J. Plant Production, Mansoura Univ., Vol. 8 (1): 19 - 25, 2017

Partial Replacement of Mineral Potassium Fertilizer for Thompson Seedless Grapevines by Using Different Sources of Organic and Natural Fertilizers

Belal, B. E. A.; M. A. El-kenawy and Thoraua S. A. Abo EL-Wafa
Viticulture Dept., Hort. Res. Inst., Agric. Res. Center, Giza, Egypt

ABSTRACT

The present investigation was carried out during three successive seasons (2013 & 2014 and 2015) (the first season was considered as a preliminary trial) in a private vineyard of Thompson seedless grapevines at El-deer village, Aga, Dakahlia Governorate, Egypt. The vines were 13-years old in a clay soil under surface irrigation system. The vines were trained on three wires system and cane-pruned. The aim of study was to evaluate the possibility of decreasing the amount of mineral potassium fertilizer by using various sources of organic and natural fertilizers. Plant compost and rock-feldspar were used as sources of organic and natural fertilizers either individual or mixed with mineral potassium on the basis content of potassium in plant compost and rock-feldspar. Data revealed that possibility of using organic and natural fertilizers as a partial replacement of mineral potassium fertilizer. This investigation showed that application of 60% mineral potassium fertilizer combined with 40% of (plant compost + rock-feldspar) had significant increased of shoot length, leaf surface area, total chlorophyll in leaves, leaf mineral content (N, P, K and Mg), yield, cluster weight and 100 berry weight. Also, enhanced chemicals properties of berries and total carbohydrates in canes as well as decreased the production cost and gave the best net profit/ feddan of Thompson seedless grapevines.

Keywords: Grapevines, Thompson seedless, Mineral potassium, Plant compost and Rock- feldspar

INTRODUCTION

Grape (*Vitis vinifera, L.*) is considered one of the most important fruit crops in Egypt and the whole world. In Egypt it occupies the second position of the fruit trees planted area after citrus trees and because of its precious characteristics, this area increased in the last few years especially in the newly reclaimed lands, it reached about 196993 feddans among them about 178323 feddans fruitful with a total production about 1686706 tons according to latest the statistics of the (Ministry of Agriculture, 2016).

Thompson seedless grape considered one of the most important table grape varieties grown in Egypt. It is as a fresh table grape, making raisins and for export.

Grapevines fertilization is one of the important agricultural practices for increasing crop yield and quality especially the potassium fertilization.

Large quantities of agricultural residues and animal wastes produced each year in Egypt, these quantity is about 30-35 million tons of wastes (Ministry of Agriculture, 2012). Mismanagement of organic wastes, have impacted public health and environment, these organic wastes are rich in nutrients minerals and through proper management such as composting can be used as a soil conditioner as well as a nutrient source for plants. Also, the soil of Egypt is characterized by low content of organic matter due to the prevailing dry condition. Therefore, addition of compost become essential to increase organic matter content of soil, since it maintains crop nutritional requirements as well as other factors that enhance crop growth, and it can also reduce the use of chemical fertilizers, which adverse environmental effects.

Mineral fertilizers that used in agricultural production, not only have harmful effects on the human, soil, water and high price, but also they can change the components of fruits, vegetables and root crops and reduce their contents of vitamins, minerals and other beneficial compounds (Bogatyre, 2000).

Organic fertilizers have become in the few decades a positive alternative to mineral fertilizers because of the harmful effect and very high cost especially mineral potassium fertilizers in Egypt. Furthermore, the organic fertilizers improves physical and chemical properties of the soil and reduce soil pH as well as supplying the soil with macro and micro nutrients necessary for plant growth (Yagodin 1984; Nijjar, 1985; Darwish *et al.* 1995 and, Nasser, 1998)

Fertilizing of Grapevines varieties with organic and natural sources in combination with inorganic sources were accompanied by enhancing in vegetative growth, leaf mineral content, yield and its quality than using inorganic sources individually as mentioned by (Abd El-Wahab, 2011; Mostafa *et al.* 2011; Masoud, 2012; Adel, (2012); Shaheen, *et al.* 2013 and Hegazi *et al.* 2014).

Potassium is one of the most important elements in plant nutrition. It is the mineral nutrient required in the largest amount by plants especially in fruits production. The important roles of potassium in plants can be grouped into group physiological-biochemical roles: (1) Potassium has a useful role in the energy status of the plant (Marschner, 1995), (2) Enzyme activation (Walker *et al.* 1996) and (3) Osmotic potential regulation, which is one of the important mechanisms in the control of plant water relations, turgor maintenance and growth (Leigh, 2001). In addition, increased potassium concentration in leaf may be increase the number of chloroplast per cell, number of cell per leaf and consequently leaf area (Taiz and Zeiger, 1991).

Potassium plays a major role in production and yield quality. It is necessary for the translocation of sugars and formation of carbohydrates and enhances the size of fruit. Potassium also increases resistance against diseases and drought as well as frost stress (Imas and Bansal, 1999). Excessive levels of potassium increased SSC % and decreased the total acidity of berries (Martin *et al.* 2004).

Mineral potassium fertilizer became very costly in Egypt so most growers decreasing the used amount to the minimum dose or ignored using it.

The main non- artificial sources of potassium for plants growing come from the weathering of rocks such as rock- feldspar and organic potassium sources such as plant residues (compost).

Thus, the use of indigenous alternative resources such as plant compost and rock-feldspar are gaining importance to alleviate the dependence of imported or costly commercial fertilizer. (Aisha and Taalab, 2008).

Potassium content in rock- feldspar ranges from 9 to 12 % and not easily suitable for direct application where feldspar structure is Aluminum silicate mixed with potassium to make Orthoclase ($KAlSi_3O_8$). It is a slow release fertilizer, so various laboratory studies have shown that microbes can increase the dissolution rate of silicate and aluminum silicate minerals by producing some organic and inorganic acids (Barker, 1997 and Aisha and Taalab, 2008). Therefore, the silicate dissolving bacteria (*Bacillus circulans*) are generally used to release potassium from rock-feldspar (Sheng, 2002; Shaheen, *et al.* 2013 and Hegazi *et al.* 2014).

This investigation aimed to study the effect of different sources of organic and natural fertilizers such as plant compost and rock-feldspar, respectively, as a partial substitute for mineral potassium fertilizer and their effect on vegetative growth, mineral content of the leaves, yield and berries quality of Thompson seedless grapevines.

MATERIALS AND METHODS

This investigation was conducted during three successive seasons (2013 & 2014 and 2015) (the first year was considered as a preliminary trial) in a private vineyard of Thompson seedless grapevines at El-deer village, Aga, Dakahlia Governorate, Egypt. The Vines were 13 years old planted at 2 x 2 m. in a clay soil as shown in (Table 1) under surface irrigation system and trained on three wires system. During January of each experimental season, the tested vines were pruned to 6 canes with 12 eyes each along with 6 renewal spurs. The total bud load was 84 buds. Ninety vines uniform in vigor as possible were chosen for this study, all vines received the same cultural managements recommended by ministry agriculture. The experiment consisted of ten treatments arranged in a complete randomize blocks design, each treatment include three replicates, each made of three vines.

Table 1. Mechanical and Chemical analysis of the experimental soil

Mechanical analysis		Chemical analysis					
Sand (%)	25. 66	pH (1:2.5)	8.12	soluble anions (Meq/100 g soil)		Soluble cations (Meq/100 g soil)	
		$CaCO_3$ (%)	1.80				
Silt (%)	24. 16	O.M. (%)	2.0	CO_3^{--}	0.00	Ca^{++}	0.7
Clay (%)	50.18	N (ppm)	43.0	HCO_3^{--}	0.3	Mg^{++}	0.6
Texture	Clay	P (ppm)	11.0	CL^-	0.9	Na^+	1.5
		K (ppm)	292.0	SO_4^{--}	1.9	K^+	0.3

The plant compost from (El-sharkia Company for organic fertilizers, El-sharkia, Egypt) was used as a source of organic potassium fertilizer and rock-feldspar from (Al-Ahram Mining Company, Giza, Egypt) was used as a source of natural potassium fertilizer. Analysis of the used plant compost and rock-feldspar fertilizers as shown in (Tables 2 and 3).

Table 2. Analysis of plant compost fertilizer

Components	O. M. (%)	Total N (%)	Organic C (%)	C/ N (%)	P (%)	K (%)	pH 1:2.5	E.C. ds/m^{-1} 1:5	Humidity (%)
2014	40	1.25	22	17.6	0.78	1.05	7.6	2.25	27
2015	38	1.12	19.3	17:2	0.68	1.0	7.8	2.69	25

Table 3. Analysis of the rock-feldspar fertilizer

Components	K_2O	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O_3	P_2O_5
(%)	9.16	68.40	16.50	0.40	0.03	0.57	3.35	0.02

The mineral potassium fertilizer was applied as individual or mixed with plant compost or rock-feldspar and together at (50%:50%) ratio on the basis content of potassium in plant compost and rock-feldspar as shown in (Table 4).

The plant compost and rock-feldspar were applied at once in the soil at the second week of January in both seasons in holes with 50 cm length, 40 cm diameter and 40 cm depth at a distance of 50 cm from the vines trunk in the two sides

(*Bacillus circulans*) bacteria from (Central Lab of Organic Agriculture, Agricultural Research Center, Giza, Egypt) was used as soil application with rock-feldspar at rate 10g /vine (each g have 10^{8-9} bacterial cell) mixed with the organic matter at the second week of January then covered with the soil and irrigated with water according to (Gawad Shaheen, *et al.* 2012).

Table 4. The amount of K from mineral, plant compost, rock-feldspar sources applied in the studied ten treatments

No	Type	Mineral (K) Unit/ Fed.	Mineral (K) g /vine	Plant compost Unit/ Fed.	Plant compost amount of g /vine 2014	Plant compost amount of g /vine 2015	Rock-feldspar Unit/ Fed.	Rock-feldspar g /vine	Total K/fed (units)
1	100 % mineral K (Control)	100	200	--			--	--	100
2	80 % mineral K +20 % plant compost	80	160	20	2420	2500	--	--	100
3	80 % mineral K +20 % rock feldspar	80	160	--	--	--	20	218	100
4	80 % mineral K +20% (mixed)*	80	160	10	1210	1250	10	109	100
5	60 % mineral K +40 % plant compost	60	120	40	4840	5000	--	--	100
6	60 % mineral K +40 % rock feldspar	60	120	--	--	--	40	436	100
7	60 % mineral K +40% (mixed)*	60	120	20	2420	2500	20	218	100
8	40 % mineral K +60 % plant compost	40	80	60	7260	7500	--	--	100
9	40 % mineral K +60 % rock feldspar	40	80	--	--	--	60	654	100
10	40 % mineral K +60% (mixed)*	40	80	30	3630	3750	30	327	100

***mixed = (plant compost 50% + rock-feldspar 50%)**

Mineral fertilizers were added as recommended by the Ministry of Agriculture. Potassium from mineral K source was added as potassium sulphate from (48.5 % K_2O) and applied at two equal doses at the second week of January and after fruit set as 100 units /fed. Nitrogen added as ammonium nitrate (33.5% N) as 80 units /fed at three times: 25% was added at growth start, 50% after berry set and 25% after harvest. Calcium super phosphate (15.5 % P_2O_5) as 30 units /fed was added at the time of adding the plant compost and rock-feldspar.

The amounts of Nitrogen and Phosphate from organic fertilizers were discounts from the total amounts of fertilizers requirements.

The treatments were as following:-

1 - 100 % mineral K (Control)
2 - 80 % mineral K + 20 % plant compost
3 - 80 % mineral K + 20 % rock-feldspar
4 - 80 % mineral K + 20 % mixed *
5 - 60 % mineral K + 40 % plant compost
6 - 60 % mineral K + 40 % rock-feldspar
7 - 60 % mineral K + 40 % mixed *
8 - 40 % mineral K + 60 % plant compost
9 - 40 % mineral K + 60 % rock-feldspar
10- 40 % mineral K + 60 % mixed *

*** mixed = (plant compost 50% + rock-feldspar 50%)**

The following characteristics were determined:

Vegetative growth parameters (shoot length and leaf surface area):

Vegetative growth parameters were taken from non-fruiting shoots and determined at two weeks after fruit set as follows:

Average shoots length (cm) - Average leaf surface area (cm^2): Sixth and seventh leaves from the tip of the growing shoot were used for leaf surface area measurement by the method of (Montero *et al.* 2000).

Total chlorophyll content in the leaves (mg/g fresh weight):

Sixth and seventh leaves from the tip of the growing shoots were used for the determination of total chlorophyll content in the leaves at two weeks after fruit set according to (Mackinny, 1941)

N, P, K, Mg Fe and Ca content in the leaves:

Two weeks after fruit set, samples of 20 leaf petioles per each replicate were taken from leaves opposite to cluster were used for the determination of N, P, K, Mg, Ca and Fe content as mentioned by (Cottenie *et al.* 1982).

Yield:

At harvesting time when SSC % of berries reached about 16-17 % in control vines (Sabry *et al.* 2009), six clusters/ vine were weighted and the average cluster weight was multiplied by number of clusters/vine to calculation average yield/vine.

Physical and chemical properties:

A sample of 6 clusters/ vine was taken to determine:

- Average cluster weight (g) and average of 100 berry weight (g).
- Soluble solids content (SSC %) was determined by using hand refractometer.
- Total acidity percentage was determined by the method of (A.O.A.C. 1980).
- Total sugars (%) were estimated on the method described by (Sadasivam and Manickam, 1996)

Total carbohydrates in the canes:

Total carbohydrates were taken from fruiting canes for next season and determined at winter pruning according to modified method of (Shaffer and Hartman, 1921).

Statistical analysis

The complete randomized blocks design was perform for the experiment. The statistical analysis of the present data was carried out on the methods described by (Snedecor and Chocran, 1980) and significant differences among various treatments were compared using the new L.S.D. values at 5% level.

RESULTS AND DISCUSSION

Vegetative growth parameters (shoot length and leaf surface area):

Data presented in (Table 5) indicated that shoot length and leaf surface area were greatly affected by the applied different fertilizers as compared with control in both seasons. Data should that vines receiving 60% mineral potassium fertilizer + 40% (plant compost, rock- feldspar and mixed of them) recorded significant values of shoot length and leaf area followed in a descending order by 80% mineral potassium fertilizer + 20% (plant compost, rock-feldspar and mixed of them) then 40% mineral potassium fertilizer + 60% (plant compost, rock- feldspar and mixed of them). On the other hand, vines receiving 100% mineral potassium fertilizer (control) had significant decrease values as compared with other treatments in both seasons.

Table 5. Effect of using plant compost and rock-feldspar on shoot length, leaf area, total chlorophyll and total carbohydrates of Thompson seedless grapevines during 2014 and 2015 seasons

Characteristics / Treatments	Shoot length (cm)		Leaf area (cm^2)		Total chlorophyll (mg / g f.w.)		Total Carbohydrates (%)	
	2014	2015	2014	2015	2014	2015	2014	2015
1 100 % mineral K (Control)	105	103	115	120	10.36	10.88	18.38	18.8
2 80 % mineral K +20 % plant compost	117	120	135	140	11.74	11.85	19.98	20.48
3 80 % mineral K +20 % rock feldspar	114	118	130	135	11.38	11.54	19.34	19.81
4 80 % mineral K +20% (mixed)*	120	126	138	142	12.25	12.38	20.28	20.78
5 60 % mineral K +40 % plant compost	124	128	142	148	12.66	12.64	20.87	21.23
6 60 % mineral K +40 % rock feldspar	123	126	140	143	12.39	12.45	20.33	20.88
7 60 % mineral K +40% (mixed)*	128	133	146	150	12.78	12.97	20.94	21.45
8 40 % mineral K +60 % plant compost	110	112	128	132	13.09	13.25	21.4	21.86
9 40 % mineral K +60 % rock feldspar	107	112	123	125	13.0	13.17	21.25	21.78
1040 % mineral K +60% (mixed)*	113	116	130	132	13.22	13.48	21.69	22.26
New L.S.D at 5%	6.0	6.0	7.0	8.0	0.51	0.40	0.51	0.41

*** mixed = (plant compost 50% + rock-feldspar 50%)**

The best values for shoot length and leaf surface area were obtained from vines receiving 60% mineral potassium fertilizer + 40% mixed of (plant compost + rock-feldspar) in both seasons.

The beneficial effects of organic fertilizers on shoot length and leaf surface area may be related to the improvement of physical and chemical conditions of the soil, providing energy for microorganisms activity, improving the efficiency of macro and micro elements and increasing nutrient supply (Table 6) (Kolble et al. 1995) which reflected in enhancing vegetative growth.

Total chlorophyll content in the leaves and total carbohydrates in canes:

With respect to total chlorophyll content in the leaves and total carbohydrates in the canes data in the (Table 5) revealed that total chlorophyll content in the leaves and total carbohydrates in canes were significantly increase when applied different fertilizers as compared with control (mineral K alone) during 2014 and 2015 seasons. Vines receiving 40% mineral potassium fertilizer + 60% (plant compost, rock-feldspar and mixed of them) gave significant values of total chlorophyll content in the leaves and total carbohydrates in canes followed by 60% mineral potassium fertilizer + 40% (plant compost, rock-feldspar and mixed of them) then 80% mineral potassium fertilizer + 20% (plant compost, rock-feldspar and mixed of them) in both seasons. The best values for total chlorophyll content in the leaves and total carbohydrates in canes were obtained from vines receiving 40% mineral potassium fertilizer + 60% mixed of plant compost + rock-feldspar during 2014 and 2015 years of study.

The promoting effects of organic and natural fertilizers on increasing total chlorophyll may be due to more uptakes of nutrients such as N, Mg and Fe as shown in (Table 6) which is involved in chlorophyll formation and led to enhance in photosynthesis process and increase carbohydrates content as mentioned by (El Haggar *et al.* 2004 and Mohamed, 2008).

The data in (Table 5) were in agreement with those found by (Abd El-Wahab, 2011; Mostafa *et al.* 2011; Adel, (2012); Gawad Shaheen *et al.* 2012; Masoud, 2012; Shaheen, *et al.* 2013, and Hegazi *et al.* 2014) on grapevines cultivars.

N, P, K, Mg, Ca and Fe (%) content in leaf petioles:

Concerning the effect of organic and natural fertilizers on leaf mineral content, data in (Table 6) indicated that treatments of 60% mineral potassium fertilizer + 40% (plant compost, rock- feldspar and mixed of them) had the highest values of N, P, K and Mg content in leaf petioles followed by 80% mineral potassium fertilizer + 20% (plant compost, rock feldspar and mixed of them) then 40% mineral potassium fertilizer + 60% (plant compost, rock-feldspar and mixed manure) in the two seasons of study while vines receiving 40% mineral potassium fertilizer + 60% (plant compost, rock-feldspar and mixed of them) had significant values of Ca and Fe content in leaf petioles followed by 60% mineral potassium fertilizer + 40% (plant compost, rock-feldspar and mixed of them) then 80% mineral potassium fertilizer + 20% (plant compost, rock-feldspar and mixed of them) during 2014 and 2015 years of study.

The improving effects of organic fertilizers on leaf content of N, P, K, Mg, Ca and Fe may be related to their influence manifested in increasing the organic matter in the soil which reflected on enhances the soil water holding capacity, soil structure and fertility, which improves solubility and consequently availability of absorbing both macro and micro elements (Nijjar, 1985 and Nasser, 1998). Also, the importance application of natural rocks (rock-feldspar) may be attributed to their release of macro and micro elements which make converting them in soluble forms of P, K, Ca, Mg and Fe in comparison with the fertilizers without natural rocks.(El Haggar *et al.* 2004 and Mohamed, 2008).

Our results were in harmony with the work carried out by (Abd El-Wahab, 2011; Mostafa *et al.* 2011; Gawad Shaheen, 2012; Masoud, 2012; Shaheen *et al.* 2013 and Hegazi *et al.* 2014) on grapevines cultivars.

Yield, cluster weight and 100 berry weight:

Data in (Table 7) showed that the yield, cluster weight and 100 berry weights of Thompson seedless grapevines were greatly affected by mineral potassium fertilizers with organic and natural fertilizers in the two seasons of study as compared with mineral potassium fertilizer alone (control). Also, data revealed that 60% mineral potassium fertilizer + 40% from (plant compost or rock-feldspar and mixed of them) recorded pronounced significant values of yield/vine, cluster weight and 100 berry weight followed in a descending order by 80% mineral potassium fertilizer + 20% (plant compost or rock-feldspar and mixed of them) then 40% mineral potassium fertilizer + 60% (plant compost or rock-feldspar and mixed of them). On the other hand, vines receiving 100% mineral potassium fertilize gave the lowest values in both years of study.

The highest values of these parameters were obtained with vines receiving 60% mineral potassium fertilizer + 40% mixed of plant compost + rock-feldspar during the two seasons of study.

The beneficial effects of using organic fertilizers on increasing yield, cluster weight and 100 berry weight may be due to their impact on providing vines with their requirements from different nutrients (macro and micro elements) at a longer time and consequently promoting the nutritional status of the vines (Table 6) and vegetative growth (Table 5) which in favor of yield and cluster weight (Nijjar, 1985).

Also, the importance of application of natural rocks (rock- feldspar) may be attributed to their release of macro elements which make converting them in soluble forms of P, K, Ca and Mg in comparison with the fertilizers without natural rocks.(El Haggar *et al.* 2004 and Mohamed, 2008).

Table 6. Effect of using plant compost and rock-feldspar on N, P, K, Mg, Ca and Fe of Thompson seedless grapevines during 2014and 2015 seasons

Treatments / Characteristics	Leaf N (%)		Leaf P (%)		Leaf K (%)		Leaf Mg (%)		Leaf Ca (%)		Fe mg/ 100g d.w	
	2014	2015	2014	2015	2014	2014	2014	2015	2014	2015	2014	2015
1 100 % mineral K (Control)	2.21	2.33	0.26	0.28	1.78	1.76	0.326	0.322	1.22	1.19	0.5	0.54
2 80 % mineral K +20 % plant compost	2.54	2.60	0.30	0.32	2.06	2.11	0.372	0.389	1.29	1.33	0.6	0.65
3 80 % mineral K +20 % rock feldspar	2.38	2.53	0.28	0.32	2.02	2.08	0.364	0.380	1.38	1.44	0.66	0.71
4 80 % mineral K +20% (mixed)*	2.55	2.62	0.32	0.35	2.07	2.12	0.380	0.395	1.40	1.45	0.68	0.74
5 60 % mineral K +40 % plant compost	2.67	2.76	0.36	0.39	2.18	2.20	0.390	0.408	1.42	1.50	0.70	0.76
6 60 % mineral K +40 % rock feldspar	2.60	2.68	0.33	0.37	2.10	2.15	0.386	0.400	1.46	1.52	0.74	0.78
7 60 % mineral K +40% (mixed)*	2.76	2.80	0.38	0.42	2.21	2.25	0.402	0.414	1.52	1.53	0.78	0.82
8 40 % mineral K +60 % plant compost	2.27	2.39	0.28	0.30	1.98	2.02	0.352	0.362	1.55	1.56	0.82	0.83
9 40 % mineral K +60 % rock feldspar	2.13	2.32	0.24	0.26	1.86	1.92	0.348	0.355	1.58	1.6	0.83	0.85
1040 % mineral K +60% (mixed)*	2.35	2.45	0.30	0.30	1.99	2.03	0.358	0.367	1.60	1.64	0.85	0.88
New L.S.D at 5%	0.14	0.14	0.05	0.06	0.08	0.09	0.007	0.006	0.07	0.08	0.06	0.06

mixed* = (plant compost 50% + rock-feldspar 50%)

Table 7. Effect of using plant compost and rock-feldspar on yield, clusters weight and 100 berry weights of Thompson seedless grapevines during 2014and 2015 seasons

Treatments / Characteristics	Yield (Kg/vine)		Cluster weight (g)		100 berry weight (g)	
	2014	2015	2014	2015	2014	2015
1 100 % mineral K (Control)	8.44	8.84	506	520	186	190
2 80 % mineral K +20 % plant compost	9.22	9.29	528	545	208	216
3 80 % mineral K +20 % rock feldspar	8.97	9.27	522	540	204	210
4 80 % mineral K +20% (mixed)*	9.24	9.37	534	545	204	220
5 60 % mineral K +40 % plant compost	9.44	9.80	544	555	220	226
6 60 % mineral K +40 % rock feldspar	9.32	9.62	538	547	216	222
7 60 % mineral K +40% (mixed)*	9.50	9.83	548	558	228	228
8 40 % mineral K +60 % plant compost	8.67	9.14	510	530	198	202
9 40 % mineral K +60 % rock feldspar	8.64	9.02	508	520	195	200
1040 % mineral K +60% (mixed)*	8.84	9.18	521	538	202	208
New L.S.D at 5%	0.55	0.62	7.0	6.0	10.0	9.0

*** mixed = (plant compost 50% + rock-feldspar 50%)**

These findings confirmed those results obtained by (Wiens and Reynolds, 2008; Abd El-Wahab, 2011; Mostafa *et al.* 2011; Gawad Shaheen, *et al.* 2012; Masoud, 2012; Shaheen, *et al.* 2013, and Hegazi *et al.* 2014) on yield, cluster weight and berry weight of tested grapevines with significant increased by using different types of organic and natural fertilizers compared with using mineral fertilizers only (control).

Chemical characteristics of berries:

Data presented in (Table 8) indicated that soluble solids content, total acidity and total sugars content of berries were significantly affected by mineral potassium fertilizer with organic and natural fertilizers as compared with mineral potassium fertilizer alone in the two years of study. The highest values of SSC % and total sugars content in addition the lowest significant values of total acidity were obtained from vines treating with 40% mineral potassium fertilizer + 60% (plant compost, rock feldspar and mixed of them) followed by 60% mineral potassium fertilizer + 40% (plant compost, rock feldspar and mixed of them) then 80% mineral potassium fertilizer + 20% (plant compost, rock feldspar and mixed of them) during the two seasons of study. While vines treating with 100% mineral potassium fertilizer had significant decrease of SSC % and total sugars content and the highest values of total acidity as compared with other treatments in the two years of study.

The best results of SSC % and total sugars content in addition the lowest significant of total acidity values were obtained from vines treating with 40% mineral potassium fertilizer + 60% mixed of (plant compost + rock feldspar) in both seasons of study

The obtained results may be due to that plant compost and rock-feldspar are rich in their content of macro and micro elements (El Haggar *et al.* 2004 and Mohamed, 2008) which reflected on improve in photosynthesis process, this means that more sugar is available for growth and fruit quality. Also, the improving effect of organic fertilizers on berries quality was mainly due to their major role in improving organic foods especially total carbohydrates and plant pigments as shown in table (5) which is reflected on advancing berry quality and ripeness.

These results were in accordance with (Abd El-Wahab, 2011; Mostafa *et al.* 2011; Uwakiem, 2011; Gawad Shaheen *et al.* 2012; Masoud, 2012; Shaheen, *et al.* 2013 and Hegazi *et al.* 2014) they reported that the gradual increasing of organic fertilizer doses with decreasing the dose of mineral fertilizer gave significant increase of SSC %, total sugars and significant decrease of total acidity of tested treatments

Table 8. Effect of using plant compost and rock-feldspar on ssc, total acidity and total sugars of Thompson seedless grapevines during 2014and 2015 seasons

Treatments / Characteristics	SSC (%)		Total Acidity (%)		Total sugars (%)	
	2014	2015	2014	2015	2014	2015
1 100 % mineral K (Control)	17.4	17.6	0.590	0.578	14.62	14.95
2 80 % mineral K +20 % plant compost	18.2	18.8	0.526	0.490	15.88	16.30
3 80 % mineral K +20 % rock feldspar	18.0	18.4	0.543	0.525	15.51	15.82
4 80 % mineral K +20% (mixed)*	18.4	18.8	0.522	0.486	15.95	16.32
5 60 % mineral K +40 % plant compost	18.6	19.3	0.500	0.472	16.20	16.58
6 60 % mineral K +40 % rock feldspar	18.4	19.0	0.508	0.484	16.15	16.35
7 60 % mineral K +40% (mixed)*	18.8	19.4	0.488	0.470	16.27	16.64
8 40 % mineral K +60 % plant compost	19.0	19.8	0.476	0.430	16.68	16.98
9 40 % mineral K +60 % rock feldspar	18.8	19.6	0.482	0.440	16.36	16.86
10 40 % mineral K +60% (mixed)*	19.2	20.0	0.458	0.416	16.87	17.26
New L.S.D at 5%	0.7	0.7	0.045	0.052	0.54	0.57

***mixed = (plant compost 50% + rock-feldspar 50%)**

The economic study

It is clear from the obtained data in (Table 9) that all treatments under this study except the treatment of (40% mineral potassium fertilizer + 60% plant compost) minimized the production cost and gave the best net profit / feddan as compared with control. Application of 60% mineral potassium fertilizer mixed with 40% of plant compost + rock-feldspar gave the highest values of net profit / feddan which recorded 2690 (L.E.) over control as average two seasons.

Table 9. Economic study on costs and net profit / feddan of different sources of mineral, plant compost and rock-feldspar fertilizers applications of Thompson seedless as average for two seasons (2014and 2015)

Treatments	Costs of *cultural Practices / fed. (L .E)	Treatments costs / fed. (L .E)	Total costs / fed. (L .E)	Yield/fed. (Kg)	Total production / fed. (L .E)	Net profit / fed. (L .E)	Net profit /fed. Over control (L .E)
1 100 % mineral K(Control)	4200	2150	6350	8640	21600	15250	0
2 80 % mineral K +20 % plant compost	4200	2080	6280	9255	23140	16860	1610
3 80 % mineral K +20 % rock feldspar	4200	2080	6280	9120	22800	16520	1270
4 80 % mineral K +20% (mixed)*	4200	2085	6285	9305	23260	16975	1725
5 60 % mineral K +40 % plant compost	4200	2050	6250	9620	24050	17800	2550
6 60 % mineral K +40 % rock feldspar	4200	2020	6220	9470	23675	17455	2205
7 60 % mineral K +40% (mixed)*	4200	2020	6220	9665	24160	17940	2690
8 40 % mineral K +60 % plant compost	4200	2150	6350	8905	22260	15910	660
9 40 % mineral K +60 % rock feldspar	4200	1955	6155	8830	22075	15920	670
1040 % mineral K +60% (mixed)*	4200	1925	6125	9010	22525	16400	1150

*** mixed = (plant compost 50% + rock-feldspar 50%)**
*** Cultural practices such as (Pesticides, fungicide, Irrigation and Labour)**
- Price/1 ton from mineral K=6000 (L .E.) - Price/1 ton from plant compost = 230 (L .E.)
- Price/1 ton from mineral N =3000 (L .E.) - Price/1 ton from rock-feldspar = 800 (L .E.)
- Price/1 ton from mineral P =1000 (L .E.) - Price/1 kg from Yield = 2.5 (L .E.)
- One feddan = 1000 vines

CONCLUSION

From the previous results, it can be concluded that there is a possibility of using organic and natural resources of potassium fertilizers as a partial substitute of mineral potassium fertilizer in vineyard of Thompson seedless. However, this investigation confirmed that application of 60% mineral potassium fertilizer mixed with 40% of (plant compost 50% + rock-feldspar 50%) was the best management system for achieving significant values of shoot length, leaf surface area, total chlorophyll of the leaves, leaf minerals content, yield, cluster weight and 100 berry weights as well as enhanced chemicals properties of berries and total carbohydrates in canes. Also, minimized the production cost and gave the best net profit/ feddan of Thompson seedless grapevines.

REFERENCES

A.O.A.C. (1980). Association of Official Analytical Chemists. 14th ed published by A.O.A.C., Washington D.C., USA

Abd El-Wahab, M.A. (2011) Reducing the amount of mineral nitrogen fertilizers for Red globe grapevines by using different sources of organic fertilizers. J. of Amer. Sci., 7(8) 810-822.

Adel, M. R. (2012) Effect of some organic treatments on some grapevines cultivars. Ph. D. Thesis Fac. Agric., Cairo Univ., Egypt,

Aisha, H.A. and A.S. Taalab (2008). Effect of natural and /or chemical Potassium fertilizers on growth, bulbs yield and some physical and chemical constituent of Onion (*Allium cepa*, *L*). J. Agric and Biological Sci., 4(3): 228-237.

Barker, W.W.; S.A. Welch and J.F. Banfield, (1997). Geomicrobiology of silicate minerals weathering. Rev. Mineral, 35: 391-428.

Bogatyre, A.N. (2000). What are we to eat or how to live longer? Pishchevaya Promyshlennost, 7: 34-35.

Cottenie, A.; M. Verloo; L. Kiekens; G. Relgho and W. Camerlynuck (1982). Chemical analysis of plant and soil. Lab. of analytical and Agrochemistry State Univ. Gent, Belgium.

Darwish, O.H., N. Persaud and P.C. Martens, (1995). Effect of long term application of animal manure on physical properties of three soils. Plant and Soil., 175: 289-295.

El-Haggar, S.M., B.E. Ali; S.M. Ahmed and M.M. Hamdy, (2004). Solubility of some natural rocks during composting. Proceedings of the 2nd International Conf. Organic Agric.25-27 March, Nasr City, Cairo, Egypt, pp: 105-116.

Gawad Shaheen, M.A.; S.M. Abd El-Wahab; E.A. Hassan and A.M.R.A. Abd ElAziz (2012). Effect of some soil conditioners and organic fertilizers on vegetative growth and quality of Crimson seedless grapevines. J. Hort. Sci. & Ornam. Plants 4 (3): 260-266.

Hegazi, A.H.; N.R. Samra; E.A. Hassan and A.M. Yasmin (2014). Effect of compost as organic fertilizers, natural rocks and some different biofertilizers on yield and quality of Flame seedless grapevines. J. Plant Production, Mansoura Univ., Vol. 5 (10): 1625 – 1636.

Imas, P. and S.K. Bansal (1999). Potassium and integrated nutrient management in potato. Presented at the global conference on potato, 41: 34-48. December 6-11, New Delhi, India.

Kolbe, H.; Neineke, H.S. and W.L. Zhang (1995): Differences in organic and mineral fertilization on potato tuber yield and chemical composition compared to model calculation. Agribiol. Res., 48(1): 63-73.

Leigh, R.A. (2001). Potassium homeostasis and membrane transport. J. Plant Nutrition and Soil Sci., 164: 193-198.

Mackinny, G. (1941). Absorption of light by chlorophyll soluation. J. Bio. Chem., 140: 315-322.

Marschner, H. (1995). Mineral nutrition of higher plant. Academic press, London, 4th printing (1999): 889 pp.

Martin, P.; R. Delgado; M.R. Gonzalez and J.I. Gallegos. (2004). Coulour of 'Tempranillo' grapes as affected by different nitrogen and potassium fertilization rates. Acta. Hort., 652: I International Symposium on Grapevine Growing, Commerce and Research, Lisbon, Portugal.

Masoud A.A.B. (2012). Effect of organic and bio nitrogen fertilization on growth, nutrient status and fruiting of Flame seedless and Ruby seedless grapevines. R. J. of Agri.and Biol. Sci., 8(2): 83-91.

Ministry of Agriculture (2012). Agriculture Economics vol. 6. September.

Ministry of Agriculture (2016). Agriculture Economics vol. 2. September.

Mohamed, N.M. (2008). Reducing agro chemical residues in grapes by using different sources from bio and organic fertilizers. Ph.D. Thesis. Institute. of Environ. Stud., and Res., Ain Shams Univ.

Montero, F.J.; J.A. De Juan; A. Cuesta and A. Brasa (2000). Non-destructive methods to estimated leaf area in (*Vitis vinifera* L.). Hort. Sci., 35:696 - 698.

Mostafa, M.F. M.; E.E.T. El-Baz; A.F. Abd El-Wahab and A.M.O. Saeed (2011). Using different sources of compost tea on grapevines. J. Plant production, Mansoura Univ., 2 (7):935-947.

Nasser, L.N. (1998). Utilization of the municipal carbage (MG) as a soil amendment. Alex. J. Agric. Res., 43(3): 317-332.

Nijjar, G.S. (1985): Nutrition of Fruit Trees. Kalyani Publishers New Delhi, India, 320 p.

Sabry, G. H.; M. S. Rizk-Alla and M. A. Abd El-Wahab (2009). Influence of effective micro-organisms, seaweed extract and Amino acids application on growth, yield and berry quality of Red Globe grapevines. J. Agric. Sci. Mansoura Univ., 34 (6):6617-6637

Sadasivam, S. and A. Manickam (1996). Biochemical Method Second Edition , New Age International, India.

Schaffer, P.A. and A.F. Hartman (1921). The idometric determination of copper and its use in sugar analysis. J. Bio. Chem., 45:349-364.

Shaheen, M.A.; S.M. Abd El-Wahab, F.M. El-Morsy and A.S.S. Ahmed (2013) Effect of organic and bio-fertilizers as a partial substitute for NPK mineral fertilizer on vegetative growth, leaf mineral content, yield and fruit quality of Superior grapevine J. of Hort. Sci. & Ornamental Plants 5 (3): 151-159.

Sheng, X.F., W.Y. Huang, (2002). Mechanism of potassium release from feldspar affected by the strain NBT of silicate bacterium. Acta Pedologica Sinica, 39(6): 863-871 (in Chinese, with English abstract).

Snedecor, G.W. and W.G. Cochran (1980). Statistical Methods.7th ed., The Iowa State Univ. Press. Ames. , Iowa, U.S.A., pp. 593.

Taiz L and E Zeiger (1991). Cytokinins. In: (L. Taiz and E Zeiger, eds) Plant Physiology. Benjamin/ Cummings, Redwood City, CA., pp 452-472.

Uwakiem, M.Kh., (2011). Effect of some organic, bio and slow release N fertilizers as well as some antioxidants on vegetative growth, yield and berries quality of Thompson seedless grapevines. Ph.D, Thesis. Fac. of Agric. Minia Univ. Egypt.

Walker, D.J.; C.R. Black and A.J. Miller. (1996). The role of cytosolic potassium and pH in the growth of barley roots. Plant Physio., 118: 957-964.

Wiens, G. and A.G. Reynolds, (2008). Efficacy testing of organic nutritional products for Ontario Canada Vineyards. I. J. Fruit Sci, 8(1–2).

Yagodin, B.A. (1984). Agricultural Chemistry, vol. 2, Mir Pub. Moscow.

الاستبدال الجزئى للسماد البوتاسى المعدنى للعنب الطومسون سيدلس عن طريق استخدام مصادر مختلفة من الأسمدة العضوية والطبيعية

بسام السيد عبد المقصود بلال ، مسعد عوض القناوى و ثريا صابر على أبو الوفا
قسم بحوث العنب - معهد بحوث البساتين – مركز البحوث الزراعيه – الجيزة

أجريت هذة الدراسة خلال مواسم 2013 &2014 & 2015 فى مزرعة خاصة فى قرية الدير التابعة لمركز أجا محافظة الدقهلية على كرمات عنب بناتى عمرها 13 سنة ومنزرعة فى تربة طينية وتروى بنظام الرى بالغمر ومنزرعة على مسافة 2x2 م ومرباه بالطريقة القصبية وقدأخذت قياسات الموسم الثانى والثالث حيث اعتبر الموسم الاول تجربة تمهيدية وكان الهدف من هذة الدراسة هو تقليل استخدام الأسمدة المعدنية البوتاسية ذات التكلفة العالية عن طريق استخدام مصدرين مختلفين من الأسمدة العضوية والطبيعية الاقل تكلفة. حيث تم استخدام الكمبوست النباتى كمصدر للأسمدة العضوية وخام الفلسبار كمصدر للأسمدة الطبيعية أو خليط منهما بنسبة 50% : 50% على أساس المحتوى البوتاسى فى كليهما وذلك مع الأسمدة البوتاسية المعدنية (سلفات البوتاسيوم) .وقد أظهرت النتائج الاتى: امكانية استبدال جزء من السماد المعدنى البوتاسى ليحل محلة جزء من السماد العضوى فى صورة الكمبوست النباتى أو السماد الطبيعى فى صورة خام الفلسبار أو الاثنين معا حيث أكدت النتائج أن اضافة السماد المعدنى البوتاسى مع كل من سماد الكمبوست النباتى أو سماد خام الفلسبار أو الاثنين معا أدت الى الحصول على أفضل النتائج من حيث القياسات الخضرية (طول الفرع والمساحة الورقية) وزيادة محتوى الاوراق من الكلورفيل الكلى والنسبة المئوية لعناصر النتروجين والفسفور والبوتاسيوم والماغنسيوم والكالسيوم والحديد وكذلك زيادة المحصول ووزن العنقود وتحسين الصفات الكيماوية فى الحبات وزيادة محتوى القصبات من الكربوهيدرات الكلية وكذلك تقليل تكلفة التسميد البوتاسى و زيادة صافى ربح الفدان وذلك بالمقارنه بالكنترول (السمادالبوتاسى المعدنى فقط) خلال موسمى الدراسة وكانت أفضل المعاملات هى اضافة 60 % من السماد المعدنى البوتاسى مع 40 % من السماد الخليط (كمبوست نباتى50% + خام الفلسبار50%).