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Response of Saidy date palm fruiting for potassium silicate and zinc sulphate spraying under New Valley climate conditions

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Abstract

The objective of the present study is to investigate the effects of spraying Saidy date palm bunches with potassium silicate (PS) (0.5% and 1 %) and zinc sulphate (ZS) (500 and 1000 ppm) and their combinations on yield components (bunch weight) and fruit physical and chemical characteristics. The present study was carried out during the 2021 and 2022 seasons on 20-year-old date palms grown on a farm located in the district of Baris - New Valley Governorate - Egypt. The experiment was arranged in a randomized complete block design (RCBD) including nine treatments with seven replications of one bunch each. Results indicated that all spraying treatments significantly increased yield and improved fruit physical and chemical characteristics compared to control. Spraying bunches with 1% potassium silicate plus 500 ppm zinc sulphate was a more effective treatments in increasing yield components and improving components fruit's physical and chemical properties.

Keywords: Date palms, bunch weight, fruiting, potassium silicate, zinc sulphate.

Introduction

Date palm (*Phoenix dactylifera* L.) has long been one of the most important fruit crops grown in semiarid and arid- regions. In Egypt, many farmers rely on date palms cultivation and exportation of their fruit. Egypt was ranked the first in the world among date producing countries, with a production volume that amounted to over 1.7 million metric tons of dates according to FAO (2022), 'Saidy' is one of the most commercial and semi-dry fruit cultivars in Egypt. Fruit trees are seriously impacted by climatic variables. Increased CO2 levels due to global warming and predicted climate changes may cause more significant variations in fruit yield and quality. Climate variables, such as high temperatures, low soil moisture, and high evaporative transpiration, has a direct impact on fruiting. Therefore, managing natural resources like water and nutrients could be an answer to a changing climate (Schaffer et al., 2009). Date growers also have to deal with significant issues like poor fruit quality and a low yearly average output. Minerals, particularly silicon and potassium, are crucial for improving fruit quality and output. Finding the ideal amounts for date palm fertilization is essential since it boosts the trees' resistance to a variety of challenges. The key to raising fruit trees' yield and quality is their foliar spray of macro and amino acids, which also helps fruit trees recover from physiological and nutritional deficits (Rai, 2002; Lalithya et al., 2014 and Khan et al., 2022).

Potassium is essential for several basic physiological processes, including the synthesis of proteins, the meristematic tissue development process, and the creation of sugars and starches. By activating a variety of enzymes involved in cell division, development, and fruit formation, it may enhance the color, flavor, and size of the fruit (Dhillon et al., 1999 and Abbas and Fares, 2009). Furthermore, it has been demonstrated to support the prevention of plant diseases, and potassium stress can exacerbate crop damage caused by fungi and bacteria (Holzmueller et al., 2007). One source of silicon and potassium that are very soluble is potassium silicate. In addition to serving as a silica supplement in agricultural production systems, it also provides trace levels of potassium (Epstein, 1999 and Al-Wasfy, 2013).

In terms of structure, plants deficient in silicon are weaker than those rich in silicon are; they exhibit slower growth, development, viability, and reproduction. Furthermore, both biotic and abiotic stressors can affect these plants more readily. The idea behind using foliar sprays containing silicon compounds is that, in situations where there is a deficiency of absorbable silicon in the soil and the roots' relatively complex process of absorbing Si, foliar feeding of Si could make up for the low uptake by the roots and result in enhanced silicon uptake with advantageous effects.

Silicon serves a variety of purposes in plant nutrition. In addition to improving water retention, photosynthesis, plant pigments, the synthesis of carbohydrates, and natural growth regulators, it plays a variety of regulatory roles in plants' ability to withstand biotic and abiotic challenges (Gong et al., 2003; Lux et al., 2003; Ma, 2004 and Hattori et al., 2005) .

The application of silicon is beneficial in increasing the tolerance of plants to stresses as well as enhancing photosynthesis and leaf water potential. Spraying potassium silicate at 0.1% significantly increased yield and improved the fruit quality of pomegranate trees (Epstein, 1999; Ahmed et al., 2015; Wassel et al., 2015).

Fruit set, retention, and development, as well as yield and fruit quality, are all enhanced by micronutrient spraying (Sarrwy et al., 2012; Omer et al., 2015 and Mostafa, 2015). Regarding this matter, boron plays a role in numerous functions like protein synthesis, sugar transport, and carbohydrate metabolism (Hansch and Mendel, 2009). Achieving acceptable fruit set and fruit quality appears to be significantly influenced by the effects of particular microelements, such as boron, on

date yield and fruit quality (Etman et al., 2007 and Khayyat et al., 2007). Plants require zinc, an essential microelement, for growth and development, as well as for the metabolism of proteins and carbohydrates. Zinc is involved in numerous enzyme activities. Zinc sulphate applied foliarly has a greater effect on date palm yield and fruit quality (Omar et al., 2015 and Mostafa, 2015).

Previous studies emphasized the benefits of potassium and zinc on fruiting of palm dates (Abdi and Hedayat, 2010; Al-Wasfy, 2013; Mohamed and Saleh ,2013; Abdalla, 2016; Esam et al., 2016; Omar et al., 2018; Khodair and Abd El-Rahman, 2021, El-Salhy et al., 2021 and El-Kady et al., 2022).

This investigation aims to study the effect of spraying with potassium silicate, and zinc sulphate on obtaining high fruit quality of Saidy date palms .

Materials and Methods

This study was carried out on 20-year-old Saidy palm trees over the course of the two succeeding seasons in 2021 and 2022. The chosen palm trees were planted in the Baris Oasis, New Valley Governorate, Egypt, on sandy loamy soil. The laboratory work was carried out at New Valley University's Horticulture Department under the Faculty of Agriculture. Seven robust palms with almost identical growth vigor were chosen. As usual, routine agricultural procedures were followed. The leaf/bunch ratio was modified to achieve its target of 8:1. To prevent metaxenia residues, artificial pollination was uniformly performed in respect of source, date, and technique

Spraying treatments are carried out twice: immediately after fruit set and at the beginning of coloring as follows:

1 -Control (spraying with water only) T1

2 -Spraying with 0.5% potassium silicate (PS) T2

3 -Spraying with 1% (PS) T3

4 -Spraying with 500 ppm zinc sulphate (ZS) T4

5 -Spray with 1000 ppm (ZS). T5

6 -Spray with 0.5% (PS) plus 500 ppm (ZS) T6

-7 Spraying with 0.5% (PS) plus 1000 ppm (ZS) T7

-8 Spraying with 1% (PS) plus 500 ppm (ZS) T8

-9 Spraying with 1% (PS) plus 1000 ppm (ZS) T9

Triton B as a 0.05% was added as a wetting agent to each spray solution before used.

These treatments were applied on the same palm. The design of the experiment is complete randomized block design containing 9 treatments and 7 replications, one bunch each.

The response of Saidy date palms to potassium silicate or zinc sulphate and their combinations were evaluated through the following determinations:

Yield components as, fruit retention and bunch weight

The fruit retained percentages were calculated from five inner and outer strands per bunch at harvest time using the following equation:

Fruit retained %= (Total number of retained fruits/strand)/(number of retained fruits/strand+ number of flower scars)×100

The harvest took place at the peak of full color stage (before it´s quite ripe) and bunches weight were recorded in kilograms.

Fruit physical characteristic:

Fruit was randomly selected from each bunch at the height of colour to measure physical attributes like fruit weight (g), fruit dimensions (cm) (length and diameter) and flesh.%

Fruit chemical characteristics:

A hand refractometer was used to measure total soluble solids content (TSS) % The fruit's chemical qualities, including, total acidity (gm. citric acid /100gm fruit weight), tannins content (as gallactronic acid %), moisture percentage, B. carotene mg /100 gm. dw, also, the percentages of reducing, non-reducing, and total sugars determined according to the methods of A.O.A.C.(1995) .

Statistical analysis

The obtained data during two studied seasons were subjected to analysis of variance according to Snedecor and Cochran (1990). Means were differentiated using values of new LSD at 5% level.

Results

1 -Yield components

Data in Table (1) showed the effect of spraying zinc sulphate and potassium silicate on yield components of Saidy date palm during 2021 and 2022 seasons. It is obvious from the data that results showed similar trend during the two studied seasons.

Results indicate that yield components i.e. fruit retention, bunch weight significantly increased due to zinc sulphate and potassium silicate spraying with different concentrations than control. In this respect, the best treatment that gave the highest significant fruit retention was (68.51& 68.53 %) as an av. of the two studied seasons due to spraying with 1% potassium silicate (PS) plus 500-ppm zinc sulphate (ZS) T8 and spraying by 1%potassium silicate (PS) plus with 1000 ppm zinc sulphate (ZS) T9 followed by spraying with 0.5% potassium silicate (PS) plus spraying with 1000 ppm zinc sulphate (ZS) T7 as an av. of the two studied seasons. On other hand, unsprayed (control) bunches gave the lowest significant fruit retention, where it was recorded (65.08 %) as an av. of the two studied seasons. No significant differences were found due to spraying potassium silicate (PS) alone or plus zinc sulphate .

Moreover, all treatments significantly increased the fruit retention percentage and bunch weight compared to the untreated one control. The increment was associated with both potassium silicate (PS) and zinc sulphate (ZS) spraying. The recorded fruit retention was (65.08, 67.36, 67.37, 67.92, 68.02, 68.21, 68.25, 68.51 & 68.53 % as an av. the two studied seasons) due to T1 to T9, respectively. Hence, the increment percentage of fruit retention attained (3.50, 3.52, 4.36, 4.52, 4.81, 4.87, 5.27 and 5.30% as an av. of the two studied seasons) due to T2, T3, T4, T5, T6, T7, T8 and T9 compared to T1 (control), respectively

In addition, concerning bunch weight, results in Table (4) and Figure (1) reveal that all potassium silicate (PS) and zinc sulphate (ZS) combinations had a positive effect on bunch weight as compared with the control.

Concerning bunch weight, results in the same table reveal that zinc sulphate and potassium silicate singly or in combinations had a positive effect on bunch weight compared to the control. Spray with 0.5% potassium silicate (PS) plus 500-ppm zinc sulphate (ZS) T6 and spraying with 0.5% potassium silicate (PS) plus spraying with 1000 ppm zinc sulphate (ZS) T7 as well as spraying by 1% potassium silicate (PS) plus 1000 ppm zinc sulphate (ZS) T9 gave the highest bunch weight (12.84, 12.82 and 12.63) followed by spraying with 1% potassium silicate (PS) plus 500 ppm zinc sulphate (ZS) T8 and spraying with 1% potassium silicate (PS) T3 (12.55 & 12.38 kg) as an av. of the two studied seasons. On the other hand, the control treatment T1 recorded the lowest bunch weight (10.41kg) as an av. of the two studied seasons .

The recorded bunch weight was (10.41, 12.33, 12.38, 11.64, 11.68, 12.84, 12.82, 12.55 & 12.63 kg) as an av. of the two studied seasons due to T1 to T9, respectively. Then, the corresponding increment percentage of bunch weight due to treatments over control attained (18.44, 18.92, 11.82, 12.20, 23.34, 23.15, 20.56& 21.33%), respectively.

No significant differences were found due to spraying potassium silicate alone or combined it plus zinc sulphate whatever concentration of spraying solution. Therefore, from a general economic view, it concluded that spraying potassium silicate alone or in combination with zinc sulphate at lower concentrations.

Table (1): Effect of potassium and zinc spraying on yield component of Saidy date palm during 2021 and 2022 seasons

Treatments		Fruit retention %			Bunch weight (kg)		
		2021	2022	Mean	2021	2022	Mean
Control	T1	61.85 B	68.31 B	65.08 B	9.68 C	11.13 C	10.41 C
PS 0.5%	T2	63.88A	70.83A	67.36 A	11.38 A	13.28 A	12.33 A
PS 1%	T3	63.80A	70.91A	67.37 A	11.45 A	13.31 A	12.38 A
ZS 500	T4	64.49A	71.35A	67.92 A	10.75 B	12.52 B	11.64 B
ZS 1000	T5	64.53A	71.50A	68.02 A	10.79 B	12.56 B	11.68 B
PS 0.5%+ ZS 500	T6	64.81A	71.60A	68.21 A	11.86 A	13.81 A	12.84 A
PS 0.5%+ ZS1000	T7	64.67A	71.83A	68.25 A	11.84 A	13.79 A	12.82 A
PS 1%+ ZS 500	T8	65.12A	71.90A	68.51 A	11.62 A	13.48 A	12.55 A
PS 1% +ZS 1000	T9	65.18A	71.88A	68.53 A	11.68 A	13.57 A	12.63 A
$LSD_{0.05}$		1.93	2.26	1.51	0.63	0.76	0.52

2 -Fruit quality

A- Fruit physical characteristics

Results in Tables (2 & 3) indicate that spraying potassium silicate (PS) and zinc sulphate (ZS) on some physical properties i.e. fruit weight and flesh percentage, as well as dimensions of Saidy date palms during 2021 and 2022 seasons. The results showed a similar trend in the studied cultivar during the two studied seasons .

Spraying bunches with either potassium silicate (PS) or zinc sulphate (ZS) significantly increased the fruit weight, flesh percentage, and dimensions compared with the unsprayed ones (control). The promotion of these traits was improved and associated with increased potassium silicate (PS) and zinc sulphate (ZS) concentration spraying. Spraying with 0.5% potassium silicate (PS) plus spraying with 1000-ppm zinc sulphate (ZS) T7 gave the highest fruit weight, flesh percentage, and dimensions of fruits during the two studied seasons .

In general, spraying with 0.5% potassium silicate (PS) T2 or spraying with 1% potassium silicate (PS) T3 as well as spraying with 500 ppm zinc sulphate (ZS) T4 or spraying with 1000 ppm zinc sulphate (ZS) T5 significantly increased the previously studied traits compared to control. Moreover, spraying with 0.5% potassium silicate (PS) plus 1000 ppm zinc sulphate (ZS) T7 was achieved higher fruit weight (11.49g) and flesh % (87.40%) and fruit length (3.50 cm) as av. of the two studied seasons compared with the other treatments and control, while the control recorded the lowest value in this respect, which fruit weight was (9.49g), flesh % (84.74%) and fruit length (3.30cm) as an av. of two studied seasons, respectively.

The recorded fruit weight was (9.49, 10.96, 11.10, 10.46, 10.51, 11.46, 11.49, 11.19& 11.26g) and flesh % was (84.74, 87.42, 87.30, 86.86, 86.95, 87.50, 87.40, 87.25& 87.48%) and Moisture% (14.52, 15.13, 15.18, 15.03, 15.05, 15.20,15.23,15.25&15.27%) and fruit length was (3.30, 3.46, 3.51, 3.41, 3.43, 3.48, 3.50, 3.47& 3.49cm) and fruit diameter (1.99, 2.20, 2.22, 2.21, 2.22, 2.26, 2.24, 2.25&2.24 cm) as an av. of the two studied seasons due to T1 to T9, respectively.

Moreover, the increment percentage of fruit weight due to spraying potassium silicate or zinc sulphate compared to control attained (15.49, 16.97, 10.22, 10.75, 20.76, 21.08, 17.91 & 18.65%) due to T2 to T8 compared to T1, respectively.

The corresponding flesh increment percentage attained (3.16, 3.02, 2.50, 2.61, 3.25, 3.14, 2.96 and 3.23%) as an av. of the two studied seasons, respectively.

From these results, it is clear that spraying potassium silicate alone of combination of

potassium silicate and zinc sulphate are of great importance for date palm production. Such application leads to an increase in the fruit weight and its flesh percentage. This effect are considered very important, as increasing the fruit weight is considered one of the most important goals of the producer, as this leads to an increase in the price of fruits and its preference in local or export markets.

In other words, increasing the fruit weight is better than increasing the producer's yield, since the price is determined based on the quality of the product and not its quantity.

These results showed that no significant differences were seen due to an increase in the concentration of spraying potassium silicate or zinc sulphate solutions. Therefore, from an economic standpoint, it could be concluded that potassium silicate alone or potassium silicate plus zinc sulphate could be sprayed in a lower concentration.

Table (2): Effect of potassium and zinc spraying on fruit weight, flesh percentage and Moisture percentage of Saidy dates during 2021 and 2022 seasons

Treatments		Fruit Wight(g)			Flesh%			Moisture%		
		2021	2022	Mean	2021	2022	Mean	2021	2022	Mean
Control	T1	8.68 C	10.30 C	9.49 C	84.21B	85.27B	84.74B	14.38B	14.65B	14.52B
PS 0.5%	T2	9.95 A	11.97 A	10.96A	86.73A	88.10A	87.42A	14.98A	15.28A	15.13A
PS 1%	T3	10.08 A	12.11 A	11.10A	86.65A	87.95A	87.30A	15.03A	15.33A	15.18A
ZS 500	T4	9.53 B	11.38 B	10.46B	86.13A	87.58A	86.86A	14.88A	15.18A	15.03A
ZS 1000	T5	9.56 B	11.45 B	10.51B	86.25A	87.65A	86.95A	14.90A	15.20A	15.05A
PS 0.5%+ ZS 500	T6	10.41 A	12.50 A	11.46A	86.84A	88.15A	87.50A	15.05A	15.35A	15.20A
PS 0.5%+ ZS 1000	T7	10.40 A	12.58 A	11.49A	86.70A	88.10A	87.40A	15.08A	15.38A	15.23A
PS 1%+ ZS 500	T8	10.15 A	12.22 A	11.19A	86.58A	87.91A	87.25A	15.10A	15.40A	15.25A
PS 1% + ZS 1000	T9	10.22 A	12.30 A	11.26A	86.80A	88.16A	87.48A	15.12A	15.42A	15.27A
$LSD_{0.05}$		0.59	0.78	0.54	1.89	2.13	1.48	0.53	0.94	0.73

Table (3): Effect of potassium and zinc spraying on fruit length (cm) and fruit diameter (cm) of Saidy dates during 2021 and 2022 seasons.

Treatments		Fruit length (cm)			Fruit diameter (cm)		
		2021	2022	M	2021	2022	M
Control	T1	3.23B	3.37B	3.30C	1.95B	2.03B	1.99B
PS 0.5%	T2	3.38A	3.53A	3.46A	2.16A	2.23A	2.20A
PS 1%	T3	3.44A	3.57A	3.51A	2.18A	2.25A	2.22A
ZS 500	T4	3.34A	3.48A	3.41B	2.16A	2.25A	2.21A
ZS 1000	T5	3.36A	3.50A	3.43B	2.18A	2.26A	2.22A
PS 0.5%+ ZS 500	T6	3.40A	3.55A	3.48A	2.22A	2.30A	2.26A
PS 0.5%+ ZS1000	T7	3.42A	3.58A	3.50A	2.19A	2.28A	2.24A
PS 1%+ ZS 500	T8	3.39A	3.55A	3.47A	2.22A	2.27A	2.25A
PS 1% +ZS 1000	T9	3.41A	3.57A	3.49A	2.20A	2.28A	2.24A
LSD0.05		0.09	0.10	0.07	0.07	0.09	0.06

B- Fruit chemical characteristics:

It is clear from the results in Tables (4, 5& 6) that the effect of spraying with zinc sulphate (ZS) and potassium silicate (PS) either alone or in combinations, in terms of increasing T.S.S percentage, sugar contents, moisture percentage, and B carotene, moreover, decreasing the acidity% and tannins % in relative to the control treatment on some chemical properties i.e. total soluble solids,

sugar contents, as well as total acidity, and total soluble tannins percentage of Saidy date fruits during the 2021 and 2022 seasons. It is obvious from the data that the results showed a similar trend in two studied cultivars during the two studied seasons. All studied treatments significantly improved the chemical fruit constituents. Foliar application of 1% (PS) plus 1000 ppm (ZS) (T9) and 1% (PS) plus 500-ppm (ZS) (T8) followed by spraying with 0.5% (PS) plus 1000 ppm (ZS) (T7) in descending order gave better results (74.70& 65.63 %), (74.68 & 65.53) and (74.06 & 65.01 %) as an av. of the two studied seasons from T.S.S and total sugars due to T9, T8 and T7, respectively. On the other hand, unsprayed ones (control) recorded the lowest value in this respect (70.78 & 61.34 %), respectively. The recorded T.S.S was (70.78, 73.13, 73.44, 72.57, 72.72, 73.83, 74.06, 74.68 & 74.70%) and total sugar was (61.34, 64.33, 64.61, 63.91, 64.03, 64.97, 65.01, 65.53& 65.63%) as an av. of the two studied seasons due to T1, T2, T3, T4, T5, T6, T7, T8 and T9, respectively. Then, the corresponding increment percentage of total sugar attained (4.88, 5.33, 4.19, 4.39, 5.92, 5.98, 6.83& 6.99%) due to T2 to T9 compared to T1, respectively .

Moreover, no significant differences were found due to spraying potassium at 0.5 or 1% alone or in combination with zinc sulphate at 500 ppm plus 1000 ppm.

Concerning acidity % and tannin contents all spray treatments reduced such studied traits as compared with the control. Lower values in this respect (0.187& 0.438%) and (0.189&0.438%) as an av. of two studied seasons were obtained by spraying with 1% potassium silicate plus 500 ppm zinc sulphate (T8) or spraying with 1% potassium silicate plus 1000 ppm zinc sulphate (T9), respectively. Meanwhile, control treatment gave the highest value in this respect (0.200& 0.492%) as an av. of two studied seasons.

In general, the lowest percentage of fruit chemical properties except acidity and tannins contents were recorded on unsprayed bunches (control). On the other hand, spraying with 1% potassium silicate plus 500-ppm zinc sulphate (T8) followed by spraying with 1% potassium silicate plus 1000-ppm zinc sulphate (T9) recorded the highest value in this respect. No significant differences were found due to spraying potassium silicate alone or potassium silicate plus zinc sulphate in any concentration of the spraying solution. Therefore, in general, economic view, it concluded that spraying either potassium silicate alone or potassium silicate combination with zinc sulphate at lower concentrations to get a high yield with good date quality .

Table (4): Effect of potassium and zinc spraying on T.S.S % and total sugars of Saidy dates during 2021 and 2022 seasons.

Treatments		T.S.S%			Total sugars		
		2021	2022	M	2021	2022	M
Control	**T1**	70.13C	71.42C	**70.78C**	60.82C	61.85B	**61.34C**
PS 0.5%	**T2**	72.41A	73.85A	**73.13B**	63.69A	64.96A	**64.33A**
PS 1%	**T3**	72.68A	74.91A	**73.44A**	63.91A	65.31A	**64.61A**
ZS 500	**T4**	71.86B	73.82B	**72.57B**	63.25B	64.56A	**63.91B**
ZS 1000	**T5**	71.49B	73.49B	**72.72B**	63.43B	64.71A	**64.03B**
PS 0.5%+ ZS 500	**T6**	73.10A	74.55A	**73.83A**	64.51A	65.43A	**64.97A**
PS 0.5%+ ZS1000	**T7**	73.27A	74.84A	**74.06A**	64.42A	65.60A	**65.01A**
PS 1%+ ZS 500	**T8**	73.95A	75.40A	**74.68A**	65. 18A	65.88A	**65.53A**
PS 1% +ZS 1000	**T9**	74.10A	75.29A	**74.70**	65.15A	66.11A	**65.63A**
LSD0.05		**1.70**	**1.83**	**1.32**	**1.69**	**2.18**	**1.42**

Table (5): Effect of potassium and zinc spraying on reducing and non-reducing sugars of Saidy dates during 2021 and 2022 seasons

Treatments		Reducing sugars			Non-reducing sugars		
		2021	2022	M	2021	2022	M
Control	T1	55.11B	56.18B	55.65C	5.71B	5.67B	5.69C
PS 0.5%	T2	57.30A	58.26A	57.78AB	6.39A	6.70A	6.55B
PS 1%	T3	57.52A	58.40A	57.96AB	6.39A	6.91A	6.65AB
ZS 500	T4	56.93A	57.85A	57.39B	6.32A	6.71A	6.52B
ZS 1000	T5	56.95A	57.96A	57.46AB	6.39A	6.75A	6.57B
PS 0.5%+ ZS 500	T6	58.10A	58.54A	58.32AB	6.41A	6.89A	6.65AB
PS 0.5%+ ZS1000	T7	58.00A	58.70A	58.35AB	6.42A	6.90A	6.66AB
PS 1%+ ZS 500	T8	58.60A	58.94A	58.77A	6.58A	6.94A	6.76AB
PS 1% +ZS 1000	T9	58.54A	58.98A	58.72AB	6.61A	7.03A	6.82A
LSD0.05		1.76	1.88	1.34	0.31	0.36	0.24

Table (6): Effect of potassium and zinc spraying on Acidity %, tannins and B carotene of Saidy dates during 2021 and 2022 seasons

Treatments		Acidity%			B. carotene mg 100gdw			Tannins		
		2021	2022	M	2021	2022	M	2021	2022	M
Control	T1	0.199A	0.218A	0.200A	0.658B	0.728B	0.693B	0.470A	0.513A	0.492A
PS 0.5%	T2	0.188B	0.202B	0.195B	0.658A	0.761A	0.723A	0.435B	0.476B	0.456B
PS 1%	T3	0.185B	0.200B	0.193B	0.689A	0.768A	0.729A	0.432B	0.471B	0.452B
ZS 500	T4	0.190B	0.207B	0.199B	0.675A	0.755A	0.715A	0.499B	0.489B	0.469B
ZS 1000	T5	0.190B	0.210B	0.200B	0.679A	0.754A	0.717A	0.446B	0.488B	0.467B
PS 0.5%+ ZS 500	T6	0.183B	0.196B	0.195B	0.690A	0.768A	0.729A	0.425B	0.463B	0.444B
PS 0.5%+ ZS1000	T7	0.183B	0.198B	0.191B	0.689A	0.763A	0.726A	0.428B	0.460B	0.444B
PS 1%+ ZS 500	T8	0.180B	0.193B	0.187B	0.698A	0.778A	0.738A	0.419B	0.456B	0.438B
PS 1% +ZS 1000	T9	0.181B	0.196B	0.189B	0.700A	0.778A	0.739A	0.421B	0.455B	0.438B
LSD0.05		0.009	0.010	0.007	0.025	0.024	0.018	0.012	0.018	0.011

Discussion

Zinc sulphate and potassium silicate were used in this study to improve the fruit qualities and yield of the Saidy date palm. Potassium is necessary for the synthesis and operation of proteins, lipids, carbohydrates, and chlorophyll as well as for preserving the equilibrium of water and salts in plant cells (Marschner, 1995). Silicon has many functions in plant nutrition. It has many regulatory roles in enhancing the tolerance of plants to biotic and abiotic stresses, water retention, photosynthesis, plant pigments and building of carbohydrates and natural growth regulators (Ma, 2004 and Hattori et al., 2005). Potassium stimulates a wide range of enzymes essential to the health and growth of plants. Additionally, by controlling the opening and closing of stomata, it improved water loss, sugar translocation, resilience to salinity and drought, and root growth. Because potassium is necessary for photosynthesis, the transportation of water and nutrients, and plant cooling, it makes plants more resilient to both biotic and abiotic challenges (Martin et al., 2004 and Dordas, 2008). Thus, potassium enhances the quality of output in areas like colour, flavour consistency, and fruit preservation. It was found to be important in regulating the water content of cells, the production of carbohydrates, and their mobilization in plant tissues. It also had a significant impact on the retention of fruit. The application of potassium, which is essential for

pH stabilization, osmoregulation, enzyme activation, protein synthesis, stomata movement, photosynthesis, cell extension, and key soluble in growing cells, may be the cause of the increase in fruit physical characteristics (Dhillon et al., 1999).

Potassium helped in enhanced fruit retention, ultimately resulting in increased bunch weight and yield/palm due to improve the photosynthesis and metabolic reaction to increase fruit size and weight. These effects result in increasing the yield. Our results indicated spray the bunches with potassium silicate alone or combined with zinc sulphate significantly the fruit retention about 3.50 to 5.30%, bunch weight about 18.92 to 21.13% and fruit weight about 16.96 to 17.79 compared to untreated ones (control).

Moreover, potassium (K) plays an important role in improving chemical fruit constituents as it involves the transport of sugars to other parts of the plant resulting in improved fruit quality. Also, converts complex substances into simple ones to speed up the metabolic activity of fruit to increase TSS. The TSS of date fruit is greatly improved when K is applied in any form.

The important role of potassium fertilization on the fruiting of date palm was confirmed by the results of Al-Hamoudi (2006), Khayyat et al. (2007), Abdi and Hedayat (2010), Harhash and Abdel-Nasser (2010), Abdel-Migeed et al. (2013), El-Wasfy (2013), Abdalla (2016), El-Sayed et al. (2016), Esam et al. (2016), Ali et al. (2018), Omer et al. (2018), Al-Hajaj et al. (2020), Khan et al. (2020), Alebidi et al. (2021) and El-Salhy et al. (2021). They concluded that potassium is very effective in improving fruiting especially when applied with the optimum rate of N and P fertilizers. Spraying liquid potassium sulphate or potassium nitrate was very effective in improving the yield and fruit quality. Spraying potassium nitrate had a positive effect on leaf mineral content, yield and fruit quality of date palm.

Applying zinc to date palm cultivars has improved fruit set, fruit retention percentage, bunch weight, and yield. One possible explanation for this issue is that the removal force of zinc is increased because these elements are involved in several enzymatic activities that control the metabolism of proteins and carbohydrates, both of which are essential for development and growth (Swietlik, 1999 and Sarrwy et al., 2012). Applications of zinc have increased the fruit quality of date palm cultivars. Zinc is essential for numerous functions, chief among them being the transportation of sugars, carbohydrates, and proteins, which stimulates cell growth and division, increasing fruit weight and size and speeding up fruit maturity. These results are consistent with those attained by (Ashour et al., 2004, Khayyat et al., 2007, Harhash and Abdel-Nasser 2010, El-Sabbah, 2012, Sarrwy et al., 2012, El-Khayat & El-Noam 2013, Oraby 2013, Omer et al., 2014, Mostafa 2015, Hassan et al. (2015), Abdalla (2016) and Saleh et al. (2016). They concluded that the direct application of nutrient elements on inflorescences and fruit is one of the best tools for date palm production.

Conclusion

From the current study, it can be concluded that fruit yield and fruit physical and chemical characteristics were improved significantly by twice foliar application of bunches with 0.5% potassium silicate alone or in combined with 500 ppm zinc sulphate. These treatments were the best and most effective in enhancing yield components and improving the fruit quality of Saidy date palms.

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إستجابة اثمار نخيل البلح الصعيدي لرش سليكات البوتاسيوم وسلفات الزنك تحت ظروف الوادي الجديد المناخية

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الملخص العربى

أجريت هذه الدراسة خلال موسمين متتاليين 2021 و 2022 بمزرعة إنتاجية خاصة علي نخيل البلح الصعيدي بواحة الخارجة بمركز باريس محافظة الوادي الجديد– مصر، بهدف دراسة تأثير رش سيليكات البوتاسيوم وسلفات الزنك علي إثمار نخيل البلح الصعيدي حيث تم رش سيليكات البوتاسيوم بتركيز 0,5 أو 1% أو سلفات الزنك بتركيز 500 أو 1000 جزء في المليون في حالة فردية أو معا بعد العقد وكذلك عند بداية التلوين.

وقد أظهرت النتائج التالي:

- أهمية رش سيليكات البوتاسيوم بتركيز 0,5 % سواء في حالة فردية أو بالإضافة الي رش سلفات الزنك بتركيز 500 جزء في المليون لانتاج محصول عالي.

- أهمية رش سيليكات البوتاسيوم بتركيز 0,5 % سواء فردية او خليط مع سلفات الزنك بتركيز 500 جزء في المليون لتحسين خصائص الثمار من حيث وزن وابعاد الثمار ونسبة اللحم ومحتواها من المواد الصلبة الذائبة الكلية والسكريات مع قلة محتواها من التانينات والحموضة.

من نتائج هذه الدراسة فإنه يوصي بأهمية رش سوباطات البلح الصعيدي بخليط من سيليكات البوتاسيوم بتركيز 0,5% وسلفات الزنك بتركيز 500 جزء في المليون وذلك مرتين بعد العقد وكذلك عند بداية التلوين وذلك لانتاج محصول عال ذو خصائص ثمرية جيدة للتسويق المحلي والمنافسة في أسواق التصدير.

الكلمات الدالة: نخيل البلح الصعيدي- سليكات البوتاسيوم- سلفات الزنك – جودة الثمار