Response of Flame Seedless Grapes to Sulphur and Different Nitrogen Sources and Application Times under Calcareous Soil and Drainage Irrigation Water
I. Soil pH, Growth, Yield and Leaf Chlorophyll and Mineral Content

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ABSTRACT

1. Effect of nitrogen sources

The results of 2001 and 2002 seasons indicated that, regardless of nitrogen application times and sulphur rates, the addition of nitrogen as urea or ammonium nitrate to Flame Seedless grapes grown in calcareous soil and irrigated by drainage water increased shoot length, leaf chlorophyll content, yield and petioles N and K content during both seasons and increased petioles Ca content in the first season as compared with ammonium sulphate. The ammonium sulphate and urea applications increased petioles Mn and Zn in the second season as compared with ammonium nitrate that increased petioles Mg during both seasons. Whereas, urea fertilizer increased petioles Ca and decreased the soil pH in the second season as compared with ammonium sulphate and ammonium nitrate. The ammonium sulphate increased petioles Fe in the second season and Mn in the first season, but decreased soil pH during both seasons. The different nitrogen sources did not affect petioles P and Na content, in both seasons, and Fe and Zn in the first season.

2. Effect of nitrogen application times

Regardless of nitrogen sources and sulphur rates, the application of nitrogen fertilizer at three equal doses to Flame Seedless grapes increased shoot length, yield, leaf chlorophyll content and petioles N, Ca and Mg content. Meanwhile, no differences were found between the three times of nitrogen application, during both seasons, on soil pH and petioles P, K, Na, Zn and Mn content.

3. Effect of sulphur application

The sulphur applied to the soil of Flame Seedless grapes increased shoot length, leaf chlorophyll content, yield and petioles N, Ca and Mg content during the second season, and increased petioles P, K, Fe, Zn and Mn content during both seasons. The sulphur application decreased soil pH and petioles Na in the second season.

INTRODUCTION

The Flame Seedless grape is considered as the most important cultivar among the cultivated grapes in Egypt. During the last few years its cultivated area was rapidly increased, especially in the newly reclaimed land. In addition, attention has been made to increase the vine productivity and quality by means of fertilization.

The response of a large number of fruit crops to the application of NO_3, NH_4 and urea as sources of nitrogen have been reported by Edwards and Horton (1982) on peach, Leschyson and Eaton (1971) on Cran berry vines, Kassem *et al.*(1995a) on citrus, Saleh *et al.*(2000) on pears and Harhash and Abd El-Nasser (2000) on grapes. In most instances, NO_3 form has given the best growth response. However, the response to NH_4 differed among plant species and was affected by the temperature, light intensity, pH and nutrients composition of the medium (Edwards and Horton, 1982). The most commonly reported effect of NH_4 was the reduction of Ca and Mg uptake that occurred regardless of the nutrient solution pH. However, soil pH has a great effect on nutrients, since in acidic soil the nutrient uptake is lower than that in neutral one (Mengel and Kerkby, 1987). In addition, rate of nitrogen uptake has been altered by soil pH where high pH at 7 is favouring for the uptake of NH_4^+ ions and low pH at 5 is convenient for NO_3^- uptake (Abd El-Khalek, 1992). Mills *et al.*(1974) reported that the ammonium volatized from soil at pH 7.2 was 17%, whereas its percentage reached 63% during 7 days by increasing the pH to 8-8.5. Many studies reported the effect of nitrogen form on growth, yield and leaf mineral content in calcareous soil (Maatouk *et al.*, 1988; Ghobrial, 1991; Abd El-Khalek, 1992 and Saleh *et al.*, 2000). Also, the date of nitrogen application had a great effect on yield, leaf chlorophyll and mineral content of fruit trees (Abdel-Khalek, 1992; Kassem *et al.*, 1995a and Saleh *et al.*, 2000).

In the last few years, there has been an increase concern about the role of sulphur application as a soil amendment and fertilizer in calcareous soil. Recently, elemental sulphur has been used to reduce alkalinity in order to reclaim the calcareous soil (Abo Rady *et al.*, 1988 and Modaihsh *et al.*, 1989). Elemental sulphur is oxidized by soil microorganisms to sulphate which lowers soil pH, improves soil structure and increases the availability of certain plant nutrients (Abdel-Fattah and Hilal, 1984 and 1985). Yousry *et al.*(1984) and El-Morshedy (1997) pointed out that sulphur application affected leaf chlorophyll and mineral content and growth of plants.

The objectives of the present study were to investigate the effect of nitrogen forms (urea, ammonium sulphate and ammonium nitrate) at different dates and sulphur application on growth, yield and leaf chlorophyll and mineral content of Flame Seedless grapes grown in calcareous soil and irrigated by drainage water.

MATERIALS AND METHODS

The present investigation was conducted during 2001 and 2002 growing seasons on 8-year old Flame Seedless grapevines (*Vitis vinifera*, L.) grown at Mariut region near Alexandria, Egypt. Vines were grown in calcareous soil and irrigated by drainage water. Trees were planted at 1x4 m spacing and pruned by retaining a maximum of 35-40 nodes/vine. Vines were trained to the quadrilateral cordon system, trellised on two story cross arms system, pruned to approximately 2-3 nodes/fruiting spur. The analysis of orchard soil and irrigation water is presented in Table (1). Organic manure and superphosphate (15.5%

P_2O_5) were added at rates of 15 m^3 and 250 kg per feddan, respectively in December of both seasons. Potassium sulphate (48% K_2O) was added to all vines at rate of 150 kg/fed. at two equal doses in March and May in both seasons. Manure samples were taken, dried and chemically analyzed. Average N, P, K, Ca and Mg contents of the manure were 1.78-1.86, 0.73-0.77, 0.81-0.85, 2.86-2.93 and 1.26-1.32%, respectively, on dry weight basis, of both seasons. The corresponding values of Fe, Mn, Zn and Cu were 540-548, 28-32, 120-126 and 46-50 ppm, respectively in both seasons.

Table 1.
(a) Physical and chemical properties of experimental orchard soil samples.

Properties	Soil depth (cm)	
	0 - 30	30 - 60
$CaCO_3$, %	28.92	31.22
EC, dS/m	4.3	5.3
PH	8.3	7.7
Texture	sandy clay loam	sandy clay loam
Ca^{++}, meq/L	20	24
Mg^{++}, meq/L	8	10
Na^{+}, meq/L	12.7	17.5
K^{+}, meq/L	2.3	1.3
CO_3^{2-}, meq/L	0.0	0.0
HCO_3^-, meq/L	10	10
Cl^-, meq/L	19	17.5

(b) Chemical analysis of irrigation water.

EC dS/m	pH	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{2-}	HCO_3^-	Cl^-
		meq/L						
3.7	7.7	14	7.1	15	1.4	0.0	10	16.5

Seventy two trees, as uniform as possible, were selected for the present study. Three sources of nitrogen fertilizer (urea, ammonium sulphate and ammonium nitrate) were applied at the rate of 150 g N/tree as follows: 1) one dose at March, 2) two equal doses at March and April, and 3) three equal doses at March, April and May during both seasons. Two rates of elemental sulphur (zero and 250 g/vine) were added in December in both seasons. Sulphur was mixed with the organic manure and superphosphate in the 30 cm surface layer of the soil under the vines foliage, about 0.5 m around the vine trunk. Eighteen fertilization treatments, representing all the possible combinations of three sources of nitrogen fertilizer, three nitrogen application times and two levels of elemental sulphur, were used in the present study (3x3x2 = 18 treatments). Each particular fertilization treatment was repeated on the same trees in the two experimental seasons. The treatments were arranged in a randomized complete block design with four replicates for each treatment, using one tree as a single replicate (18 treatments x 4 replicates = 72 trees).

In order to determine shoot length, 5 fruiting spurs were tagged around each tree in March of each year and shoot length was measured in mid June of both seasons. At harvest time (early July), the number and weight of clusters were recorded.

Leaf samples of 20 leaves per replicate were taken from the first fully mature leaves from the tip of the growing shoots in mid June of both seasons for mineral analysis. Leaf samples were separated to petioles and blades. The petioles were washed with tap water and distilled water, oven dried to a constant weight at 70°C and ground. The ground material of each petioles sample was digested with sulphuric acid and hydrogen peroxide, as outlined by Evenhuis and Dewaard (1980). In the digested solution of each sample, N and P were determined colourimetrically according to Evenhuis (1976) and Murphy and Riley (1962), respectively. Potassium and sodium were determined by a flame photometer. Ca, Mg, Fe, Zn and Mn were determined by atomic absorption spectrophotometer. Blade samples were taken to measure leaf total chlorophyll according to Moran and Parath (1980). Soil pH values were determined in August of each season in soil water extract (1:2, w/w) using pH meter. All collected data were subjected to statistical analysis according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

1. Soil pH

1.1. Effect of nitrogen sources

Concerning the effect of nitrogen sources on the soil pH, regardless of nitrogen application times and sulphur, it is clear from data in Table (2) that ammonium sulphate, in both seasons, and urea, in the second season only, reduced the soil pH as compared with ammonium nitrate. These results agreed with those reported by Havelka (1979).

1.2. Effect of nitrogen application times

The data in Table (2) indicated that there were no differences between the three times of nitrogen application on soil pH during both seasons.

1.3. Effect of sulphur

The data (Table 2) clearly indicated that soil pH values significantly decreased as a result of sulphur application in the second season. The reduction in soil pH may be due to the acidification resulted from sulphur oxidation (Abd El-Nasser and Harhash, 2000).

Table 2. Effect of nitrogen sources and application times and sulphur rates fertilization on average shoot length, leaf chlorophyll, yield and soil pH of Flame Seedless grapes during 2001 and 2002 seasons.

Treatment		2001 season					2002 season				
		pH	Leaf chlorophyll (mg/100 g)	Yield		Average shoot length (cm)	pH	Leaf chlorophyll (mg/100 g)	Yield		Average shoot length (cm)
				kg/tree	clusters No./tree				kg/tree	clusters No./tree	
Nitrogen sources (N)	Urea	8.20	250	6.46	14.4	77.3	8.1	260	6.72	14.0	86.5
	Am. sulphate	8.10	230	5.53	13.2	69.4	8.0	232	5.04	11.7	81.0
	Am. nitrate	8.40	244	6.08	13.6	74.1	8.4	256	5.96	12.0	85.3
L.S.D$_{0.05}$		0.21	12	0.40	NS	4.2	0.13	20	0.86	2	3.9
Nitrogen application times (T)	T_1	8.20	230	5.86	13.8	70.7	8.2	231	5.42	12.0	78.8
	T_2	8.30	240	5.77	14.4	72.6	8.2	246	5.34	11.4	83.2
	T_3	8.20	255	6.45	13.0	77.5	8.1	270	6.96	14.3	90.5
L.S.D$_{0.05}$		NS	12	0.40	NS	4.2	NS	20	0.86	2	3.9
Sulphur rates (S)	S_0	8.30	238	5.90	13.8	72.8	8.3	233	5.21	11.5	82.2
	S_1	8.20	245	6.14	13.7	74.4	8.0	266	6.60	13.5	86.3
L.S.D$_{0.05}$		NS	NS	NS	NS	3.4	0.11	16	0.71	1.6	3.2
L.S.D$_{0.05}$											
N x T		NS	*	*	NS	*	NS	*	*	*	*
N x S		NS	*	*	NS	*	*	*	*	*	*
T x S		NS	NS	*	NS	NS	NS	*	*	NS	*
N x T x S		NS	*	*	NS	*	*	*	*	*	*

Am. = Ammonium. * = Significant. NS = Not significant.

2. Shoot length

2.1. Effect of nitrogen sources

Regarding the effect of nitrogen sources on shoot length of Flame Seedless grapes, it is clear from data in Table (2) that addition of nitrogen as urea or ammonium nitrate increased the shoot length as compared with the ammonium sulphate during both seasons. The differences between urea and ammonium nitrate were not significant. These results are in agreement with those reported by Ghobrial (1991) on grapes, who found that urea and ammonium nitrate increased grape growth in sandy calcareous soil. Lavin and Valenzuele (1986) on grapes and Kassem *et al.*(1995a) on citrus found that the highest growth was recorded by using ammonium nitrate.

2.2. Effect of nitrogen application times

With regard to the effect of nitrogen application times on growth, the obtained data in Table (2) revealed that during both seasons there was a significant increase in shoot length of Flame Seedless treated with nitrogen applied at three equal doses compared with one or two equal doses. This was probably due to increase of leaf nitrogen under application of nitrogen at three equal doses (Tables 3 and 4). Gao *et al.*(1992) reported that the growth of apple trees was profoundly influenced by the time of nitrogen applied.

2.3. Effect of sulphur

Regardless of nitrogen forms and times of application, the data in Table (2) revealed that the addition of sulphur increased shoot length of Flame Seedless grapes. This increment was significant in the second season only. These results agree with those reported by Harhash and Abd El-Nasser (2000) on Flame Seedless grapes. Yousry *et al.*(1984) reported that the oxidation of sulphur applied to the soil led to acidification which enhanced the solubility of soil nutrients.

3. Leaf chlorophyll

3.1. Effect of nitrogen sources

Regardless of nitrogen application times and sulphur rates, the data in Table (2) indicated that the highest leaf chlorophyll content was obtained from grapes fertilized with urea or ammonium nitrate during both seasons. The increase in leaf chlorophyll due to urea and ammonium nitrate could be attributed to positive effect of urea and ammonium nitrate on leaf nitrogen content (Tables 3 and 4). Rombola *et al.*(1997) found that urea increased leaf chlorophyll content as compared with ammonium nitrate applied to the peach orchard.

3.2. Effect of nitrogen application times

The data in Table (2) showed that, regardless of nitrogen sources and sulphur rates effect, the highest leaf chlorophyll content was obtained from trees fertilized with nitrogen at three equal doses during both seasons. This was probably due to increase of leaf nitrogen and magnesium under fertilization with nitrogen at three equal doses (Tables 3 and 4).

3.3. Effect of sulphur

With regard to the effect of sulphur on leaf chlorophyll content of Flame Seedless grapes, the obtained results (Table 3) showed that the application of sulphur, generally, increased leaf chlorophyll content, with increase being significant in the second season only. Such increase may be explained on the basis that sulphur applied increased the uptake of nitrogen, magnesium and iron content (Tables 3 and 4), such elements have close association in chlorophyll biosynthesis (Hall and Rao, 1996). Or may be attributed to the increase of photosynthesis rate as a result of more uptake of soil available nutrients, which cause an increase in growth and photosynthesis efficiency. These results could be supported by El-Morshedy (1997) and Harhash and Abd El-Nasser (2000) findings.

4. Yield

4.1. Effect of nitrogen sources

Concerning the effect of nitrogen sources on Flame Seedless grapes yield, data in Table (2) illustrated that urea and ammonium nitrate fertilizers significantly increased the yield as kg/tree, during both seasons. The number of clusters/tree, in the second season increased by urea. These results are in line with those reported by Ghobrial (1991) on grapes under calcareous soil. Saleh *et al.*(2000) on pear and Mansour (1998) on grapes found that the bentonite-coated urea significantly increased yield (kg/tree and number of fruits/tree) comparing with urea treatment.

4.2. Effect of nitrogen application times

Data presented in Table (2) showed that application of nitrogen at three equal doses increased yield as kg/tree, during both seasons, and as number of clusters/tree, in the second season, as compared with one dose or two equal doses. These findings are not in line with those obtained by other investigators such as Saleh *et al.*(2000) on pear and Kassem *et al.*(1995a), who found that the yield/tree was not significantly affected by the number of doses of nitrogen fertilization.

4.3. Effect of sulphur

Regardless of nitrogen sources and times of application, the data in Table (2) showed that sulphur application significantly increased both of yield as kg/tree and number of clusters/tree in the second season only. The increase of yield as a result of sulphur application may be attributed to the effect of sulphur in decreasing soil pH (Jones, 1982; Kassem *et al.*, 1995b and Harhash and Abd El-Nasser, 2000) and, consequently, increasing the nutrient uptake and

Table 3. Effect of nitrogen sources and application times and sulphur rates fertilization on petioles mineral content of Flame Seedless grapes during 2001 season.

Treatment		N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Na (%)	Fe (ppm)	Zn (ppm)	Mn (ppm)
Nitrogen sources (N)	Urea	2.21	0.18	1.73	1.41	0.36	0.38	90	26	30
	Am. sulphate	2.01	0.20	1.57	1.19	0.32	0.34	84	30	36
	Am. nitrate	2.13	0.16	1.72	1.42	0.53	0.33	94	29	31
$L.S.D_{0.05}$		0.09	NS	0.13	0.16	0.11	NS	NS	NS	5
Nitrogen application times (T)	T_1	1.97	0.18	1.60	1.22	0.32	0.32	93	26	33
	T_2	2.02	0.17	1.70	1.36	0.42	0.36	87	28	34
	T_3	2.36	0.18	1.71	1.43	0.48	0.38	88	30	31
$L.S.D_{0.05}$		0.09	NS	0.13	0.16	0.11	NS	NS	NS	NS
Sulphur rates (S)	S_0	2.09	0.15	1.56	1.40	0.39	0.37	82	25	30
	S_1	2.14	0.20	1.78	1.28	0.43	0.33	97	32	35
$L.S.D_{0.05}$		NS	0.04	0.11	NS	NS	NS	12	5	4
$L.S.D_{0.05}$										
N x T		*	NS	*	*	*	NS	NS	NS	*
N x S		*	*	*	*	NS	NS	*	*	*
T x S		*	NS	*	NS	NS	NS	NS	NS	NS
N x T x S		*	*	*	*	*	NS	*	*	*

Am. = Ammonium. * = Significant. NS = Not significant.

Table 4. Effect of nitrogen sources and application times and sulphur rates fertilization on petioles mineral content of Flame Seedless grapes during 2002 season.

Treatment		N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Na (%)	Fe (ppm)	Zn (ppm)	Mn (ppm)
Nitrogen sources (N)	Urea	2.33	0.19	1.71	1.38	0.33	0.30	78	35	32
	Am. sulphate	2.00	0.21	1.45	1.18	0.31	0.35	93	34	34
	Am. nitrate	2.24	0.17	1.69	1.10	0.54	0.32	79	27	26
	$L.S.D_{0.05}$	0.15	NS	0.20	0.13	0.12	NS	13	5	4
Nitrogen application times (T)	T_1	2.05	0.19	1.63	1.13	0.35	0.28	87	34	30
	T_2	2.15	0.18	1.60	1.18	0.32	0.32	82	30	32
	T_3	2.36	0.20	1.62	1.35	0.50	0.36	79	32	30
	$L.S.D_{0.05}$	0.15	NS	NS	0.13	0.12	NS	NS	NS	NS
Sulphur rates (S)	S_0	2.10	0.16	1.51	1.13	0.32	0.38	75	28	29
	S_1	2.27	0.22	1.72	1.31	0.47	0.26	92	36	33
	$L.S.D_{0.05}$	0.12	0.06	0.18	0.11	0.10	0.08	11	4	3
$L.S.D_{0.05}$										
	N x T	*	NS	*	*	*	NS	*	*	*
	N x S	*	*	*	*	*	*	*	NS	*
	T x S	*	NS	*	*	*	NS	*	NS	NS
	N x T x S	*	*	*	*	*	*	*	*	*

Am. = Ammonium. * = Significant. NS = Not significant.

translocation (Hening *et al.*, 1991), thereby improving vine conditions and increasing the yield.

5. Petioles elemental composition

5.1. Effect of nitrogen sources

Concerning the effect of nitrogen sources on the nutritional status of Flame Seedless, it is clear from data in Tables (3 and 4) that no significant differences were found in petioles P and Na content during both seasons, and petioles Fe and Zn in the first season. These results, generally, agreed with those reported by Raese (1986), who found that the nitrogen source in the form of urea, ammonium sulphate and ammonium nitrate did not affect leaf P, Fe and Zn content. Additionally, Eltahir and Oberly (1982) found that the nitrogen source had little influence on leaf Fe and Zn content. In the meantime, Ghobrial (1991), Kassem *et al.*(1995a) and Saleh *et al.*(2000) reported that leaf P percentage was not significantly affected by different nitrogen sources.

The same data in Tables (3 and 4) revealed that the application of urea and ammonium nitrate increased petioles N and K, in both seasons, and Ca in the first season, as compared with ammonium sulphate which increased petioles Fe, in the second season, and Mn, in the first season. Additionally, urea applied increased petioles Ca content, in the second season, as compared with ammonium sulphate or ammonium nitrate. Besides, urea and ammonium sulphate application increased petioles Mn and Zn, in the second season, as compared with ammonium nitrate which increased petioles Mg, in both seasons.

The increase in petioles Mg content resulting from ammonium nitrate fertilizer could be attributed to the presence of Mg in ammonium nitrate fertilizer used in this study. Saleh *et al.*(2000) found that there was a significant increase in leaf N and K content of pear trees treated with bentonite-coated urea as compared with urea fertilizer. Raese (1986) reported that ammonium nitrate and ammonium sulphate increased leaf N content. In the meantime, Leschyson and Eaton (1971) found that NO_3 increased leaf N and Mg, but decreased leaf K and Ca. Meanwhile, Kassem *et al.*(1995a) found that ammonium sulphate increased leaf N, Ca, Fe, Zn and Mn as compared with ammonium nitrate which increased leaf Mg content.

5.2. Effect of nitrogen application times

The data in Tables (3 and 4) indicated that, regardless of nitrogen sources and sulphur applications, there were no differences between the three times of nitrogen application, in both seasons, on petioles P, K, Na, Fe, Zn and Mn content of Flame Seedless grapes. Meanwhile, the applied nitrogen at three equal doses increased petioles N in both seasons, Ca and Mg content in the second season as compared with one dose or two equal doses. Saleh *et al.*(2000), on pear, found that the nitrogen application time did not affect leaf N, P and K content. In the meantime, Kassem *et al.*(1995a), on citrus, found that nitrogen application time did not affect N, P, K, Ca, Mg, Fe, Zn and Mn content. The increase in petioles N content under applied nitrogen at three equal doses could be attributed to the minimizing the loss of nitrogen from soil by leaching of nitrate and nitrite, or reduction of nitrate resulting in the formation of nitrogen gas that loss by volatilization (Harhash and Abd El-Nasser, 2000).

5.3. Effect of sulphur

Data presented in Tables (3 and 4) showed that the petioles P, K, Fe, Zn and Mn content, during both seasons, and N, Ca and Mg in the second season, were significantly increased as a result of sulphur application. Meanwhile, petioles Na content decreased in the second season. Such results may be due to the effect of sulphur oxidation to SO_4^{2-} and sulfuric acid by microorganisms which, in turn, lowered the soil pH and, consequently, increased the availability of nutrients and improved the nutrients uptake. These results are in line with those obtained by Hening *et al.*(1991), Kassem *et al.*(1995b), El-Morshedy (1997) and Harhash and Abd El-Nasser (2000).

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الملخص العربى

إستجابة أشجار العنب صنف فيلام سيدلس النامى فى أرض جيرية ورى صرف لإضافة الكبريت والنتروجين بصور وعدد مرات إضافة مختلفة.

١- درجة قلوية التربة والنمو والمحصول ومحتوى الأوراق من الكلوروفيل والعناصر المعدنية.

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أجريت هذه الدراسة خلال عامى ٢٠٠١ ، ٢٠٠٢ على أشجار عنب صنف فيلام سيدلس نامى فى أرض جيرية ورى صرف وذلك لغرض دراسة تأثير الكبريت المعدنى كذلك إضافة النتروجين بصور وطرق مختلفة على الحالة الغذائية والنمو والمحصول ومحتوى الأوراق من الكلوروفيل كذلك على درجة قلوية التربة وكانت أهم النتائج المتحصل عليها:

١- تأثير نوع مصدر النتروجين

- إضافة النتروجين فى صورة يوريا أو نترات الأمونيوم سبب زيادة فى النمو ومحتوى الأوراق من الكلوروفيل والمحصول ومحتوى أعناق الأوراق من النتروجين والبوتاسيوم فى عامى الدراسة والكالسيوم فى الموسم الأول بالمقارنة بصورة سلفات الأمونيوم التى سببت زيادة فى محتوى أعناق الأوراق من الحديد فى الموسم الثانى والمنجنيز فى الموسم الأول بالمقارنة بصورة نترات الأمونيوم واليوريا. كذلك سببت نقص فى درجة قلوية التربة فى عامى الدراسة بالمقارنة بنترات الأمونيوم.
- سبب إضافة النتروجين بصورة سلفات الأمونيوم واليوريا زيادة فى محتوى أعناق الأوراق من المنجنيز والزنك فى الموسم الثانى فقط بالمقارنة بصورة نترات الأمونيوم التى سببت زيادة فى محتوى أعناق الأوراق من المغنيسيوم فى عامى الدراسة، أدت صورة اليوريا إلى زيادة فى محتوى أعناق الأوراق من الكالسيوم ونقص فى درجة قلوية التربة فى الموسم الثانى بالمقارنة بصورة نترات الأمونيوم أو سلفات الأمونيوم.
- لم يكن هناك تأثير لنوع صورة النتروجين المضاف على محتوى أعناق الأوراق من الصوديوم والفوسفور فى عامى الدراسة وكذلك على الحديد والزنك فى الموسم الأول.

ثانيا: تأثير عدد مرات إضافة النتروجين

- إضافة النتروجين على ثلاث دفع متساوية إلى عنب الفيلام سيدلس سبب زيادة فى النمو والمحصول ومحتوى الأوراق من الكلورفيل ومحتوى الأعناق من النتروجين والكالسيوم والمغنيسيوم فى عامى الدراسة . بينما لم يكن هناك تأثير لعدد حدوث الإضافات على درجة قلوية التربة ومحتوى أعناق الأوراق من الفوسفور والبوتاسيوم والصوديوم والزنك والمنجنيز فى عامى الدراسة.

ثالثا: تأثير إضافة الكبريت

- أدت إضافة الكبريت إلى العنب الفيلام سيدلس النامى فى الأرض الجيرية إلى زيادة النمو والمحصول ومحتوى الأوراق من الكلورفيل والنتروجين والكالسيوم والمغنيسيوم وذلك فى العام الثانى فقط وكذلك زيادة محتوى أعناق الأوراق من الفوسفور والبوتاسيوم والحديد والزنك والمنجنيز فى عامى الدراسة ولكن سبب إنخفاض فى درجة قلوية التربة ومحتوى الأعناق من الصوديوم فى الموسم الثانى فقط.