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SUCCESSFUL APPLICATION OF NATURAL ORGANIC NUTRIENTS TO PRODUCE SAFETY FRUITS FROM THOMPSON SEEDLESS GRAPEVINES

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ABSTRACT

This investigation was carried out to study the effect of some natural organic nutrients including compost extract which recently called in agriculture field (compost tea) and chicken manure extract with different concentrations on yield, cluster characteristics, total sugars and nitrate content in berries of Thompson seedless grapevines. Seasonal changes of NPK in leaf petioles during different stages of grapevines were also studied.

Treatment No. 8 (Compost tea (1:10) x chicken manure extract (1:10) gave the highest values of yield (kg/vine), cluster weight (g) and volume (ml) and also for total sugars and nitrate content of berries. From the other side, the best treatment for producing safety fruits for using human kind was the treatment No. 9 {(Compost tea (1:20) x chicken manure extract (1:20)}, which gave satisfactory yield and cluster weight and volume as well as total sugars (significantly more than values of control treatment), besides it produce the lowest nitrate contents of berries, that means its more safety for human use.

INTRODUCTION

Grapes *(Vitis vinifera,* L.) are among the oldest cultivated fruits and are considered one of the most favorite, delicious and popular fruits for many people in the world. They are consumed as fresh fruits, raisins, juices, compote and sweets industry. The importance of grapes is due to their high production, which gives a high net income to the grape growers. In Egypt, grapes are considering the second fruit crop, and consume mainly as table grapes. The total planted area reached about 153.685 feddan with a total annual production of 1391749 metric ton. Thompson seedless is considers one of the most important and principle commercial grape cv. in Egypt, its acreage is about 93630 feddan; produced about 934.657 metric ton according to the latest statistics of the Ministry of Agriculture (2005).

To obtain an economic yield, the cultural practices during growing season usually took the attention, especially fertilization. In the recent years, water-based compost extracts which is commonly known as compost tea have been attracted increasing attention from bath grape growers and researchers. Field trials, laboratory and grower tests suggest that these extracts have the potential to fruit improve physical and chemical characteristics and suppress plant diseases, particularly those caused by fungal infections.

Compost is known as any product of a composting process that is effectively free from pathogens, weed seeds and inert contaminates that makes it fit for an intended purpose. The process from which compost must be derived is defined as Composting (Brinton *et al.,* 1996 and William *et al*., 1996).

This investigation was carried out to study the effect of some natural organic nutrients including compost extracts and chicken manure at different concentrations on the yield, cluster characteristics, total sugars and nitrates of Thompson seedless grape. Seasonal changes in NPK during successive stages of grapevine were also studied.

MATERIALS AND METHODS

This study was conducted during the two seasons of 2003 and 2004 in a private vineyard of Thompson seedless grapevines *(Vitis vinifera,* L.) located at Abo-Arsa village in Belkas district, Mansoura City, Dakahlia Governorate, Egypt. The vines were 15-year-old, cultivated at 2 m within rows and 2.5 m between rows. The vines are grown in clay soil under surface irrigation system, and trained as cane pruning under canes trellis system. An equal number of buds were left on 5 canes per vine, with maximum 12 buds each.

The current investigation was aimed to study the effect of some natural organic nutrients including compost tea and chicken manure extract at different concentrations on yield, cluster characteristics, total sugars and nitrates of Thompson seedless grape. Seasonal changes in NPK during successive stages of grapevines were also studied.

Ninety vines were chosen, uniform in vigor as possible, all the chosen vines received the common cultural management such as irrigation, diseases and insects control that normally performed in that district. The experimental design was randomized complete blocks design in both years of study. The vines subjected to 10 treatments with 3 replicates, 3 vines each, and also borders were left around and between each replicate and treatment as well as between blocks. Treatments used were as follows:

Treatments	Organic nutrients
T_1	Control (60 units N)
T_2	20 units N + compost tea 1:10
T_3	20 units N + compost tea 1:20
T_4	20 units N + compost tea 1:30
T_5	20 units N + chicken manure extract 1:10
T_6	20 units N + chicken manure extract 1:20
T_7	20 units N + chicken manure extract 1:30
T_8	20 units N + combination of T2 x T_5
T_9	20 units N + combination of T_3 x T_6
T_{10}	20 units N + combination of T_4 x T_7

Nitrogen was added at rates of 60 units per feddan in three equal doses for control. As for treatments, vines were received the first dose (20 Units N) only.

Phosphorus was added to all vines at 40 units per feddan in form of super phosphate (15.5% P_2O_5) before the beginning of growth.

Organic nutrients: contained compost tea and chicken manure

extracts were added in three concentrations (1:10, 1:20 and 1:30 w/v). There are three stages to prepare compost and chicken manure extracts as follows:

1-preperation stage: Compost and chicken manure is blended with tap water in a dilution ratio of 1:10, 1:20 and 1:30 (w/v), solid compost and chicken manure 2, 3 and 6 kg were soaked in 60 liter of tap water in plastic tanks.

2-Extraction stage: The above mixtures were allowed to soak over 7-8 days at 15-25ºC. Meanwhile, they were stirred 5 times during a day until the water turns brown and the tea has no smell.

3-Filteration stage: The best approach is to decant from part way up from the bottom of the tank and pass through a 200 mesh (75-micron) (Brinton *et al.,* 1996). The chemical and microbiological characteristics of compost and the tested compost tea were shown in Table 1, also chemical composition characteristics of the tested chicken manure extract were shown in Table 2.

The vineyard soil prior to treatments application was sampled and subjected to chemical and physical analysis to measure certain characteristic of soil (Table 1).

Table (1): Chemical and microbiological characteristics of compost and the tested compost tea.

Characteristics	Values	
	Compost	**Compost tea**
PH	7.35	7.15
EC (ds\m)	4.85	4.25
Organic carbon (%)	21.88	ND*
Total nitrogen (%)	1.40	0.007
C/N ratio	15.63	ND
Total phosphorus (%)	0.35	0.09
NH_4-N (ppm)	300.15	40.50
NO_3-N (ppm)	58.48	40.50
Available-N (ppm)	358.63	45.00
Available-P (ppm)	139.25	20.00
DTPA-extractable Fe (ppm)	294.15	11.50
DTPA-extractable Mn (ppm)	25.11	2.80
DTPA-extractable Zn (ppm)	45.13	6.45
DTPA-extractable Cu (ppm)	8.51	0.95
Dehydrogenase enzyme activity (mg TPF/100g dwt.)	9.50	ND
Total count of bacteria (cfu/g)	2.3×10^7	0.01×10^7
Total count of fungi (cfu/g)	1.1×10^3	0.01×10^3
Total actincomycetes (cfu/g)	1.3×10^5	0.01×10^6

At the end of experiment in each season of study, the treated grapevines were subjected to the following determinations:

1- Yield, it was represented as average kg / vine.

2- Cluster weight (g) and volume (ml), they were represented as average g/cluster and ml/cluster.

3- Total Sugars % in berries juice: It was determined by Schaffer and Somogy methods as described by Ranganna (1979). The obtained results were represented as mg / 100ml juice of berries.

4- Nitrate content in berries (ppm): It was determined as described by Singh, (1988). The obtained results were represented as ppm in juice of berries.
5- Contents of NPK in leaf petioles: They were determined in three sampling dates in each growing season (Growth onset, full bloom and before harvest). Nitrogen contents were determined using microkjeldahl method as described by Black (1965). Phosphorous contents were photomertrically estimated as described by Snell and Snell (1967). Potassium determinations were carried out according to the methods described by Brown and Lillind (1946). The obtained results were represented as g/100g dry weight of leaf petioles.

Table (2): Chemical composition of the tested chicken manure extract.

Macro- and Microelements	Concentrations (%)	
	2003	**2004**
N	3.08	3.21
P	1.51	1.40
K	2.45	2.15
Ca	12.18	10.82
Fe	1430	1410
Mn	190	218
Zn	210	190
Cu	55	58
O.M (%)	44.70	50.80
C/N ratio	12.20	11.90
pH	8.20	7.80
EC (dsm^{-1})	0.79	0.75

Table (3): Measurements of physical and chemical soil properties.

Soil properties			
Physical properties		**Chemical properties**	
Coarse sand %	1.57	**Soluble cations (meq/l)**	
Fine sand %	14.63	Ca^{++}	21.84
Silt %	37.25	Mg^{++}	7.16
Clay %	47.41	Na^{+}	8.68
Texture grade	Clay	K^{+}	0.60
*S.P %	8.3	**Soluble anions (meq/l)**	
pH	7.25	CO_3^{--}	-
*EC (ds/m)	1.8	HCO_3^{--}	1.04
Biological analysis		Cl^{-}	7.52
Dehydrogenase activity (mg *TPF/100 g soil)	591.1	SO_4^{--}	29.67
		Total Soluble N (ppm)	44.0
		Organic C%	0.66
		C/N ratio	6.11
		Available P (ppm)	3.2

***EC = Electrical conductivity of soil saturation extract.**
***Sp = Saturation percent.** ***TPF= 2, 3, 5-Triphenylformazan.**

The obtained data were statistically tested for analysis of variance using Gomez and Gomez (1984) and significant differences among various Treatments were compared using LSD values at probability of 0.05.

RESULTS AND DISCUSSION

Yield (kg/vine)

The concerned results in table 4 showed an obvious effect of compost tea, chicken manure extracts as well as their interactions on grapevines yield. Such effect was differed according to the applied treatments. Regardless, the tabulated yield values for all tested organic nutrient treatments significantly were greater than those of the control in both seasons of study. The recorded values for the control treatment were 8.53 and 8.08 kg/vine in 2003 and 2004, respectively. On the hand, the highest yield values relatively were on grapevines under the treatment of interaction between compost tea and chicken manure extracts at the rate of 1:10 X 1:10 w/v (T8). Such grapevines yielded the values 19.82 and 20.41 kg/vine in the same season, respectively. The next order in this great effect was to the treatment contained of both organic nutrients but at the rate of 1:20 X 1:20 w/v (T9). Grapevines received the later treatment gave the yield values 15.62 and 19.49 kg/vine in the same season. The effect of the rest treatments was between these two extremes with yield values in the first season ranged from 9.43 to 13.77 kg/vine. As for the second season they were ranged from 10.55 to 15.66 kg/vine.

Cluster weight and volume

Data in the same table concerning changes in these two cluster characteristics indicated a trend very similar to that of yield / vine. The best treatment to produce the greatest cluster weight and volume in both seasons was that of the interaction with 1:10 X 1:10 w/v (T8) with the values for the former characteristic were 655.13 and 696.06 g along with 530.00 and 620.00 ml for the later one in 2003 and 2004, respectively. Once again the interaction treatment with 1:20 X 1:20 w/v (T9) could be considered the next in that respect especially in the first season with the corresponding values 537.12 and 658.44 g for cluster weight along with 448.33 and 693.33 ml for cluster volume. On the other hand, the minimum values for both cluster characteristics tested in both seasons were resulted from vines under the control treatment (T1). Such treatment tabulated the values 362.12 and 372.59g for cluster weight along with 243.33 and 353.33 ml for cluster volume in 2003 and 2004, respectively.

The current results are in harmony with those obtained by Schmitz (2002). The superiority of the treatments T8 and T9 may be due to the high concentration of N in the liquid extracts of compost tea and chicken manure. In this respect, it is important to point herein to functional effect of N as biological catalytic agent which speed up life processes in plant through it represents a major constituent in protein and enzymes. Likewise, it presents in nucleoproteins, amino acids, polypeptides and many other nitrogenous compounds in plant. Consequently, a significant supply of N is required for strong and healthy grapevines. In the same line, some non nitrogenous

compounds such as cellulose and lignin are required N to be functioning in building plant structure (Nijjar, 1985).

Table (4): Effect of compost tea and chicken manure extracts and their interactions on yield/vine along with cluster weight and volume of Thompson seedless grapevines in 2003 and 2004 seasons.

Treatments			Cluster weight (g)		Cluster volume (ml)	
	2003	2004	2003	2004	2003	2004
T1	8.53	8.08	362.12	372.59	243.33	353.33
T2	12.08	12.14	466.00	487.15	425.00	463.33
T3	10.58	10.95	417.00	434.52	390.00	420.00
T4	9.43	1055	379.74	421.23	356.67	406.67
T5	13.06	14.17	477.97	491.03	428.33	490.00
T6	11.34	10.62	438.27	391.40	413.33	400.00
T7	9.57	11.34	381.39	418.56	383.33	460.00
T8	19.82	20.41	655.13	696.06	530.00	620.00
T9	15.62	19.49	537.12	658.44	448.33	693.33
T10	13.77	15.66	490.60	565.37	431.67	573.33
LSD 5%	1.889	2.717	40.993	84.544	30.545	29.177

Total sugars % and Nitrate (ppm) in berries

Effects of compost tea, chicken manure extracts and interaction between them on total sugars % of berries juice were recorded in Table 5. Data in this table showed insignificant differences among the obtained values of all used treatments. The highest sugar values relatively were 16.57 and 17.00% in the 2003 and 2004 seasons, respectively, they were obtained from the treatment number 8(the interaction between compost tea and chicken manure extracts at 1:10 x 1:10).

As for nitrate concentration in berries, the concerned results in the same table showed significant differences among treatments used in both seasons of the study.

Among the tested treatments, the most effective ones to induce an increase on Nitrate contents in berries juice were those containing 20 N units plus compost tea at 1:10 (T2), chicken manure at 1:10 (T5) or the interaction 1:10 x 1:10 w/v (T8). These treatments determined in the first season, respectively, the values 5.41, 5.63 and 6.03 ppm. The corresponding values in the second season were 6.24, 6.25 and 6.29 ppm. The difference among the later values was insignificant. On the other hand, the treatments had either compost tea extract (T4) or chicken manure extract (T7) each the lowest concentration 1:30 and that contained the interaction 1:30 X 1: 30 (T10) produced berries of the lower nitrate contents with the values, respectively, 4.65, 4.66 and 4.36 ppm in the first season. As for the second season they were 5.43, 5.66 and 4.69 ppm. These findings could be attributed to the highest concentration of nitrogen in the components of the effective treatments. In this line, Nelson (1984) reported that high amount of

nitrate present in soil solution is the major factor increasing its concentration in plant. Excessive N fertilizer is used, substantial changes occur in the fruits and vegetables**.** Such changes were explained in the study of Sohuphan (1972), who reported a decrease in the shelf life, loss in flavor of some commodities, increase in the contents of undesired free amino acids and decrease in ascorbic acid and K contents. It is important to state herein that a high nitrate intake has been caused undesirable cases on human health particularly on the babies up to 4-month-old (Black, 1989)

Table (5): Effect of compost tea and chicken manure extracts and their interactions on total sugars and nitrate in berries of Thompson seedless grapevines in 2003 and 2004 seasons.

Treatments	Total sugars %		Nitrate (ppm)	
	2003	2004	2003	2004
T1	15.41	16.00	5.16	5.45
T2	16.07	16.13	5.41	6.24
T3	15.89	16.33	4.98	5.82
T4	15.63	15.40	4.65	5.43
T5	16.05	16.40	5.63	6.25
T6	15.93	16.24	4.92	5.91
T7	16.24	16.20	4.66	5.66
T8	16.57	17.00	6.03	6.29
T9	15.98	16.43	4.86	5.86
T10	15.55	16.52	4.36	4.69
LSD 5%	NS	NS	0.265	0.365

Seasonal changes of the major nutrients N, P and K

These changes were determined in leaf petioles from the treated grapevines during three stages of the growing season (Growth onset, full bloom and pre-harvest). The behavior of the above nutrients could be illustrated as follows:

1- Seasonal changes of nitrogen

The obtained results as illustrated in Figure 1clearly showed obvious differences among the tested treatments in N values at seasonal changes during the growing season stages used. These values for the tested organic nutrients were higher than the control (T1). As for the tested treatments, such values were increased during the growing season's stages in ascending order from T2 to T 10. According to the determined values, it was noticed in the same figure two opposite trends on the behavior of N in leaf petioles. The first trend was from the beginning of growing stage and continued till full bloom stage. This period was characterized by gradual increase on petiole N contents. As for the second trend, it was characterized by a gradual decrease as the season advanced till pre-harvest stage. These two opposite trends were observed on the behavior of N contents of leaf petioles of grapevines under all the treated treatments. The behavior of N indicated herein are in complete agreement with Wasnik and Bhargava (1989) working on Thompson seedless grapevines along with Hanson and Howell (1995) on

Concord grapevines. They found that N contents began to increase two weeks later bud break, increased more rapidly from mid-May, then declined between fruit maturation and the beginning of leaf senescence. These findings also in accordance to Dhillon *et al.* (1998) worked on Perlette grapevines to compare efficiency of single and split applied nitrogen on leaf N contents. The obtained data indicated that the lowest nitrogen contents were at harvest stage.

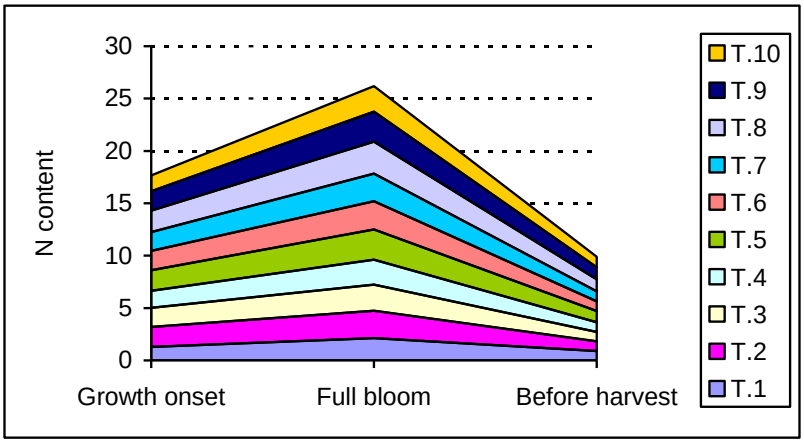
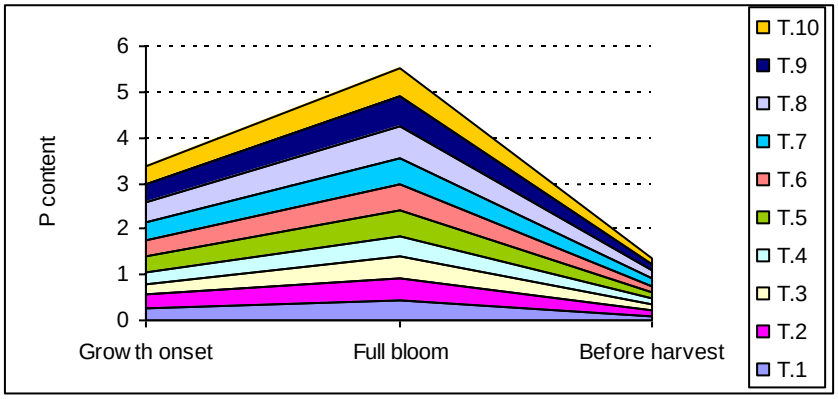


Fig (1): Diagram showing nitrogen seasonal changes in Thompson seedless leaf petioles during growing season as an average of 2003 and 2004.

2- Seasonal changes of phosphorous

The illustrated P behavior in Figure 2 concerning the three growing stages tested clearly showed among the tested treatments trend of differences in leaf petioles P values and of P behavior very similar to those of N in the same leaf petioles as indicated above. An obvious gradual increase from the growth onset stage till full bloom, and then a gradual decrease as the season advanced. These two opposite trends proved that the assimilation rate of phosphorus in grapevines at the first stages of growing season was higher than that at the stages from berry set till harvest. The increasing need for P by grapevines at rapid shoot growth stage in spring and early berries development stage is considered logic, since such period is characterized by a high rate of growth and the biological activities of cell are in peak for optimum cell division and elongation. Phosphorus plays an effective role in that respect. It keeps the continuous formation of pyrophosphate bonds (ATP), which allow energy transfer and synthesis of other nucleotide triphosphates, which is essential to synthesize sucrose; phospholipids and cellulose. Moreover, it is involved in the synthesis of nucleic acids (DNA and RNA). These genetic materials are required for make up the basic living parts of cell (protoplasm) and nucleus as well as cell walls. The high mobility of phosphate in the plant and its capability to move upward or downward greatly support these effective functions of phosphorus in plant cells (Bouma 1967; Clarkson *et al.,* 1968; Morard, 1970 and Hall and Baker 1972).



Fig(2): Diagram showing phosphorus seasonal changes in Thompson seedless leaf petioles during growing season as an average of 2003 and 2004.

3- Seasonal changes of potassium

The concerned results as illustrated in figure 3 indicated patterns for K behavior during the growing season completely differed than those of N and P. Potassium concentration in leaf petiole on grapevines under all the tested treatments started with high K values at the growth onset stage, then gradually decreased as the season advanced. From the same figure, the patterns showed that K values in leaf petioles of all organic treatments tested higher than those for the control. Comparing the determined K values among such organic treatments, it was observed an increasing effect in ascending order from T2 to T10. These findings greatly reflect the need of Thompson seedless grapevine for potassium fertilization throughout the growing season and such need was differed among the different physiological stages of development. This may be due to the effect of potassium ions on most biological activities in plant such as metabolic process and photosynthesis. Furthermore, it helps in building up carbohydrates and has some part in protein synthesis **(**Mengel and Kirkby, 1987).

The current results in the present study pointed to the interaction treatment containing compost tea at 1:10 w/v plus chicken manure extract at 1:10 w/v (T8) as the best treatment to produce the greatest yield (kg/vine) and the obtained clusters had the highest weight and volume. A similar effect was detected on berries total sugars. The next order in this respect was to T9 (compost tea at 1:20 w/v and chicken manure extract at 1:20 w/v). Such later treatment, beside it gave satisfactory yield and cluster characteristics tested, the obtained berries contained relatively the lowest nitrate contents. Therefore, its berries are considered more safety for the Thompson seedless grapevines consumers. According to these statements, it could be stated that our investigation was succeeded to reach two important aims. The fruit is to avoid undesirable effect on human health from eating berries of high nitrate contents. The second one is protecting the surrounding environment from pollution through out the applied extra nitrogen chemical fertilizers.

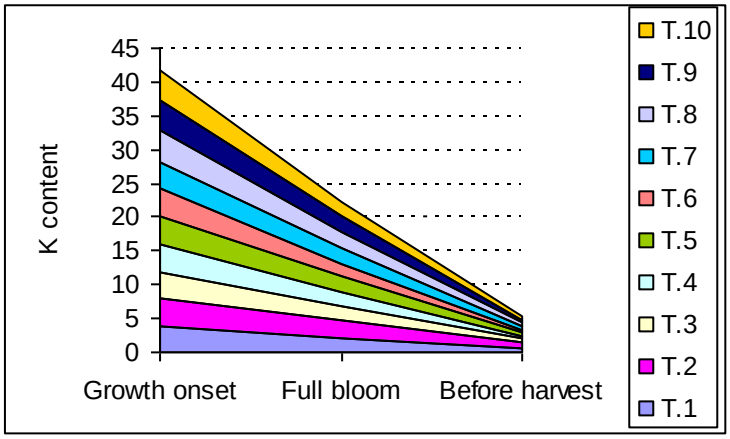


Fig (3): Diagram showing potassium seasonal changes in Thompson seedless leaf petioles during growing season as an average of 2003 and 2004.

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إستعمال بعض المنشطات العضوية الطبيعية لإنتاج ثمار آمنة فى العنب البناتى

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أجريت هذه الدراسة خلال موسمى ٢٠٠٣،٢٠٠٤ على شجيرات عنب صنف العنب البناتى عمره 15 سنة مزروع فى أرض طينية، ومرباة بالتربية القصبية، والرى سطحيا بمزرعة بأبو عرصه، مدينة بلقاس، محافظة الدقهلية.

أجريت هذه الدراسة لمعرفة تأثير إستعمال بعض المنشطات العضوية الطبيعية التى تشتمل على تركيزات من مستخلص الكمبوست (شاى الكمبوست) ، مستخلص سماد الفراخ على المحصول ، وصفات العناقيد، ومحتوى السكريات، والنترات فى حبات العنب.

وقد بينت نتائج الدراسة أن معاملة شاى الكمبوست ١: ١٠ مع مستخلص سماد الفراخ ١: ١٠ أعطت أعلى القيم بالنسبة لمحصول الكرمة، وزن العناقيد وحجمها، ومحتوى السكريات الكلية بالحبات، كذلك محتوى النترات فى حبات العنب.

وعلى الجانب الأخر أعطت المعاملة بشاى الكمبوست ١: ٢٠ ومستخلص سماد الفراخ ١: ٢٠ محصولا مرضيا معنويا، وكذلك وزن وحجم العناقيد والسكريات الكلية بالمقارنة بمعاملة الكنترول إلى جانب أن مستوى النترات كان أقل ما يمكن فى الحبات مما يؤكد على إنتاج عنب آمن صحياً للمستهلك.