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INFLUENCE OF ORGANIC -N SOURCES ON SOME CHEMICAL AND PHYSICAL PROPERTIES OF SOIL, GROWTH, ROOT DISTRIBUTION AND LEAF NPK CONTENT OF YOUNG VALENCIA ORANGE TREES GROWN IN SANDY SOIL UNDER DRIP IRRIGATION.

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ABSTRACT : One year old Valencia orange trees budded on Volkamer lemon rootstock grown in sandy soil located in citrus grove of El-kassasin Horticulture Research station, Ismailia Governorate were fertilized by organic materials (balady, compost, town refuse, biogas and green manure) and mineral fertilizer as ammonium sulphate, as singly or combined treatments.

Manures led to decrease in pH, bulk density and significant increase in organic matter content, available NPK in soil with all treatments. The biogas individually or combined with mineral fertilizer gave the optimum values of available NPK in the soil and leaves followed by compost, balady, mineral, town refuse and green manure.

Dry weights of roots and vegetative growth increased significantly with combined treatments, as compared with both mineral or single manures.

Applying the combined fertilization of mineral and manure to sandy soil led to improving the physical and chemical properties. This improvement was reflected on soil productivity and caused significant efficiency increases of fibrous, skeletal and semi-skeletal roots and vegetative growth under drip irrigation. Superiority of biogas and compost manures over all the studied organic manures in the two studied seasons for NPK uptake, root distribution and vegetative growth can be attributed to their higher content of available NPK.

INTRODUCTION

Sandy soil is characterized by its low content in organic matter and nutrient elements, which in turn create many nutritional problems. *Tester (1990)* stated that successful management of these sandy soils requires judicious use of organic materials to better control erosion and improve productivity. *Tahoun et al. (2000)* summarized the effect of organic matter and manure as improving soil tilth, supply small amounts of nitrogen, phosphorus, potassium and small amounts of other elements and improves the base exchange capacity, the relative potential fertility and organic matter content of soil. Generally, organic and inorganic fertilizers are added to the soil to improve its fertility and increase crop yield. The main forms in which nitrogen becomes available for absorption from soil by plant roots are as ammonium or nitrate ions *(Owen, 1986)*. Increase in citrus yield and fruit quality often occurs after the addition of various organic manures *(Giginejsvili and Meladze, 1967; Pinckard, 1979; Pomares; et al., 1983 and El-Banhawy, et al., 1997)*. The traditional orchard practices in Egypt depend mainly on using balady manure which is becoming dearer year after year due to the decrease in animal production and the sharp rise in its costs. The present study aims at evaluating the effect of organic and inorganic –N sources singly or at combined treatments on some chemical and physical soil properties, soil fertility, growth, root distribution and leaf NPK content of young Valencia orange trees grown in sandy soil under drip irrigation.

MATERIALS AND METHODS

This study was carried out on one year old of Valencia orange trees (Citrus sinensis , Osbeck.) budded on Volkamer lemon (Citrus volkameriana) root- stock, planted 5 meters apart in citrus grove of the Horticulture Research Station at El-Kassasin, Ismailia Governorate. The trees were about 1 year old grown in a coarse sandy soil as shown in Table (1).

The experiment was arranged in a randomized block design with 11 treatments as follows:

- 1 treatment with one level of mineral N fertilizer according to the common recommendat-ion.
- 5 treatments with one level of singly organic N as the same level of the previous treatment.
- 5 treatments with the same level of mineral N as combined (50 % mineral N + 50 % organic N).

Table (1) : Fertilizing treatments during the two seasons of study.

Treatment	Season 2000							Season 2001						
	Organic (gm/tree/year)			Mineral (gm/tree/year)			Time of addition	Organic (gm/tree/year)			Mineral (gm/tree/year)			Time of addition
	N	P	K	N	P	K		N	P	K	N	P	K	
A	-	-	-	104	310	240	In (A) treatment amount of mineral Fertilizers were evently splited to be added at 9 times at one month intervals starting from mid Feb to mid Oct. but for other treatments were added at 3 times in mid Feb, May and Oct. The organic manure was added in Nov.1999	-	-	-	500	155	240	In (A) treatment. Amounts of mineral fertilizers were evently splited to be added at 4 times at 2 months intervals starting from 1st Feb. till 1st Aug. but for the other treatments were added at 3 times in mid Feb. may and Oct. the organic manure was added in Nov. 2000
B	104	30	42	-	-	-		500	144	200	-	-	-	
C	104	30	44	-	-	-		500	144	214	-	-	-	
D	104	42	66	-	-	-		500	202	320	-	-	-	
E	104	30	40	-	-	-		500	144	190	-	-	-	
F	104	34	18	-	-	-		500	166	90	-	-	-	
G	52	15	21	52	155	120		250	72	100	250	77.5	120	
H	52	15	22	52	155	120		250	72	107	250	77.5	120	
I	52	21	33	52	155	120		250	101	160	250	77.5	120	
J	52	15	20	52	155	120		250	72	95	250	77.5	120	
K	52	17	0.9	52	155	120		250	83	45	250	77.5	120	

A: The complete mineral fertilizer program as recommended.

B,C,D, E and F: The complete organic fertilizer program for manures of : balady, compost, town refuse, biogas, and green manure, respectively.

G,H, I, J and K: The combined fertilizing (mineral 50 % + organic 50 %) from the previous manures, respectively.

Table (2): Chemical analysis for NPK and organic matter of the used manures was:

Manure	N (%)	P (%)	K (%)	Organic mater (%)
Balady	1.80	0.52	0.72	66.7
Compost	2.06	0.59	0.88	54.6
Town refuse	1.88	0.76	1.20	32.8
Biogas	2.16	0.62	0.82	66.5
Green manure	1.56	0.52	0.28	52.6

The used NPK fertilizer sources were ammonium sulphate 20.6% (N), superphosphate (15.5% P_2O_5), potassium sulphate (48% K_2O), and manures of balady, compost, town refuse, biogas, and green manure. Shown Table (2).

Trees which received the complete mineral fertilizer program (A) were also sprayed with a solution consisted of zinc sulphate (3%), copper sulphate (3%), ferrous sulphate (3%), manganese sulphate (3%) and lime (2.3%) to neutralize the acidity of solution. The previous amounts of micronutrients as well as lime were dissolved in 400 liters of water, each plant was sprayed twice, on Feb. 1st and on May 1st in each season using about 1 and 2 liters of the solution per tree in 2000 and 2001 seasons, respectively.

In Feb. 2001 and 2002 three trees per each treatment (one from each plot) were pulled out by digging at ditch 1.5× 1.5× 1 meters in the 1st season and 2.5 × 2.5 ×1.5 meters in the 2nd one. It should be mentioned that the soil is sandy, thus the root system was completely excavated. Each plant was divided into leaves, shoots less than 2 years, shoots more than 2 years, fibrous roots, skeletal and semi-skeletal roots. The various tree portions were cleaned with tap water then fresh weighed and oven dried at 70°C till constant weight to determine the dry weight of each. The obtained results were statistically analyzed as a complete randomized block design according to *Snedecor (1956)*.

The total NPK of organic manures and plant material were digested with $HCLO_4$ and H_2SO_4 as described by *Chapmann and Pratt (1961)*. Available NPK in the organic manure were extracted as given by *Jackson (1958)*: N by 2 N KCl, P by 0.5 $NaHCO_3$, P was determined by the ascorbic acid method, and K was determined by the flame photometer. Soil samples were taken from each treatment at equal depth of 0.30 cm and analysed according to *Black et al. (1982).*

RESULTS AND DISCUSSION

I. Influence of applied different N sources on some chemical, physical of soil properties, fertility parameters and leaf NPK content:

Data in Table (3) show a decrease in the value of soil pH after the two seasons from 7.9 to 7.6 that may be attributed to organic and inorganic acids resulted from organic manure decomposition which have a contribution in decreasing soil pH values as well chelating Ca ions. *Wassif et al. (1995) and Hashim et al. (1995)* also obtained similar results. The data also illustrated that addition of organic manure significantly increased the values of organic matter content in the two seasons, the values increased from 0.55% to 0.81%. On the other hand, the values of bulk density were decreased as a result of addition of organic manure from an initial value of 1.65 to 1.51 g cm^{-3}. These results correspond with the findings of *Khalil (1984), Tester (1990), and Ahmed (1991)* who reported that the addition of organic manure improves the physical properties of soils.

Data in Table (4) indicate that addition of organic manures (balady, compost, town refuse, biogas and green manure) mixture with ammonium sulphate greatly increased the available content of soil NPK, where the highest increase was obtained by biogas mixed with ammonium sulphate. On the other hand, the effect of different treatment on the NPK availability can be arranged as follows: mixture biogas followed by mixture compost, balady, town refuse and green manure. Data also reveal that the addition of organic manure singly increased the NPK of sandy soil availability, which can be arranged in its effect as follows: biogas, compost, balady, ammonium sulphate and green manure.

The increase in the available NPK content of the sandy soil was found in the two seasons but the 2nd season has slight increase in the available NPK than the 1st season, this may be due to the complete decomposition of organic matter and release of nutrients in the available form. Similar results were reported by *Tahoun et al. (2000) and Awad (2003).*

Table (3): Some recorded physical and chemical properties of the experimental soil before and after the study.

Property	Before	After
C. Sand, %	74.69	73.71
F.Sand, %	20.51	19.59
Silt, %	2.70	3.80
Clay,%	2.10	2.90
B.D, $g.cm^{-3}$	1.65	1.51
T.P, %	36.0	39.0
K,m / day	3.10	2.80
$CaCo_3$, %	0.40	0.30
Organic matter, %	0.55	0.81
EC, ds/m^2	0.23	0.28
Soil, pH	7.90	7.60
Soluble cations, meq/ 100 g soil extract (1-5)		
Ca^{++}	0.45	0.48
Mg^{++}	0.30	0.33
Na^{+}	0.30	0.35
K^{+}	0.13	0.14
Co^{--}_3	----	----
HCO_3	0.30	0.32
Cl^-	0.51	0.56
SO^{--}_4	0.40	.45
Exchangeable cations, meq, / 100 g soil		
Ca^{++}	5.10	7.15
Mg^{++}	2.80	3.70
Na^{++}	0.80	1.20
K^{+}	0.30	0.45
CEC	9.00	12.50
Available P, mg/kg soil	8.50	18.20
Available N, mg/ kg soil	14.30	27.60

Table (4): Influence of applied different N sources on available NPK in the soil and its content in the leaves .

Treatments	Soil available NPK,						Leaf NPK content,					
	1st season			2nd season			1st season			2nd season		
	N	P	K	N	P	K	N	P	K	N	P	K
Mineral 100%	23.12	15.21	30.11	25.18	16.17	27.12	33.39	2.21	22.82	41.16	3.73	25.25
Balady 100%	27.54	16.78	28.43	29.12	17.21	31.18	33.21	2.74	23.82	52.11	4.27	36.71
Balady 50%	28.43	18.43	30.84	31.65	19.98	32.14	38.46	2.89	25.41	56.21	5.11	40.19
Compost 100%	31.31	18.22	27.16	25.17	20.17	31.28	34.12	3.10	26.43	57.82	6.82	38.61
Compost 50%	32.12	19.12	29.78	27.28	22.14	33.19	39.15	3.42	27.13	61.16	6.31	42.67
Town refuse100%	30.09	18.42	33.66	33.68	21.57	35.98	36.51	2.51	23.11	46.21	3.27	35.81
Town refuse50%	31.79	19.40	32.28	31.79	20.19	34.38	41.72	2.63	24.42	51.62	4.10	38.44
Biogas 100%	34.64	19.85	36.81	28.66	15.13	38.17	50.87	3.86	29.67	65.32	7.25	41.29
Biogas 50%	34.01	20.60	34.54	29.81	17.61	36.27	45.62	3.91	30.11	68.12	7.84	45.33
Green man 100%	25.84	13.72	26.87	27.44	14.71	29.91	31.34	2.47	21.61	42.32	8.12	28.11
Green man 50%	26.65	15.08	25.13	28.65	16.49	26.78	33.15	2.51	22.57	44.53	3.82	34.16

The combined biogas gave the highest amount of leaf NPK content in the two studied seasons indicating the high potential fertility of the soil and that green manure singly gave that lowest amount of leaf NPK content in the two seasons. The difference in uptake between the 1st and 2nd seasons due to the annual addition of the organic manure , these results are in harmony with reported by *Sommerfeldt, (1985).*

Superiority of biogas manure over all the organic manure in the 1st and 2nd seasons for NPK uptake can be attributed to its higher content of available NPK. These results agree with those obtained by *Tahoun (2000). Robinson and Sharply (1996).*

Generally, addition of the organic manure to sandy soil greatly enhanced the potential productivity of the soil and improved the determined physical properties.

II. Influence of applied different N sources on root distribution

Data in Table (5) generally indicate that combined fertilizer treatments significantly increased root dry matter of the trees over those treated with mineral fertilizer separately or by different manure fertilizers.

Treatment of mineral N considered as control, so increases over this treatment ranged from 5.4 to 47.5 %, while decreases ranged from 35.6 to 1.8%. As singly manures were used, some dry weight of root system were decreased especially with green manure and town refuse treatments than the mineral treatment. The combined biogas was followed by compost and balady which gave the highest values of root dry weight.

Numbers not followed by the same letter are significantly different at 0.05 (Duncan multiple range test).

Data of 2001 season were considered as preliminary values that need to be much supported by the following season because the root system of trees under study was not developed enough to exploit the nutritional advantages of the different fertilizer treatments in the current study. Show Data in Table (6).

The combined manures had over values of the general dry weight of roots arranged from 55.0 to 75.6% than mineral treatment, while singly manures treatments ranged from –27.9 to 7.5 %.

In depth of 0-30cm, fibrous roots had arranged as following: combined manures > singly manures > mineral except green manure, town refuse, balady were least than mineral, this trend showed also with skeletal and semiskeletal roots.

Table (5): Influence of applied different N sources on dry weight of root system, in the 1st season.

Treatment	Root type		Total root dry weight (gm)	Increase of dry root weight (%) according to mineral treatment
	Fibrous (gm)	Skeletal and semi-skeletal roots (gm)		
Mineral 100 %	33.8 f	225.1 f	258.9 g	00.0
Balady, 100 %	32.4 f	222.0 fg	254.2 h	- 1.8
Balady, 50%	71.6 c	256.2 c	327.8 c	26.6
Compost, 100%	52.3 e	220.5 g	272.8 f	5.4
Compost, 50%	66.7 d	268.4 b	335.1 b	29.4
Town refuse, 100%	28.2 g	173.0 h	201.2 i	-22.3
Town refuse, 50%	70.3 c	244.8 d	315.0 d	21.7
Biogas, 100%	53.6 e	225.7 f	279.3 e	7.9
Biogas, 50%	85.3 a	296.6 a	381.9 a	47.5
Green manure, 100%	23.2 h	143.5 I	166.7 j	-35.6
Green manure, 50%	82.2 b	219.8 g	302.0 e	16.6

Table (6): Influence of applied different N sources on dry weight (gm) for different types of root system and its distribution in different soil depths in the 2nd season:

Treatment	Root distribution						Total dry root weight (gm)	Increase in dry root weight (%) according to mineral treatment
	0-30 cm		30-60 cm		60-90cm			
	Fibrous (gm)	Skeletal and semi-skeletal (gm)	Fibrous (gm)	Skeletal and semi-skeletal (gm)	Fibrous (gm)	Skeletal and semi-skeletal (gm)		
Mineral, 100%	142.7 g	455.4 i	161.3 a	738.3 e	72.8 a	396.2 j	1966.7 h	00.0
Balady, 100%	144.3 fg	464.3 h	77.6 f	604.7 g	31.6 f	564.2 h	1886.7 i	-4.1
Balady, 50%	333.6 c	698.7 d	97.8 d	996.6 a	38.6 e	1056.5 c	3221.8 d	63.8
Compost 100%	106.2 h	625.5 f	32.3 g	475.1 h	27.7 g	823.8 d	2090.6 g	6.3
Compost 50%	354.6 a	748.0 bc	112.7 b	996.6 a	43.6 d	1177.1 b	3432.6 b	74.5
Town ref. 100%	78.2 j	453.7 i	33.2 g	419.8 i	25.4 h	531.3 i	1541.6 j	-21.6
Town ref. 50%	312.3 e	744.1 c	104.0 c	976.3 c	47.7 c	1178.3 b	3362.7 c	71.0
Biogas 100%	146.3 f	472.5 g	77.5 f	710.5 f	31.6 f	666.8 f	2114.2 f	7.5
Biogas 50%	316.7 d	744.8 c	106.7 c	980.4 b	52.6 b	1253.3 a	3454.5 a	75.6
Green man. 100%	93.2 i	415.0 j	26.2 h	239.1 j	18.2 i	526.7 g	1418.4 k	-27.9
Green man. 50%	342.7 b	928.4 a	89.6 e	957.9 d	27.3 gh	702.7 e	3048.6 e	55.0

Numbers not followed by the same letter are significantly different at 0.05 (Duncan multiple range test).

In depth of 30-60 cm, the arrangement was found as follows for fibrous roots: mineral > combined manures > singly manures, this trend was true in skeletal and semi-skeletal roots.

In depth of 60-90cm, the arrangement was found in fibrous roots to be mineral > combined manures > singly manures, but for skeletal and semi-skeletal roots combined manures > singly manures > mineral treatments.

Generally, treatments of mixed manures with mineral fertilizers had the highest total root dry matter over other treatments. Data of 2001 and 2002 seasons confirm the beneficial effect of adding the organic manures to newly reclaimed sandy soil and its impact on root dry matter and root distribution. Moreover, it is evident that fibrous roots under mineral fertilizer treatment were significantly decreased than mixed fertilizing treatments in the 1st root zone (0-30cm) from soil surface, while such trend was inverted in the second foot as the fibrous roots dry matter of mineral fertilizing treatments had exceeded those of mixed fertilizing treatments. Such behavior may be due to the ability of citrus roots to adapt its growth to the environmental conditions by increasing its potentiality in absorbing water and nutrient elements from the second foot, which kept more soil moisture, and nutrient elements than the 1st foot commonly exposed to evaporation.

Data in Table (7) reveal that combined fertilizing treatments had increased the dry matter percentage of fibrous roots in the 1st foot of surface soil in comparison with both singly added mineral and manures, while such trend was reversed in both the 2nd and 3rd foot. Furthermore, the general trend of dry matter percentages of root components (skeletal and semi-skeletal) was inconsistent in the different root zones. Thus, it could be concluded that citrus root system is distributed as follows: 30.4; 45.8 and 23.8% in the 1st , 2nd and 3rd foot, respectively under mineral fertilizing treatment and 30.8-41.6; 31.4-34.0 and 24.1-34.0% in the 1st , 2nd and 3rd foot under combined treatments.

Moreover, it is obviously shown that citrus root components in this study took values of 19.2% fibrous roots under mineral fertilizing treatment; and 8.0-13.4% under singly manures treatments, respectively, while the obtained values for combined treatments were 13.8-15.1%. As shown in Table (8) the percentage of fibrous roots in respect to the total root system of the same treatment under mineral fertilizing treatment was generally higher than those of the combined fertilizing and singly added manures treatments.

Table (7): Influence of applied different N sources on dry matter percentage for different types of root system and its distribution in the 2nd season:

Treatments Root type	0-30 cm										
	Mineral%	Balady		Compost		Town refuse		Biogas		Green manure	
		100%	50%	100 %	50%	100%	50%	100%	50%	100%	50%
Fibrous roots, %	7.3	7.6	10.4	5.2	10.3	5.1	9.3	6.9	9.2	6.6	11.2
Skeletal and semi-skeletal,%	23.1	24.6	21.6	29.9	21.8	29.4	22.2	22.3	21.6	29.3	30.4
Total root system,%	30.4	32.2	32	35.1	32.1	34.5	31.5	29.2	30.8	35.9	41.6
30- 60 cm											
Fibrous roots, %	8.2	4.1	3	1.5	3.3	2.2	3.1	3.7	3.1	1.8	2.9
Skeletal and semi-skeletal,%	37.6	32.1	31	22.7	29.1	27.3	29.0	34.0	28.3	16.8	31.4
Total root system,%	45.8	36.2	34	14.2	32.4	29.5	32.1	37.7	31.4	18.6	34.3
60-90 cm											
Fibrous roots, %	3.7	1.7	1.2	1.3	1.3	1.6	1.4	1.5	1.5	1.3	1.0
Skeletal and semi-skeletal,%	20.1	29.9	32.8	39.4	34.2	34.4	35.0	31.6	36.3	44.2	23.1
Total root system,%	23.8	31.6	34	40.7	35.5	36	36.4	33.1	37.8	45.5	24.1

Table (8): Influence of applied different N sources on dry matter percentage for different types of root system in relation to the total root dry matter of the same treatment in the 2nd season.

Treatment	Mineral	Balady		Compost		Town refuse		Biogas		Green manure	
Root type	100%	100%	50%	100%	50%	100%	50%	100%	50%	100%	50%
Fibrous roots, %	19.2	13.4	14.6	8.0	14.9	8.9	13.8	12.1	13.8	9.7	15.1
Skeletal and semi-skeletal,%	80.8	86.6	85.4	92.0	85.1	91.1	86.2	87.9	86.2	90.3	84.9

The treatments resulted in better percentage of fibrous roots as compares to the other components of the root system due to the applied treatments.

III. Influence of different N sources applied on the vegetative growth:

Data in Table (9) indicate a marked increase in the 2nd season than the 1st season in dry weight of leaves, shoots less than 2 years, shoots more than 2 years, total dry weight of vegetative growth and dry matter per tree in all treatments under study. Moreover, it is obviously noticed that the total dry weight of vegetative growth of combined manure treatments had significantly exceeded those of singly added manure and mineral treatments in the two seasons. In the meantime, the values obtained in the 2nd season regarding dry weight of vegetative growth indicate about 6.5-9.6 fold increase and of tree dry matter about 6.7-9.9 fold increase over the first season with all tested treatments.

Data regarding to root ratio show that an obvious decrease in the 2nd season which indicates a marked change as the increase in the favour of the root system.

Furthermore, it is clear that there is a significant increase within singly added manure treatments, also within combined manure treatments

In this regard, *Tahoun et al (2000)* stated that adding organic matter and manure improves soil tilth, supply appreciable amounts of P and K and small amounts of other elements in addition to N and increased the base-exchange capacity, the relative potential fertility and organic matter content of soil. *Gobran (1978)* indicated that using mixed fertilizing program to pre bearing Valencia orange trees yielded higher dry weight content than that of the mineral fertilizer program. He reported that dry weight was greater when N was added in a mixed form of organic and inorganic forms. *Sato and Ishihara (1984)* found that total weight per tree increased with increasing application of N. *Ono et al. (1986)* found that there was a significant correlation between the feeder root biomass and the leaf or young green wood biomass of the tree. *Keleg and Minessy (1965)* concluded that increasing N more than 0.71-0.89 pounds tree in the form of organic manure had no effect on dry matter and tree growth expressed as length of shoots.

Table (9): Influence of applied different N sources on dry weight of tree parts:

Treatments	1st season							2nd season						
	Dry weight (gm)							Dry weight (gm)						
	Leaves	Shoots less than 2years	Shoots more than 2 year	Total vegetative growth	Root system	Total tree	Top / root ratio	Leaves	Shoots less than 2years	Shoots more than 2 year	Total vegetative growth	Root system	Total tree	Top / root ratio
Mineral 100%	102 i	118 f	148 f	368 i	259 g	627 h	1.42:1	806 h	674 g	1195 h	2675 h	1967 h	4642 h	1.36:1
Balady 100%	114 h	117 f	145 g	376 h	245 h	630 h	1.48:1	851 g	705 f	1303 g	2865 g	2091 i	4956 g	1.37:1
Balady 50%	241 c	157 b	196 c	594 c	328 c	922 c	1.81:1	1562 c	1279 c	2218 c	5059 d	3222 d	8281 d	1.57:1
Compost 100%	125 g	123 e	167 e	415 g	273 f	688 g	1.52:1	817 h	726 e	1155 i	2698 h	1887 g	4585 i	1.43:1
Compost 50%	253 b	163 a	213 b	629 b	335 b	964 b	1.88:1	1838 a	1531 a	2124 d	5493 b	3433 b	8926 b	1.60:1
Town refuse 100%	74.0 j	96.0 g	113.0 h	283 j	201 i	484 i	1.41:1	522 j	442 i	1071 j	2035 i	1542 j	3577 i	1.32:1
Town refuse 50%	231 d	147 c	170 d	548 d	315 d	863 d	1.74:1	1467 b	1279 c	2433 e	5179 c	3363 c	8542 c	1.54:1
Biogas 100%	136 f	147 c	149 f	432 f	279 e	711 f	1.55:1	934 f	713 ef	1418 f	3065 f	2114 f	5179 f	1.45:1
Biogas 50%	260 a	155 b	316 a	731 a	382 a	1113 a	1.91:1	1582 b	1398 b	2717 a	5597 a	3455 a	9052 a	1.62:1
Green manure 100%	57 k	76 h	102 i	235 k	168 j	403 j	1.40:1	588 i	472 h	798 k	1858 j	1418 k	3276 j	1.31:1
Green manure 50%	204 e	143 d	172 d	519 e	302 e	821 e	1.72:1	1406 e	1009 d	2066 e	4481 e	3049 e	7530 e	1.47:1

Numbers not followed by the same letter are significantly different at 0.05 (Duncan multiple range test).

Gobran et al. (1992) recommended to add mineral fertilizer in case of lacking organic manure with adopting closer planting distances or applying organic and inorganic fertilizers, as the best of fibrous, and total vegetative growth when the mixed fertilization was used in sandy soil.

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تأثير مصادر الآزوت العضوي على بعض الخصائص الطبيعية والكيمائية للتربة، النمو، توزيع الجذور، ومحتوى الأوراق من النتروجين، الفوسفور، البوتاسيوم لأشجار البرتقال الفالنشيا حديثة النمو في التربةالرملية تحت ظروف الري بالتنقيط

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أجريت هذه الدراسة في عامي ٢٠٠٠;٢٠٠١ على أشجار برتقال فالنشيا عمر سنة مطعومة على أصل فولكاماريانا ومنزرعة في أرض رملية تروى بالتنقيط بمزرعة محطة بحوث البساتين بالقصاصين، محافظة الإسماعيلية. شملت المعاملات إضافة سماد معدني فقط (سلفات النشادر ٢٠,٥%) طبقاً للتوصيات، كما أضيف نفس المعدل الآزوتي في صورة عضوية مختلفة المصادر (سماد بلدي-كومبوست- قمامة مدن- بيوجاز- مخلفات المزرعة) كما شملت المعاملات خليط الآزوت المعدني مع كل من الصور العضوية مناصفة.

أوضحت نتائج البحث أن إضافة السماد العضوي منفرداً أدى إلى تحسين الصفات الطبيعية للتربة حيث انخفضت قيم الـــpH والكثافة الظاهرية وازدادت المادة العضوية بالتربة كما تحسن التوصيل الهيدروليكي وازدادت المسامية الكلية كما ارتفعت السعة التبادلية الكاتيونية.

أما إضافة السماد العضوي مخلوطاً مع سلفات الأمونيوم أدى إلى تحسين الصفات الكيماوية وخصوبة التربة حيث ازدادت نسبة صلاحية العناصر للامتصاص والتي اتضحت زيادتها في تفوقت معاملتي التسميد العضوي بالبيوجاز والكومبوست سواء منفرداً أو وقد أوراق النبات. مخلوطاً مع السماد المعدني.كذلك أظهرت الدراسة زيادة معنوية في الوزن الجاف للجذور والمجموع الخضري للمعاملات التي سمدت بالأسمدة الخليطة من المعدني والعضوي عن تلك التي سمدت بالسماد المعدني فقط أو العضوي فقط.استخدام التسميد الخليط كان الأفضل حيث أدى إلى زيادة الجذور الليفية وجذور الامتصاص ومجموع النمو الخضري- كما تفوق سمادي البيوجاز والكومبوست.