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Effect of Organic Compost Tea and Humic Acid to Reduce Dose of NPK Fertigation of Banana Plants cv."Grand Nain"

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THIS EXPERIMENT was carried out during two successive crop cycles of 2013/2014 (first ratoon plant) and 2014/2015 (second ratoon plant) of Giant Cavendishi banana (*Musa spp. AAA* sub group) cv. Grand Nain, grown in sandy soil. The goal of this research is to study beneficial effect of compost tea (compost extract), which abstracted by 1.0 kg/10 L water or 2.0 kg/10 L water and humic acid (2.5 g/L water or 5 g/L water) single or incombination to reduce the doses of chemical fertigiation by 20% of the recommended rate NPK(N:640 , P2O5: 80 ,K2O: 800 g/plant/year)in nine equal doses and added at monthly from March to Nov. on the growth, yield and fruit quality of Grand Nain banana. The dose of both treatments(compost tea) was 9 liter/hole for each date and humic acid was 3liter /hole for each date, compared to standard treatment NPK fertigation 100% of the recommended rate (N: 800, P2O5: 100, K2O: 800 g/plant/year) as a control.

The results revealed that the plants receiving 80% NPK of the recommended rate plus compost tea (2.0 kg/10L water or 1.0 kg/10 L water) andthe combination with humic acid (2.5 g/L water or 5.0 g/L water) treatments showed an increases in the vegetative growth parameters (psedostem height, circumference and assimilation area compared with the standard treatment of NPK fertigation (100%). The highest values of yield and leaf contents of N and K were obtained from plants received (NPK fertigation 80% of the recommended rate pluscompost tea 2kg/10L and humic acid 5 g/L) while, the lowest values were obtained with the plants received 80% NPK of the recommended rate only but had no significant effect on leaf P content. Organic compost tea(2kg/10 L/water) and humic acid (5 g/L water) was favorable for improving fruit quality in terms of increasing finger weight (119.00 & 124.00 g), total soluble solids % (22.21& 22.05 %), total sugars (18.47 & 18.16) compared with the other treatments. accordingto the obtained results, it can be concluded that using compost tea(2 kg/10 L water) in combination with humic acid (5 g / L water) reduce the recommended doses of the chemical fertilizers by 20%.

Keywords: Organic compost tea, Humic acid, Grand Nain, Yield, Fruit quality.

Banana is among the most important worldwide consumed fruit product (Musa spp.). It was reported that its word's production exceeded 91 million tonnes. Whereas it's total harvested area reached approximately (25073) ha. producing about (1129777) tons annually (FAO. 2012).Biological fertilization is based on the use of natural inputs including fertilizers, decaying remains of organicmatter, excess crops, domestic sewage, animal manure and microorganisms such as fungi and bacteria (Chirinos and Montilla, 2006).Bio fertilizations now are very important method for providing the plants with their nutritional requirements without having an undesirable impact on the environment (Abou El-Yaziedand Sellim, 2007). Bio fertilizers are known to improve fixation of nutrients in the rhizosphere, produce growth stimulants for plants, improve soil stability and provide biological control. They also biodegrade substances, recycle nutrients, promote mycorrhiza symbiosis and develop bioremediation processes in soils contaminated with toxic, xenobiotic and recalcitrant substances (Rivera-Cruz, *et al.,* 2008). Compost, rich in plant nutrients, is a readily available fertilizer with beneficial effects on physical, chemical, biochemical and biological properties of the soils. Moreover compost-based treatments can exert protective effects against plant diseases occurrence and/or stimulate an enhanced plant physiological status with improvements in quantity and quality of crop productions (Loredana Liguori *et al.,* 2015).

Compost tea in modern terminology means compost extract brewed with microbial food source, humic, fulvic acids and catalyst amendments to promote the growth and multiplication of microbes in the tea (Steve, 2009).Compost tea is a liquid extract produced by diluting compost with water. Anecdotal evidence suggests these teas may be effective against pathogens associated with foliar and fruit diseases. These organisms may work by inducing plant resistance, inhibiting pathogen growth, or outcompeting the pathogens. Some compost teas apparently contain large numbers of beneficial microbes that compete for space on leaves and fruits, denying pathogens space to colonize. Benefits described to the use of humic acid and related products to increase nutrient uptake, tolerance to drought and temperature extremes, activity of beneficial soil microorganisms, and availability of soil nutrients particularly in alkaline soils and low organic matter (Russo and Berlyn, 1990). Also, humic materials may increase root growth in a similar manner to auxins (Tatini *et al.,* 1991).These water extractable components include active microorganisms, primarily bacteria, fungi and some protozoa, mineral nutrients, organic acids and other microbial by products.

Fertilization is an important and limiting factor for growth, productivity and production of banana plants because plants remove large amounts of nutrients from the soil. Among these nutrients, nitrogen is considered the prime nutrient for the plant growth. The sandy soils are considered recently, as the main area for agricultural extension, under such conditions, it is necessary to use the improved irrigation fertilization (fertigation) by adding the dissolved nutrients through a drip (trickle) irrigation system (Ibrahim, 2003). For growth and fruit production, bananas require high amounts of nutrients which are often supplied only in part by the soil. These nutrients have to be replaced in order to maintain soil fertility and to permit the continuous production of high yields. Hence the importance of nitrogen to bananas, it is considered second only in terms of the amount needed for growth and production. Nitrogen is strongly redistributed from old banana leaves to young ones. When banana plants grown in sand culture had access only to the nitrogen contained within the planting material, the effect on growth was more marked than with any other nutrient (Gowen, 1995). So, the major problems facing banana growers are the high costs of excessive manufactured fertilizers needs for banana plants. Several investigators reported that, combined application of Bio fertilizers and inorganic fertilizers increased soil N,P and K availability and decreased soil pH compared with the treatments with inorganic fertilizers alone of banana plants [Athani & Hulamani (2000), El-Shammaa, (2001), Suresh & Hasan, (2001), Hammam *et al.* (2003), Abd El-Moniem & Radwan, (2003), Gogoi *et al.* (2004), Damatto *et al.* (2007), Abd El-Moniem *et al.* (2008), Mohammed et al. (2010) and Barakat *et al.* (2011)].

Materials and Methods

This investigation was carried out during two successive experimental seasons at sandy soil at El-Khatataba region, Minofia Governorate Egypt. Plants from tissue culture were planted 3X3.5 m.apartin March 2012(mother plant). 2013 (first ratoon) and 2014 (second ratoon) of Grand Nain cultivar. The experimental soil in texture and deficient in fertility according to mechanical and chemical analysis (Table 1).

TABLE 1. Soil characteristics of the banana plantation at the start of the experiment.

Properties	Depth (cm)		
	0-30	**30-60**	**60-90**
Coarse %	51.50	44.60	64.00
Fine sand %	23.0	28.40	22.00
Silt %	15.25	16.50	11.00
Clay %	13.25	10.50	3.00
Texture	Loamy sand	Sandy	Sandy
Black density gm/cm	1.56	1.64	1.70
pH	5.0	8.2	8.40
E.C.m.mhos/cm	0.53	0.61	0.70
$CaCO_3$	0.72	0.81	0.78
Na meg/L	1.79	1.84	2.21
K meg/L	0.015	0.17	0.17
Ca meg/L	2.20	1.44	1.92
Mg meg/L	0.84	0.74	0.54
$H\ CO_3$	2.16	2.44	2.93
Cl meg/L	1.74	1.50	1.59
SO_4 meg/L	0.82	0.89	0.74

All orchard plants received the recommended regular organic fertilization the farm compost was added to the soil at the first week of December (60m3/fed/year). The source of water supply was well. The drip irrigation system with two lines per single row and promising micro-flapper emitters discharging 4 littre/ hour was used. The chemical fertilizers doses were added from Feb. until Nov. through drip irrigation system (fertigation).Ammonium nitrate (NH4NO3, 33.5% N) was used as a source of nitrogen, phosphoric acid (45% P2O5) was used as a source of phosphors and potassium sulphate (50% K2O) was used as a source of potassium. Standard treatment, NPK fertilization 100% of the recommended rate NPK (800, 100, 1000 g/plant)*(Ibrahim, 2003)* and treatment, NPK fertilization 80% of the recommended rate (640, 80, 800 g/plant), All the considered N,K rates were divided into 20 doses/month while, P rate was divided into (8 doses / month) Table 2.

TABLE 2. Time and actual amount of NPK fertigated all year round to the experimental Grand Nain plants.

Treatment	**Standard treatment (100% NPK)**			**Treatments (reduced of 20% of the recommended rate)**		
Months	**N g/plant**	**P_2O_5 g/Plant**	**K_2O g/plant**	**N g/plant**	**P_2O_5 g/Plant**	**K_2O g/plant**
Feb.	30	6	25	24	4.80	20
March	45	8	60	36	6.40	48
April	60	10	80	48	8.00	64
May.	80	12	125	64	9.60	100
June	100	12	145	80	9.60	116
July	130	12	150	104	9.60	120
August	140	12	175	112	9.60	140
Sept.	100	12	130	80	9.60	104
Oct.	80	10	70	64	8.00	56
Nov.	35	6	40	28	4.80	32
Dec.	-	-	-	-	-	-
Jan.	-	-	-	-	-	-
Total	800	100	1000	640	80	800

● N and K were dissolved and applied through the trickle system in 20 doses /month.
● P was dissolved and applied through the trickle system in 8 doses /month.
● The annual rates per plant were 800 or 640 g N /plant in the form 60 NH_4NH_3, 100 or 80 g P_2O_5 /plant as H_3PO_3 and 1000 or 800 g K_2O /plant as K_2SO_4.

Compost tea preparation

Compost tea (compost extract) was extracted by soaking 10 kg or 20 kg mature compost with 100 liter water + 100 cm Molasses for 7 days in a special unit, attached to air pump and the aerator provides continuous flow of air bubblers to extract compost tea until completion of the fermentation process and extract color becomes light Brown (Fayek *et al.* 2014). The microbial population and the chemical properties of compost tea is shown in (Table 3 a and b) compost tea was added as soil application in March to Nov. The dose of both treatments (compost tea) was 9 liter/mat for each date and humic acid was 3liter /mat for each date.

TABLE (3-a). Microbial population of organic compost tea

Bacterial Plate count (CFU/ml)	7.1 x 107
Bacterial Direct count (cell/ml)	6.4 x 108
Spore forming bacteria (CFU/ml)	7 x 104
Total fungi (CFU/ml)	1.1 x 104
Actinomycetes (CFU/ml)	2.8 X 105

(CFU) = Colony Forming Unit

TABLE (3-b). Chemical analysis of the organic compost tea

Parameter	Compost tea (extract) Composition
Cubic meter weight	530kg
Moisture%	33.6%
Organic matter%	45%
pH(1:10)	7.44
EC (ds/m)	2.33
C/N ratio	22.2
Total N%	1.15%
Total P%	0.92%
Total K%	1.25%
Total Ca%	1.95%
Total Mg%	0.85%
Total Fe (ppm)	1960ppm
Total Mn (ppm)	450ppm
Total Zn (ppm)	140ppm
Total Cu (ppm)	28ppm

Treatments:

- T1: Standard treatment NPK fertigation (100% of the recommended rate 800+100+1000 g/plant /year)
- T2: NPK fertigation (80% NPK of the recommended rate: 640+80+800g/plant /year)
- T3: NPK fertigation 80%NPK of the recommended rate + compost tea 1kg/10L.water
- T4: NPK fertigation 80%NPK of the recommended rate + compost tea 2kg/10L. water
- T5 :NPK fertigation 80% of the recommended rate + humic acid 2.5 g/L. water
- T6: NPK fertigation 80% of the recommended rate + humic acid 5 g/L. water
- T7: NPK fertigation 80% of the recommended rate + compost tea 1kg/10L. water +humic acid 2.5 g/L. water.
- T8: NPK fertigation 80% of the recommended rate + compost tea 1kg/10L. water +humic acid 5 g/L. water.
- T9: NPK fertigation 80% of the recommended rate + compost tea 2kg/10L. water +humic acid 2.5 g/L. water.
- T10: NPK fertigation 80 % of the recommended rate + compost tea 2kg/10L. water + humic acid 5 g/L. water.

The following parameters were used to evaluate the tested treatments:
Vegetative growth

Morphological measurements were done at bunch shooting stage via the following parameters: pseudostem height (cm.), pseudostem circumference (cm.), number of green leaves per plant, leaf area (m2/leaf) and assimilation area per plant (m2/plant).Assimilation area was determined using the equation = leaf area X number of green leaves (Ibrahim, 1993).

Bunch characteristics

At time of harvesting, bunch weight (kg), number of hand/bunch and number of finger /hand were counted and recorded.

Finger parameters (physical and chemical) properties of fruits:

Finger weigh (g), finger length and diameter (cm), were estimated from samples of mature fruits taken from the middle portion of each two hands of bunch. Total sugar and titratable acidity were determined according to A.O.A.C (2000) T.S.S were estimated by hand refractometer.

Yieldwas calculated according to the following equations:
Yield = Bunch weight (kg) X Number of plant / fed.

Leaf mineral content of N, P and K were also determined as follow:

Samples of leaves were taken from the third upper leaf in the descending foliar succession of the plant after bunch shooting as recommended by (Hewitt, 1955) and adopted by (Saad and Saad, 2007). Total nitrogen was determined by using micro-kjeldehl method as described by (Pregel, 1945). Phosphorus was determined according to the colorimetric method of Troug and Meyer (1939). Potassium was determined according to photometric method described by (Brown and Lilleland 1946).

Statistical analysis

The design of this experiment was randomized complete block design. Each treatment contained three replicates and each replicate had three hole with three plants in each hole. Data were tabulated and statistically analyzed according to *Snedecor and Cochran (1980)*and differences between various treatments mean were tested by New LSD according to*Waller &Duncan (1969).*

Results and Discussion

Vegetative growth

Data presented in Table 4 indicated that vegetative growth parameters (pseudostemheight, pseudostem, circumference, number of leaves/plant, leaf area and assimilation area) of Grand Nain banana plants at bunch shooting stage were significantly affected by compost tea applications in the two seasons of the study. The best results with regard to pseud. height (310.67 & 305.00 cm) pseud. circumference (90.00 & 88.33 cm), number of leaves/plant (14.67 & 14.33 leaf/plant), leaf area (2.36 & 2.42 m2/leaf) and assimilation area (34.62 & 34.67 m2/plant) were obtained with the plants receiving 80% NPK (640 + 80 + 800 g/plant) plus organic fertilizers (compost tea 2kg/10 litter water + humic acid 5 g/L.) while, the lowest values to pseud. height (230.67 & 226.33 cm), pesud.

Circumference(74.33 & 69.33 cm), number of leaves (12 & 12.33 leaf/plant), leaf area (1.38 & 1.51 m2/leaf), assimilation area (16.56 & 18.61 m2/plant) were recorded with the treatment (80% NPK fertigation and untreated compost tea or humic acid) in both tested seasons, respectively. These results are in agreement with those obtained by Abd El-Moniem & Radwan (2003), Hammam, (2003), Hammam *et al.* (2003), Damatto *et al.* (2007), Thippesha *et al*. (2008)and Barakat *et al.* (2011) who found that the plants receiving 25 or 50% NPK plus bio-fertilizersshowed slight increases in the vegetative growth parameters.

Bunch weight and yield

Data presented in Table 5 indicated that bunch weight (kg/plant) and yield (ton/fed.) were significantly of affected by different organic fertilizers treatments during the studied seasons. Plants fertilized using 80% NPK of the recommended rate (640, 80, 800 g/plant) plus compost tea 2 kg/10L. and humic acid 5 g/L. was greatly increased bunch weight (32.41 & 31.37 kg/plant) and yield (35.65&33.50ton/fed) followed by T9, T8, T7,T1 (standard treatment), T4, T3, T6, T5 ascending order. While the lowest were obtained from plants received the 80% NPK of the recommended rate + untreated compost tea or humicacid (19.35 & 18.36 kg/plant and 21.28 &19.19 ton /fed) in both tested seasons. These results are in agreements with those reported by Athani & Hulamani (2000), Suresh & Hasan (2001), Abd El- Moniem & Radwan (2003), Hammam (2003), Hammam *et al.* (2003), Gogoi *et al.* (2004), Damatto *et al.* (2007) and Thippesha *et al.* (2008) who report that the yield significantly increased as a result of receiving 75% NPK plus biofertilizers compared with the other treatments. Moreover, the biofertilizer improve plant physiological processes i.e. increased cell divisions, enlargement and consequently increased vegetative growth which positively reflected on the yield and yield components (El-Kafrawy, 2005). Also, Kamel (2002) demonstrated that fertilizing banana plants with farm refuse compost at 75kg/hole improved effectively bunch weight. In additions, Abd El-Naby & El-Sonbaty (2005) recorded that banana plants supplied with mineral fertilizers combined with organic manure (farm refuse compost) at 25 + 75% improved bunch weight.

Finger parameters

Table 6 cleared that, hand number/bunch, fingers number/hand and fingers number/bunch were significantly affected by different organic treatments during the two studied seasons. Whatever, treating Grand Nain banana by compost tea treatment at 80% NPK fertigation of the recommended rate plus compost tea 20kg/L + humic acid 5 g/L gave the highest values of hand number (13.67 & 13.00), fingers number/hand (20.67 & 19.67) and fingers number/bunch (245.40 & 233.80) comparing with the other treatments. These results are in accordance with those obtained by Abd El-Naby (2000), Suresh & Hasan (2001), Abd El-Moniem & Radwan (2003), Hammam (2003), Hammam *et al*. (2003), Gogoi *et al*. (2004), Damatto *et al*. (2007) and Thippesha *et al.* (2008) who found that the best fingers parameters were which was applied with banana compost application and with 50 or 25% chemical fertilizer.

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TABLE 5. Effect of compost tea, humic acid and different levels of NPK on bunch weight and yield of Grand Nain banana plants during 2013 and 2014 seasons

Treatments	bunch weight (kg)		Yield/feddan	
	2013	2014	2013	2014
T1:Standard treatment NPK fertigation (100% of the recommended rate 800+100+1000 g/ plant)	27.50	27.50	30.25	30.25
T2: NPK fertigation (80% of the recommended rate, 640+80+800 g/ plant)	19.35	18.36	21.28	19.19
T3: NPK fertigation 80% of the recommended rate + compost tea 1 kg/ 10 L. water.	23.00	21.30	25.30	23.43
T4: NPK fertigation 80% of the recommended rate + compost tea 2 kg/ 10 L. water.	23.50	21.50	25.85	23.65
T5 :NPK fertigation 80% of the recommended rate + humic acid 2.5 g /L. water.	20.33	21.17	22.36	23.28
T6: NPK fertigation 80% of the recommended rate + humic acid 5 g/ L. water.	21.70	21.17	23.87	23.28
T7: NPKfertigation80% of the recommended rate + compost tea 1 kg/ 10 L. water +humic acid 2.5 g /L. water.	25.14	24.70	27.65	27.17
T8: NPKfertigation80% of the recommended rate + compost tea 1 kg/ 10 L. water +humic acid 5 g/L. water.	29.95	29.76	32.94	32.73
T9: NPK fertigation 80% of the recommended rate + compost tea 2 kg/ 10 L. water +humic acid 2.5 g/L. water.	31.88	30.11	33.06	33.12
T10: NPKfertigation 80% of the recommended rate + compost tea 2 kg/ 10 L. water +humic acid 5 g /L. water.	32.41	31.37	35.65	34.50
NewL.S.D at 0.05 level	2.372	2.775	3.309	3.153

Data presented in Table 6 indicated that finger weight, finger length and diameter were significantly affected by different doses of organic fertilization treatment during the two studied seasons. The highest values for finger weight (119 & 124 g), finger length (18.23 & 18.05 cm) and finger diameter (3.86 & 3.81cm) were obtained the plants receiving 80% NPK fertilizers of the recommended rate plus compost tea 20 kg/100 L + humic acid 5 g/L as compared with the other treatments.

TABLE 6.

Fruit chemical parameters

As shown in Table 7 fruit chemical parameters (TSS%, total sugar) in banana fruit was significantly affected by different fertilization treatments during the two studied seasons. Acidity (%) of banana fruit was insignificantly affected by compost tea treatments. The present results are in agreement with those obtained by Athani & Hulamani (2000), Suresh & Hasan (2001), Abd El- Moniem & Radwan (2003), Hammam (2003), Hammam *et al.* (2003) and Thippesha *et al.* (2008) who found that organic fertilization by using compost tea was favorable for improving fruit quality.

Leaf Mineral contents

The effect of compost tea treatments and NPK fertigation on NPK leaf content of Grand Nain during two seasons are shown in Table 7. Leaf N and K contents were significantly affected by compost tea applications, the plant which received 80% NPK plus bio-fertilizers (compost tea 20 kg/100L + humic acid 5 g/L) gave the higher leaf minerals content (N and K) followed by standard treatment NPK fertigation (100% of the recommended rate 800 + 100 + 800 g/plant) compared as the other treatments. In addition, the results of leaf P content between treatmentswere insignificant. These results go in line with Mostafa et al. (2009) and Mohammed et al. (2010) who showed that application of compost tea gave the higher leaf N,P,K contents compared with control. According to the results obtained in this experiment, it can be concluded that using compost tea (NPK fertigation 80% of the recommended rate + compost tea 20 kg/100L + humic acid 5 g/L) led to reduction by 20% of recommended amount of fertilizers added. The plants receiving bio-fertilizers combination (humic acid and compost tea) gave better results of all vegetative growth and yield.

TABLE 7.

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تأثير مستخلص الكمبوست العضوى و حمض الهيوميك لتقليل جرعة التسميد بالعناصر نتروجين ، فوسفور ، بوتاسيوم مع ماء الرى فى نباتات الموز صنف "جراندنان"

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اجريت هذه التجربة من خلال موسمين متتاليين ٢٠١٤/٢٠١٣م (نباتات الخلفة الأولى) ، ٢٠١٥/٢٠١٤م (نباتات الخلفة الثانية) على نبات الموز صنف جراندنان (مجموعة كافنديشى AAA) المنزرعة فى التربة الرملية .

الهدف من هذا البحث دراسة تأثير مستخلص الكمبوست العضوى التى استخلصت من ١كجم كمبوست/١٠ لتر ماء أو ٢ كجم كمبوست /١٠لتر ماء و حمض الهيوميك (٢,٥جم/لتر ماء أو ٥جم/لتر ماء) منفردة او مجمعه مع تخفيض جرعة التسميد بالعناصر الغذائية ٢٠NPK٪ من المعدل الموصى بها (N : ٦٤٠ ، P2O5: ٨٠، K2O: ٨٠٠جم/نبات/سنة) موزعة على ٩ جرعات بمعدل جرعة شهريا من مارس حتى نوفمبر على النمو و المحصول و جودة الثمار فى نبات الموز صنف جراندنان . وكانت الجرعة المضافة من مستخلص الكمبوست ٩ لتر /جورة ، و حمض الهيوميك ٣ لتر /جورة/ شهريا و كانت معاملة التسميد القياسية من العناصر ١٠٠NPK٪ من المعدل الموصى به (N: ٨٠٠، P2O5: ١٠٠، K2O:٨٠٠جم/نبات/سنة) .

قد أظهرت النتائج ان النباتات التى سمدت ٨٠٪ NPK من المعدل الموصى به بالأضافة الى الكمبوست تى (مستخلص ٢ كجم/١٠لتر ماء أو ١ كجم / ١٠ لترماء) مجمعه مع حمض الهيوميك (٢,٥ جم /لتر ماء أو ٥ جم/لتر ماء) أدت الى زيادة فى صفات النمو الخضرى (طول الساق الكاذبة – محيط الساق الكاذبة - المساحة الفعالة للورقة) بالمقارنة بمعاملة التسميد القياسية (الكنترول) من المعدل الموصى به ١٠٠٪ NPK بدون اضافة الكمبوست تى أو حمض الهيوميك .

كما سجلت النتائج ان النباتات التى سمدت ٨٠٪ من المعدل الموصى به بالأضافة الى ٢كجم/١٠لتر ماء مستخلص الكمبوست مع حمض الهيوميك ٥ جم/لترماء أعطى أعلى القيم فى المحصول و محتوى الأوراق من عنصر النتروجين و عنصر البوتاسيوم بينما تحصل على أقل القيم من معاملة النباتات التى سمدت ب ٨٠٪ من المعدل الموصى به بدون أضافة التسميد الحيوى.ولم توجد فروق معنوية فى محتوى الاوراق من عنصر الفوسفور فى مختلف المعاملات تحت الدراسة.

التسميد الحيوى باستخدام كمبوست تى ٢ كجم/١٠لتر ماء و حمض الهيوميك ٥ جم/لتر ماء كان مشجعا فى تحسين جودة الثمار عن طريق زيادة وزن الثمرة (١١٩ & ١٢٤ جم) و المواد الصلبة الكلية (٢٢,٢ & ٢٢,٥) و السكريات الكلية (١٨,٤ & ١٨,١) بالمقارنة بالمعاملات الأخرى .

و بصفة عامة وجد من النتائج التى تحصل عليها فى هذا البحث التوصية باستخدام مستخلص الكمبوست (٢ كجم/١٠ لتر ماء) مع حمض الهيوميك (٥ جم / لتر ماء) أدى الى تخفيض ٢٠٪ من جرعة التسميد الموصى به، و قد يرجع ذلك الى زيادة تيسير العناصر النتروجين و البوتاسيوم المتاحة للامتصاص .