

Effect of Some Organic and Mineral Fertilizer Applications on Growth and Productivity of Pomegranate Trees

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ABSTRACT

This investigation was carried out during 2007 and 2008 growing seasons on six years old Arabi-pomegranate trees, grown in sandy clay loamy soil in a private farm located at Alexandria-Matrouh road, to study the effect of different fertilizers i.e., minerals (Ammonium Sulphate, Potassium Sulphate and Calcium Super Phosphate) at rate of 100% or 50% of the recommended dose or organic (humic acid or compost solely) or their combinations on growth, fruit set, yield, fruit quality and leaf minerals content during both seasons of study. The obtained results showed that, vegetative growth, fruit set, yield as weight or number of fruits /tree as well as fruit quality (average fruit weight, diameter, length, TSS and anthocyanine) and leaf N content were, generally, improved under all treatments as compared with control in both seasons. While, slight effect on leaf P and K content were noticed. The studied treatments decreased juice acidity and did not significantly affect V.C. and tannins content in both seasons. The striking treatments 50% of the recommended rate of NPK + organic matter (compost or humic acid) were most effective in improving all parameters when compared with other treatments. It is worthy to note that, using 50% of the recommended rate of NPK + organic matter (compost at 25Kg/ tree or humic acid at 12.5 or 25g /tree) had a similar effect to the treatment 100% of the recommended rate of NPK solely. Hence, it could be concluded that fertilizing pomegranate trees with 50% of the recommended rate of NPK + humic acid at higher rate 25g/ tree is the promising treatment under the same condition of our study. Moreover, it reduced half the amount of the recommended mineral fertilizers as well as soil pollution.

INTRODUCTION

Recently, there has been an increasing demand for pomegranate (*Punica granatum L.*) to meet the need of local as well as the foreign markets of some European and Arabic countries.

Nowadays a great attention is focused on minimizing the intensive amounts of mineral fertilizers, because of their harmful effect and high costs. Hence, organic fertilization is happening to have a great importance.

In sandy and sandy loam soils, organic fertilization is used to improve the physical, chemical and biological characteristics of the soil. Adjusting soil pH, and increasing the solubility and availability of nutrients (P, K, Ca & Mg) and influence the plant growth and

production (Pinton, *et al.*, 1992). Compost is an organic fertilizer and soil amendment that provide plants with mineral nutrition and other benefits (Haggag, 1996) and gave the best fruit characteristics (Abd El-Naby, 2000). On the other hand, many commercial products containing humic acid (HA) have been promoted for use on various crops, Liu *et al.*, (1998). Benefits ascribed to the use of humic acid, particularly in low organic matter, alkaline soil, include increasing nutrient uptake, tolerance to drought and temperature extremes, stimulating activity of beneficial soil microorganisms and availability of soil nutrients (Seen and Kingman, 1973 and Russo and Berlyn, 1990). Humic materials may also increase root growth in a manner similar to auxin (O'Donnell, 1973 and Petrovic *et al.*, 1982). Humic substances are ubiquitous in the environment. Their importance in agriculture and soil sciences has been acknowledged for over 150 years, (Maggioni *et al.*, 1987). Humic acid contains sulfur, nitrogen and phosphorus in varying amounts. It also contains metals such as Ca, Mg, Cu, Zn etc. A substantial fraction of the mass of the humic acids is in carboxylic acid functional groups, which endow these molecules with the ability to chelate positively charged multivalent ions (Mg^{++} , Ca^{++} , Fe^{++} and most other "trace elements" of value to plants, as well as other ions that have no positive biological role, such as Cd^{++} and Pb^{++}). This chelation of ions is probably the most important role of humic acids with respect to living system (Purchase, 1997).

Accounting for the aforementioned aspects, this investigation was planned to study the effect of humic acid, compost and mineral fertilizers in the form of calcium super phosphate, potassium sulphate and ammonium sulphate as well as their combinations on vegetative growth, leaf chlorophyll and some mineral content, yield and fruit physical and chemical characters of Arabi pomegranate trees as a trial to reduce the costs of fertilizers, increase the yield and improve fruit quality.

MATERIALS AND METHODS

The present study was carried out during 2007 & 2008 successive seasons on six years old Arabi pomegranate trees, grown in sandy clay loamy soil of a private farm located at Alex-Matrouh road and spaced at

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5x5 meters apart. The physical and chemical properties of the experimental soil are presented in Table (1).

Nine treatments were used to evaluate soil application of 100% and 50% of the recommended doses of mineral NPK fertilization with or without organic fertilization as humic acid (HA) or compost (Nile compost) compared with the control trees which received organic fertilizer in the form of sheep manure at 15m³/ feddan as follow:

- T₁ – Control (sheep manure at 15m³/ feddan)
- T₂– 100% of the recommended doses of NPK (2Kg ammonium sulphate + 1Kg potassium sulphate + 1Kg super phosphate) /tree
- T₃– 50% of the recommended doses of NPK (1Kg ammonium sulphate + 0.5Kg potassium sulphate + 0.5 Kg super phosphate) /tree
- T₄ – Compost (Nile compost) 25Kg /tree
- T₅ – Humic acid (hummer 86% potassium hummate) at 12.5g/tree as soil application
- T₆ – Humic acid (hummer 86% potassium hummate) at 25g /tree as soil application
- T₇ – 50% of mineral fertilizers NPK + 25 Kg compost
- T₈ – 50% of mineral fertilizers NPK + 12.5 g humic acid
- T₉ – 50% of mineral fertilizers NPK + 25 g humic acid

The mineral fertilization treatments were added as a percent of the recommended rate by Ministry of Agric.i.e. 2Kg / tree of ammonium sulphate (20.6N) as a source of nitrogen and 1.0 Kg/tree of potassium sulphate (48%K₂O) as a source of potassium per tree were added as soil application in three equal doses at February, April and June. 1.0 Kg/tree calcium superphosphate (15.5%P₂O₂) was added with 15m³/feddan organic (sheep manure) in December of both seasons. Mineral fertilizers were mixed with soil surface layer (20 cm depth) surrounding the trunk till the external end of canopy shade. Organic fertilizers were applied in the form of compost at rate of 25 Kg/tree in January of each year. The chemical analysis of compost is shown in Table (2). Also, the hummer (86% potassium hummate) was added at two concentrations (12.5 and 25 gm) per tree at the first week of February. The organic fertilizers were applied in two parallel ditches of 50 cm width and 30 cm depth. The ditches surrounded the tree from two directions in the end of canopy. In the 2nd season, they were dug in the other two directions.

The experiment was set in Randomized Complete Block Design with replications for each treatment using three trees as a single replicate (9 treatments x 3 replicates x 3 trees = 81 trees).

In each season of study (on early April), 20 new shoots (one year old) well distributed around periphery of each replicate tree (5 shoots toward each direction) were randomly selected, labeled and measured their length as well as the number of their leaves. The following parameters were used to evaluate the tested treatments:

1. Vegetative growth:

At the end of growing season, the selected shoots were measured to determine the average length (cm) and number of leaves /shoot. Five leaves were collected randomly from the first mature leaves from the tip of the previously tagged shoots and their areas (cm²) were measured and numbers of fruits / shoot were determined for fruit set percentage. Also, total leaf chlorophyll content was determined in the same fresh leaves according to the method described by Yadava (1986) using Minolta chlorophyll Meter Spad. 502 (Minolta Camera, LTD Japan).

2. Yield and Fruit quality:

The total yield (kg) of each replicate tree was calculated using the average fruit weight (gm) and the total number of fruits per tree. On the 1st August in both seasons, number of fruits per each experimental tree was counted. At harvesting time, on August 30th, in both seasons, five fruits were taken at random from each replicate to determine fruit quality expressed as average fruit weight (gm), diameter (cm) and length (cm). In juice of each fruit sample, total soluble solids (TSS) percentage was determined by a hand refractometer and the percentage of acidity was measured according to A.O.A.C. (1995). Vitamin C was determined by the titration with dichlorophenol indophenol blue dye and expressed as mg vitamin C /100 ml juice. Also, total anthocyanine content in fruit juice was determined as described by Hsia *et al.*, (1965). Tannins content was measured in the juice by the method described by Winton and Winton, (1945).

3. Leaf mineral content:

A sample of five leaves was randomly selected from the middle part of non fruiting shoots of each replicate tree in both seasons. The selected leaves were washed with tap water, rinsed with distilled water and oven dried at 70°C to constant weight and then ground. The ground leaf samples were digested with sulfuric acid and hydrogen peroxide according to Evenhuis and Dewaard (1980). Suitable aliquots were taken for the determinations of N, P and K. Nitrogen and phosphorus were determined colorimetrically according to Evenhuis (1976), and Murphy and Riley (1962), respectively. Potassium was determined against a standard by Flamephotometer (Corning 410).

Table 1. Physical and chemical analysis of soil

Soil Depth (cm)	CaCO ₃ %	PH	EC ds/m	Soluble cations meq/L				Soluble anions meq/L				Mechanical Analysis %			Soil Texture
				Na ⁺	K ⁺	Ca ⁺	Mg ⁺	CO ₃ ⁻	HCO ₃ ⁻	CL ⁻	SO ₄ ⁻	Sand	Silt	Clay	
0-30	28.0	8.0	0.75	3.84	0.36	2.38	0.92	-	2.60	3.64	1.26	31.73	7.02	11.25	Sandy loam
30-60	28.0	9.1	0.61	2.16	0.26	2.04	1.04	-	2.44	3.30	0.36	67.53	14.24	18.23	Sandy loam
60-90	35.2	8.7	0.45	2.09	0.21	1.78	0.44	-	1.60	2.66	0.24	52.49	15.18	21.51	Sandy clay loam

Table 2. Chemical analysis of the experimental organic compost

Organic Fertilizer	Organic Carbon (%)	Moisture Content (%)	Organic Matter (%)	Macronutrients (%)					Micronutrients (PPM)		
				N	P	K	Ca	Mg	Fe	Mn	Zn
Nile Compost	28.9	17.8	71.0	1.87	1.48	1.23	1.20	0.34	1400	126	28

Data were statistically analyzed according to Snedecor and Cochran (1990) and L.S.D. test at 0.05 level was used for comparison between treatments.

RESULTS AND DISCUSSIONS

1. Vegetative growth

It is quite evident as shown in Table (3) that, all the evaluated growth measurements [average shoot length, number of leaves per shoot and leaf area] of Arabi pomegranate trees were statistically improved by all mineral and organic fertilization treatments either applied alone or in combinations as compared with the control treatment. In this respect, the combination representing 50% of the recommended rate of mineral nutrients (NPK) + humic acid at higher concentration (25kg/tree) was the most effective treatment as it gave the best results, while when combined with humic acid at lower concentration (12.5 g /tree) or compost at rate of 25Kg /tree were intermediate. However, the lowest values of the studied vegetative growth parameters except for (no. of leaves / shoot in the 1st season) were recorded when 50% of the recommended rate of mineral fertilizer NPK was added alone compared with the other treatments. No significant differences were noticed for this treatment for leaf area in both seasons. The data mostly followed the same trend of response during both seasons. Data also indicated that application of humic acid with both concentrations whether alone or in combination with 50% of the recommended rate of mineral fertilizer markedly increased growth parameters. These results may be due to the beneficial effect of organic fertilizer in increasing the availability of most nutrients and improving physical and chemical properties of soil in

favour of increasing nutritional status and growth of the tree could explain the present results for the necessity of using organic with mineral fertilizer (Nijjar, 1985). In addition, the microorganisms produce growth promoting substances which increase plant growth leading to increase photosynthetic rate (Nardi *et al.*, 2002). The improving effect of using organic matter and in particular of humic acid on both plant metabolism and plant growth has been extensively investigated by (Lee and Bartlett, 1976; Tan and Tantiwiranond, 1983; and Chen and Aviad, 1990). The results are in agreement with many investigators who worked on the effect of organic matter and reducing mineral fertilizers (Fernandez-Escobar *et al.*, 1996 and Abou El-Khashab *et al.*, 2005) on olive, (Safia, 2004) on pecan, (Athani *et al.*, 2007(a&b), Barbara *et al.*, 2007 and Naik and Sri Hari Babu, 2007) on guava, (Eman *et al.*, 2008) on grapevine and (El-Shenawi *et al.*, 2008) on banana.

2. Fruit set and yield

As for the effect of organic and mineral fertilizer NPK whether alone or in combinations, it is clear from Table (4) that fruit set was significantly increased with application of all treatments in both seasons. In the meantime, yield as number or weight (Kg/ tree) of fruits were significantly increased with application of 100% of the recommended rate of NPK or with 50% of the recommended rate of NPK either with compost or humic acid in two different concentrations (12.5 or 25 gm /tree). Thus, 50% of the recommended rate of NPK + humic acid at 25g /tree gave significantly the highest yield as number and weight of fruits (kg) per tree than most of other treatments. This pronounced effect may be attributed to the favorable effect of mixed organic with mineral fertilizers which reserved the sufficient amounts

Table 3. Effect of some organic and mineral fertilizers on some vegetative growth parameters of Arabi pomegranate trees during 2007 and 2008 seasons

Treatments	Average Shoot length (cm)		No. of leaves/shoot		Leaf area (cm) ²	
	2007	2008	2007	2008	2007	2008
Control (Adopted Fertilization in the Farm)	15.5	16.2	18.6	20.1	3.9	4.0
100% of NPK	19.8	20.0	30.1	32.7	5.0	4.9
50% of NPK	17.6	18.0	27.8	29.3	4.4	4.4
Compost at 25 kg/tree	18.0	19.1	26.3	28.4	4.5	4.4
Humic acid at 12.5 gm/tree HA ₁	18.5	18.5	29.2	29.0	4.5	4.6
Humic acid at 25 gm/tree HA ₂	19.0	19.6	30.0	30.2	4.9	4.9
50% of NPK + Compost	21.0	23.2	33.1	34.9	6.1	6.0
50% of NPK + HA ₁	20.1	25.5	35.5	36.0	5.8	6.2
50% of NPK + HA ₂	23.4	24.0	36.7	37.8	6.5	6.7
L.S.D _{0.05}	1.2	1.1	1.09	1.35	0.53	0.54

Table 4. Effect of some organic and mineral fertilizers on fruit set and yield of Arabi pomegranate trees during 2007 and 2008 seasons

Treatment	Fruit set %		Yield /tree			
			No. of fruits /tree		Kg /tree	
	2007	2008	2007	2008	2007	2008
Control (Adopted Fertilization in the Farm)	19.90	19.50	122	116	23.63	23.50
100% of NPK	25.90	24.60	127	120	27.96	28.11
50% of NPK	25.10	22.00	122	118	25.51	25.00
Compost 25 kg/tree	24.40	23.80	124	119	24.42	24.12
Humic acid at 12.5 gm/tree HA ₁	24.00	23.50	123	119	24.83	25.35
Humic acid at 25 gm/tree HA ₂	24.80	24.10	124	120	25.50	26.77
50% of NPK + Compost	30.50	29.40	132	132	31.00	32.22
50% of NPK + HA ₁	33.20	32.20	144	134	34.11	33.00
50% of NPK + HA ₂	35.40	34.30	149	147	36.08	36.55
L.S.D_{0.05}	1.21	1.56	3	5	4.20	3.10

of N and K for plant development (Rosa *et al.* 2004). Moreover, the addition of organic fertilizer to the soil encouraged proliferation of soil microorganisms, increased microbial populations and activity of microbial enzymes i.e. dehydrogenase, urease and nitrogenase (Maggioni *et al.*, 1987). These results are in agreement with those obtained by Safia (2004), Saleh *et al.*, (2006), Athani *et al.*, (2007a&b), Naik and Sri Hari Babu (2007), Eman *et al.*, (2008) and EL-Shenawi *et al.*, (2008). They reported that adding humic acid or compost with mineral fertilizer significantly increased yield of different fruit species than organic fertilizer or mineral alone.

3. Fruit physical and chemical properties:

Data in Table (5) show the effect of mineral and organic fertilizer either alone or in combination on fruit physical and chemical properties of pomegranate trees in the two experimental seasons.

It is obvious that fruit weight (g), TSS and Anthocyanine were significantly increased by all the studied treatments as compared with control. The same observations were found in fruit length and diameter except, with 50% of NPK, compost or humic acid at lower concentration (12.5gm) alone, where the differences were too low to be significant. Acidity, however showed an opposite trend, while, V.C. as well as Tannin content were not significantly affected. It is noteworthy to mention that the effect of 50% of the recommended rate of NPK + higher humic supply 25g/tree was more pronounced than the other treatments followed by 50% of the recommended rate of NPK + lower humic concentration 12.5g/tree or with compost at rate of 25 Kg/tree. The previous improvement in pomegranate yield and fruit characters may be attributed to the synergistic effect of the combination between

organic and mineral amendments. This is due to the improvement of soil chemical and physical properties and available nutrients which in turn improves plant growth and fruit production and quality (Li, 1999 and Itoo and Manivannan 2004). Finding of many investigators gave a real support to our results Neri *et al.*, (2002), Saleh *et al.*, (2006), Athani *et al.*, (2007a&b), Naik and SriHariBabu (2007), El-Shenawi *et al.*, (2008) and Eman *et al.*, (2008).

4. Leaf chlorophyll and mineral content:

Data concerning the effect of the investigated treatments on leaf total chlorophyll and mineral content during the two experimental seasons are shown in Table (6). It is easy to say that, generally, all treatments resulted in enhancing leaf chlorophyll content and nitrogen percentage when compared with the control in both seasons, whereas 50% of the recommended NPK alone gave the lowest values when compared with other treatments. In the meantime, leaf P content increased by adding compost at rate of 25kg /tree or humic acid at two concentrations either alone or when mixing with 50% of the recommended rate of NPK in the second season only. As for leaf K content, NPK fertilizers when applied alone at the full dose solely or at half dose and mixed with either compost or humic acid at both concentrations produced the richest leaves in K content in the second season only. Such effect may be attributed to the effect of organic matter and in particular of humic acid which able to stimulate root development, elongation and increased the production of thin and lateral roots that probably represents the most important effect of HA on plant development (Rosa *et al.*, 2004) and largely affect absorption and assimilation of several inorganic nutrients, (Tan and Nopamombodi, 1979, Albuzio *et al.*, (1986), Tattini *et al.*, 1991 and Andrade *et al.*, 2004).

Table 5. Effect of some organic and mineral fertilizers on some chemical and physical fruit properties of Arabi pomegranate trees during 2007 and 2008 seasons

Treatments	Fruit Weight (gm)		fruit Length (cm)		Fruit Diameter (cm)		T.S.S (%)		Acidity (%)		Vitamin C mg/100 ml juice		Tannins(%)		Anthocyanine(%)	
	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
Control (Adopted Fertilization in the Farm)	193.1	201.6	8.00	8.11	7.11	7.1	12.5	13.0	1.23	1.33	2.13	2.17	2.71	2.52	0.330	0.344
100% of NPK	220.1	234.2	8.25	8.75	7.25	7.11	15.0	15.5	1.13	1.17	2.15	2.19	2.70	2.50	0.341	0.365
50% of NPK	208.4	211.5	8.06	8.17	7.18	7.08	14.3	15.0	1.20	1.23	2.13	2.17	2.70	2.50	0.338	0.360
Compost 25 kg/tree	196.2	202.4	8.11	8.21	7.24	7.08	14.5	15.0	1.20	1.24	2.13	2.17	2.68	2.50	0.338	0.362
Humic acid at 12.5 gm/tree HA ₁	201.5	213.0	8.11	8.23	7.24	7.08	14.5	15.2	1.19	1.23	2.14	2.19	2.68	2.50	0.337	0.360
Humic acid at 25 gm/tree HA ₂	205.5	223.0	8.19	8.33	7.25	7.09	15.0	15.5	1.04	1.20	2.16	2.20	2.68	2.48	0.352	0.364
50% of NPK + Compost	233.3	243.6	8.66	8.71	7.36	7.15	17.2	18.0	0.98	1.00	2.17	2.20	2.67	2.48	0.364	0.370
50% of NPK + HA ₁	235.8	246.2	8.33	8.80	7.34	7.18	18.3	18.5	0.93	0.92	2.19	2.23	2.68	2.46	0.369	0.379
50% of NPK + HA ₂	242.0	247.8	8.90	8.83	7.41	7.17	18.0	18.6	0.93	0.93	2.19	2.22	2.67	2.46	0.371	0.379
L.S.D _{0.05}	01.2	02.1	0.12	0.17	0.07	0.04	0.56	0.83	0.09	0.11	N.S	N.S	N.S	N.S	0.007	0.014

Table 6. Effect of some organic and mineral fertilizers on total leaf chlorophyll and some minerals content of Arabi pomegranate trees during 2007 and 2008 seasons

Treatments	Total chlorophyll mg/cm ²		N%		P%		K%	
	2007	2008	2007	2008	2007	2008	2007	2008
Control (Adopted Fertilization in the Farm)	4.90	4.13	1.82	1.90	0.12	0.13	0.93	0.95
100% of NPK	5.33	5.15	2.27	2.43	0.13	0.15	0.98	1.12
50% of NPK	5.02	4.90	1.87	1.95	0.13	0.15	0.94	0.97
Compost 25 kg/tree	5.30	4.90	1.83	2.11	0.14	0.17	0.95	1.09
Humic acid at 12.5 gm/tree HA ₁	5.11	4.95	1.86	2.10	0.13	0.16	0.96	1.07
Humic acid at 25 gm/tree HA ₂	5.11	6.10	1.84	2.15	0.13	0.16	0.96	1.08
50% of NPK + Compost	5.19	6.00	2.00	2.21	0.15	0.19	1.00	1.09
50% of NPK + HA ₁	5.35	6.53	2.13	2.26	0.14	0.18	0.99	1.13
50% of NPK + HA ₂	6.55	6.58	2.20	2.32	0.14	0.18	1.00	1.15
L.S.D_{0.05}	0.28	0.41	0.06	0.13	N.S	0.03	N.S	0.07

The present results concerning the effect of using combination with organic and mineral nutrients on increasing leaf chlorophyll and NPK are similar to those obtained by Murillo *et al.*, (2005), Saleh *et al.*, (2006), Athani *et al.*, (2007b) Eman *et al.*, (2008). However, Naik and SriHariBabu, (2007), and EL-Shenawi *et al.*, (2008) found that leaf N remained almost the same before and after the trial. On the other hand, leaf P and K showed an increase after the termination of the trial due to various treatments except control.

CONCLUSION

Generally it could be concluded that, applying organic matter (compost or humic acid) or with mineral fertilizers improved pomegranate growth, productivity and fruit quality. Also, it seems that fertilizing pomegranate trees with 50% of the recommended rate of NPK + humic acid at higher rate (25gm /tree) is the promising treatments under the same conditions of our study. Moreover, it reduces half of the amount of the recommended mineral fertilizers as well as soil.

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الملخص العربي

تأثير إضافة بعض الأسمدة العضوية والمعدنية على نمو وإنتاجية أشجار الرمان

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وقد كان هناك زيادة بسيطة في محتوى الاوراق من الفوسفور والبوتاسيوم في الموسم الثاني من الدراسة بينما لم يوجد تأثير واضح على محتوى الثمار من فيتامين ج و التانينات خلال موسمي الدراسة.

وكانت أكثر المعاملات تأثيراً هي إضافة نصف الجرعة من السماد المعدن مع المادة العضوية سواء كانت حمض الهيومك بكلا تركيزيه (١٢٠٥ أو ٢٥ جم لكل شجرة) أو الكمبوست بمعدل ٢٥ كج للشجرة على جميع المعاملات خلال موسمي الدراسة وادت الى تحسن واضح في جميع الصفات تحت الدراسة.

ومن الجدير بالذكر أن استخدام المعاملات ٥٠% من الجرعة الموصى بها من التسميد المعدن مع السماد العضوي بنوعيه ثمانل او تزيد عن استخدام الجرعة الكاملة الموصى بها من التسميد المعدن منفردا وتفيد هذه النتائج في تقليل معدلات السماد المعدن المسببه للتلوث بالأضافة الى تحسين نمو ومحصول وصفات ثمار أشجار الرمان العربي.

أجري هذا البحث عامي ٢٠٠٧-٢٠٠٨ على أشجار الرمان صنف العربي عمرها ٦ سنوات ومترعة في أرض رملية طميية بمزرعة خاصة علي طريق اسكندرية -مطروح الساحلي لدراسة تأثير الاسمدة المختلفة: المعدنية(سلفات الامونيوم، سلفات البوتاسيوم، سوبر فوسفات الكالسيوم) بمعدل ١٠٠% أو ٥٠% من الجرعة الموصى بها وذلك لكل شجرة أو العضوية(حمض الهيومك بمعدل ١٢٠٥ أو ٢٥ جم لكل شجرة أو كمبوست النيل بمعدل ٢٥ كج لكل شجرة) والخليط بينهما علي النمو وعقد الثمار والمحصول ومحتوى الاوراق من العناصر وصفات جودة الثمار خلال موسمي الدراسة. :

وقد أوضحت النتائج أن جميع المعاملات أدت الي زيادة واضحة في النمو الخضري ومحتوى الاوراق من الكلوروفيل والنيتروجين عند مقارنتها بالكنترول.

كذلك وجد تحسن واضح في نسبة العقد والمحصول وبعض صفات جودة الثمار(وزن وطول وعرض الثمار والمواد الصلبة الذائبة الكلية والانتوثيانين) بينما قلت الحموضة وذلك بالمقارنة بمعاملة الكنترول.