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A Comparative Study on Fertilization of Pomegranate Transplants 1- Vegetative growth measurements

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ABSTRACT

This investigation was carried out during both 2015 and 2016 seasons to study the influence of the two investigated factors i.e., pomegranate cultivars (Manfalouty and Wonderful) and fertilization (mineral & bio- fertilization) and their possible combinations on some vegetative growth measurements.

The specific effect of cultivar type on some vegetative growth, data revealed that, Wonderful cultivar was better than the other investigated cultivar (Manfalouty cultivar) in this respect. Also, fertilizer with soil application of Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers was superior in this respect where it was able to increase significantly vegetative growth as compared with the other different investigated fertilization especially NPK only (control) during both seasons of study. Concerning the interaction effect of the two investigated factors i.e., pomegranate cultivars (Manfalouty and Wonderful) and fertilization (mineral & bio- fertilization) on vegetative growth of pomegranate transplants, data show the highest vegetative growth were obtained with the combination between Wonderful cultivar transplants and fertilized with soil application of Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers.

Keywords: Pomegranate, bio fertilizer, Nitrobene, Phosphorene, Potasene

Introduction

The pomegranate tree grows well in a wide range of climatic conditions, but the most satisfactory areas are interior valleys of California, Arizona and Northern Mexico, where hot dry summer mature fruit of highest quality. It is a desert plant, but also grows well under high humidity as in high Himalayas, but shipping and keeping qualities are declared by humid conditions. This plant well succeeds as for as the 35 the degree latitude north but during extreme cold periods, the plant are sometimes injured by cold. The trees with stand a temperature of 10 F to 15 F, a rather large amount of summer heat is required to ripen the fruits (The Standard Cyclopedia of Horticulture, 1970). The pomegranate area in Egypt (13609) feddans, according to annual of the Ministry of Agriculture Anonymous (2011).

There are many factors face the growers to improve and maximize their productivity for example, propagation, fertilization, irrigation and other horticultural practices. Fertilization is one of the important management tools in increasing growth and crop yield, especially with nitrogen (Nijjar, 1985).

Nitrogen fertilization effects depend upon the nutrient status of cultivated soil, as well as applied amount, sources and methods of N applications. In addition, ammonia fertilizers are rapidly nitrified and the nitrate nitrogen is leached downward during watering from the root zone or upward after watering to the surface. As a result of the rapid nitrification of the ammonium nitrogen in fertilizers with its subsequent denitrification, sizable amount of nitrogen in the gaseous form are lost. This reduces the uptake of nitrogen by fruit trees from fertilizers and lowers their effectiveness, consequently, research workers have been trying in recent years to develop sparingly soluble

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fertilizers whose nitrogen is slowly solubilized and gradually taken up by fruit trees throughout the whole season (Yagodin, 1990).

Phosphorus is an essential nutrient as a part of several key plant structure compounds and as a catalysis in the conversion of numerous key biochemical reactions in plants. Phosphorus is noted especially for its role in capturing and converting the sun's energy into useful plant compounds (Bill, 2001).

Potassium, like phosphorus and nitrogen, constitutes is important macronutrient in the nutrition of trees for regular, large-scale production of high quality fruits. Fruit crops, in general are heavy feeders of potash and the quantities of potash removed are comparable to nitrogen and in some cases even much higher (Miller *et al*, 1990). Potassium is essential element in many plant metabolic processes. In spite, K does not become a part of plant compounds; it plays many important regulatory roles in development of different tissues. In addition, K may also increase disease resistance by increasing the thickness of outer walls in epidermal cells (Mengel *et al*., 2001). Potassium is very effective especially when applied with the optimum rate of N and P (Fawzi *et al*., 1990 and Dass and Srivastava, 1997).

The use of bio-fertilizers in enhancing plant growth and yield has gained momentum in recent years because of higher cost and hazardous effect of chemical fertilizers. Nitrogen-fixing bacteria and arbuscular mycorrhizal fungi were found to enhance the growth and production of various fruit trees significantly (Khanizadeh *et al*., 1995), besides improving the microbiological activity in the rhizosphere (Aseri *et al*., 2008). Bio-fertilizer improves growth and fruit quality of pomegranate (Abo-Taleb, Safia *et al*., 1999 and Wadee, 2007). Moreover, the alternative bio-fertilizer helps to maintain and preserve soil and water resources for future generations.

This study aimed to know more knowledge about the effect of bio-fertilizer on growth and nutrients status of Manfalouty and Wonderful pomegranate transplants and throw some light on the accelerating and stimulating the vigor and nutritional status of transplants in the first year in orchard to be ready for training in the subsequent years and suggesting the recommendation for the best source of N, P and K that applied for obtaining an vigor growth of pomegranate transplants.

Materials and Methods

This study was carried out during the two successive seasons of 2015 and 2016 on uniform in vigor transplants of Manfalouty and Wonderful pomegranate (*Punica granatum* L.) cultivars.

This experiment aimed to know more knowledge about the effect of bio-fertilizer on growth and nutrients status of Manfalouty and Wonderful pomegranate transplants at the nursery of the Faculty of Agriculture, Benha University.

Uniform and healthy one-year- old seedlings of Manfalouty and Wonderful pomegranate cultivars were the plant material used in this study. In both seasons of study and during the second week of February, these seedlings were transplanted individually each in clay pot of 25 cm. in diameter that previously had been filled with specific weight of media consisting of clay and sand at equal proportion (by volume).

Before the experiments had been conducted in the first season, both mechanical and chemical analysis were done shown in Table 1(a & b) according to the methods described by Jackson, (1967 and A. O. A. C., 1985).

Table (1-a): Physical properties of soil (%):

Partial distribution		
Total sand	Silt	Clay
60.00	10.00	30

Table (1-b): Chemical properties of soil:

Soluble cations mg/L				Soluble anions meg /L				Ca Co_3	PH	EC
Mg^{++}	$^{++}$ Ca	K^+	Na^+	HCO_3^-	CO_3^{--}	$SO4^{--}$	Cl^-			
2.10	8.80	0.60	7.70	3.00	-	9.20	6.90	1.30	8.72	1.90

The bio-fertilizers (BF) which used in this study were produced by soil microbiology unit, desert research center. Nitrobene application as an additional N bio-fertilization, while Phosphorene additional P bio-fertilization as well as Potasene additional K bio-fertilization to the seedlings. This experiment involved seven treatments:

1- Mineral fertilizers: NPK fertilization program, as control was added from 40 g from ammonium sulphate, 20 g from superphosphate and 10 g potassium sulphate were annually added per plant monthly from April to July.
2- Soil application of Nitrobene at 4 g/ transplant + Phosphorene at 4 g/ transplant + Potasene at 4 g/ transplant +1/2 mineral fertilizers.
3- Soil application of Nitrobene at 8 g/ transplant + Phosphorene at 8 g/ transplant + Potasene at 8 g/ transplant +1/2 mineral fertilizers.
4- Soil application of Nitrobene at 16 g/ transplant + Phosphorene at 16 g/ transplant + Potasene at 16 g/ transplant +1/2 mineral fertilizers.
5- Soil application of Nitrobene at 4 g/ transplant + Phosphorene at 4 g/ transplant + Potasene at 4 g/ transplant +1/4 mineral fertilizers.
6- Soil application of Nitrobene at 8 g/ transplant + Phosphorene at 8 g/ transplant + Potasene at 8 g/ transplant +1/4 mineral fertilizers.
7- Soil application of Nitrobene at 16 g/ transplant + Phosphorene at 16 g/ transplant + Potasene at 16 g/ transplant +1/4 mineral fertilizers.

Bio-fertilizers (Nitrobene + Phosphorene + Potasene) were applied twice in April and May.

Experimental layout:

The complete randomized block design with four replications was used for arranging the differential investigated treatments. Every replicate was represented in each of the aforesaid two plants. The response of Pomegranate transplants to differential treatments of the experiment was investigated throw determining of the following vegetative growth measurements:

On last week of August during both seasons as the experiment was ended, the effect of different treatments on some vegetative growth measurements were evaluated by the following growth parameters during both seasons as follows:

1. Increment percentage in stem height.

Net increase in stem height = plant height in the end of August- initial plant height on the first of April. Increment percentage in stem length was estimated as follows:

$$\frac{\text{Final stem length} - \text{Initial stem length}}{\text{Initial stem length}} \times 100$$

2. Increment percentage in stem diameter.

Net increase in stem diameter = Stem diameter in the end of August - Initial stem diameter in the first of April. Increment percentage in stem diameter was estimated as follows:

$$\frac{\text{Final stem diameter} - \text{Initial stem diameter}}{\text{Initial stem diameter}} \times 100$$

3. Average number of lateral shoots / transplant.

4. Average number of leaves / transplant.

5. Leaf area:

Five mature leaves were taken from the middle of shoots for each transplant to measure the leaf area (cm^2) according to the following equation.

$$\text{The leaf area } (cm^2) \quad \frac{\text{Leaves weight (g)}}{\text{Sections weight (g)}} \times 2$$

6. Dry weights of (stem and roots) (g) and top/ root ratio.

Statistical analysis:

All data of the present investigation were subjected to analysis of variance and significant differences among means were determined according to Snedecor and Cochran, (1990). In addition, significant differences among means were differentiated according to the Duncan's, multiple test range (Duncan, 1955).

Results and Discussion

This investigation was carried out to study the influence of the two investigated factors namely: 1- pomegranate cultivars (Manfalouty and Wonderful) and 2- fertilization (mineral & bio- fertilization) and their possible combinations on "pomegranate transplants were studied during both 2015 and 2016 seasons. Such influence was evaluated through the response of some vegetative growth measurements.

Therefore, obtained results presented in Tables (2 -9) in this study dealing with any of the abovementioned three aspects are separately during both seasons of study discussed some vegetative growth:

In this regard in stem height; stem diameter; number of lateral shoots; number of leaves; leaf area; stem dry weight; roots dry weight and top: root ratio were investigated pertaining their response to the specific effect of investigated variables of each studied factor i.e., pomegranate cultivars (Manfalouty and Wonderful) and fertilization (mineral & bio- fertilization) soil applications as well as interactions effect of the combinations between the variables of both investigated factors.

1. Increment percentage of stem height:

A. Specific effect:

As for the response to specific effect of pomegranate cultivar, data in Table (2) displays that; Wonderful cultivar surpassed statistically Manfalouty cultivar during two seasons of study in this respect. Meanwhile, the specific effect of fertilizer treatments, Table (2) displays that the stem was longer (higher) in transplants fertilized with Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers.

B. Interaction effect:

Regarding the interaction effect of various (pomegranate cultivar x fertilizer treatments) combinations Table (2) reveals that, Wonderful cultivar and Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers had significantly the tallest stem. Meanwhile, the reverse was true with Manfalouty cultivar and fertilized with NPK only, In addition other combinations were in between during two seasons. The obtained results are in confirmed with (Prasanna and Dhandar, 1996 and Padmavathamma and Hulamani, 1998).

2. Increment percentage of stem diameter:

A. Specific effect:

As for the response to specific effect of pomegranate cultivar, data in Table (3) displays that; Wonderful cultivar surpassed statistically Manfalouty cultivar during two seasons of study. Meanwhile, the specific effect of fertilizer treatments, Table (3) displays that, the stem was thickness in transplants fertilized with Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each +1/2 mineral fertilizers rather than in other treatments especially NPK only (control).

B. Interaction effect:

Regarding the interaction effect of various (pomegranate cultivar x fertilizer treatments) combinations, Table (3) reveals that, Wonderful cultivar and fertilized with Nitrobene + Phosphorene

+ Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers had significantly the thickened stem during the first season. But, in the second season Wonderful cultivar and fertilized with Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/2 mineral fertilizers had significantly the thickened stem. Meanwhile, the reverse was true with Manfalouty cultivar and fertilized with NPK (control), In addition other combinations were in between during two seasons. A similar result was also obtained by El-Haddad *et al*., (1993) and Abd Ella-Eman (2006).

Table 2: Specific and interaction effects of pomegranate cultivars, fertilizer treatments and their combinations on increment percentage of stem height of pomegranate transplants during 2 and 2016 seasons.

Treatments	Increment percentage of stem height					
	Manfalouty	Wonderful	Mean	Manfalouty	Wonderful	Mean
	First season			Second season		
Mineral fertilizers (control)	23.57 F	45.08C	34.33 C	26.83 F	14.85 G	20.84 E
Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each +1/2 mineral fertilizers.	25.67 EF	48.47BC	37.07 BC	46.40 CD	27.90 F	37.15 D
Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each +1/2 mineral fertilizers.	30.71 DE	64.63A	47.67 A	42.10 D	43.32 D	42.71 BC
Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each +1/2 mineral fertilizers.	35.20 D	64.13A	49.66 A	30.20 EF	49.00 BC	39.60 CD
Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers.	31.18 DE	68.48A	49.83 A	42.83 D	54.73 A	48.13 A
Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each +1/4 mineral fertilizers.	25.41EF	46.84C	36.12 BC	35.13 E	53.43 AB	44.93 AB
Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each +1/4 mineral fertilizers.	24.71EF	54.31B	39.51 B	42.20 D	53.33 AB	47.77 A
Mean	28.06 B	55.99 A		37.96 B	42.37 A	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

Table 3: Specific and interaction effects of pomegranate cultivars, fertilizer treatments and their combinations on increment percentage of stem diameter of pomegranate transplants during 2015 and 2016 seasons.

Treatments	Increment percentage of stem diameter					
	Manfalouty	Wonderful	Mean	Manfalouty	Wonderful	Mean
	First season			Second season		
Mineral fertilizers (control)	35.63 H	41.17 GH	38.40 C	27.80 I	29.40 I	28.60 E
Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each +1/2 mineral fertilizers.	69.57 C	82.00 AB	75.78 A	33.53 HI	66.23 A	49.88 A
Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each +1/2 mineral fertilizers.	66.33 CD	79.00 B	72.67 A	41.47 FG	47.53 CDE	44.50 C
Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each +1/2 mineral fertilizers.	63.33 CDE	79.00 B	71.17 A	36.53 GH	33.50 HI	35.02 D
Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers.	58.67 E	87.73 A	73.20 A	39.67 FG	56.17 B	47.92 ABC
Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each +1/4 mineral fertilizers.	64.80 CDE	48.67 F	56.73 B	49.00 CD	41.67 EFG	45.33 BC
Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each +1/4 mineral fertilizers.	60.33 DE	45.33 FG	52.83 B	53.43 BC	45.17 DEF	49.30 AB
Mean	59.81 B	66.13 A		40.20 B	45.67 A	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

3. Number of lateral shoots / transplant:

A. Specific effect:

As for the response to specific effect of cultivar, data in Table (4) displays that; Wonderful cultivar surpassed statistically Manfalouty cultivar during two seasons of study in this respect. Meanwhile, the specific effect of fertilizer treatments, Table (4) displays that the pomegranate transplants fertilized Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each +1/2 mineral fertilizers or Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers gave highest number of lateral shoots per transplant compared with other treatments especially NPK (control).

C. Interaction effect:

Regarding the interaction effect of various (pomegranate cultivar x fertilizer treatments) combinations, Table (4) reveals that Wonderful cultivar and fertilized with Nitrobene + Phosphorene + Potasene at 16g/ transplant for each +1/2 mineral fertilizers had significantly the highest number of lateral shoots in both seasons. Meanwhile, the reverse was true with Manfalouty cultivar and fertilized with NPK, In addition other combinations were in between during two seasons.

Table 4: Specific and interaction effects of pomegranate cultivars, fertilizer treatments and their combinations on number of lateral shoots of pomegranate transplants during 2015 and 2016 seasons.

Treatments	Number of lateral shoots					
	Manfalouty	Wonderful	Mean	Manfalouty	Wonderful	Mean
	First season			Second season		
Mineral fertilizers (control)	3.333 BCD	3.667 BCD	3.500 AB	3.667 A	3.333 AB	3.500 AB
Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each +1/2 mineral fertilizers.	2.333 D	3.333 BCD	2.833 B	4.000 A	3.000 AB	3.500 AB
Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each +1/2 mineral fertilizers.	2.667 CD	4.333 AB	3.500 AB	4.000 A	3.333 AB	3.667 A
Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each +1/2 mineral fertilizers.	3.000 BCD	5.667 A	4.333 A	3.333 AB	4.000 A	3.333 AB
Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers.	3.333 BCD	4.333 AB	3.833 AB	3.333 AB	3.333 AB	3.667 A
Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each +1/4 mineral fertilizers.	2.333 D	4.000 BC	3.167 B	3.333 AB	2.333 B	2.833 BC
Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each +1/4 mineral fertilizers.	3.667 BCD	4.000 BC	3.833 AB	2.333 B	2.333 B	2.333 C
Mean	2.952 B	4.190 A		3.429 A	3.495 A	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

4. Number of leaves / transplant:

A. Specific effect:

Table (5) shows that, the number of leaves per each individual transplants was influenced by pomegranate cultivars. Herein, Wonderful cultivar resulted in an increase in number of leaves /transplant as compared to that in Manfalouty cultivar during both seasons of study. As for the specific effect of fertilizer treatments, it is quite evident that, transplants fertilized with Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each + 1/2 mineral fertilizers gave highest value rather than in other treatments especially NPK only (control).

B. Interaction effect:

Regarding the response of number of leaves per transplants to interaction effect of various combinations between pomegranate cultivars and fertilizer treatments, it was so clear to notice that, Wonderful cultivar fertilized with fertilized with Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each + 1/2 mineral fertilizers or fertilized with Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers gave the highest number of leaves/transplant during two seasons of study. On the other hand, the reverse was found with the Manfalouty cultivar and fertilized with NPK (control). In addition other combinations were in between during two seasons.

5. Average leaf area (cm^2):

A. Specific effect:

Data presented in Table (6) displayed that, no significant differences between tow cultivars during two seasons of study. Meanwhile, the specific effect of fertilizer treatments, Table (6) displays that, the average leaf area was largest in transplants fertilized with Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers rather than in other treatments especially NPK (control).

B. Interaction effect:

Referring the interaction effect of pomegranate cultivars and fertilizer treatments, it was quite evident that, the Wonderful cultivar fertilized with Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers gave the highest value of leaf area during two seasons of study. On the other hand, the reverse was found with the Manfalouty cultivar and fertilized with NPK (control). In addition other combinations were in between during two seasons. These results are in harmony with those obtained by (Abd Ella–Eman, 2006, Wadee, 2007 and Sheikh and Manjula, 2009).

Table 5: Specific and interaction effects of pomegranate cultivars, fertilizer treatments and their combinations on number of leaves per pomegranate transplant during 2015 and 2016 seasons.

Treatments	Number of leaves/transplant					
	Manfalouty	Wonderful	Mean	Manfalouty	Wonderful	Mean
	First season			Second season		
Mineral fertilizers (control)	130.0 F	143.3 EF	136.7 C	105.0 D	108.3 D	106.7 C
Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each +1/2 mineral fertilizers.	175.0 DE	233.3 B	204.2 A	136.7 C	160.0 B	148.3 AB
Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each +1/2 mineral fertilizers.	185.0 D	232.7 B	208.8 A	120.0 CD	175.0 AB	147.5 AB
Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each +1/2 mineral fertilizers.	166.7 DE	266.0 A	216.3 A	133.3 C	170.0 AB	151.7 A
Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers.	188.7 CD	243.3 AB	216.0 A	111.7 D	185.0 A	148.3 AB
Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each +1/4 mineral fertilizers.	130.3 F	220.0 BC	175.2 B	120.0 CD	161.0 B	140.5 AB
Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each +1/4 mineral fertilizers.	184.0 D	250.0 AB	217.0 A	110.3 D	161.7 B	136.0 B
Mean	165.7 B	227.0 A		119.6 B	160.1 A	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

Table 6: Specific and interaction effects of pomegranate cultivars, fertilizer treatments and their combinations on leaf area of pomegranate transplants during 2015 and 2016 seasons.

Treatments	Leaf area (cm2)					
	Manfalouty	Wonderful	Mean	Manfalouty	Wonderful	Mean
	First season			Second season		
Mineral fertilizers (control)	4.300 F	4.600 EF	4.450 E	3.500 F	3.600 F	3.550 E
Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each +1/2 mineral fertilizers.	5.733 D	4.533 F	5.133 C	4.300 DEF	5.400 ABC	5.100 ABC
Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each +1/2 mineral fertilizers.	4.700 EF	5.333 DE	5.017 CD	4.300 DEF	4.833 BCD	4.567 CD
Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each +1/2 mineral fertilizers.	5.700 D	4.800 EF	4.550 D	4.667 CDE	4.833 BCD	4.750 BCD
Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers.	7.333 B	8.300 A	6.983 A	5.600 AB	5.900 A	5.500 A
Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each +1/4 mineral fertilizers.	5.567 D	6.633 BC	6.933 A	5.967 A	4.567 CDE	5.267 AB
Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each +1/4 mineral fertilizers.	6.067 CD	6.533 C	6.300 B	3.867 EF	4.400 DEF	4.133 DE
Mean	5.629 A	5.819 A		4.600 A	4.790 A	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

6. Stem dry weight (g):

A. Specific effect:

As for the response to specific effect of pomegranate cultivars, data in Table (7) displays that; Wonderful cultivar surpassed statistically Manfalouty cultivar during two seasons of study. Meanwhile, the specific effect of fertilizer treatments, Table (7) displays that, the stem dry weight was heaviest in pomegranate transplants fertilized with Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers rather than in other treatments especially NPK (control).

B. Interaction effect:

Regarding the interaction effect of various (pomegranate cultivars x fertilizer treatments) combinations, Table (7) reveals that, Wonderful cultivar and fertilized with Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each + 1/4 mineral fertilizers had significantly the stem dry weight. Meanwhile, the reverse was true with Manfalouty cultivar and fertilized with NPK (control). In addition other combinations were in between during two seasons.

Table 7: Specific and interaction effects of pomegranate cultivars, fertilizer treatments and their combinations on stem dry weight of pomegranate transplants during 2015 and 2016 seasons.

Treatments	Stem dry weight (g.)					
	Manfalouty	Wonderful	Mean	Manfalouty	Wonderful	Mean
	First season			Second season		
Mineral fertilizers (control)	18.62 FG	14.25 G	16.43 C	26.25 E	33.24 A-D	29.74 B
Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each +1/2 mineral fertilizers.	28.07 B-E	31.86 AB	29.96 AB	34.03 A-D	36.18 AB	35.10 A
Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each +1/2 mineral fertilizers.	31.12 ABC	31.77 ABC	27.12 B	30.00 DE	36.59 AB	33.30 A
Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each +1/2 mineral fertilizers.	25.74 DE	28.26 BCD	27.00 B	36.27 AB	31.71 CD	33.99 A
Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers.	26.93 CDE	27.32 B-E	31.44 A	33.44 A-D	36.85 A	35.15 A
Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each +1/4 mineral fertilizers.	24.29 DE	34.01 A	29.15 AB	32.24 BCD	36.19 AB	34.22 A
Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each +1/4 mineral fertilizers.	23.28 EF	31.32 ABC	27.30 B	35.03 ABC	34.26 A-D	34.65 A
Mean	25.43 B	28.40 A		31.95 B	34.52 A	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

7. Root dry weight (g):

A. Specific effect:

As for the response to specific effect of pomegranate cultivars, data in Table (8) displays that, Manfalouty cultivar surpassed statistically Wonderful cultivar during two seasons of study. Meanwhile, the specific effect of fertilizer treatments, Table (8) displays that, the root dry weight was heaviest in pomegranate transplants fertilized with Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each + 1/4 mineral fertilizers rather than in other treatments especially NPK (control).

B. Interaction effect:

Regarding the interaction effect of various (pomegranate cultivars x fertilizer treatments) combinations, Table (8) reveals that, Manfalouty cultivar and fertilized with Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each + 1/4 mineral fertilizers or Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers had significantly the heaviest root dry weight. Meanwhile, the reverse was true with Wonderful cultivar and fertilized with NPK (control). In addition other combinations were in between during two seasons.

8. Top/ root ratio:

A. Specific effect:

As for the response to specific effect of pomegranate cultivars, data in Table (9) displays that, Manfalouty cultivar surpassed statistically Wonderful cultivar during first season of study. Meanwhile, the specific effect of fertilizer treatments, Table (9) displays that, the top/ root ratio was highest in pomegranate transplants fertilized with Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each + 1/2 mineral fertilizers or Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/2 mineral fertilizers rather than in other treatments especially NPK (control).

B. Interaction effect:

Regarding the interaction effect of various (pomegranate cultivars x fertilizer treatments) combinations Table (9) reveals that, Manfalouty cultivar and fertilized with Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each + 1/2 mineral fertilizers or Wonderful cultivar fertilized with Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/2 mineral fertilizers had significantly the highest Top/ root ratio during two seasons. Such trend of response goes generally in line with finding of Abd-Ella, Eman *et al.,*(2010); Moawad *et al.*, (2014); Shazia, 2016 and EL-Gioushy, (2016).

Table 8: Specific and interaction effects of pomegranate cultivars, fertilizer treatments and their combinations on root dry weight of pomegranate transplants during 2015 and 2016 seasons

Treatments	Root dry weight (g.)					
	Manfalouty	Wonderful	Mean	Manfalouty	Wonderful	Mean
	First season			Second season		
Mineral fertilizers (control)	15.25 DE	13.06 E	14.16 D	17.24 DE	14.47 E	15.85 E
Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each +1/2 mineral fertilizers.	17.85 CDE	16.40 DE	17.13CD	25.62 BC	16.96 DE	21.29 D
Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each +1/2 mineral fertilizers.	18.87 CD	16.75 CDE	17.81 C	24.59 BC	16.50 E	20.55 D
Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each +1/2 mineral fertilizers.	19.08 CD	21.44 BC	20.26 BC	24.69 BC	19.19 DE	21.94 CD
Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers.	24.76 AB	19.96BCD	22.36 AB	37.53 A	17.35 DE	27.44 AB
Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each +1/4 mineral fertilizers.	29.53 A	19.28 CD	24.40 A	34.56 A	24.36 BC	29.46 A
Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each +1/4 mineral fertilizers.	29.41 A	19.37 CD	24.39 A	27.89 B	21.80 CD	24.84 BC
Mean	22.11 A	18.04 B		27.45 A	18.66 B	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different**.**

Table 9: Specific and interaction effects of pomegranate cultivars, fertilizer treatments and their combinations on top /root ratio of pomegranate transplants during 2015 and 2016 seasons.

Treatments	Top /root ratio					
	Manfalouty	Wonderful	Mean	Manfalouty	Wonderful	Mean
	First season			Second season		
Mineral fertilizers (control)	2.093 BCD	1.436 F	1.765 C	2.062 CDE	2.999 AB	2.530 AB
Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each +1/2 mineral fertilizers.	2.486 AB	2.459 AB	2.473 A	1.696 DEF	3.698 A	2.697 A
Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each +1/2 mineral fertilizers.	2.641 A	2.502 AB	2.572 A	1.767 DEF	3.118 AB	2.443 AB
Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each +1/2 mineral fertilizers.	1.991 CDE	2.264 ABC	2.127 B	2.130 CD	2.658 BC	2.394 AB
Nitrobene + Phosphorene + Potasene at 4 g/ transplant for each + 1/4 mineral fertilizers.	2.262 ABC	1.826 C-F	2.044 BC	1.369 EF	2.746 BC	2.058 BC
Nitrobene + Phosphorene + Potasene at 8 g/ transplant for each +1/4 mineral fertilizers.	2.005 CDE	1.766 DEF	1.886 BC	1.347 F	2.218 CD	1.783 C
Nitrobene + Phosphorene + Potasene at 16 g/ transplant for each +1/4 mineral fertilizers.	1.987 CDE	1.575 EF	1.781 C	1.790 DEF	2.285 CD	2.038 BC
Mean	2.209 A	1.975 B		1.737 B	2.817 A	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

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