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RESPONSE OF SEWY DATE PALM GROWN IN SANDY SOIL TO SPRAYING TWO SOURCES OF SULFUR

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ABSTRACT: In order to study the effect of sulfur concentration (200, 300 and 400 ppm) and sources (agriculture sulfur and liquid sulfur) on leaf macronutrients, yield and fruit physical and chemical properties, during two consequently seasons, of Sewy date palm fruits grown in sandy soil under El-Karga Oasis – New valley governorate a field experiment was tack place. The obtained results showed that spraying sulfur at 200 to 400 ppm in form of agriculture sulfur or liquid sulfur was significantly enhanced leaves nitrogen, Phosphorus and potassium contents rather than untreated palms. However, non-significant differences were observed in calcium contents. Regardless sulfur source, yield in kg/palm and punch weight (kg) were significantly enhanced as a result of spraying sulfur at 200 ppm to 400 ppm in comparison to untreated palms. All physical and chemical properties of Sewy date palm fruits were significantly improved as a result of spraying sulfur at 200 to 400 ppm. Non-significant differences neither in physical properties nor in chemical properties were obtained between the two higher concentrations (300 and 400 ppm), during the two experimental seasons. Furthermore, using the sulfur as a foliar application in liquid sulfur source present superiority than the agriculture sulfur. Based on the obtained data we can recommended to spraying the Sewy date palm grown in sandy soil at El-Karga Oasis New Valley Governorate or resampling conditions.

Key words: *Phoenix dectylifera*, Sewy date palm, menial status, yield, fruit physical and chemical characteristics sulfur sources.

INTRODUCTION

Date palm tree (*Phoenix dectylifera* L.) is one of the old fruits trees in Arab regions as old as agriculture. The date palm is one of the tropical and subtropical region fruits (**Hodel and Johnson 2007**). It is believed that, it originated in the Arab countries and its cultivation is still concentrated in this region until today (**Abbas *et al.*, 2015**). Egypt considered as the first one of the major production countries of date palm (**FAO, 2016**). Sewy cultivar (also known as saedy date palm in New valley Governorate) considered as one of the most pupillary cultivar in Egypt **(Hussein 2005** and **Muhammad, 2017**). This cultivar well adapted and cultivated in middle Egypt and New valley (**Hussein 2005; Abd-Allah 2016** and **Muhammad, 2017**). Among all the Egyptian Governorates, New valley Governorate ranked the third position after Behaira and Sharkia according to the numbers of female date palm trees. Since they are 1853441 palms, with total production 102092 tons of fruit. Sewy cultivar is covered most acreage of total cultivated area in such governorate where the present study carried out. The number of females of Sewy date palm grown under New Valley region reached 1800000 females. They produced 110000 ton fruits (**Annual Reports of Statistical and Agricultural Economics in Arab Republic of Egypt, 2018**).

Sulfur considered as one of the macro essential element for plant nutrition. This element plays many important physiological roles in growth and plant healthy (**Turrell, 1950** and **Leustek & Saito 1999**). Sulfur has become more important as a limiting nutrient in crop production in recent years for several reasons (**Turrell, 1950 and Marschner 1995**). However, sulfur serves many functions in plants, such as: 1- it is use in amino acids formation, 2- it is necessary for chlorophyll formation and it is essential building block, 3- it help develop and it is required by

the nitrogen fixing bacteria, it play an important role in activation of certain enzymes, 4- it participate the structure of two very important amino acids (**Marschner 1995 and Leustek & Saito 1999**).

Sulfur is soluble and easily lost from soil by leaching spatially in sandy soil, such as New Valley land, Elemental sulfur is a good acidifying agent, So, applied 500 pounds of sulfur per acre on sandy soil can reduces the pH from 7.5 to 6.5 (**Maathuis 2009**). Sulfur ion (SO4) is the form primarily absorbed by plants (**Maathuis 2009**).

However, the extensive uses of sulfur in the field of pesticides and plant pest control industries has made many farmers add it in small quantities or condone its additions to the plant. It well documented that plant needs of sulfur closely associated with nitrogen (**Mraschner 1995** and **Leustek & Saito 1999**).

The target of this investigation was examining the effect of using two sources of sulfur at different concentrations (200m 300 and 400 ppm) on leaf mineral content, productivity and fruit quality of Sewy date palms cultivar grown in sandy soil under New Valley conditions.

MARTIALS AND METHODS

The current investigation was conducted during 2018 and 2019 on twenty-one uniform in vigor 15-years old Sewy date palm grown in private orchard located at El-Kharga Oasis - New Valley Governorate (600 km south western Cairo city) - Egypt, where the soil texture is sandy loam soil. The chosen palms are planted at 8 X 8 meters apart. The chosen palms are subjected to regular horticulture practices that were commonly applied in date palm orchards including fertilization, irrigation, hoeing and pest management. Pruning was performed to maintain leaf / bunch ratio at 8:1. The number of female spathes per palm was adjusted to 10 spathes by removing excess earliest, latest and small bunches.

Soil and water used in irrigation analysis

The soil texture where the present investigation takes place was sandy. Composite samples of soil well water used in irrigation were collected and subjected to physical and chemical analysis according to **Wilde *et al.*, 1985 and Walsh & Beaton (1986)**. The obtained data are illustrated in the following Table.

Table (1): Physical and chemical analysis of experiment orchard soil and the water used in irrigation

Soil analysis		Water analysis	
Constituents	**Values**	**Constituents**	**Values**
Sand %	81.5	E.C (m.mhos/cm/25C)	0.8
Silt %	11.0	Hardness	19.7
Clay %	7.5	pH	7.35
Texture	Sandy	Ca (mg/L)	40.4
EC (1:2.5Extract) mmhos/cm/ 25 C	0.75	Mg (mg/L)	24.3
Organic matter %	0.4	K (mg/L)	6.07
pH (1 : 2.5 extract)	8.6	Na (mg/L)	21.8
Active lime %	8.3	Sum of Cations (mg/L)	8.16
N (mg/kg)	0.2	Alkalinity (mg/L)	165
Phosphorus (ppm)	2.1	Chlorides (mg/L)	108
Available Ca (meq/100g)	0.51	Nitrate (mg/L)	10.2
C/N Ratio	16.7	SAR	1.97

Experimental work

In order to study the effect and the suitable dose of different sources of sulfur on Sewy date palm, two sources of sulfur namely: agriculture sulfur and liquid sulfur were examined on the present experiment. Each sulfur source was used at three concentrations (200 ppm, 300 ppm and 400 ppm). All treatments were applied three times yearly (just at fruit setting, one month after fruit setting and one month later). Then, this study arranged in complete randomized block designee (RCBD) and included the following seven treatments from sulfur sources and its concentrations.

1- Control (0.0% sulfur, untreated palms, sprayed with water).

2- Spraying agriculture sulfur at 200 ppm.

3- Spraying agriculture sulfur at 300 ppm.

4- Spraying agriculture sulfur at 400 ppm.

5- Spraying liquid sulfur at 200 ppm.

6- Spraying liquid sulfur at 300 ppm.

7- Spraying liquid sulfur at 400 ppm.

All treatments were replicated three times, and each replicate was represented by one palm. The following parameters were measured during this study:

Determination of leaves macro nutrients (N, P, K and Ca) in leaves

Samples included sixteen leaflet/palm (in order of four leaflets/leaf, from the meddle part of leaf) were chosen from four leaf/palm labeled six months leaves/palm, (Leaves samples were collecting in the second week of August, in both two seasons. according to **Martin-Préval *et al.* (1984)**. The samples washed with tap water and rinsed with distilled water, so, it air-dried at 70 °C for 72 hrs. Then, the sample grounded to fine powder, and 0.5 g weight digested by using H_2SO_4 and H_2O_2 until clear solution was obtained (**Martin-Préval *et al.,* 1984**). The digested solution quantitatively transferred to 100 ml volumetric flask and completed to 100 ml by distilled water. Then, contents of N. P, K and Ca (%) were determined for each sample as follows:

- **Nitrogen** was determined by using the modified microkejldahl described by (**Martin-Préval *et al.,* 1984**).

- **Phosphorus** determined by using colorimetric method, according to **Olson *et al.,* (1974)** and **Wilde *et al.* (1985)**, by using the optical density of phosphor-molibdo-vanadate complex by photometrically at wave length 430 nm.

- **Potassium** determined by flam-photometrically, using the method outlined in **Martin-Préval *et al.* (1984)**.

- **Ca** was determined using atomic absorption method as described by **(Martin-Préval *et al.,* 1984)**.

Yield and its component: Bunches were picked at the optimum commercial harvesting time in New Valley region conditions (the second week of Augusts) during the two seasons. Then, each punch was weighted (kg) and recorded, and the main punch weight was calculated. Then, the yield in kg per palm was calculated, by multiplying the average bunch weight (kg) by total number of bunches per palm.

Fruit physical characteristics: Samples of one hundred dates from the yield of each palm were taken randomly and the following physical and chemical characteristics were studied:

- Average fruit weight (g) was recorded, as a result of tack 20 fruit weight individually, using balance of 0.01g sensitivity.

- Fruit dimensions (length and diameter in cm) were recorded as a result of 2o fruit length and diameter (cm) individually, by using vernier caliper.

Fruit Chemical characteristics: Sample (100 g) of fruit pulp was added to 100 ml distilled water and stand 4 hours, and then the samples minced will with electric blender for determination of the following chemical constituents: Percentage of total soluble solids (T.S.S %) were determined by hand refractometer (**according to A.O.A.C., 1995**); Percentage of total and reducing sugar and total sugars (%), according to Lane and Eynone volumetric method (illustrated in **Ranganna, 1977**). Percentage of total acidity (expressed as grams of malic acid per 100 grams of fruit pulp) by titration against with 0.1 NaOH in presence of phenolphthalein as an indicator (according to **A.O.A.C., 1995**).

Statistical analysis: All obtained data were tabulated and subjected for the statistical analysis; by analysis of variance (ANOVA) using MSTATC Program. Comparisons between means were made using least significant differences (L.S.D) at p= 0.05 (**Snedecor and Cochran, 1977**).

RESULTS AND DISCUSSION

Leaf macro nutrients content

Data obtained during the two experimental seasons (2018 and 2019) as shown in Table (2) displayed that, spraying sulfur in form of agriculture or liquid sulfur at different concentrations (200, 300 and 400 ppm) enhancing the leaves of Sewy date palm contents form nitrogen, phosphorus and potassium % (on basis of dray weight) rather than control treatment. In this concern using the sulfur in form of liquid sulfur present higher and significant positive effect rather than control or using the sulfur in form of agriculture sulfur, these data were true during the two seasons.

This increment was gradual and parallel with increasing the concentration of sulfur from 200 ppm to 400 ppm. However, the palms sprayed with sulfur in form of liquid sulfur at 400 ppm present the highest level of macro nutrient in their leaves (1.95 & 2.01% for nitrogen, 0.36 & 0.38% for phosphorus and 1.31 & 1.33% for potassium). However, non-significant differences were observed in leaves calcium contents. Furthermore, non-significant differences were observed in between the two higher concentrations (300 and 400 ppm) neither in the first season nor in the second season. On the opposite side, untreated palms present the lowest macro-nutrients in their leaves (1.65 & 1.71% for nitrogen, 0.20 & 0.22% for phosphorus and 1.11 & 1.15% for potassium), during the two experimental seasons respectively.

The positive effect of sulfur application on nutritional status of Sewy data palm which showed in the present study may be explained by the important role of sulfur in increasing the nutrient availability. Thus, there is a growing interest in S applications to improve availability of nutrients and overcome nutrient deficiencies in soils **(Neilsen *et al.*, 1993 and Al-Obeed *et al.*, 2013)**. Furthermore, application of sulfur element significantly increased Zn solubility in soil, these lead to increasing their uptake by trees roots, then increasing the synthesis of tryptophan amino acid which participant the structure of indol acetic acid (**Marschner 1995 and Kayser *et al.*, 2001**).

Table 2. Effect of sulfur source and concentration on leaves N%, P%, K% and Ca% of Sewy date palm during 2018 and 2019 seasons.

Treatments	Leaf N %		Leaf P %		Leaf K %		Leaf Ca %	
	2018	2019	2018	2019	2018	2019	2018	2019
Control	1.65	1.71	0.20	0.22	1.11	1.15	1.8	1.9
Agriculture sulfur at 200 g/palm	1.73	1.79	0.25	0.26	1.17	1.20	1.7	1.9
Agriculture sulfur at 300 g/palm	1.81	1.88	0.30	0.31	1.23	1.25	1.8	1.8
Agriculture sulfur at 400 g/palm	1.86	1.93	0.32	0.33	1.26	1.28	1.9	1.9
Liquid sulfur at 200g/palm	1.83	1.89	0.31	0.32	1.25	1.26	1.8	1.8
Liquid sulfur at 300g/palm	1.91	1.96	0.35	0.36	1.29	1.30	1.8	1.9
Liquid sulfur at 400g/palm	1.95	2.01	0.36	0.38	1.31	1.33	1.9	1.9
New LSD at 5%	**0.06**	**0.07**	**0.03**	**0.03**	**0.04**	**0.04**	**0.3**	**0.3**

Yield (kg/palm) and its component

Data concerning the effect of different sources of sulfur as well as the concentration used on yield expressed in punch weight (kg) and yield (kg/palm) as well as fruit weight (g) of Sewy date palm trees during 2018 and 2019 seasons are illustrated in Tables (3). It is clearly shown from these data that treating Sewy date palm three times with the two sources of sulfur at different concentrations (200, 300 and 400 ppm) significantly was accompanied with improving punch weight (kg), yield (kg/palm) and fruit weight (g), relater than untreated palms, during the two experimental seasons.

In this concern the data also showed clearly that, using sulfur in form of liquid sulfur had a superior positive effect rather than agriculture sulfur, these data were true during the two experimental seasons. Regardless the source of sulfur, this positive promotion was in proportional to the gradual increase in sulfur concentration from 200 ppm to 400 ppm, during the two experimental seasons. However, non-significant differences were observed between the two highest concentrations of sulfur forms (300 and 400 ppm) neither in the first nor in the second season.

Furthermore, the palms received the highest concentration of sulfur (400 ppm) in form of liquid sulfur (400 ppm) present the highest punch weight (12.48 & 12.33 kg), yield in kg/palm (124.8 & 123.3 kg), and fruit weight (11.5 & 11.8 g), in both seasons respectively. On the other hand, the lowest punch weight (10.00 & 10.05 kg), yield in kg/palm (100.0 & 100.5 kg), and fruit weight (9.5 & 9.3 g) were obtained from untreated palms, during the two experimental seasons respectively. In order to improve the punch weight (kg), yield (kg/palm) and fruit weight (g) of Sewy date, it is may be logical recommend under this experiment conditions and resampling conditions spraying Sewy date palm by sulfur at 300 ppm in form of micronized sulfur

Similar results concerning the positive effect of sulfur on yield and its component were observed by certain authors in date palm or other fruit trees, such as: **Abbas *et al.* (2015)** when they studied the positive effect of sulfur application at 100 and 200 g on Barhee and Sayer date palm offshoots; **Awad and Badawi (2017)** they studied the effect of organic and chemical fertilizers with or without sulfur on date palm cultivar Neghal tosome under sandy calcareous; **Salem and Ali (2020)** mentioned the same findings when studied the effect of some slow fertilizers on Khalas date palm grown under Luxor Governorate conditions; **Moradi *et al.*, (2020)** who studied the effect of foliar application of sulfur on date palm, and **Said *et al.*, (2020)** who spraying of olive (*Olea europaea L.*) by sulfur at 0, 500, 1000, 1500 ppm as foliar application during different physiological stages.

All these previous studies confirmed the positive role of sulfur in increasing fruit trees yield and its components that we found during the present study. In addition, application of sulfur significantly increased Zn solubility, these lead to increasing their uptake by trees roots, then increasing the synthesis of tryptophan amino acid which participant the structure of indol acetic acid (**Marschner 1995 and Kayser *et al.*, 2001**). Furthermore, **Dilmaghani *et al.* (2012)**

mentioned that Fe concentration increased parallel to sulfur applications that may be explained by drop the pH level. Also, **Kalbasi *et al.* (1988)** suggested that sulfur application can change the pH of the soil or rhizosphere from alkaline to acidic, this can led to increase of iron availability and its concentration in plants.

Fruit physical properties

Data concerning the effect of the two sources of sulfur and its concentrations on fruit length and diameter of Sewy date palm during 2018 and 2019 seasons are illustrated in Tables (4). It is noticed from the obtained data that the physical characteristics of the Sewy date palm fruit were improved significantly as a result of spraying agriculture and liquid sulfur in different concentration (200, 300 and 400 ppm). Treating Sewy date palm thrice times with liquid sulfur was significantly favorable in improving fruit physical characteristics, rather than control or those treated with agriculture sulfur as shown in Table (4), during the two experimental seasons. Increasing sulfur concentration caused a significant increase in fruit length (cm) and diameter (cm) over than untreated palms, as clearly shown in Table (4). It is Cleary that, the high concentrations (400 ppm) of the two sulfur sources were remarkable effective than the lower sulfur concentrations (200 and 300 ppm). While non-significant differences were observed between the two highest concentrations (300 and 400 ppm), in both experimental seasons.

The same Table showed that the palms received the highest sulfur concentration (400 ppm) in form of liquid sulfur present the highest fruit length (5.0 & 5.5 cm) and fruit diameter (4.0 & 3.9 cm) during the two experimental seasons respectively. Contrary of this, untreated palms present the lowest fruit length (3.4 & 3.6 cm) and fruit diameter (2.5 & 2.6 cm), during the two experimental seasons respectively.

Table 3. Effect of sulfur source and concentration on bunch weight (kg), yield (kg/palm) and fruit weight (g) of Sewy date palm during 2018 and 2019 seasons

Treatments	Bunch weight (kg)		Yield (kg/palm)		Fruit weight (g)	
	2018	2019	2018	2019	2018	2019
Control	10.00	10.05	100.0	100.5	9.5	9.3
Agriculture sulfur at 200 g/palm	10.65	10.60	106.5	106.0	10.1	10.0
Agriculture sulfur at 300 g/palm	11.32	11.21	113.2	116.6	10.8	10.6
Agriculture sulfur at 400 g/palm	11.82	11.66	118.2	116.6	11.2	11.1
Liquid sulfur at 200g/palm	11.40	11.25	114.0	112.5	10.6	10.7
Liquid sulfur at 300g/palm	12.00	11.85	120.0	118.5	11.2	11.4
Liquid sulfur at 400g/palm	12.48	12.33	124.8	123.3	11.5	11.8
New LSD at 5%	**0.55**	**0.50**	**5.50**	**5.00**	**0.50**	**0.60**

Table 4. Effect of sulfur source and concentration on fruit length (cm) and fruit diameter (cm) of Sewy date palm, during 2018 and 2019 seasons

Treatments	Fruit length (cm)		Fruit diameter	
	2018	2019	2018	2019
Control	3.4	3.6	2.5	2.6
Agriculture sulfur at 200 g/palm	3.9	4.1	2.8	2.9
Agriculture sulfur at 300 g/palm	4.3	4.7	3.2	3.3
Agriculture sulfur at 400 g/palm	4.5	5.0	3.4	3.4
Liquid sulfur at 200g/palm	4.4	4.8	3.3	3.4
Liquid sulfur at 300g/palm	4.9	5.2	3.8	3.8
Liquid sulfur at 400g/palm	5.0	5.5	4.0	3.9
New LSD at 5%	**0.3**	**0.4**	**0.3**	**0.2**

On the line with our results, concerning the effect of different sources of sulfur treatments on fruit physical properties were the findings of **Muhammad *et al.* (2017)** who compared the effect of three different sources of sulfur namely; gypsum ($CaSO_4.2H_2O$), elemental sulfur (S) and ammonium sulfate $\{(NH_4)_2 SO_4\}$ on fruit physical properties of *Citrus limon*; **Kassem (2012**) on Zaghloul date palm grown in calcareous soil.; **Chun *et al.*, (2012)** they studied the effect of lime sulfur at 1% or 2% on 'Fuji'/M.9 and 'Hongro'/M.9 apple cultivars; and **Said *et al.*, (2020)** they examined the effect of sulfur at 0, 500, 1000, 1500 ppm as foliar application on physical and chemical properties of olive (*Olea europaea L.*).

Fruit chemical properties

Data concerning the effect of different source of sulfur and its concentration on total soluble solids, reducing sugars and total sugars, total acidity, total soluble tannin and total crude fibers of Sewy date palm during 2018 and 2019 seasons are illustrated in Tables (5 and 6). Table (5) shows that, both sulfur source and concentration used were capable of causing a significant promotion in T.S.S%, reducing and total sugars % of Sewy date palm over the control palms, during the two experimental seasons. However, regarding the source of sulfur, the palms received the sulfur in form of liquid sulfur present superiority in fruit TSS% and Sugars contents rather than those received the sulfur in form of agriculture sulfur. This data were true during both experimental seasons. Furthermore, both TSS% and sugars contents (reducing sugars% and total sugars%) gradual and significant increased as a result of increasing the concentration of sulfur from 200 ppm to 400 ppm, however non-significant differences were observed between the two highest concentrations namely 300 ppm and 400 ppm.

The highest TSS% (69.9 & 701 %), Reducing sugar % (35.0 & 36.0 %) and total sugars (71.9 & 65.0 %) were obtained from the palms received the sulfur at 400 ppm in form of liquid sulfur, during the two experimental seasons respectively. On the opposite side, untreated palms present the lowest TSS%, Reducing sugar % and total sugars during the two seasons respectively.

On the other hand, gradual and significant decreased in fruit total acidity %, total tannins % and crude fibers% during the two experimental seasons as a result of spraying sulfur at different sources and different concentrations were observed compared to untreated palms (Table 5). This increment was parallel with increasing the sulfur concentrations from 200 to 400 ppm. However, regardless the form of sulfur used, the palms received the highest concentration 400 ppm present the lowest total acidity %, lowest total tannins % and lowest crude fibers % in their fruits. Other words, using the sulfur in form of liquid sulfur showed more effective in decreasing fruit acidity total acidity, total soluble tannins and total crude fibers rather than the agriculture sulfur, these data were true in the both experimental seasons. Furthermore, the obtained data in Table (5) also showed that, no-significant promotion was attributed to increasing the concentration of sulfur from 300 to 400 ppm. Contrary, untreated palms present the highest total acidity %, total soluble tannins and total crude fibers in their fruits, during the two seasons. Then, in economical view, we can recommend treated in this respect was spraying sulfur at 300 ppm in form of liquid sulfur to improve all fruit physic-chemical properties of Sewy date palm.

Table 5. Effect of sulfur source and concentration on TSS%, total sugars% and reducing sugars% of Sewy date palm, during 2018 and 2019 seasons

Treatments	TSS (%)		Total sugars (%)		Reducing sugars (%)	
	2018	2019	2018	2019	2018	2019
Control	65.0	65.6	58.0	58.5	29.5	30.0
Agriculture sulfur at 200 g/palm	66.1	67.0	58.9	59.5	30.6	30.9
Agriculture sulfur at 300 g/palm	67.4	68.1	59.7	60.4	31.4	31.7
Agriculture sulfur at 400 g/palm	68.1	68.8	70.2	61.0	31.8	32.3
Liquid sulfur at 200g/palm	67.5	68.3	59.8	60.5	31.5	31.8
Liquid sulfur at 300g/palm	69.8	69.9	70.5	64.5	34.2	35.5
Liquid sulfur at 400g/palm	69.9	70.1	71.9	65.0	35.0	36.0
New LSD at 5%	**0.8**	**0.9**	**0.6**	**0.7**	**0.5**	**0.6**

The role of spraying sulfur in improving the chemical characteristics of Sewy date palm in terms increasing the T.S.S% total sugars%, and Reducing sugar % as well as decreased total acidity %, total tannins % and total crude fibers % of Sewy date palm fruits was previously illustrated by certain authors such as: **Kassem (2012**) on Zaghloul date palm; **Chun *et al.*, (2012)** on apple trees ; **Al-Obeed *et al.*, (2013)** on Khalas date palm; **Kaur *et al.*, (2013)**on yield and quality of Barhee date palm and **Said *et al.*, (2020)** on olive trees.

It is worth to mention that, promoting the physic-chemical characteristics of Sewy date palm, which observed in this study, may be explained by the essential role sulfur as a constituent of the amino acids cysteine and methionine and part of proteins that plays an important role in the synthesis of vitamins **(Marschner, 1995; Kacar and Katkat, 2007)**. Then, some authors also demonstrated that sulfur fertilization can be significantly changes the chemical composition of fruit crops. Furthermore, the availability of sulfur can determines the efficient use of nitrogen by plants, and then consequently affects plant mineral composition (**Wielebski and Muśnicki, 1998; Krauze and Bowszys, 2000; Kopriva, 2002; Podlesna 2003 and Kulczycki, 2003).** Nitrogen content is significantly modified by the sulfur available (**Kopriva, 2002**). However, application of sulfur significantly increased Zn solubility in soil, these lead to increasing their uptake by trees roots, then increasing the synthesis of tryptophan amino acid which participant the structure of indol acetic acid (**Maquieira *et al.*, 1984; Marschner 1995 and Kayser *et al.*, 2001**).

Table 6. Effect of sulfur source and concentration on total acidity%, total tannins% and total crude fiber% of Sewy date palm, during 2018 and 2019 seasons

Treatments	Total acidity (%)		Total soluble tannins (%)		Total crude fibers (%)	
	2018	2019	2018	2019	2018	2019
Control	0.356	0.350	1.10	1.12	2.44	2.37
Agriculture sulfur at 200 g/palm	0.330	0.328	1.05	1.07	2.28	1.98
Agriculture sulfur at 300 g/palm	0.319	0.300	0.99	1.03	1.95	1.82
Agriculture sulfur at 400 g/palm	0.293	0.295	0.95	1.00	1.77	1.83
Liquid sulfur at 200g/palm	0.300	0.298	0.97	1.00	1.81	1.90
Liquid sulfur at 300g/palm	0.270	0.275	0.91	0.95	1.62	1.55
Liquid sulfur at 400g/palm	0.259	0.258	0.88	0.91	1.54	1.42
New LSD at 5%	**0.02**	**0.02**	**0.05**	**0.04**	**0.21**	**0.22**

Conclusion

From the obtained data during this study, it is maybe strongly recommended to spray Sewy date palms grown in sandy soil under New Valley Governorate conditions with sulfur at 300 ppm in form of liquid sulfur three times just after fruit sett, one month after fruit setting and one month later in order to improve nutritional status, yield and fruit physic - chemical properties.

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RESEARCH ARTICLE

Response of Sewy Date Palm Grown in Sandy Soil to Spraying Two Sources of Sulfur

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