J. Agric. Sci. Mansoura Univ., 31 (4): 2239 - 2252, 2006

VEGETATIVE GROWTH AND YIELD OF THOMPSON SEEDLESS GRAPEVINES AS AFFECTED BY NPK FERTILIZATION AND APPLICATION OF SOME SOIL AMENDMENT AGENTS

Zayan, M.A.*; M.M. El-Mogy ** and G.B. Mikhael **
*** Horticulture Depart., Faculty of Agric. (Kafr El-Sheikh), Tanta Univ.**
****Horticulture Res. Institute, Agric. Res. Center. Giza, Egypt**

ABSTRACT

This study was carried out to study the effect of NPK fertilization and application of some soil amendment agents on vegetative growth and yield of Thompson Seedless grapevines in three years 2002, 2003 and 2004. Results were taken in the second and third season. Thirteen treatments were applied. Three doses of N with one dose of K, P, gypsum or sulphur. Each N dose was applied in three times as equal ratios, at the first of February and mid April and May, respectively. While, P fertilizer was applied with the application of gypsum or sulphur in November. K fertilizer was applied once at the first application of nitrogen on February.

Soil application with gypsum or sulphur led to improve most soil physical and chemical properties. Adding gypsum or sulphur to the fertilization program gave the highest shoot length and best root distribution as number of fibrous roots and fresh weight (g) in the upper layer (0-30) cm and at (30-60) cm depth compared to the control in three seasons.. Higher nitrogen rate (N_3) with gypsum or sulphur treatments led to improve nutrient status as leaf chlorophyll a and b values total carbohydrate and leaf petioles mineral contents especially N, P, Ca and Mg in the three seasons of study. Moderate nitrogen rate (N_2) with gypsum or sulphur treatments produced higher yield as number of clusters and weight (g)/vine and improved most physical and chemical properties of clusters and berries juice TSS value.

Thus, the best treatment in this study was by adding Moderate nitrogen rate (N_2) with gypsum or sulphur treatments to the fertilization program to gain maximum yield with good cluster quality for Thompson seedless grapevines.

INTRODUCTION

Thompson Seedless (Banaty) *Vitis vinifera* is one of the main varieties of grapes grown under Egyptian environmental conditions. It is well be grown in the Delta and North Sector of Tharir (Abdel-Kawi *et al.*, 1984). At North Delta in Kafr El-Sheikh region where the soil is alkaline, productivity of grape vine is low with poor fruit quality. The addition of gypsum or sulphur to alkaline soils reduced soil pH and improved soil physical and chemical properties (El-Mowelhi, 1982 and Zayan *et al.*, 1989c) also, increased uptake of nutrients (El-Morshedy, 1997) and enhanced vine growth and yield.

The interaction of plants, soil and application of fertilizers and cycle of nutrients in agriculture is very important to improve soil fertility, yield and fruit of trees, their quality and. Maximum yield and quality was obtained from competition between the requirements of tree and the cultivation conditions related to soil physical and chemical properties and other environmental factors in any region. Therefore, it is difficult to outline a single fertilization program that is suitable for all soil conditions.

The present work was planned to study the possible effects of gypsum and sulphur as soil amendment agents added with three nitrogen levels with the recommended doses of P and K on vegetative growth, nutrition uptake, yield and fruit quality of Thompson Seedless grapevines grown in Kafr El-Sheikh region. Treatments effects were also studied on soil physical and chemical properties.

MATERIALS AND METHODS

This study was carried out during 2002, 2003 and 2004 seasons on 16-years old Thompson seedless grapevines grown in a private orchard at Biala District, Kafr El-Sheikh governorate, where the soil is slightly alkaline. The soil was classified as clay silt and the depth of water table was about 140 cm. Results were taken in the second and third season.

Table (1): Mechanical and chemical analysis of the experimental soil (0-60 cm).

Mechanical analysis				Chemical analysis		
Clay %	Silt %	Sand %	Texture grade	Soil pH	EC mmhos/cm	SAR
53.15	40.61	6.24	Clay silt	8.2	3.10	4.11

The vines were planted at 2.5 x 2.5 meters, trained according to the cane pruning system to (4 canes/vine x 12 buds/cane) and trellised by the "T" shape system.

The objective of this experiment was to study the effect of three nitrogen levels with the recommended levels of P and K fertilizers, in addition to the effect of gypsum and sulphur as two soil amendment agents. Vines which received NPK fertilization programme as grape growers used to apply in this region (control). 156 uniform grapevines were selected for the 13 listed treatments including the control. Complete randomized block design was used, each treatment included 3 replicates with 4 vines for each treatment which presented in Table (2).

Table (2): Treatments used in this experiment.

Treatments	Doses of fertilization and soil amendments
N_1 + P	70 g N + 16 g P_2O_5/vine/year
N_2 + P	90 g N + 16 g P_2O_5/vine/year
N_3 + P	110 g N + 16 g P_2O_5/vine/year
N_1 + P + K	70 g N + 16 g P_2O_5 + 48 g K_2O/vine/year
N_2 + P + K	90 g N + 16 g P_2O_5 + 48 g K_2O/vine/year
N_3 + P + K	110 g N + 16 g P_2O_5 + 48 g K_2O/vine/year
N_1 + P + K + G	70 g N + 16 g P_2O_5 + 48 g K_2O + 2 kg gypsum/vine/year
N_2 + P + K + G	90 g N + 16 g P_2O_5 + 48 g K_2O + 2 kg gypsum/vine/year
N_3 + P + K + G	110 g N + 16 g P_2O_5 + 48 g K_2O + 2 kg gypsum/vine/year
N_1 + P + K + S	70 g N + 16 g P_2O_5 + 48 g K_2O + 1 kg sulphur/vine/year
N_2 + P + K + S	90 g N + 16 g P_2O_5 + 48 g K_2O + 1 kg sulphur/vine/year
N_3 + P + K + S	110 g N + 16 g P_2O_5 + 48 g K_2O + 1 kg sulphur/vine/year
NPK control	50 g N + 16 g P_2O_5 + 48 g/vine/year

N = Nitrogen from ammonium sulphate 20.6% N
P = Phosphorus from calcium super phosphate 16.0% P_2O_5
K = Potassium from potassium sulphate 48% K_2O
G = Gypsum 70% $CaSO_4$. $2H_2O$
S = Sulphur: elemental sulphur 99.5%.

Soil amendment agents (2 kg gypsum or 1 kg sulphur per vine) were applied in an area covering about 1.25 meters on all directions of the treated vines in November of each year. The land was hawed after adding gypsum and sulphur to mixed them with the soil and directly irrigated afterwards. Each nitrogen rate was applied in three doses at the end of February and mid April and May, respectively in both years. Phosphorus fertilizer was applied with the application of gypsum or sulphur in November. Potassium fertilizer was applied once at the first application of nitrogen on February of 2002, 2003 and 2004. Two rows of neutral vines were left from all sides of the treated vines.

1- Soil physical and chemical properties:

The effect of the listed treatments was studied on soil physical and chemical properties. Soil samples were taken at the end of two growing seasons from major root zone before and after the treatments. Soil samples were air-dried and passed through 2 mm sieve to be ready for physical and chemical analysis. Soil chemical properties were determined according to Jackson (1967). Soil physical (total porosity and aggregation) were made according to Singh (1980).

2-Morphological growth parameters:

3 shoots/cane were sampled in both seasons of 2003 and 2004 at 20 days intervals from 22 April to 22 June and used for measuring shoot length (cm). Fibrous roots density was determined in soil samples taken in August of both seasons at 0-30 and 30-60 cm depth by soil auger at 100-120 cm from vine trunk horizontally in the four directions. Fibrous roots less than 2 mm in diameter from each sample were cleaned, counted and their fresh weight was determined as g/hole (1508.57 cm^3 soil) according to methods described by (Cahoon *et al.*, 1959 and Ford, 1962).

3-Nutritional status:

Petioles were collected from leaves opposite to the first basal clusters on the shoots in May to determine of N (Pregl, 1945), P (Snell and Snell 1967), K (Jackson, 1967), Ca and Mg Yoshida *et al.* (1972). Chlorophyll a and b were determined according to Moran (1982). Total carbohydrates were determined by Dobios *et al.* (1956). Then the C/N ratio was calculated.

4-Yield and its components:

Yield and its components (number of clusters and weight of cluster/vine (g)) were recorded at harvest time (at 16-17% TSS) Tourky *et al.*, (1995) of 2003 and 2004 seasons.

5. Physical and chemical fruit properties:

Weight of 100 berries (g), volume of 100 berries (cm^3), total soluble solids (TSS) were determined hand refractometer and total acidity was determined as tartaric acid equivalent per 100 ml grape juice (AOAC, 1965), then TSS/acid ratio was calculated.

6- Statically analysis :

The statistical analysis of the present data was carried out according to the methods described by Snedecor and Cochran (1980). Treatment means were compared statistically using Duncan's multiple range test at 5% level of probability.

RESULTS AND DISCUSSION

1. Soil physical and chemical properties:

a. Soil physical properties:

Data presented in Table (3) indicated that, aggregation parameters i.e. water stable aggregates % (WSA) and aggregates index (AI) in upper layer (0-30) cm were increased with sulphur and gypsum applications thus, soil structure was improved. This obtained result is in agreement with that reported by Zayan *et al.* (1989b), Shehata *et al.* (1992) and Koriem (1994). Also, total porosity % was increased by application of the two types of soil amendment agents which caused a fast improving in soil water infiltration. Similar results were obtained by Scott *et al.* (1968).

b. Soil chemical properties:

Data in Table (3) showed that, the addition of gypsum or sulphur to alkaline soils reduced pH values in both surface and subsurface layers (0-30) and (30-60) cm, respectively. Meanwhile, NPK control treatment exhibited the highest pH value. The obtained data are in line with those reported by Yousry *et al.* (1984) they found that, sulphur application decreased pH values through its oxidation by soil microorganisms which are able to produce free sulphuric acid in amount enough to lower the pH. Similar results were obtained by Khafagi and Abd el-Hadi (1990) and Koriem (1994).

Soluble salts as represented by values of electrical conductivity (EC) was reduced in all soil depths especially in surface layer (0-30) cm by soil application with gypsum or sulphur as a result of acidity and formation of soluble Na_2SO_4 which leaching through movement of irrigation water downward due to improvement of soil structure. Similar results were obtained by Koreim (1994). As for sodium absorption ratio (SAR) it is clear that gypsum or sulphur application reduced it value especially at soil surface layer (0-30) cm where amendment agents were incorporated. This reduction in SAR value of alkaline soil by gypsum and sulphur application may be due to reduced its sodium content whereas, Ca^{++} replaces Na^{+} on the soil exchange complex (Zayan *et al.*, 1989d). Moreover, Koriem (1994) indicated that, SAR considerable good index for testing the effectiveness of reclamation processes.

It is clear that, $CO^{=}_3$, HCO^{-}_3 and Cl^{-} anions were decreased by adding gypsum or sulphur. Higher reduction was noticed in the surface layer (0-30) cm while, $SO^{=}_4$ concentration in soil extract was increased due to presence of free sulphuric acid. Moreover, K^{+} and Na^{+} cations were decreased whereas, Ca^{++} and Mg^{++} were increased. These results may be attributed to Ca^{++} and Mg^{++} replaced Na^{+} and K^{+} in soil exchange complex. Similar results were obtained by Khafagi and Abdel-Hadi (1990) and Koriem (1994).

The obtained results in this investigation concluded that, applying gypsum or sulphur to alkaline soils led to improve most of soil physical and chemical properties which allowed a better conditions for grape vine root growth as a result which in turn improved vegetative growth and achieved maximum vine yield.

Table (3): Physical and chemical properties of soil orchard as affected by some fertilization and amendment agent treatments (average of 2003 and 2004).

Treatments	Sampling depth	Soil pH	EC mmhos/	SAR	Soluble cations meq/L				Soluble anions meq/L				Total porosity	Aggregation	
	(cm)		cm		Na^+	K^+	Ca^{++}	Mg^{++}	CO_3^-	HCO_3^-	SO_4^-	Cl^-	%	WSA %	A.I
Average N + P	0-30	8.14	3.14	3.92	11.37	2.41	8.96	7.02	1.09	2.07	12.49	14.11	46.83	10.41	0.24
	30-60	8.16	2.98	4.20	11.32	2.23	7.72	5.25	1.20	2.19	8.81	14.32	-	-	-
Average N + P + K	0-30	8.07	3.12	4.11	10.91	2.76	8.75	6.91	1.13	2.04	12.78	13.38	48.56	10.37	0.25
	30-60	7.98	2.85	4.32	10.94	2.51	7.60	5.17	1.14	2.22	8.65	14.21	-	-	-
Average N + P + K + G	0-30	7.91	2.91	0.55	4.86	2.10	15.14	8.69	0.15	0.41	24.11	6.12	57.19	15.69	0.36
	30-60	7.94	2.78	2.19	6.71	2.17	14.26	6.42	0.50	0.59	21.06	7.41	-	-	-
Average N + P + K + S	0-30	7.55	2.88	0.81	5.11	2.07	14.07	10.45	0.26	0.46	24.63	6.35	55.36	14.20	0.31
	30-60	7.62	2.51	2.23	7.09	2.15	13.66	6.80	0.54	0.78	20.13	8.25	-	-	-
NPK control	0-30	8.18	3.15	4.01	10.98	2.50	8.86	7.25	1.12	2.15	13.09	14.23	45.71	10.18	0.25
	30-60	8.20	3.02	4.16	10.87	2.38	7.64	4.88	1.24	2.19	7.95	14.39	-	-	-

W.S.A. ; Water stable aggregation A.I.: Aggregation index

Table (4): Effect of NPK fertilization and application of some soil amendment agents on shoot length (cm) of Thompson Seedless grapevines in 2003 and 2004 seasons.

Treatments	Shoot length (cm)							
	2003 season				2004 season			
	22 April	12 May	2 June	22 June	22 April	12 May	2 June	22 June
N_1 + P	25.7 h	57.2i	99.3 k	117.2 j	26.6 h	58.1 L	90.3 g	120.1 h
N_2 + P	26.8 g	65.5 g	104.3 i	140.3 h	27.1 g	65.8 j	105.7 e	140.3 f
N_3 + P	26.7 g	65.5 g	100.3 j	142.2 f	27.1 g	66.1 i	106.3 e	146.1 f
N_1 + P + K	27.5 f	63.2 h	106.5 g	134.1 i	28.1 f	64.2 k	102.2 f	138.2 g
N_2 + P + K	28.5 e	67.5 f	116.5 f	142.2 f	28.4 f	68.2 f	108.1 e	146.7 f
N_3 + P + K	30.6 d	70.8 e	105.3 h	159.2 e	31.4 d	71.7 e	120.2 d	159.4 e
N_1 + P + K + G	28.2 e	65.7 g	121.2 e	141.2 g	29.0 e	66.4 g	106.5 e	145.2 f
N_2 + P + K + G	33.3 b	76.4 c	132.3 d	161.5 d	34.2 b	75.7 c	122.4 d	164.2 d
N_3 + P + K + G	35.7 a	81.4 b	104.1 i	174.3 c	35.4 a	82.4 b	133.7 c	178.6 c
N_1 + P + K + S	30.2 d	66.6 fg	161.3 a	176.5 b	31.2 d	67.5 g	106.2 e	180.2 c
N_2 + P + K + S	32.5 c	73.3 d	140.5 c	199.3 a	33.1 c	74.4 d	169.8 a	205.8 a
N_3 + P + K + S	33.3 b	92.7 a	141.4 b	180.3 b	34.1 b	93.3 a	148.4 b	184.4 b
NPK control	25.7 h	56.4 i	86.7 l	106.3 k	26.5 h	57.5 m	91.2 g	110.4 i

In the same column, means followed by the same letter are not significantly different according to DMRT

N_1, N_2 and N_3 = 70, 90 and 110 gm N/vine/year, respectively.

P = 16 gm P_2O_5/vine/year. K = 48 gm K_2O/vine/year.

G = 2 km gypsum/vine/year. S = 1 km sulphur/vine/year.

NPK control = 50 gm N + 16 gm P_2O_5 + 48 gm K_2O/vine/year.

2. Morphological growth parameters:
a. Shoot growth:

Data concerning shoot length (cm) and relative shoot length increment of Thompson seedless grapevines as affected by NPK fertilization and soil amendment agents treatments are shown in Table (4) and Fig. (1) which indicated that, all treatments tend to increase shoot length at different dates during the two growing seasons from April till the end of June and its relative increment than the control. A significant increases in shoot length were noticed by adding high rate of nitrogen (110 g N/vine) in all fertilization treatments in both seasons. This result may be attributed to the role of high level of nitrogen in enhanced the net of photosynthesis (Pn) and increasing the photosynthetic products (Compelell and Marini, 1990). Such findings are in agreement with those reported by Hassan *et al.* (1984) they indicated that shoot length of Thompson seedless grapevines was significantly increased by increasing nitrogen levels. Adding K to all NP treatments also increased shoot length in all dates in the two seasons as shown in Table (4). Similar results were obtained by Canradia and Saaymnd (1989) on "Chenin Blanc" vines.

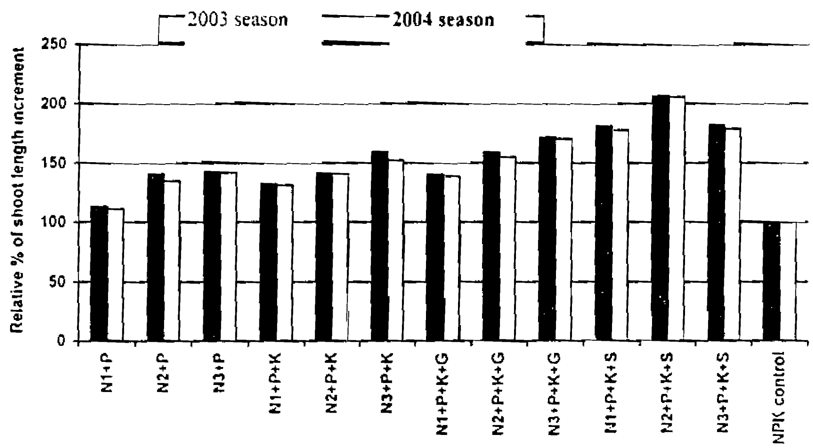

Fig. (1): Effect of NPK fertilization and application of some soil amendment agents on relative % of shoot length of Thompson seedless (grape vines) in 2003 and 2004 seasons.

The data also, revealed that, treatments involved gypsum or sulphur led to a significant increase in shoot length and the highest values were obtained with gypsum or sulphur to (N_2 + P + K) and (N_3 + P + K) treatments. The same trend was observed in the second seasons. These results are in line with those reported Zayan *et al.* (1989a) and El-Morshedy (1997). The more pronounced increase were found with (N_2 + P + K + S) treatment where the relative percentage of shoot length increment was about 106.95% and 105.84% over the control during second and third seasons, respectively.

b. Root growth:

Table (5) shows the average number and fresh weight (g/hole)of fibrous roots of Thompson seedless grapevine at (0-30) and (30-60) cm soil depth during 2003 and 2004 seasons. It is clear that, adding (N_2 + P + K) treatment produced the highest number and weight of fibrous roots either at (0-30) or (30-60) cm soil depth, gypsum or sulphur when added produced the best root distribution as number and fresh weight of fibrous roots in the upper layer (0-30) cm and the following one (30-60 cm) depth in both seasons. These results may be attributed to positive effects of gypsum and sulphur on soil properties i.e. infiltration of water into the soil, decreased soil salinity and pH value as well as improved nutrients uptake so, best results for shoot growth and root distribution were obtained. These results are in harmony with those obtained by Dawood (1988).

Table (5): Effect of NPK fertilization and application of some soil amendment agents on number and fresh weight (gm/hole) of fibrous root of Thompson Seedless grapevines in 2003 and 2004 seasons.

Treatments	Average number of root*				Average root fresh weight (g/hole)			
	0-30 cm depth		30-60 cm depth		0-30 cm depth		30-60 cm depth	
	2003	2004	2003	2004	2003	2004	2003	2004
N_1 + P	671.59 m	670.67 k	288.00 k	232.00 k	3.15 h	2.01 h	1.08 g	1.11 L
N_2 + P	686.63 j	687.44 i	300.17 i	254.67 i	3.59 c	2.26 g	1.39 de	1.39 f
N_3 + P	673.20 L	673.13 j	293.17 j	250.31 j	3.28 f	2.17 g	1.18 fg	1.19 j
N_1 + P + K	759.10 i	759.02 g	309.33 h	309.20 h	3.42 d	3.03 c	1.28 ef	1.28 g
N_2 + P + K	817.75 f	617.66 m	395.70 g	453.65 c	3.81 a	2.52 e	1.55 cd	1.55 b
N_3 + P + K	789.20 h	789.18 e	399.47 f	399.42 f	3.74 b	2.40 f	1.49 cd	1.48 c
N_1 + P + K + G	899.20 e	760.50 f	420.41 e	320.31 g	3.21 g	2.61 de	1.64 bc	1.41 k
N_2 + P + K + G	1200.41 a	1200.34 c	590.54 a	420.10 e	3.61 c	2.42 f	1.96 a	1.43 e
N_3 + P + K + G	1100.94 b	976.08 d	590.06 a	400.25 f	3.73 e	3.22 b	1.41 de	1.25 h
N_1 + P + K + S	802.39 g	1339.08 b	490.39 b	499.20 d	3 41 d	2.63 d	1.89 a	1.27 g
N_2 + P + K + S	920.31 c	1441.32 a	463.30 c	540.92 a	3.57 c	3.82 a	1.79 ab	1.28 a
N_3 + P + K + S	908.34 d	704.72 h	440.98 d	460.21 b	3.29 f	2.98 c	1.82 ab	1.20 i
NPK control	683.86 k	618.80 L	301.31 i	223.23 L	3.21 g	2.25 g	1.45 cde	1.45 d

In the same column, means followed by the same letter are not significantly different according to DMRT

N_1, N_2 and N_3 = 70, 90 and 110 gm N/vine/year, respectively.

P = 16 gm P_2O_5/vine/year. K = 48 gm K_2O/vine/year.

G = 2 km gypsum/vine/year. S = 1 km sulphur/vine/year.

NPK control = 50 gm N + 16 gm P_2O_5 + 48 gm K_2O/vine/year.

* The average number of fibrous roots in (hole) 1508.57 cm^3 or 1.82 kg soil

3. Nutritional status:

a. Leaf chlorophyll content:

Data from Table (6) showed that, increasing nitrogen levels in all fertilization treatments significantly increased both chlorophyll a and b values in leaves of Thompson Seedless grapevines. Similar results were reported by El-Azab *et al.* (1994) and Zayan *et al.* (2002) on "Costata" persimmon trees indicated that, high level of nitrogen gave the highest values of leaf chlorophyll contents. These results may be due to the role of nitrogen as important constitute in chlorophyll formation. Moreover, application of potassium fertilizer significantly increased leaf chlorophyll a and b contents. In addition, gypsum and sulphur application in all (N + P + K) treatments markedly increased leaf chlorophyll a and b contents. The highest values always belonged to (N_3 +P + K + S) treatment. The differences between this treatment and the control or other treatments were significant in both seasons. The positive effects of gypsum or sulphur may be attributed to the role of these amendments in improving soil physical and chemical properties and increased the availability of macro and micronutrients (Koreim, 1994) especially nitrogen and magnesium which consequently raised in leaf petioles as shown in Table (7).

b. Total carbohydrate and C/N ratio:

It is clear from table (6) that, high level of nitrogen fertilizer in (N + P) and (N + P + K) treatments recorded the highest percent of total carbohydrate compared to low and medium rates. Similar results were obtained by Zayan *et al.* (2002). Also, adding K in all fertilization treatments increased total carbohydrate content, as a result improved photosynthesis and increased the formation and translocation of carbohydrates. After gypsum or sulphur was added to NPK fertilizers, total carbohydrate content was increased. High percent of total carbohydrate was obtained with (N_3 + P + K) or (N_3 + P + K + G) treatments in both seasons. As for C/N ratio, the date indicted no significant differences were noticed among all fertilization and soil amendment agent treatments in the two seasons of this study.

Table (6): Effect of NPK fertilization and application of some soil amendment agents on leaf total carbohydrates %, C/N ratio and chlorophyll contents of Thompson Seedless grapevines in 2003 and 2004 seasons.

Treatments	Total carbohydrates %		C/N ratio		Leaf chlorophyll contents $\mu g/cm^2$			
					Chl. a		Chl. b	
	2003	2004	2003	2004	2003	2004	2003	2004
N_1 + P	15.43 f	16.67 cde	6.22 a	6.36 a	30.41 h	32.48 h	7.42 i	7.93 h
N_2 + P	15.79 de	16.84 bc	6.24 a	6.35 a	32.63 g	34.97 g	9.08 g	9.73 f
N_3 + P	16.02 b	17.41 ab	6.21 a	6.55 a	34.24 e	36.33 e	9.84 e	10.44 d
N_1 + P + K	15.45 f	16.77 c	6.23 a	6.38 a	33.46 f	35.55 f	8.65 h	9.19 g
N_2 + P + K	15.94 bc	16.96 abc	6.25 a	6.38 a	34.34 e	36.36 e	9.26 f	9.80 f
N_3 + P + K	16.27 a	17.26 a	6.23 a	6.39 a	33.62 f	37.69 c	9.15 f	10.26 e
N_1 + P + K + G	15.72 e	16.70 cd	6.24 a	6.37 a	34.66 d	36.80 de	9.66 e	10.26 e
N_2 + P + K + G	15 91 bcd	16.42 de	6.24 a	6.20 a	35.70 c	37.12 cd	10.52 d	10.94 c
N_3 + P + K + G	16.03 b	16.10 f	6.24 a	6.01 a	36.74 b	38.73 b	10.96 c	11.55 d
N_1 + P + K + S	15.83 cde	16.87 bc	6.26 a	6.39 a	34.70 d	36.81 de	8.73 h	9.26 g
N_2 + P + K + S	16.00 b	17.10 ab	6.29 a	6.40 a	36.77 b	38.79 b	11.02 b	11.63 b
N_3 + P + K + S	16.24 a	17.26 a	6.25 a	6.35 a	37.77 a	39.84 a	11.96 a	12.62 a
NPK control	15.31 f	16.40 e	6.24 a	6.43 a	30.37 h	32.46 h	7.29 i	7.79 h

In the same column, means followed by the same letter are not significantly different according to DMRT
N_1, N_2 and N_3 = 70, 90 and 110 gm N/vine/year, respectively.
P = 16 gm P_2O_5/vine/year. K = 48 gm K_2O/vine/year.
G = 2 km gypsum/vine/year. S = 1 km sulphur/vine/year.
NPK control = 50 gm N + 16 gm P_2O_5 + 48 gm K_2O/vine/year.

c. Leaf petioles mineral content:

Data presented in Table (7) indicated that, increase the rate of nitrogen fertilizer from 70, 90 to 110 g N/vine in all fertilization treatments significantly increased leaf petioles N, P, Ca and Mg contents, while, K content was decreased in both seasons. Similar results were obtained by Habib *et al.* (1987). Adding K to NP treatments significantly increased leaf petioles K-content. These results are supported by those previously obtained by Mikhael (1994). The data also revealed that adding gypsum or sulphur to (N + P + K) fertilizers led to a significant increase in leaf petioles N, K, Ca and Mg. Contents due to reducing soil pH value and improvement of root growth and nutrient uptake. These results are in line with those of Koriem (1994) and El-Morshedy (1997).

Table (7): Effect of NPK fertilization and application of some soil amendment agents on leaf petiole mineral contents of Thompson Seedless grapevines in 2003 and 2004 seasons.

Treatments	Macronutrients (%) on D. Wt									
	N		P		K		Ca		Mg	
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
N_1 + P	2 48 c	2 62 c	0 273 c	0.284 bc	1 60 e	1 61 d	2 75 fg	2 06 d	0 38 cd	0 40 c
N_2 + P	2 53 bc	2 65 b	0.209 g	0 296 ab	1 58 f	1 62 d	2 74 fg	2 08 cd	0 42 bc	0 43bc
N_3 + P	2 58 ab	2.66 b	0.280 b	0 307 a	1 56 f	1.59 e	2.78 fg	2.48 bcd	0 44 bc	0 44 b
N_1 + P + K	2 48 c	2 63 bc	0.276 de	0.267 cd	1 78 b	1 76 bc	2 83 fg	2.52 bc	0 45 bc	0 46 a
N_2 + P + K	2 55 b	2 66 b	0.212 f	0.274 cd	1 72 d	1.74 c	2.72 g	2.54 bc	0 44 bc	0 44 b
N_3 + P + K	2.61 a	2.70 a	0.300 a	0.264 cd	1.70 d	1.73 c	3.00 e	2.69 b	0 45 bc	0.46 ab
N_1 + P + K + G	2 52 bc	2.62 c	0.225 e	0 233 e	1 82 a	1.83 a	3.13 d	3.50 a	0 43 bc	0.45 ab
N_2 + P + K + G	2 55 b	2.65 b	0 226 e	0.234 e	1.80 ab	1.82 a	3.61 c	3.52 a	0.46 b	0 47 a
N_3 + P + K + G	2 57 ab	2.68 ab	0.252 d	0.307 a	1.76 c	1.78 b	3.78 b	3 57 a	0 48 a	0 48 a
N· + P + K + S	2 53 bc	2 64 bc	0 200 g	0 276 cd	1 78 b	1 79 b	3.83 b	3 39 a	0 43 bc	0 46 ab
N_2 + P + K + S	2.54 b	2 67 b	0.208 g	0 279 bc	1.75 c	1.76 bc	3.25 d	3.44 a	0 43 bc	0 45 ab
N_3 + P + K + S	2 60 a	2.72 a	0.245 d	0.297 ab	1 74 cd	1 75 bc	3 93 a	3 48 a	0 42 bc	0 44 b
NPK control	2 45 d	2 55 d	0.198 h	0 259 d	1.56 f	1.58 e	2 87 f	2 32 bcd	0 34 d	0 35 d

In the same column, means followed by the same letter are not significantly different according to DMRT

N_1, N_2 and N_3 = 70, 90 and 110 gm N/vine/year, respectively.

P = 16 gm P_2O_5/vine/year. K = 48 gm K_2O/vine/year.

G = 2 km gypsum/vine/year. S = 1 km sulphur/vine/year.

NPK control = 50 gm N + 16 gm P_2O_5 + 48 gm K_2O/vine/year.

4. Yield and its components:

Data presented in Table (8), it is clear that, effects of fertilization and soil amendment agents treatments on yield, yield of "Thompson seedless" grapevines as weight (kgs) and number of clusters per vine was significantly increased by raising nitrogen levels up to 110 g N/vine in all NPK fertilization treatments. These results are in line with those reported by Hassan *et al.* (1984) on Thompson seedless and Ahmed *et al.* (1988) on "Roomy Red" grape vines. Also, adding K to all fertilization treatments increased vine yield. Such results reported by Haeseler *et al.* (1980) on "Concord" vines and Shoeib (2004) on "Thompson Seedless" vines. This results could be attributed to the effect of K in improving berries setting. Maximum yield (kg/vine) was produced by soil amendment agents application especially with N_2 + P + K + G and N_2 + P + K + S treatments which exhibited the highest number of clusters and weight of cluster in the two seasons. These two superior treatments produced (8.03 & 8.20) and (7.81 & 8.16) kg/vine in 2003 and 2004 seasons, respectively. Such results are in general harmony with those reported by Conradie and Saayman (1989) reported that increasing N fertilization up to 96 kg N/ha significantly increased yield. In addition average cluster weight (g) gave the same trend of yield (kgs)/vine. The result was true in both seasons. Heavy clusters were obtained by the application of (N_2 + P + K + G) and (N_2 + P + K + S) treatments as shown in Table (8).

Table (8): Effect of NPK fertilization and application of some soil amendment agents on fruit setting and yield components of Thompson Seedless grapevines in 2003 and 2004 seasons.

Treatments	Av. cluster weight (g)		No. of cluster/vine		Yield/vine (kg)	
	2003	2004	2003	2004	2003	2004
N_1 + P	401.16 e	406.96 e	17.25 h	17.52 ef	6.92 gh	7.13 f
N_2 + P	399.54 e	405.08 e	17.57 g	17.70 def	7.02 fg	7.17 f
N_3 + P	409.69 d	411.43 de	17.33 h	17.50 ef	7.10 f	7.20 f
N_1 + P + K	402.94 e	412.92 de	17.67 f	17.80 cde	7.12 f	7.35 ef
N_2 + P + K	423.53 b	428.10 c	17.85 e	18.15 cd	7.56 d	7.77 bc
N_3 + P + K	427.41 a	417.41 d	17.15 i	17.92 cde	7.33 e	7.48 de
N_1 + P + K + G	432.60 a	453.30 a	18.10 d	18.20 cd	7.83 bc	8.25 a
N_2 + P + K + G	427.81 a	436.87 b	18.77 a	19.07 a	8.03 a	8.20 a
N_3 + P + K + G	432.22 a	443.90 a	18.37 c	18.36 bc	7.94 ab	8.15 a
N_1 + P + K + S	407.04 d	413.81 d	18.18 d	18.39 bc	7.40 e	7.61 cd
N_2 + P + K + S	418.32 c	428.94 c	18.67 b	19.00 a	7.81 c	8.16 a
N_3 + P + K + S	426.52 b	420.21 cd	18.10 d	18.80 ab	7.72 c	7.90 b
NPK control	402.58 e	405.79 e	17.04 j	17.17 f	6.86 h	6.97 g

In the same column, means followed by the same letter are not significantly different according to DMRT

N_1, N_2 and N_3 = 70, 90 and 110 gm N/vine/year, respectively.

P = 16 gm P_2O_5/vine/year. K = 48 gm K_2O/vine/year.

G = 2 km gypsum/vine/year. S = 1 km sulphur/vine/year.

NPK control = 50 gm N + 16 gm P_2O_5 + 48 gm K_2O/vine/year.

5. Physical and chemical fruit properties:

a. Physical fruit properties:

In both seasons, physical properties of berries i.e. weight of 100 berries (g) as well as volume of 100 berries (cm^3), as shown in Table (9) were improved in vine received (N_2 + P + K + G) or (N_2 + P + K + S) treatment which had moderate nitrogen level (90 g N/vine) and involved K and (gypsum or sulphur) amendment agent. The obtained results herein are in line with those reported by Hosam El-Deen (2002). Moreover, Dawood (1988) found that, gypsum and sulphur amendment agents increased fruit weight of "Valencia" and "Washington Navel" orange. The data also revealed that, adding K to all fertilization treatments improved most physical fruit properties particularly weight of 100 berries (g) and volume of 100 berries (cm^3). Similar results were obtained by Michael (1994).

b. Chemical fruit properties:

Table (9) show chemical juice properties such as TSS, acidity and TSS/acidity ratio it is clear that, at harvest time TSS and TSS/acidity ratio were decreased by increasing the rate of nitrogen from 70, 90 to 110 g/vine in all fertilization treatment. It could be observed that, adding potassium fertilizer with 48 g K_2O in all fertilization treatment significantly increased TSS and TSS/acidity values. This results may be due to the effect of potassium on advancing fruit maturity (Barden and Thompson, 1962). These results are in general agreement with those reported by Ahlawat and Yamadagni (1991) they indicated that, raising nitrogen rate decreased berry TSS whereas, adding K fertilizer increased TSS in the juice of "Perlette" grapes. Gypsum and sulphur gave the highest TSS and TSS/acidity values when they applied to (N_2 + P + K) in (N_2 + P + K + G) and (N_2 + P + K + S) treatments in both seasons. However, Zayan *et al.* (1989a) reported unsignificant differences in TSS of orange fruits by adding gypsum or sulphur as soil amendment agents.

Table (9): Effect of NPK fertilization and application of some soil amendment agents on some physical and chemical fruit proprieties of Thompson Seedless grapevines in 2003 and 2004 seasons.

Treatments	Weight of 100 berries (gm)		Volume of 100 berries (cm^3)		TSS %		Acidity %		TSS/acid ratio	
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
N_1 + P	156.10 i	161.47 e	141.23 i	146.31 e	17.00 c	17.30 de	0 820 a	0 850 a	20.73 f	20.35 e
N_2 + P	153.98 j	159.13 ef	138.64 j	143.92 ef	17.12 c	17.50 cd	0.817 a	0.848 a	20 96 e	20 64 d
N_3 + P	162.42 g	167.38 d	147.33 g	152.24 d	17 10 c	17.30 de	0 825 a	0.850 a	20 73 f	20.35 e
N_1 + P + K	151.84 k	156.86 f	136.71 k	141.63 f	17.47 b	17.80 bc	0 819 a	0.847 a	21 33 d	21.02 bc
N_2 + P + K	163 90 f	168.77 d	147.81 f	153.49 d	17.73 ab	18 00 ab	0 822 a	0.850 a	21 57 bc	21.18 b
N_3 + P + K	173.73 d	178.01 c	158.13 d	162.74 c	17.60 b	17.89 ab	0.818 a	0.650 a	21.52 c	21 05 b
N_1 + P + K + G	161.83 h	166.80 d	145.74 h	150.97 d	17.55 b	17.78 bc	0 822 a	0.849 a	21.35 d	20.94 c
N_2 + P + K + G	172 10 e	188.40 b	156 91 e	172.83 b	17 93 a	17.12 e	0 820 a	0.849 a	21 87 a	20.16 f
N_3 + P + K + G	183.12 b	180 70 c	168.35 b	165.61 c	17 81 a	18.13 ab	0 820 a	0.850 a	21 73 ab	21.33 a
N_1 + P + K + S	175.27 c	188.50 b	161.24 c	173.41 b	17.43 b	17.51 cd	0.819 a	0.850 a	21.28 d	20.60 d
N_2 + P + K + S	183.20 b	203 73 a	168.47 b	188.41 a	17 67 a	18.19 a	0 819 a	0.849 a	21.82 a	21.42 a
N_3 + P + K + S	194.98 a	204.13 a	178.87 a	189 04 a	17.81 a	18.10 ab	0 820 a	0.849 a	21.72 ab	21.32 a
NPK control	144.17 L	149.93 g	129.22 L	134.76 g	16.97 c	17.18 de	0 820 a	0.848 a	20.70 f	20.26 e

In the same column, means followed by the same letter are not significantly different according to DMRT

N_1, N_2 and N_3 = 70, 90 and 110 gm N/vine/year, respectively.

P = 16 gm P_2O_5/vine/year. K = 48 gm K_2O/vine/year.

G = 2 km gypsum/vine/year. S = 1 km sulphur/vine/year.

NPK control = 50 gm N + 16 gm P_2O_5 + 48 gm K_2O/vine/year.

Data also revealed that, juice acidity of Thompson Seedless berries was unsignificantly affected with all NPK fertilization and soil amendment agents used in this study in both seasons as shown in Table (9). These results herein are in line with those reported by Etman *et al.* (1985) they found that, titratable acidity of "Thompson seedless" and "Roomy Red" grapes juice was not affected by N, P and K fertilization at the rates of 300, 100 and 50 g/vine, respectively.

Thus, this study recommends, Thompson Seedless grape growers in alkaline soil at North Delta to adding 2 kg gypsum or 1 kg sulphur with the fertilization program: 90 g N + 16 g P_2O_5 + 48 g K_2O/vine/year in (N_2 + P + K + G) or (N_2 + P + K + S) treatments, which are considered the beast treatments in this study. These two treatments not only increased shoot and root growth, produced maximum yield (kg/vine) as number of clusters and weight but also improved most physical cluster and berries proprieties particularly, average cluster weight (g), weight of 100 berries (g) and volume of 100 berries (cm^3). Also, increased juice berry TSS and TSS/acidity values. Moreover, gypsum and sulphur amendments in these tested treatments led to increase leaf petioles Ca-content.

REFERENCES

Abdel-Kawi, A.; G. El-Banna and A. Kamel (1984). Effect of GA_3 spray, berry thinning and girdling treatments on yield and fruit quality of Thompson seedless grapes. Agric. Res. Rev., Egypt, 26(3A): 29-35.

Ahmed, F.F.; M.A. El-Sayed and M.A. Maatouk (1988). Response of Red Roomy grapevines to nitrogen application. II- Yield and berries quality. Annals. Agric. Sci., Ain Shams Univ., Cairo, 33(11): 451-489.

Ahlawat, V.P. and R. Yamdagni (1991). Effect of nitrogen and potassium application on berry set, berry drop and quality of grapes cultivar Perlett; progressive. Horticulture. 20(1-2): 53-57.

Association of Official Agriculture Chemists (1965). Official Methods of Analysis 10^{th} Ed., p. 1008, Washington D.C., USA.

Barden, J.A. and A.H. Thompson (1962). Effect of heavy annual application of potassium on Red Delicious apple trees. Proc. Amer. Soc. Hort. Sci., 81(1): 25-32.

Cahoon, G.A.; E.S. Morton; W.W. Jones and M.J. Garber (1959). Effect of various types of nitrogen fertilizers on root density and distribution as related to water infiltration and fruit yield of "Washington Navel" Orange in a long term fertilizer experiment. Proc. Amer. Soc. Hort. Sci., 74: 289-299.

Conradie, W.J. and D. Saaymand (1989). Effects of long-term nitrogen, phosphorus and potassium fertilization on "Chenin Blanc": vines. 1-Nutrient demand and vine performance. Amer. J. Enology and Viticulture, 31: 85-90 (C.F. Hort. Abst., 51: 4002).

Dawood, S.A. (1988). Studies on fertilization on some citrus varieties. Ph.D. Thesis, Fac. of Agric. Kafr El-Sheikh, Tanta Univ.

Dobios, M.; K.A. Gilles; J. K. Humiton; P.A. Rebers and F. Smith (1956). Colorimetric method for determination of sugars and related substances. Analytical Chemistry. 28(3): 350-356.

Duncan, D.B. (1955). Multiple range and multiple F-test. Biometrics, 111.

El-Azab, E.M.; M.A. Aly; N. Ramadan and N. Abo El-Maged (1994). Effect of NPK fertilization treatments on leaf and fruit composition of persimmon trees (*Diospyrus kaki* L.). Menofiya J. Agric. Res., 19(2): 1159-1189.

El-Morshedy, F.A. (1997). Organic manure and sulphur interaction influence vegetative growth and element concentration of sour orange seedlings. J. Agric. Sci. Mansoura Univ., 22(12): 4599-4616.

El-Mowelhi, N. (1982). Field studies on sodic soil reclamation to determine the most effective placement of amendment terms of soil location and time. Fourth Annual Rep., E.G., A.R.S. 196: 56-71.

Etman, A.A.; A. Shahien; M.A. Zakaria and A.M. Eissa (1985). Effect of different NPK fertilization dates on nutrient elements in leaf petioles, yield and fruit quality of "Thompson seedless" and "Rowmi Red" grapevines. J. Agric. Res. Tanta Univ., 11(2): 347-355.

Ford, H.W. (1962). Thickness of cub soil organic layer in relation to tree size and root distribution of citrus. J. Amer. Soc. Hort. Sci., 82: 177-179.

Habib, H.; S. Castor and Z. Ismail (1987). Response of Romi Ahmar grapevines Central Minya to nitrogen application. Agric., Res. Rev., 68(3): 368-379.

Haeseler, C.W.; C.B. Smith; L.T. Kordos and H.K. Flenin (1980). Response of mature vines of *Vitis labrscal* c.v Concord to application of phosphorus and potassium over eight years. Amer. J. Enology and Viticulture, 31: 237-244 (C.F. Hort. Abst., 15: 4452).

Hassan, M.M.; A.A. Abdel-Kawi and A.. Rifay (1984). Effect of nitrogen and root distribution on grape vines. Egypt. J. Hort. Sci., 11(2): 209-213.

Hosam El-Deen, A.S.H. (2002). Effect of sulphur soil application on growth, yield and fruit quality of "Handi" banana cultivar. J. Agric. Sci. Mansoura Univ., 27(3): 1675-1681.

Jackson, M.L. (1967). Soil Chemical analysis. Printice-Hall Inc. Englewood Cliffs-N.S.

Khafagi, M. and Y. Abdel-Hadi (1990). Effect of sulphur application on salt distribution in a sodic calcareous soil. Egypt. J. Soil Sci., 30(1-2): 199-212.

Koriem, M.A. (1994). Effect of different rates and methods of sulphur application on some soil properties and elemental leaf composition of Succari orange. J. Agric. Res. Tanta Univ., 20(2): 345-360.

Mikhael, G.B.Y. (1994). Studies on "Anna" apple fertilization. M.Sc. Thesis, Fac. Agric. Kafr El-Sheikh, Tanta Univ.

Mikhael, G.B.Y.; G. Shaddad and A.S.M. Wally (2002). Effect of N, P and K fertilization levels on growth, yield and fruit quality of apricot "Canino". I- The effect on vegetative growth. The 6th Arabian Conf. Hort. Ismailia, Egypt, p. 344-352.

Moran, R. (1982). Formula for determination of chlorophyllous pigments extracted with N, N-Dimethyl formamide. Plant Physio. 59: 1376-1381.

Scott, B.J.; L.H. Evans and J.C. Noble (1968). Gypsum for problem soils in Southern New South Wales. Agric. GAZ. S.W., 79: 493-498 (C.F. Soils and Fert., 32: 1940).

Shehata, M.M.; E. El-Menshawy and M.A. Aly (1992). Sulphur application as potential solution to improve productivity and nutritional status of Navel orange orchards grown on alkaline reaction sand loam soil in Egypt. J. Agric. Res. Tanta Univ., 18(4): 672-684.

Shoeib, M.M. (2004). Effect of potassium sulphates and vine load on the growth and yield of Thompson seedless grapevines with a special reference to occurrence of cluster tip desiccation problem. J. Agric. Sci. Mansoura Univ., 29(8): 4711-4728.

Singh, R.A. (1980). Soil physical analysis kalyani Publisher, New Delhi.

Snedecor, G.W. and W.G. Cochran (1980). Statistical Methods, 7th Ed. The Iowa State Univ. Pres. Amer. Iowa, USA., p. 593.

Snell, F.D. and C.T. Snell (1967). Colorimeteric method of analysis. D. van Nestrant Company Inc., P. 551-552.

Tourky, M.N.; El-Shahat, S.S. and Rizk, M. H. (1995): Effect of dormex on fruit set, quality and storage life of Thompson seedless grapes (Banati grapes) J. Agric. Sci., Mansoura Univ., 20(12): 5139-5151.

Yoshida, S.; D.A. Forno; J.H. Cock and K.A. Gomez (1972). Laboratory manual for physiological studies of rice. The International Rice Research Institute, Los Banos. Philippines.

Yousry, M.; A. El-Leboudi and A. Khater (1984). Effect of sulfur and petroleum by-products on soil characteristic. II- Availability of some nutrients in calcareous oil. Egypt. J. Soil Sci., 24(3): 195-200.

Zayan, M.A.; El-Sayed Morsy; M.A. El-Hamady and S.A. Dawood (1989a). Effect of NPK fertilization and application of some soil amendment agents on: I. Yield and fruit quality of "València" and "Washington" Navel orange trees. J. Agric. Res. Tanta Univ., 15(2): 211-220.

..................; El-Sayed Morsy; M.A. El-Hamady and S.A. Dawood (1989b). Effect of NPK fertilization and application of some soil amendment agents on: II- Vegetative growth and root density of distribution of "Valencia" and "Washington" Navel orange varieties. J. Agric. Res. Tanta Univ., 15(2): 221-234.

.............; El-Sayed Morsy; M.A. El-Hamady and S.A. Dawood (1989c). Effect of NPK fertilization and application of some soil amendment agents on III- Soil physical and chemical properties and leaf mineral content of "Valencia" and "Washington" Navel orange varieties. J. Agric. Res. Tanta Univ., 15(2): 235-244.

.................; El-Sayed Morsy; M.A. El-Hamady and S.A. Dawood (1989d). Effect of NPK fertilization and application of some soil amendment agents on: IV- Preharvest fruit drop and the force needed to detach fruit from its pedical as related to leaf Ca content of "Valencia" and "Washington" Navel orange trees. J. Agric. Res. Tanta Univ., 15(2): 245-254.

.................; M.A. El-Hamady and E. Morsy; A.S. Wally and G.B. Mikhael (2002). Alternate bearing of "Costata" persimmon trees as affected by some pruning and nitrogen treatments. II. The effect on tree nutritional status. 2nd Inter. Conf. Hort. Sci., Kafr El-Sheikh, Tanta Univ., Egypt, p. 763-781.

تأثير إضافة النيتروجين والفوسفور والبوتاسيوم وبعض مصلحات التربـــة علـــى النمو الخضرى ومحصول العنب البناتى

محمد عبده زيان* ، محفوظ الموجى ، جهاد بشرى ميخائيل****

* قسم البساتين ــ كلية الزراعة بكفرالشيخ ــ جامعة طنطا

** معهد بحوث البساتين ــ مركز البحوث الزراعية ــ الجيزه ــ مصر

أجريت هذه التجربة لدراسة تأثير التسميد النيتروجينى والفسفورى والبوتاسى وبعض محسنات التربة مثل الجبس والكبريت فى ثلاثة مواسم متتالية ٢٠٠٢، ٢٠٠٣، ٢٠٠٤ وتم أخذ النتـــائج فـــى الموســـمين الثـــانى والثالث. ثلاثة عشرة معاملة تم إجراؤها حيث تم دراسة تأثير ثلاثة جرعات مختلفة من النيتروجين مع جرعة واحدة من الفوسفور أو البوتاسيوم أو الجبس أو الكبريت. كل جرعة من النيتروجين تم إضافتها فـــى ثلاثـــة مواعيد مختلفة وبنسب متساوية: فى منتصف فبراير ومنتصف أبريل ومايو على التوالى. بينما تـــم إضـــافة التسميد الفوسفاتى مع الجبس أوالكبريت فى نهاية نوفمبر، كما تم إضافة التسميد البوتاسى مرة واحـــدة مـــع ميعاد الإضافة الأول للتسميد النيتروجينى فى منتصف فبراير.

أدت إضافة الجبس والكبريت للتربة إلى تحسن معظم صفاتها الطبيعية والكيماوية. كما أن إضافة الجـــبس أو الكبريت إلى البرنامج السمادى أعطت أطول نموات خاصة فى نهاية موسم النمو، علاوة على ذلك أنتجت أفضل توزيع للجذور من حيث عدد جذور الامتصاص ووزنها الطازج بالجم فى كلا من الطبقـــة الـــسطحية (٠-٣٠سم) والطبقة التالية لها (٣٠-٦٠سم) مقارنة بالكنترول فى المواسم الثلاثة. كما أظهـــرت النتـــائج أن إضافة المستوى الأعلى من النيتروجين (ن٣) مع الجبس أو الكبريت حسن من الحالة الغذائية لكرمات العنـــب النباتى حيث تزيد معنويا قيم كلوروفيل أ ، ب والكربوهيدرات الكلية والمحتوى المعـــدنى لأعنـــاق الأوراق خاصة النيتروجين والفوسفور والكالسيوم والماغنيسيوم فى كلا من المواسم الثلاثة.من ناحية أخرى، لوحظ أن إضافة المستوى المتوسط من النيتروجين (ن٢) مع الجبس أو الكبريت أعطى أعلى محصول من حيث عـــدد العناقيد والوزن كجم/كرمة وتحسن معظم الصفات الطبيعية والكيماوية للثمار خاصة جودة العناقيد والحبـــات وقيم TSS فى عصير الحبات. لذلك فإن افضل معاملة فى هذه الدراسة هى إضافة المستوى المتوسط من النيتروجين (ن٢) مع الجبس أو الكبريت أعطى أعلى محصول وأفضل جودة العناقيد والحبات لكرمات عنـــب الطومسون سيدلس.