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EFFECT OF COMPOST AS ORGANIC FERTILIZER, NATURAL ROCKS AND SOME DIFFERENT BIOFERTILIZERS ON YIELD AND QUALITY OF FLAME SEEDLESS GRAPEVINES.

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ABSTRACT

The present study was carried out during three successive seasons (2011, 2012 and 2013). (the first year was considered as a preliminary trial) on ten years old Flame seedless grape vines cultivated in a private vineyard at 64th kilometer Cairo-Alexandria desert road. The main of study was to evaluate the effect of using organic fertilizer as compost in combination with or without two natural rocks ; Rock Phosphate and Feldspar. Also three different biofertilizers were used; Biogen (*Azotobacter chroococcum*) for N, Phosphorien (*Bacillus Megathrium*) for P and Potasiumag (*Bacillus circulans*) for K in comparison with the mineral fertilization , yield and its components as (number of clusters per vine and cluster weight), physical and chemical characteristics of berries, and nitrite and nitrate content in berry juice of Flame seedless grapevine.

The results revealed that using combined application of%100 compost, natural rocks and the three biofertilizers of NPK were very effective in increasing yield per vine and per feddan, cluster number per vine and weight, physical and chemical properties of berries were significantly improved. On the other side, Both nitrate and nitrite content in berry juice of Flame seedless grapevines were minimized comparing with the vines received 100% mineral fertilization or 100% compost alone. Furthermore, organic agriculture is very safe for human and environment by reducing pollution via improving soil nutritional status as well as decreasing mineral fertilization and that will be reflected on yield and quality of the grapes.

Keywords: Organic fertilizers , Biofertilizers, Natural rocks, berry quality, Yield, Leaf mineral content, Flame seedless.

INTRODUCTION

Grape (*Vitis vinifera, L*) is considered as one of the most popular and favorite fruit crops in the world, for being of an excellent flavor, and high nutritional value because of their high content from sugars, vitamins and minerals. In Egypt, grape ranks the second fruit crop after citrus. Fruiting area increased within the last two decades to reach about 154369 fed. with a total production of 1320801 metric tons fruits according to Egyptian Ministry of Agriculture Statistics (2011).

Flame seedless is considered one of the most important grape cultivars, since it produces large clusters and sweet flavor and ripen early in the last week of May under Egyptian conditions. Nowadays, many studies were accomplished for producing organic fruits through avoiding partially the application of chemicals and hormones as well as encouraging the application of organic and biofertilizers.

Organic and biofertilizers are more useful and effective for soil comparing it with chemicals. (De-Ell and Prange, 1993), more safe in production process for either applicators or consumers, also considered as an important source of macro- and micro-nutrients. In order to improve the grape quality and to decrease using with the mineral fertilization. (Mba , 1994).

Nitrogen is one of the major plant nutrients being a part of proteins, enzymes, amino acids, polypeptides and many other biochemical compounds in the plant system. It is required for the survival and growth of each plant cell (Mengel and Kirkby, 1987).

Phosphorus plays important roles in most metabolic process particularly biosynthesis and translocation of carbohydrates, a development of the fruits. Deficiency of P causes adverse effects on quality of the fruits. (Yagodin , 1990).

Potassium is one of the essential elements in plant nutrition. It intensifies the synthesis of carbohydrates, catalyzes the activity of some enzymes, promotes the synthesis and accumulation of thiamin and riboflavin and is essential for the activity of guard cells. (Yagodin, 1984).

The importance of application of natural rocks (rock phosphate and 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 compost without natural rocks, Also it is received significant interest in the recent years since it is natural, inexpensive and available fertilizer (El Haggar *et al*., 2004 and Mohamed ,2008).

The applications of biofertilizers have numerous benefits that resulted in the following features, according to Marangoni *et al.,* (2001) and Kannaiyan (2002).

- Reducing plant requirements of nitrogen by 25%.
- Improving the availability of various nutrients for plant absorption.
- Increasing the resistance of plants to root diseases.
- Reducing the environmental pollution induced by the application of chemical fertilizers.
- Improving the productivity of the trees.

Therefore, this investigation aimed to study the effect of using organic fertilizers as (compost), and natural rocks as(rock Phosphate), and (Feldspar) and three different biofertilizers as N , P and K comparing with chemical fertilizatzers on yield and quality of Flame seedless grapevine.

MATERIALS AND METHODS

This study was carried out during three successive seasons of (2011, 2012 and 2013). (The first year was considered as a preliminary trial) on ten years old Flame seedless grape vines at 64th kilometer Cairo-Alexandria desert road. Sixty-nine t vines uniform in growth vigour, healthy, productive used and receiving the common cultural practices usually applied in the vineyard orchard in that district.

The vines were cane trained with spur pruning by leaving about 84 buds/vine (12 fruiting canes X 7 buds/cane) under Spanish Parron trellis system and planted at 1.5 x 3 m in a sandy soil under drip irrigation.
The chemical and physical analysis of the soil were determined according to Wilde *et al*. (1985) and shown in Table (1)

Table (1): Physical and chemical analysis of the vineyard soil

Chemical analysis	value	Mechanical analysis	Value
pH(1:2.5 soil)	7.6	Coarse sand	42%
EC(dS/m)	0.79	Fine sand	26%
Organic matter	0.41	Silt	21%
Field capacity %	12	Clay	11%
N (%)	2.74	Texture	Sandy loam
P (%)	1.33		
K (%)	0.91		

The used compost and the natural rocks were analyzed at the Laboratory of Soil and Water Research Institute, Agricultural Research Center, Giza, Egypt according to the method of Jakson (1973) as shown in Table (2 and 3).

Table 2:Analysis of used composted materials

Analysis of compost	M^3 weight (kg)	Moisture content (%)	Ph (1^{-10})	EC (1^{-10}) (ds/m)	Total nitrogen (%)	NH_3^+ (ppm)
Value	550	27	8.05	5.28	1.03	392
Analysis of compost	**NO_3^- (ppm)**	**Organic material (%)**	**Organic carbon (%)**	**Ash (%)**	**C/N ratio**	
Value	420	32.25	18.71	67.75	18.17:1	

Table 3: Some components of the tested natural rocks.

Component (%)	L.O.I.	SiO2	$AL2O_3$	Fe2O3	CaO	MgO
Feldspar	0. 07	68.23	16.25	0.40	0.47	0.03
Rock phosphate	12.87	10.6	0.65	1.35	48.63	0.33
Component (%)	**K2O**	**Na2O**	**TiO2**	**MnO2**	**P2O5**	**So_3**
Feldspar	10.12	3.25	0.04	0.02	0.02	Nil
Rock phosphate	0.03	0.18	0.03	0.08	22.0	0.32

In this experiment the compost was obtained from the Arabian Company for organic fertilizer and was added at 10.560 kg/vine in combination without using the natural rocks as rock phosphate (22.0% P_2O_5) and feldspar rock (10.12% K_2O). The source was Al-Ahram Company for Natural fertilizers, Giza, Egypt. The rates were 195 g for rock phosphate and 1.69 kg /vine for Feldspar. Also, bacterial used as NPK biofertilizers (provided by the Bio-fertilization Unit, Water and Land Research Institute, Agriculture

Research Center) were Biogen (*Azotobacter chroococcum*) for N, Phosphorien (*Bacillus Megathrium*) for P and Potasiumag (*Bacillus circulans*) for K , at the rate of 60 , 30 and 120 g/vine, respectively. as soil application

Compost, the natural rocks and biofertilizers were added once at the second week of January after pruning and before the beginning of bud burst. The mineral doses were added at three times:25% at the beginning of bud burst till flowering, 50% after fruit set till harvesting and 25% after harvest.

The following eight treatments were applied as follow:

1-100 % Mineral (control).

2-100 % Compost.

3-50% Compost + 50% Mineral fertilization.

4-100 % Compost+ Biofertilizers.

5-100 % Compost+ Natural Rocks.

6-100 % Compost+ Phosphorien+ Phosphate rock.

7-100 % Compost+ Potasiumag+ feldspar rock.

8-100 % Compost+ Natural rocks + Biofertilizers.

For mineral fertilization, ammonium nitrate was used as a source of N , Phosphoric acid for P and Potassium sulphate for K at the ratio of 60-30-120 units recommended by the Ministry of Agriculture.

The following parameters were recorded as follows:

Yield and cluster characteristics:

At harvesting time number of clusters /vine was recorded to estimate:

Clusters weight: it was determined using an electrical sensitive balance**.**

Yield/vine (kg): it was evaluated by multiplying the average cluster number per vine times the average cluster weight.

Yield/feddan (ton):

It was calculated by multiplying the yield of vine times the number of vines/feddan.

A sample of four clusters/ treatment was harvested to determined:

Physical and chemical characteristics of berries:

Average berry weight (gm).

Average berry diameter (mm).

Soluble solids content percentage (SSC%): It was determined by using a Hand refractometer.

Total acidity content (%): (as g tartaric acid/ 100 ml juice) by titration against 0.1 NaOH using Phenolphthalein as an indicator (AOAC, 1995).

Soluble solids content / acid ratio (SSC/acid ratio): calculated by dividing the percentage of SSC by total acidity.

Nitrite and nitrate content in berries juice (ppm): was determined according to methods described by Ridnour–Lisa *et al.,* (2000).

Statistical Analysis:

The Randomized complete block design of the present study were carried out according to method described by Snedecor and Chocran (1980).Using New L.S.D. at 5% level for examining the significant differences between the studied treatment means.

RESULTS AND DISCUSSION

Cluster number and weight:

Data in Table 4 showed that the highest values of cluster number and weight were obtained from vines received 100% compost + natural rocks + biofertlizers. This was true in all studied seasons, while vines received 100% compost recorded the lowest cluster number and weight in both seasons. These results were emphasized by the results of Abd El-Maksood (2006), Mohamed (2008), Abd El-Monem *et al.* (2008) Abd El-Aziz (2012) and Omar (2013).

Table (4): Effect of compost, natural rocks and biofertilizers on clusters number and clusters weight of Flame seedless grapevines.

Treatment	Clusters number			Clusters weight (g)		
	2012	2013	**Mean**	2012	2013	**Mean**
100% Mineral	19.66	21.00	20.33	526.48	509.21	517.84
100% Compost	18.33	20.33	19.33	462.23	478.28	470.25
50% Compost + 50% mineral	20.66	22.33	21.49	546.08	581.85	563.96
100% Compost+ biofertilizers	21.33	23.33	22.33	501.31	534.24	517.77
100% Compost+ Rocks	20.00	22.33	21.16	527.04	542.77	534.90
100% Compost+ Phosphorien+Phosphat rock	19.33	22.33	20.83	548.73	587.60	568.16
100% Compost+ Potasiumag+feldspar rock	23.00	25.00	24.00	520.69	562.88	541.78
100% Compost + rocks+ biofertilizers	24.33	28.00	26.16	646.24	592.27	619.25
New L.S.D. 0.05	3.10	3.89		117.59	128.97	

Yield/vine and per feddan:

As shown in Table 5, vines received 100% compost + natural rocks + biofertilizers produced the highest significant value of yield/vine and per feddan in both seasons, respectively. On the other hand, the vines which received 100% compost recorded the lowest values of yield/vine and per feddan comparing to all tested treatments in both seasons under the study. The increment in yield per vine and per feddan may be due to their effect on increasing both number of berry and berry weight per cluster. These results are in harmony with those obtained by Kannaiyan (2002) and Wiens and Reynolds (2008), they reported that the complete organic treatments had higher yield (t/ha) in mature own-rooted 'Baco noir' grapevines compared with the vines which received mineral fertilizers (control) only. Also, Mohamed (2008), Abu El-Lail, *et al.* (2011) and Shaheen, *et al.* (2013) had the same results.

Table (5): Effect of compost, natural rocks and biofertilizers on yield/vine and per feddan of Flame seedless grapevines.

Treatment	Yield/vine (kg)			Yield/feddan (ton)		
	2012	2013	**Mean**	2012	2013	**Mean**
100% Mineral	10.38	10.68	10.53	7.27	7.47	7.37
100% Compost	8.42	9.77	9.09	5.89	6.83	6.36
50% Compost + 50% mineral	11.28	12.98	12.13	7.89	9.08	8.49
100% Compost+ biofertilizers	10.69	12.46	11.57	7.48	8.71	8.10
100% Compost+ rocks	10.57	12.13	11.35	7.39	8.48	7.94
100% Compost+ Phosphorien+Phosphat rock	10.60	13.16	11.88	7.42	9.20	8.31
100% Compost+ Potasiumag+feldspar rock	11.94	14.07	13.00	8.35	9.84	9.10
100% Compost + rocks+ biofertilizers	15.72	16.55	16.13	11.00	11.58	11.29
New L.S.D. 0.05	2.94	3.76		2.06	2.68	

The positive action of using organic fertilizers specially biofertilizers may be due to their great abilities for providing various nutrients for the vines in addition to the high influence of the biofertilizers in fixing atmospheric nitrogen, increasing uptake of elements and hormonal biosynthesis which resulted in improving yield per vine and also will appear in total yield per feddan.

Berry weight and diameter:

The results in Table 6 clearly showed insignificant differences between the tested treatments concerning berry weight, while treatment with 100% compost + natural rocks + biofertlizers gained the highest weight compared with the lowest one recorded by vines received 100% compost + phosphorein+ phosphate rock followed by vines received 100% mineral fertilization.

This results are in line with Farag (2006) Abd El-Maksood (2006), Abd El-Hamied (2007), and Omar (2013) who reported that the continuous fertilization with organic fertilizer is promising in the long run for berry weight of Flame Seedless grapevines.

As for combined application with 100% compost + natural rocks + biofertlizers, resulted in the highest berry diameter in the first season. However, vines received 100% compost + biofertilizrs showed the lowest value in the first season only. On the other hand, insignificant differences were recorded between all the treatments in this respect in the second season, whereas the control vines recorded the least diameter in the same season.

Table (6): Effect of compost, natural rocks and biofertilizers on berry weight and berry Diameter of Flame seedless grapevines.

Treatment	Berry Weight(g)			Berry Diameter(mm)		
	2012	2013	**Mean**	2012	2013	**Mean**
100% Mineral	2.99	3.15	3.07	16. 83	17. 46	17.14
100% Compost	3.21	3.59	3.40	16. 73	17. 53	17.13
50% Compost + 50% mineral	3.43	3.87	3.65	17. 56	18. 46	18.01
100% Compost+biofertilizers	3.22	3.35	3.28	16. 70	17. 53	17.11
100% Compost+Rocks	3.01	3.38	3.19	16. 73	17. 60	17.16
100% Compost+ Phosphorien+Phosphat rock	2.93	3.27	3.10	17. 86	18. 53	18.19
100% Compost+ Potasiumag+feldspar rock	3.14	3.11	3.12	17. 16	18. 46	17.81
100% Compost+rocks+ biofertilizers	3.83	3.76	3.79	18. 23	19. 16	18.69
New L.S.D. 0.05	NS	NS		2.21	NS	

These results are in accordance with those reported by El-Shennawy and Fayed (2005b) and Mohamed (2008), who showed that the highest value of berry diameter was obtained with vines fertilized with 8kg compost + 400g Rock phosphate + 400g Feldspar compared with the control in superior seedless grapvines.

These natural compounds encouraged the biosynthesis of plant growth promoters and caused the clear increase of berry dimension through better absorption of micro nutrient from the soil.

SSC, Acidity and SSC /Acid ratio:

Data presented in Table 7 indicated that berries SSC significantly increased by the application of 100% compost + natural rocks + biofertilizers followed by those berries of the vines received 100% compost + biofertilizers in comparison with those berries of the vines fertilized with 100% compost + rocks and followed by 100% mineral fertilization in both seasons. Data failed to show any significant differences for berries SSC in the first season except for 100% compost + rocks treatment when compared with 100% compost + natural rocks + biofertilizers which obtained the highest berries SSC in the second season.

Using compost in combination without natural rocks and biofertilizers and also the control vines showed insignificant differences in acidity. The application of 100% compost + natural rocks + biofertilizers gave the lowest values of total acidity in berry juice.

Application of 100% compost + natural rocks + biofertilizers clearly showed a higher values of SSC/Acid ratio followed by the vines received 100% compost + biofertilizers. Whereas, treated vines with 100% compost + rocks and mineral vines gained the lowest values.

Our results go in line with those obtained by Harhash and Abd El-Nasser (2000), Mohamed (2008) and Omar (2013) who confirmed the present results, in addition, Abd El-Aziz (2012), show clearly that treatment of Superior Seedless grape cultivar with compost (B) at rate of 20kg compost, 0.5kg rock phosphate and 1kg feldspar per vine in the presence of biofertilizers (NPK) and humic acid gave the highest SSC and total acidity as compared to untreated vines and received recommended doses of mineral NPK fertilizers.

Table (7): Effect of compost, natural rocks and biofertilizers on acidity and SSC/acidity of Flame seedless grapevines.

Treatment	SSC (%)			Acidity (%)			SSC/Acid (%)		
	2012	2013	**Mean**	2012	2013	**Mean**	2012	2013	**Mean**
100% Mineral	16.23	16.70	16.46	0.491	0.470	0.480	33.81	35.55	34.68
100% Compost	16.63	17.26	16.94	0.447	0.433	0.440	37.20	39.86	38.53
50% Compost + 50% mineral	18.13	18.06	18.09	0.450	0.442	0.446	40.24	40.88	40.56
100% Compost+ biofertilizers	18.33	18.93	18.63	0.423	0.417	0.420	43.27	45.33	44.30
100% Compost+ Rocks	15.40	15.80	15.60	0.485	0.466	0.475	32.22	34.06	33.14
100% Compost+ Phosphorien+Phosphat rock	17.43	18.63	18.03	0.436	0.428	0.432	39.92	43.57	41.74
100% Compost+ Potasiumag+feldspar rock	17.56	18.46	18.01	0.445	0.437	0.441	39.45	42.20	40.82
100% Compost + rocks+ biofertlizers	19.10	19.80	19.45	0.415	0.409	0.412	45.98	48.42	47.20
New L.S.D. 0.05	NS	3.06		NS	NS		11.63	8.72	

Nitrite and Nitrate:

It’s clear from the data in Table 8 that the treatment of 100% compost + natural rocks + biofertilizers reduced the berry juice content of both nitrite and nitrate, while the treatment of 100% mineral showed a higher values in both seasons under the study. In this respect, Saleh *et al*., (2006) and Farag (2006). showed that organic fertilization caused a sharp reduction of nitrate and nitrite of Flame Seedless grapevine, while the highest content of nitrate and nitrite was found in 100% mineral fertilizated berries Also, Abd El-Aziz (2012) on both Superior and Crimson seedless and Omar(2013) on Ruby seedless grape cultivar, come into the same conclusion.

Table (8): Effect of compost, natural rocks and biofertilizers on nitrite and nitrate of Flame seedless grapevines.

Treatment	Nitrite (ppm)			Nitrate (ppm)		
	2012	2013	**Mean**	2012	2013	**Mean**
100% Mineral	5.09	5.03	7.68	10.34	10.16	10.25
100% Compost	3.63	3.55	5.93	8.31	8.22	8.26
50% Compost + 50% mineral	2.94	3.16	5.35	7.54	7.49	7.51
100% Compost+ biofertilizers	2.24	2.19	3.76	5.33	5.27	5.30
100% Compost+ rocks	2.47	2.41	4.17	6.21	6.18	6.19
100% Compost+ Phosphorien+Phosphat rock	2.33	2.28	3.98	5.69	5.65	5.67
100% Compost+ Potasiumag+feldspar rock	2.02	1.98	2.95	3.92	3.89	3.90
100% Compost+rocks+ biofertilizers	0.97	0.93	1.55	2.18	2.16	2.17
New L.S.D. 0.05	0.81	1.00		0.94	0.95	

On conclusion, the application of organic fertilizer (compost) plus two natural rocks and three biofertilizers was the best treatment for achieving the best results of yield and quality of Flame seedless grapevine. Moreover, the use of the natural compounds will reduce environmental pollution which may occur by excessive use of chemical fertilization alone.

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تأثيرالكمبوست كسماد عضوى,الصخور الطبيعيه وبعض المخصبات الحيويه المختلفه على المحصول وجوده كرمات عنب الفليم سيدليس.

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١- قسم الفاكهه- كليه الزراعه- جامعه المنصوره.
٢- المعمل المكزى للزراعه العضويه- مركز البحوث الزراعيه.

أجريت هذه الدراسه خلال ثلاثه مواسم متتاليه (٢٠١١, ٢٠١٢ و ٢٠١٣) مع أعتبار ان السنه الاولى كتجربه تمهيديه, وذلك على كرمات عنب فليم سيدليس تبلغ من العمر ١٠ سنوات منزرعه فى مزرعه خاصه بالكيلو ٦٤ طريق مصر- أسكندريه الصحراوى ,حيث تم فيها دراسه تأثير أستخدام السماد العضوي الكمبوست مخلوط أو بدون خلط مع الصخور الطبيعيه مثل (صخر الفوسفات) و(صخر الفلسبار) وأيضا أستخدام ثلاثه مخصبات حيويه مختلفه مثل (البيوجين) كمصدر للنيتروجين *Azotobacter)* *chroococcum*,(الفوسفورين) كمصدر للفسفور(*Bacillus Megathrium*) و(البوتاسيوماج) كمصدر للبوتاسيوم *Bacillus*) *circulans)* فى مقارنه مع التسميد المعدنى على محصول الكرمه والفدان ومحتواه من عدد العناقيد للكرمه الواحدة ووزن العنقود و الخصائص الفيزيائيه والكيميائيه لحبات العنب, ومحتوى عصير الحبات من النتريت والنترات في كرمات عنب الفليم سيدليس.

اثبتت الدراسات أن أستخدام مخلوط من ١٠٠% كمبوست , الصخور الطبيعيه والثلاثه مخصبات حيويه كمصدر للنيتروجين والفسفور والبوتاسيوم كان له تأثيرا فى زياده محصول الكرمه و الفدان وعدد ووزن العناقيد لكل كرمه والخصائص الفيزيائيه والكيميائيه للحبات. وعلى الجانب الاخر, فقد أنخفض محتوى عصير الثمار لكرمات عنب الفليم سيدليس لكلا من النترات والنيتريت مقارنه بالكرمات التى سمدت ب ١٠٠% تسميد معدنى أو ١٠٠% كمبوست فقط. وعلاوه علي ذلك فتعتبر الزراعه العضويه أمنه جدا على الانسان والبيئه وذلك من خلال الحد من التلوث البيئي عن طريق تحسين حالة التربه العضوية وأيضا تقليل استخدام التسميد المعدنى والذي من شأنه ان ينعكس على كميه وجودة المحصول للعنب.

الكلمات الدالة:، الأسمدة العضوية، الأسمدة الحيوية ,الصخور الطبيعية، جودة الحبات، المحصول، المحتوى المعدني للورقة , فليم سيدليس.

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