+}	0.09
		pH**	8.12	Anions (meq/100 g soil)	
		$CaCO_3$	1.88	$CO_3^{=}$	0.00
* 1: 5 soil: water extraction				HCO_3^{-}	2.51
** 1:2.5 soil suspension				$SO_4^{=}$	0.77
				Cl^{-}	0.85

Table 2. The chemical composition of spirulina algae extract byEl-Moataaz (2019)

Proximate composition (%)	Essential amino acids (mg/100g)		Non-Essential amino acids (mg/100g)	
Protein 56.89	Leucine	29.51	Glutamic acid	47.05
Carbohydrates 13.80	Phenyl alanine	23.88	Arginine	44.93
Ash 10.35	Lysine	19.16	Aspartic	36.70
Lipids 8.43	Valine	18.60	Alanine	33.9
Moisture 6.99	Isoleucine	14.72	Cysteine	3.41
Fibers 4.55	Threonine	13.69	Tyrosine	19.83
	Histidine	13.66	Serine	18.53
	Methionine	5.35	Glycine	15.09
			Proline	14.98

Minerals (mg/100g)		Vitamins (mg/100g)	
Calcium	363.9	B-Carotene	70.0
Sodium	217	Vitamin E	60.0
Potassium	172	Niacin	12.2
Phosphorus	123.5	Riboflavin	3.7
Iron	12.5	Thiamin B1	3.0
Zinc	2.7	Phenolic compounds	997.1
		Flavonoids	711.1
		Total antioxidant activity	39.2

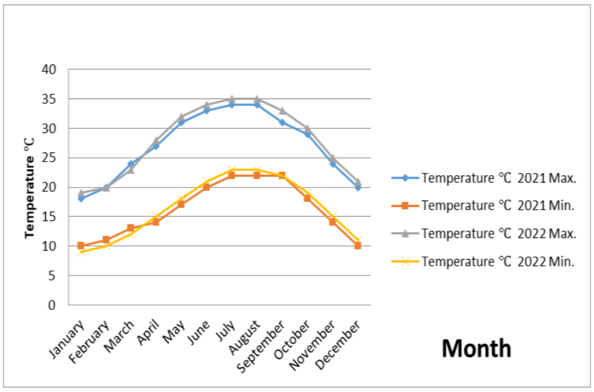

Fig. 1. The experimental region's monthly average maximum and minimum temperatures for the 2021 and 2022 seasons

Data recorded:

In both seasons, the harvest was completed on October 15th, roughly 15 days following the last foliar spray.

1. Vegetative growth and flower parameters:

- Plant length (cm).
- Number of leaves/plant.
- Number of flowers/plant.
- Fresh and dry weights (g/plant).

2. Chemical determinations:

1-Nutrient elements determination:

-N%, P % and K% determined according to Mertens (2005 a and b).

-Total carbohydrates% are determined according to Hedge and Hofreiter (1962).

-Total phenols (mg/g dry weight) determined according to Ainsworth and Gillespie(2007)

-Proline (µmol/g) determined according to (Carillo and Gibon 2011).

2-Pigments content (mg/g F.W.) Total chlorophyll and total carotenoids were determined in fresh leaf samples according to Mackinney (1941).

Statistical analysis:

Data were subjected to analysis of variance (ANOVA) according to Steel and Torrie (1980)in Randomized Complete Block Design (RCPD)with three replicates. SAS program (1994) was used and comparing between means was achieved by applying the least significant difference (LSD) at 0.05 level.

RESULTS AND DISCUSSION

Vegetative growth and flowering parameters:

The data information in Tables 3 to 5 shows how the use of foliar sprays containing calcium nitrate, salicylic acid, spirulina algae extract, and potassium silicate in controlling heat stress has an impact on the growth parameters of orange jasmine plants in Egypt.

Plant length (cm):

The information displayed in Table (3) showed that most of the materials that were used in the experiment gave favorable results on plant length (cm) and improve the growth of orange jasmine under heat- stress condition. It was found that plant foliar spray by salicylic acid at two concentrations of 50 and 75mg/l, spirulina algae extract at 2 and 3 cm/l, as well as potassium silicate with all its concentrations, had the tallest values without any significant difference between means in the first seasons.

Treating plants with potassium silicate at 3cm/l resulted in the tallest significant increase in plant height (43.00and48.33cm. respectively in both seasons) followed by salicylic acid at 75mg/l (43.00and 47.00 cm, respectively in both seasons).

Enough silicon is tightly ensured by the tested potassium silicate, which is primarily used as a soil amendment and growth enhancer. Potassium silicate may have improved growth by increasing the release of growth activators, which led to an acceptable plant height. By speeding up cell division and elongation, silica in the form of potassium silicate may improve growth and increase the bioavailability of nutrients and their uptake. This could result in taller plants. These outcomes conflict with the information provided by (Moustafa *et al.* 2018) on moringa.

Number of leaves/plant:

The information in Table (3) demonstrated a noticeable increase in the total number of leaves with potassium silicate at 3cm/l(44.00 leaves) in the first season without any significant differences as compared with other treatments except control and all spray concentrations by calcium nitrate.

It was made obvious in the second season that the trend was nearly identical to what was seen in the first.

Number of flower/plant:

It was noted that a greater quantity of flowers was attained with salicylic acid at 75 mg/l in both seasons (225.00 and 229.66 flowers, respectively) followed by spraying with potassium silicate at 3 cm/l concentration, with a significant difference between them(Table 3).

The obtained results are consistent with those that have been reported by (Abdelsadek *et al.* 2021) on *Dendranthema grandiflorum* (Ramat.)

Fresh and dry weight (g/plant):

The data recorded in Table (3) showed that treating plants with salicylic acid at 75 mg/l gave a significant heaviest in fresh weight values(43.66 and 49.89g respectively in both seasons) followed by spraying with potassium silicate at 3 cm/l (45.23 and 49.44g, respectively in both seasons). Data from the second season appeared to be around following the same trend as that of the first. Additionally, the foliar spray by salicylic acid at 50 mg/l showed the same results but without any significant increase and the previously mentioned transactions.

Salicylic acid induction can encourage numerous of physiological, metabolic processes, plant growth and development. It was also reported that it plays a significant role in plants' defense mechanisms against environmental stimuli. Due to ROS's high activity, plants use it as an essential messenger molecule in their responses to various biotic and abiotic stimuli stresses on the same trend, salicylic acid could ameliorate ROS generation after heat stress treatment. Also, the effect of salicylic acid was clear from the increase in enhances the growth and development of plants by promoting root cell division and elongation, stimulating the uptake of soluble carbohydrates to create juvenile cell components, and controlling several physiological functions in plants, including membrane permeability, ion uptake, and effects on growth and development (Simaei *et al.* 2012). Potassium silicate is used as a stimulator in plants and it has a defense role against mites and other insects. Additionally, it fortifies cell walls, creating a physical defense against pathogen invasion. Plants grow more rapidly when exposed to silicates. It strengthens the cells and encourage photosynthesis and protect plants from environmental effect.

The results shown are consistent with those that have been reported by (Abdelsadek *et al.* 2021) on *Dendranthema grandiflorum* (Ramat.)

Table 3. Effects of foliar applications of Murraya paniculata, L. plants under thermal stresses on plant length (cm), number of leaves and flowers /plants, plant fresh and dry weight (g) during the two seasons of 2021and 2022

Character Treatments	Vegetative growth parameters									
	plant length (cm)		leaves number/plant		flowers number/plants		plant fresh weight (g)		plant dry weight (g)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control	27.00e	31.00e	33.33d	37.33e	76.33d	82.00f	25.24e	27.26f	12.90d	14.64d
calcium nitrate (50mg/l)	28.33de	33.66de	34.33d	38.00de	90.00cd	86.66f	29.11d	29.43ef	12.70d	15.47cd
calcium nitrate (100mg/l)	33.66bc	36.33cde	34.66cd	39.00cde	125.00bcd	108.33ef	31.48cd	35.26de	14.09cd	16.51cd
calcium nitrate (150mg/l)	35.00bc	37.00cde	35.33bcd	40.00cde	144.00bc	130.66de	38.26b	40.69cd	16.48bc	17.48bcd
salicylic acid (25 mg/l)	34.66bc	35.66cde	37.33abcd	41.66bcde	88.00cd	97.33ef	36.83b	40.24cd	17.76ab	18.43abc
salicylic acid (50 mg/l)	41.33a	42.00abc	43.00abc	45.66abc	120.66bcd	131.00de	38.84b	44.96abc	17.81ab	19.84ab
salicylic acid (75 mg/l)	43.00a	47.00a	43.33ab	49.00a	225.00a	229.66a	43.66a	49.89 a	19.29a	21.18a
spirulina algae extract (1cm/l)	32.33cd	35.66cde	38.33abcd	43.66abcde	144.33bc	137.00cde	29.52cd	38.52cd	13.31d	14.85d
spirulina algae extract (2cm/l)	38.00ab	37.00cde	41.00abcd	44.33 abcd	128.00bcd	163.66bcd	32.66cd	38.09cd	14.81 cd	15.74cd
spirulina algae extract (3cm/l)	41.33a	39.66bcd	43.33ab	47.66ab	162.00b	175.00bc	32.95c	39.21cd	14.74cd	16.21cd
potassium silicate (1cm/l)	41.33a	44.00ab	39.66abcd	44.33abcd	117.33bcd	155.33bcd	32.21cd	38.21cd	14.82cd	16.82bcd
potassium silicate (2cm/l)	42.66a	44.33ab	41.33abcd	49.00a	135.00bcd	170.00bcd	37.13b	42.34bcd	16.45bc	18.25abc
potassium silicate (3cm/l)	43.00a	48.33a	44.00a	50.33a	152.66b	191.33b	45.23a	49.44ab	19.09a	20.79a

Means with the same letter (s) in a column are not significant at 0.05 level.

Minerals (N, P and K%):

Table (4) cleared that the largest percentage of nitrogen was obtained in the first season as a result of spraying calcium nitrate at a rate of 150 mg/l, salicylic acid at 75 mg/l and spirulina at 3 cm/l gave (2.89, 2.82 and 2.94 N% respectively), without any significant difference between them compared to the control and the other of the treatments.

The same treatments gave similar results for the second season, and were also superior to the spray by spirulina algae extract at 2cm/l, as well as spraying with a concentration of potassium silicate at 3 cm / l, without any significant difference between them.

The highest percentage of phosphorus in the plant was obtained when the plants were applied with spraying at the highest concentration of salicylic acid or potassium silicate, without any significant differences between them when compared to the other treatments and the control.

In the same Table, it was showed that the foliar spraying with both salicylic acid at75 mg/l and potassium silicate 3 cm/l gave the highest values for the percentage of potassium in the first season (2.21 and 2.17% respectively), and there was no significant difference between them, followed by spraying with calcium nitrate at 150mg/l of and Salicylic acid50 mg/l was given at a concentration (2.13 and 2.09% respectively), and there was no significant difference between all the aforementioned treatments. There were indications in the second season that it followed nearly the same pattern as in the first.

Regarding this issue, Table (4)'s data indicated that plants treated with salicylic acid at 75 mg/l and potassium silicate (3cm/l) provided the highest percentages of nitrogen, phosphorous and potassium in both seasons except potassium silicate (3cm/l) in the first season only there was significant difference.

In the opposite, orange jasmine in both seasons, the plants that received water spraying (control) produced the least amounts of N, P, and K.

Kamal (2013) on sweet pepper plants cleared that foliar spray by (1800 or 1000 m3 fed-1 potassium silicate increased the N%, P% and K%. Moreover, (Abd-Elsalam *et al.* 2021) found that fertilizing with 100% of N,P and K and spraying with salicylic acid at 0.2 g/l increased N%, P% and K% in the tomato plants.

Total carbohydrates (D.W)%:

Table (4)'s data revealed that orange jasmine plants' percentage of total carbohydrates increased after treatment by calcium nitrate at 150mg/l, salicylicacid at 75 mg/l and potassium silicate (3cm/l) give values of (26.37, 26.75 and 26.57%, respectively), in the first season with a significant distinction in comparison to alternative treatments. On the same line, the second season noted results similar to the first season.

The increases in the percentage of carbohydrates were influenced by 50 mg/l of calcium nitrate, which may be related to the effects of various enzymes, vitamins, and Ca2+ on the process of photosynthesis.

Rubisco activation in light-independent reactions has been identified through photosynthesis as a crucial step; it is inhibited at 35–40 ◦C, which leads to a decrease in net CO2 intake and the generation of carbohydrates (Dubey, 2005).

Table 4. Effects of foliar applications of *Murraya paniculata,* L. plants under thermal stresses on N, P , K, carbohydrates %, total phenol (mg/g dry weight)) and proline µmol/g during the two seasons of 2021and 2022

Character Treatments	Chemical constituent parameters											
	N %		P %		K %		Carbohydrates %		Total phenol (mg/g dry weight)		proline µmol/g	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Control	2.13 i	2.11f	0.27j	0.27h	1.62h	1.68e	23.74j	24.06 e	5.37 a	5.62a	8.69a	8.40a
calcium nitrat (50mg/l)	2.18hi	2.15f	0.30h	0.30g	1.72gh	1.75de	24.35hi	24.41de	5.42a	5.28c	8.26abc	8.43a
calcium nitrate (100mg/l)	2.47f	2.27f	0.34e	0.35 e	1.92def	1.95c	25.38efg	25.62c	4.44fg	4.45g	7.38efg	7.51c
calcium nitrate (150mg/l)	2.89ab	2.78abcd	0.37b	0.38b	2.13 ab	2.20ab	26.37abc	26.63a	4.10hi	5.45b	6.48ij	6.68e
salicylic acid (25 mg/l)	2.42fg	2.55e	0.33f	0.32f	1.88ef	1.95c	25.22fg	25.62c	4.33fgh	4.26h	7.53def	7.86b
salicylic acid (50 mg/l)	2.64de	2.65cde	0.36c	0.37bc	2.09abc	2.19ab	26.07bcd	26.45ab	4.97bcd	5.03d	6.72 hi	6.82e
salicylic acid (75 mg/l)	2.82abc	2.89ab	0.38a	0.39 a	2.21a	2.31a	26.75a	26.96a	3.89i	3.94i	5.98 j	5.98f
spirulina algae extract (1cm/l)	2.31 gh	2.68bcde	0.29i	0.29g	1.70gh	1.74de	24.18ij	24.60d	5.21ab	4.24 h	8.47ab	8.45a
spirulina algae extract (2cm/l)	2.68cd	2.92a	0.31h	0.31f	1.79fg	1.84cd	24.61hi	24.82d	4.57ef	4.60f	7.97bcd	7.50c
spirulina algae extract (3cm/l)	2.94a	2.94a	0.35d	0.35e	1.97cde	2.09b	25.68def	25.74c	4.73de	4.76e	7.08fgh	7.21cd
potassium silicate (1cm/l)	2.26hi	2.50 e	0.32 g	0.32f	1.83 fg	1.86cd	24.85gh	24.68d	4.25gh	4.30h	7.74cde	7.43c
potassium silicate (2cm/l)	2.54ef	2.58de	0.36c	0.36cd	2.03bcd	2.18ab	25.87cde	25.95bc	4.88cd	4.88de	6.88ghi	7.00de
potassium silicate (3cm/l)	2.76bcd	2.87abc	0.38a	0.39a	2.17a	2.27a	26.57ab	26.62a	5.09bc	5.19c	6.19j	6.19f

Means with the same letter (s) in a column are not significant at 0.05 level.

Phenol (mg/g DW) and proline µmol/g:

When compared to the control, the data in Table (4) demonstrated that the majority of treatments reduced total phenols, with the lowest values of total phenols occurring. The plants were treated with Salicylic acid at 75 mg/l (3.89 and 3.94mg /g as dry weight, respectively), during both seasons.

Data in the second season indicated that it had almost the same trend observed in the first season.

From data listed in Table (4), it was shown that the plants treated with salicylic acid at 75 mg/l or potassium silicate 3cm/l gave significantly least proline µ mol/g and perfect result when compared to other treatments and control.

Proline is essential to plants. According to reports, they both shielded the plants from various stresses and accelerated their recovery from stress (Shamsul *et al.* 2012)

Through the manipulation of factors related to the bioactivity of phenolic compounds, plants under stress due to temperature could potentially activate acclimated mechanisms (Rosa *et al.* 2001).

Pigments content (total chlorophyll and carotenoids mg \ g F.W.):

The results indicated that plants treated with the salicylic acid at 75 mg/l significantly induced the highest amount of total chlorophyll (8.15 and 8.21 mg/g f.w. respectively) in both seasons but no significant difference in most treatments except non-treated plants and potassium silicate at 1 and 2 cm / l Table (5).

Table 5. Effects of foliar applications of *Murraya paniculata,* L. plants under thermal stresses on photosynthetic pigments (total chlorophyll and carotenoid mg \ g F.W.) during the two seasons of 2021and 2022

Character Treatments	Photosynthetic pigments(total chlorophyll and carotenoid)			
	Total chlorophyll (mg \ g f.w.)		Carotene (mg \ g f.w.)	
	1st	2nd	1st	2nd
Control	4.38c	4.02c	2.47d	2.35f
calcium nitrate (50mg/l)	6.16abc	6.06 abc	3.51abc	3.56bc
calcium nitrate (100mg/l)	5.77abc	5.84abc	3.17bcd	3.10cde
calcium nitrate (150mg/l)	6.40abc	6.56abc	3.35 abcd	3.59abc
Salicylic acid (25 mg/l)	6.84abc	7.18ab	3.53 abc	3.66abc
Salicylic acid (50 mg/l)	7.24ab	7.40ab	3.18bcd	3.33bcd
Salicylic acid (75 mg/l)	8.15a	8.21a	3.01bcd	2.75def
spirulina algae extract(1cm/l)	6.81abc	6.93ab	4.02ab	4.05ab
spirulina algae extract(2cm/l)	6.96abc	6.91ab	3.70ab	3.83abc
spirulina algae extract(3cm/l)	5.92abc	5.96abc	2.58cd	2.47ef
potassium silicate (1cm/l)	5.31 bc	5.46bc	3.65ab	3.80 abc
potassium silicate (2cm/l)	5.31bc	5.31bc	3.72 ab	3.86 ab
potassium silicate (3cm/l)	6.48abc	7.54ab	4.18a	4.32a

Means with the same letter (s) in a column are not significant at 0.05 level.

On the same line, data revealed that carotenoids were given (4.18 and 4.32 mg/g F.W. respectively) in both seasons. A significant difference was shown when the plants were sprayed with potassium silicate at 3cm/l most carotenoids were nearly about the same trend as reported in the total chlorophyll Table (5) .

Short-term heat stress increased the content of chlorophyll, but long-term heat stress decreased it. This loss of chlorophyll may be related to damage to reaction centers. When heat stress is applied, external Ca^{2+} treatment prevents the loss of chlorophyll by either preventing photo-oxidation or by preserving membrane integrity (Coria *et al.* 1998).

CONCLUSIONS

One of the main abiotic stresses that crop plants face as a result of the current global climate change is the extreme temperatures.

To enhance orange jasmine, some agricultural treatments of antioxidant compounds were applied. These compounds ought to help preserve the photosystems' structure and operation from excessive light.

These findings lead us to conclude that the orange jasmine plants may adapt a defense against extremely high thermal stress, which is significantly higher than the temperature for optimal growth. As a potential method of adapting to this stress, the adapted mechanism in plants seems to involve the accumulation of phenolic chemicals, cellulose, and lignin. By adjusting the bioactivity of phenolic substances, cellulose, and lignin, it might be feasible to activate acclimation mechanisms in plants that are experiencing temperature stress.

Finally, the results in this manuscript indicate that treated orange jasmine plants with salicylic acid at 75 mg/l and potassium silicate at 3cm/l were more effective than other treatments. Also, the application of salicylic acid at 75 mg/l or potassium silicate at 3cm/l would reduce the loss of orange jasmine in Egyptian environments.

Depending on the effect of these treatments on increasing the height of plants, their quantity of leaves and flowers, their fresh and dry weight, the pigment content of their leaves, and the composition of their chemicals we can conclude that this is the best treatment.

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تأثير بعض مركبات الرش الورقي علي النمو والتزهير والتركيب الكيميائي لنبات المورايا النامي تحت ظروف الاجهادات الحرارية

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الملخص

التغيرات المناخية خلال الاعوام الماضية أثرت سلباً على إنتاج النباتات المختلفه وفي هذا الاتجاه تم ملاحظة تأثير ارتفاع درجة الحرارة على نباتات المورايا ولتعزيز قدرة نباتات المورايا تحت الإجهاد الحراري، تم اختبار مركبات الرش الورقي المختلفة مثل نترات الكالسيوم وحمض الساليسيليك ومستخلص طحالب السبيرولينا وسيليكات البوتاسيوم بتراكيزات مختلفة. أجريت التجربة خلال موسمين 2021 و 2022. وبشكل عام أدت مركبات الرش المختلفه إلى تقليل تأثير الإجهادات الحرارية العالية والمنخفضة وتحسين إنتاجية أزهار نبات المورايا حيث وجد ان استخدام كل من حمض الساليسيليك بتركيز 75 ملليجرام / لتر وسيليكات البوتاسيوم بتركيز 3 سم/ لتر أكثر فعالية مقارنه بمعظم المعاملات الأخرى في زيادة طول النبات وإنتاج عدد أكثر من الأوراق والأزهار وزيادة الوزن الطازج والجاف للنباتات وتحسين المحتوى الكيميائي في الأوراق.ادي رش النباتات ورقياً بحمض الساليسيليك بتركيز 75 ملليجرام /لتر أو سيليكات البوتاسيوم بتركيز 3سم/لتر شهرياً بجانب استخدام التسميد المتكامل الموصي به الي تقليل من تأثيرات الإجهاد الحراري وزاد من كمية وجودة أزهار المورايا.

الكلمات الدالة : الموريا , مضادات الاكسده , المغذيات و الاجهادات الحرارية