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Effect of some Sources and Rates of Nitrogen Fertilization on Growth and Leaf Mineral Content of Young Trees of "Wonderful", Pomegranate

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ABSTRACT

This study was carried out during two successive seasons, (2013and 2014) in a private orchard located at Giza governorate, Egypt. This investigation was conducted on one year old pomegranate trees "Wonderful" cv., planted at 3 X 4m apart grown in sandy loam soil under drip irrigation system. Three nitrogen sources(S) were tested, ammonium sulfate (20.5%) , ammonium nitrate (33.5%) and urea (46%) . Each source of nitrogen were applied at three rates (R): 70,140 and 210g N /tree /year. Nitrogen fertilizer rate was divided through fertigation system with equal doses from mid-March till September during the two studied seasons. Ammonium sulphate at the rate of 70g N /tree/year gave the highest values of stem diameter , shoot length, N, P , K, Fe and Zn leaf content, whereas fertilizing with ammonium sulphate at a rate of 140g N/tree/year achieved the highest leaf area and leaf Ca content . Meanwhile, increasing ammonium nitrate rate to 210g N/tree/year gaved the best total chlorophyll in leaves, however fertilizing with urea at rate of 210g N/tree/year gave the greatest leaf Mn content. So it could by recommended by fertilizing young Wonderful pomegranate trees by ammonium sulphate at a rate of 70g N /tree/year.

Key words: Nitrogen sources, Rates, Vegetative growth, Mineral Content, Young Pomegranate Trees, Wonderful.

Introduction

Pomegranate (*Punica granatum* L) belongs to family Punicaceae, it was considered one of the oldest cultivated trees in the history of the world cultivated about 5000 years ago. Pomegranate is one of the favorite table fruits of tropical and sub-tropical regions. The fruit is a native of Iran and is extensively cultivated in the Mediterranean region since ages, especially in Spain, Morocco, Egypt and Afghanistan. Sheikh and Manjula (2009). Pomegranate cultivation plays an important role in the economy of many countries, such as India, Iran, China, Turkmenistan, Tajikistan, Turkey, Israel, Spain, America, South Africa, and Australia. Pomegranate adapts to all kinds of soil and climate; it is tolerant of drought, salt, iron chlorosis and active calcium carbonate. Kitren and Louise (2008).The Egyptian pomegranate production reached about 51150 tons produced from 34450 Fedden, Average production 9 ton/Fed according to the statistics of the MALR (2013). Assiut, Noubaria and desert road of Cairo/Alexandria are the most important regions of Pomegranate production in Egypt. Pomegranate species includes many cultivars such as Manfaloty, Panaty, El hamede, El sokry and Wonderful originated as a cutting in Florida; propagated in California in 1896. Trees are vigorous and produce, large purple-red fruit. The fruit is round but flattened at the poles, very large, dark purple-red, with medium-thick rind deep-red, juicy, winey pulp; medium-hard seeds. Bearing strate in the first year of planting. Self-fertile. Harvest is Aug 25-Oct 1. Requires 150 chill hours (hours at or below 6 ºC) Kitren and Louise (2008).

Nitrogen is one of the essential nutrients for plant nutrition, this fact was established in 19th century .Nitrogen is generally applied to plants through mineral fertilization and organic manuring (Postgate, 1978).There are several sources of nitrogen fertilizers such as ammonium sulfate (20.5%N), ammonium nitrate (33.5%N) and urea (46%N) etc...

The goal of this research was to study the effect of different nitrogen sources and rates on growth and leaf mineral content of young Wonderful pomegranate trees grown in sandy loam soil.

Materials and Methods

This study was carried out during two successive seasons, (2013and 2014) in a private orchard located at Giza governorate, Egypt .Soil samples were taken from location of the experimental area at 30-60 cm from the soil surface for mechanical and chemical analysis, which carried out according to the standard procedures

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described by Jackson (1958); Black *et al*. (1965) and Wilde *et al*. (1979).Physical and Chemical properties of the experimental soil and chemical characteristic of water well are presented in Table (1) and Table (2), respectively.

Table 1: Physical and chemical properties of the experiment soil.

Soil characteristics	
Particle size distribution %:	
Very Coarse sand (%) 1-2 mm	50.01
Coarse sand (%) .5-1 mm	39.63
Middle sand(%) .25-.5 mm	0.36
Fine sand (%) .1-.25 mm	6.44
Very Fine sand(%).05-.1 mm	2.97
Silt and clay.05 > mm	0.59
Soil texture	Sandy loam
Chemical characteristics	
pH	7.12
EC, mmohs / cm	1.11
Soluble anions (meq / 100g soil) :	
$CO3^{=}$	-
$HCO3^{-}$	1.2
Cl^{-}	5.3
$SO4^{=}$	4.13
Soluble cations (meq / 100g soil):	
Ca^{++}	4.0
Mg^{++}	1.6
Na^{+}	5.1
K^{+}	-

Table 2: Chemical characteristics of water well:

pH	7.6
EC, mmohs / cm	3.4
Soluble anions (meq / 100g soil)	
$CO3^{=}$	-
$HCO3^{-}$	3.1
Cl^{-}	7.5
$SO4^{=}$	33.2
Soluble cations (meq / 100g soil)	
Ca^{++}	7.4
Mg^{++}	16.4
Na^{+}	20.0
K^{+}	0.9

Experimental material:

This study was carried out on one year old pomegranate trees "Wonderful" cv., planted at 3 X 4m apart grown in sandy loam soil, under drip irrigation system and uniform in shape and received the common horticultural practices. Three nitrogen sources(S) were tested, ammonium sulfate (20.5%), ammonium nitrate (33.5%) and urea (46%). Different sources of nitrogen were applied at three rates (R):70, 140 and 210g N /tree / year. Nitrogen fertilizer rate was divided through fertigation system with equal doses from mid-March till September during the two studied seasons. Each tree was annually fertilized with 62 g k_2O as potassium sulphate though soil application in winter and 110 g P_2O_5 as calcium superphosphate though soil application in winter, as a normal horticulture practises followed in this respect.

Experimental design:

The treatments were arranged in a randomized complete block design (RCBD), the experiment contains nine treatments, each contains four replicates and the replicate represented by two young trees. The following parameters were measured to evaluate the tested treatments.

Vegetative growth measurements:

Every month during the two growing seasons plants were measured for stem diameter at 5 cm above the ground surface, shoot length, leaf area and total chlorophyll. Four fully expanded leaves from middle of shoots 5-7^{th} leaves from plant top were collected to measure the leaf area according to Ahmed and Morsy (1999). Area was expressed as cm^2 the same leaf samples were used to measure total chlorophyll content by using a Soil Plant Analysis Division (SPAD) – 502 MINOLTA chlorophyll meter (Konica Minolta Business Solutions ,Tokyo, Japan).The SPAD – 502 meter determines the relative amount of chlorophyll present by measuring the transmittance of the leaf in two wavelength regions (the red and near infrared). Using these two transmittance

values, the meter calculates a numerical SPAD value which is proportional to the amount of chlorophyll present in the leaf.

Leaf Mineral Content:

Twenty leaves were taken from the middle part of the new shoots from each tree in late July according to Westwood (1993). Fresh leaves weight were taken then leaves were washed with distilled water ,then oven dried at 60-70^{o} Cuntil a constant weight .The dried samples were ground in a stainless steel Knife mill and 0.2 gram of the ground material of each sample was digested using a mixture of perchloric : sulphoric acid 1:10 (v/v) according to Jackson (1973). Nitrogen was determined by the Micro-Kjeldahlmethod as described by Pregl (1945) .phosphorus was colorimetrically determined by the method of Truog and Meyer (1929). Potassium was determined by a flame photometer according to the method of Brown and Lilleland (1946). Calcium and Sodium were determined by titration against versenate solution (Chapman and Pratt, 1961). Iron, zinc and manganese were estimated by using an atomic absorption apparatus according to the method of FAO (1980).

Statistical analysis:

All obtained data during 2013 and 2014 seasons were analysis of variances (ANOVA) according to Snedecor and Cochran (1980) using MSTAT program. Least significant ranges (LSR) was used to compare between means of treatments according to Duncan (1955) at probability of 5 %.

Results and Discussion

1-Effect of some Sources and Rates of Nitrogen fertilization on some vegetative growth parameters:

A-Effect on stem diameter:

Results in Table (3) show the effect of different nitrogen sources and rates on stem diameter of wonderful pomegranate young tress during 2013 and 2014 seasons. Data indicated that, values of stem diameter were significantly affected by nitrogen sources, rates and their interaction during different months in the two seasons. Regarding the nitrogen sources generally, Urea (S_3) gave the highest significant values of stem diameter in any given month during the two growing seasons. With respect to nitrogen rates, it was observed that fertilizing by the first rate of nitrogen(R_1)(70g N /tree / year) gave the highest significant values of stem diameter in any given month followed in decreasing order by those of level (R2)(140g N /tree / year) especially in the second season. Regarding the interaction between sources and rates treatment (S_1R_1) and (S_3R_3) gave the highest significant values of stem diameter,in any given month during the first season. While in the second treatment (S_2 R_2) gave the highest significant values of stemdiameter, in any given month except August (S_3R_1), (S_2R_2) & (S_3R_3) ,and September (S_3R_3) .In this respect, El-wakeel *et al* (2009) on young Navel Orange trees, found that ammonium nitrate at 100 or 200 g N/tree/year showed the highest stem thickness increment.

Table 3: Effect of some sources and rates of nitrogen on stem diameter (cm)of wonderful pomegranate young tress during 2013 and 2014 seasons.

Sources of Nitrogen	Rates of Nitrogen Fertilization (g N / tree)																			
	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean
	May				June				July				August				September			
	2013 season																			
Ammonium Sulphat (S1)	2.27 a	1.52 d	1.50 d	1.76 B'	2.50 a	1.72 d	1.65 d	1.95 B'	2.67 a	1.90 d	1.82 d	2.13 B'	2.95 a	2.05 de	1.95 e	2.31 B'	3.15 a	2.30 de	2.07 f	2.50 B'
Ammonium Nitrate (S2)	1.65 d	2.10 b	1.52 d	1.75 B'	1.85 cd	2.27 b	1.70 d	1.94 B'	1.95 d	2.47 b	1.95 d	2.12 B'	2.02 de	2.65 b	2.05 d	2.27 B'	2.15 ef	2.90 b	2.40 d	2.48 B'
Urea (S3)	1.87 c	1.50 d	2.40 a	1.92 A'	2.05 c	1.65 d	2.67 a	2.12 A'	2.22 c	1.90 d	2.82 a	2.32 A'	2.45 c	2.12 de	3.02 a	2.53 A'	2.67 c	2.35 de	3.25 a	2.76 A'
Mean	1.93 A	1.73 C	1.80 B		2.13 A	1.88 C	2.01 B		2.28 A	2.09 B	2.20 A		2.47 A	2.27 B	2.37 AB		2.65 A	2.52 B	2.57 AB	
	2014 season																			
Ammonium Sulphat (S1)	2.32 c	2.15 cd	2.02 d	2.16 C'	2.47 d	2.37 de	2.25 e	2.36 C'	2.72 d	2.57 de	2.42 e	2.57 C'	3.00 c	2.82 d	2.62 e	2.81 C'	3.22 d	3.00 e	2.87 e	3.03 C'
Ammonium Nitrate (S2)	2.85 b	3.12 a	2.30 c	2.75 B'	3.02 bc	3.25 a	2.50 d	2.92 B'	3.20 bc	3.40 a	2.75 d	3.12 B'	3.32 b	3.60 a	3.05 c	3.32 B'	3.55 c	3.87 ab	3.22 d	3.55 B'
Urea (S3)	2.92 b	2.82 b	2.92 b	2.89 A'	3.15 ab	2.97 c	3.17 ab	3.10 A'	3.35 abc	3.17 c	3.37 ab	3.30 A'	3.57 a	3.40 b	3.65 a	3.54 A'	3.75 b	3.50 c	3.97 a	3.74 A'
Mean	2.70 A	2.70 A	2.41 B		2.88 A	2.86 A	2.64 B		3.09 A	3.05 A	2.85 B		3.30 A	3.27 A	3.11 B		3.51 A	3.46 A	3.36 B	

In each month in each season, means of each of nitrogen source, nitrogen rates or their interactions having the same letters are not significantly different at 5% level.

B-Effect on shoot length: Data in Table (4) show the effect of some sources, rates of nitrogen on shoot length of wonderful pomegranate young tress during 2013 and 2014 seasons. In the two seasons, values of shoot

length were affect significantly by nitrogen sources, rates and their interaction in any given month. Consequently ,Ammonium sulfate (S_1) gave the highest significant values of shoot length followed closely by ammonium nitrate(S_2) especially in the first season, With respect to nitrogen rate fertilizing with (R_1) (70g N /tree / year) and (R2) (140g N /tree / year) gave the highest significant values of shoot length in the first and second season ,respectively except in May and June. In the second season. Regarding the interaction treatments (S_1R_1) and (S_1R_2) gave the highest significant values of shoot length in any given month in the first and second season, respectively.

Table 4: Effect of some sources and rates of nitrogen on shoot length (cm) of wonderful pomegranate young tress during 2013 and 2014 seasons.

Sources of Nitrogen	Rates of Nitrogen Fertilization (g N / tree)																			
	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean
	May				June				July				August				September			
	2013 season																			
Ammonium Sulphat (S1)	103.2 a	71.7 c	89.5 b	88.15 A'	108.4 a	77.2 c	94 b	93.2 A'	113.9 a	80.85 d	102.2 b	98.98 A'	118.3 a	86.75 f	109.7 b	104.9 A'	123.1 a	91.50 d	113.8 b	109.4 A'
Ammonium Nitrate (S2)	89.3 b	83.2 b	87.5 b	86.7 AB'	95.7 b	90.2 b	93.5 b	93.1 A'	101.8 b	97.82 b	97.63 b	99.09 A'	106.3 b-d	104.6 b-d	103.3 cd	104.7 A'	110.1 b	109.4 b	107.9 bc	109.1 A'
Urea (S3)	91.3 b	73.3 c	83.2 b	82.6 B'	96.2 b	82.4 c	92.3 b	90.3 A'	101.6 b	87.2 c	96.1 b	95.2 B'	107.7 bc	91.95 e	100.9 d	100.2 B'	111.3 b	94.95 d	103.7 c	103.3 B'
Mean	94.6 A	76 C	86.8 B		100 A	83.3 C	93.3 B		105.8 A	88.6 C	98.9 B		110.7 A	94.09 C	104.3 B		115.3 A	99.05 C	108.8 B	
	2014 season																			
Ammonium Sulphat (S1)	169 b	191 a	165 c	175 A'	177.8 b	203 a	173 b-d	184.6 A'	189.3 b	221 a	178.3 c	196.2 A'	196.3 bc	236.8 a	183 d	205.3 A'	207.3 b	246.5 a	187.5 c	213.8 A'
Ammonium Nitrate (S2)	157.5 d	149.3 f	153.3 e	153.3 B'	170.5 b-d	169.5 cd	171.3 b-d	170.4 B'	176.3 c	184.8 b	178.5 c	179.8 B'	182.5 d	195.3 c	185.8 d	187.8 B'	187.3 c	207.8 b	190.3 c	195.1 B'
Urea (S3)	157.5 d	147 f	158 d	154.2 B'	176.5 bc	158.3 e	166.8 d	167.2 B'	188.5 b	169.3 d	173.3 cd	177 B'	200.5 b	176 e	177.5 e	184.7 C'	211 b	181 d	181.3 d	191.1 C'
Mean	161.3 A	162.4 A	158.8 B		174.9 A	176.9 A	170.3 B		184.7 B	191.7 A	176.7 C		193.1 B	202.7 A	182.1 C		201.8 B	211.8 A	186.3 C	

In each month in each season, means of each of nitrogen source, nitrogen rates or their interactions having the same letters are not significantly different at 5% level.

C-Effect on leaf area: Data in Table (5) show the effect of some nitrogen sources and rates on leaf area of wonderful pomegranate young tress during 2013 and 2014 seasons. In the two seasons, values of leaf area were affect significantly by nitrogen sources, rates and their interaction in any given month. In respect to nitrogen source, Ammonium sulfate (S_1) gave the highest significant values of leaf area in any given month, in the both two seasons, followed by Ammonium nitrate (S_2) in most cases. Fertilizing with the second rate of nitrogen (R_2) (140g N /tree / year) gave the highest significant values of leaf area followed closely by the third rate of nitrogen (R_3) (210g N /tree / year)in most cases, in the two growing seasons. Regarding the interaction treatment (S_1 R_2) gave the highest significant values of leaf area, in most cases. However, in the last month (September) in the two growing season treatment (S_1R_3) gave the highest significant values of leaf area. In this respect, El-wakeel *et al* (2009) on young Navel Orange trees, found that ammonium nitrate at 100 g N/tree/year gave the highest leaf area value.

D-Effect on total chlorophyll content: Data in Table (6) Results showed that values of total chlorophyll content were affected significantly by nitrogen rates in any given month during the two growing seasons except May and June in the first one. The trend of nitrogen rate was more clear from the end of the first season on (August and September).Whereas, R_3 (210g N/tree/year) gave the highest significant values of chlorophyll content until the end of second season (September). Regarding the effect of nitrogen rate on chlorophyll content the trend was more clear in the end of second season (July : September) than other months whereas, S_2(ammonium nitrate) gave the highest significant values of chlorophyll content in the leaves . With respect to interaction, treatment (S_2R_3) gave the highest significant values of chlorophyll content in any given month except the first three months (May: July) in the first season.

2-Effect of some sources and rates of nitrogen fertilization on leaf macro and micronutrients content.

A-Effect on leaf macronutrients content.

Results in Table (7) show the effect of some sources and rates of nitrogen on (N, P, K, Ca and Na) content in leaves of pomegranate young tress during 2013 and 2014 seasons .In the two seasons macronutrients (N, P, K, Ca and Na) were significantly affected by sources , rates and their interaction .In respect to nitrogen content, the significant highest values were obtained the Ammonium sulphate and Ammonium nitrate with respect to nitrogen source, the first rate of nitrogen R1(70g N /tree / year)gave the highest significant values of nitrogen

content . Regarding the interaction, treatment (S_3R_3) gave the lowest significant values of N content during the two growing seasons whereas, treatment (R_1S_1) gave the highest significant values of N content in the two seasons.

Concerning phosphorus content, with respect to nitrogen source the significant highest values were obtained the Ammonium sulphate. Whereas, the first rate (R_1) of nitrogen (70g N /tree / year) gave the highest significant values of Phosphorus content. In the first season, while in the second season ($R_{1\&}R_3$) (70&210 g N /tree / year) gave the highest significant values of Phosphorus content. Regarding the interaction, treatment (R_1S_1) and (R2S1) gave the highest significant values of P content in the first and second seasons, respectively.

Table 5: Effect of some sources and rates of nitrogen on leaf area (cm^2) of wonderful pomegranate young tress during 2013 and 2014 seasons.

Sources of Nitrogen	Rates of Nitrogen Fertilization (g N / tree)																			
	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean
	May				June				July				August				September			
	2013 season																			
Ammonium Sulphat (S1)	4.03 d	4.93 a	4.73 b	4.56 A´	5.23 a	5.17 ab	4.70 d	5.03 A´	4.80 c	5.17 a	4.73 c	4.90 A´	4.85 b	5.15 a	5.20 a	5.07 A´	4.95 bc	5.07 b	5.55 a	5.19 A´
Ammonium Nitrate (S2)	4.83 ab	4.38 c	4.43 c	4.55 A´	4.70 d	5.07 bc	4.20 f	4.66 B´	5.07 ab	5.15 a	4.37 e	4.87 A´	4.27 g	4.45 d	4.65 c	4.46 C´	4.43 e	5.00 bc	4.50 e	4.64 B´
Urea (S3)	4.35 c	4.70 c	4.30 b	4.45 B´	4.27 ef	4.35 e	4.95 c	4.53 C´	4.17 f	4.57 d	4.95 b	4.57 B´	4.27 e	4.60 c	4.87 b	4.58 B´	4.27 f	4.70 d	4.90 c	4.62 B´
Mean	4.40 B	4.67 A	4.48 A		4.73 b	4.87 A	4.62 C		4.68 B	4.97 A	4.68 B		4.47 C	4.73 B	4.91 A		4.55 B	4.92 A	4.98 A	
	2014 season																			
Ammonium Sulphat (S1)	2.77 f	5.50 a	5.30 a	4.53 A´	3.47 f	5.73 a	5.43 b	4.87 A´	4.05 f	5.62 a	5.37 b	5.02 A´	4.05 f	6.42 a	5.55 c	5.34 A´	4.50 g	6.55 b	7.07 a	6.04 A´
Ammonium Nitrate (S2)	3.77 d	3.47 e	4.33 c	3.86 C´	4.37 e	4.67 d	4.95 c	4.67 B´	4.30 e	4.35 e	5.05 c	4.57 B´	4.22 f	4.75 de	5.87 b	4.95 B´	4.67 fg	4.75 f	6.00 c	5.14 C´
Urea (S3)	4.13 c	4.57 b	3.67 de	4.13 B´	4.37 e	4.70 cd	4.37 e	4.48 C´	4.27 e	4.67 d	4.37 e	4.44 C´	4.60 e	4.87 d	4.15 f	4.54 C´	5.70 d	5.25 e	5.60 d	5.52 B´
Mean	3.56 B	4.52 A	4.43 A		4.07 B	5.03 A	4.92 A		4.20 B	4.88 A	4.93 A		4.29 C	5.35 A	5.19 B		4.96 C	5.52 B	6.22 A	

In each month in each season, means of each of nitrogen source, nitrogen rates or their interactions having the same letters are not significantly different at 5% level.

Table 6: Effect of some sources and rates of nitrogen on total chlorophyll in leaves (SPAD value) of wonderful pomegranate young tress during 2013 and 2014 seasons.

Sources of Nitrogen	Rates of Nitrogen Fertilization (g N / tree)																			
	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean
	May				June				July				August				September			
	2013 season																			
Ammonium Sulphat (S1)	67.8 b-d	62.9 e	69.7 b	66.8 C'	67.5 d	72.2 ab	71 bc	70.2 A'	70.5 ab	71 a	69.7 ab	70.4 A'	62.8 d	67.5 bc	67.3 bc	65.9 A'	59.1 de	65.3 b	66.7 b	63. 1 A'
Ammonium Nitrate (S2)	67.2 cd	73 a	69.6 b	69.1 A'	74.4 a	68.7 cd	70.6 bc	71.2 A'	70.8 a	68.2 b	69.7 ab	69.5 A'	66 c	61.8 de	69.6 a	65.8 A'	60.7 cd	58.5 e	69. 1 a	62.7 B'
Urea (S3)	69.3 bc	69.3 bc	66.1 d	68.2 B'	69.1 cd	72.0 ab	68.5 cd	69.9 A'	70.4 ab	71.6 a	67.9 b	70 A'	67.6 b	61.1 e	66.1 c	65 A'	62.3 c	58.7 e	60.1 de	60.4 C'
Mean	68.1 A	68.4 A	68.5 A		70.4 A	71 A	70 A		70.6 A	70.3 AB	69.1 B		65.6 B	63.5 C	67.7 A		60.1 B	60.8 B	65.2 A	
	2014 season																			
Ammonium Sulphat (S1)	56.7 c-e	55.7 d-f	59.6 ab	57.5 A'	57.5 b	57.4 b	56.4 b-d	57.1 A'	60.1 c	59.6 c	63.7 b	61.2 B'	65.2 cd	64.6 de	67.7 b	65.8 B'	63.6 c-e	56.3 f	73.5 a	64.4 B'
Ammonium Nitrate (S2)	54.3 f	58.1 bc	60.3 a	57.6 A'	54.6 d	57.1 b	61.8 a	58.1 A'	60.3 c	64.4 b	71.5 a	65.4 A'	62.2 f	66.1 c	74.4 a	67.6 A'	64.2 cd	66.7 b	73.8 a	68.2 A'
Urea (S3)	55.3 ef	56.1 c-f	57.6 b-d	56.2 B'	57 bc	55 d	55.2 cd	55.7 B'	60.6 c	60.6 c	59.5 c	60.2 B'	62.3 f	63.4 ef	62.6 f	62.7 C'	62.8 de	61.6 e	65.5 bc	63.3 B'
Mean	55.4 C	56.7 B	59.2 A		56.3 B	56.81 AB	57.83 A		60.35 B	61.54 B	64.93 A		63.2 C	64.7 B	68.2 A		63.5 B	61.4 C	70.9 A	

In each month in each season, means of each of nitrogen source, nitrogen rates or their interactions having the same letters are not significantly different at 5% level.

Table 7: Effect of some sources and rates of nitrogen on leaf macronutrient (N, P, K, Ca and Na) content of wonderful pomegranate young tress during 2013 and 2014 seasons.

Sources of Nitrogen	Rates of Nitrogen Fertilization (g N / tree)																			
	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean
	N%				P%				K%				Ca%				Na%			
	2013 season																			
Ammonium Sulphat (S1)	1.99 a	1.78 b	1.76 b	1.84 A'	0.42 a	0.35 c	0.36 bc	0.38 A´	1.09 a	1.05 b	0.89 e	1.01 A´	0.88 b	0.99 a	0.88 b	0.92 A'	0.04 bc	.026 c	0.04 bc	0.04 B´
Ammonium Nitrate (S2)	1.97 a	1.74 b	1.73 b	1.81 A'	0.34 cd	0.32 ef	0.31 f	0.32 C'	0.98 c	.976 c	0.73 f	0.90 C'	0.88 b	0.84 cd	0.82 d	0.85 C´	0.04 bc	.040 bc	0.03 c	0.04 B'
Urea (S3)	1.64 c	1.77 b	1.52 d	1.64 B'	0.33 de	0.37 b	0.35 bc	0.35 B´	0.91 d	.983 c	0.97 c	.95 B´	0.89 b	0.97 a	0.85 c	0.90 B'	0.03 c	.060 a	0.05 ab	0.05 A´
Mean	1.86 A	1.76 B	1.67 C		0.37 A	0.35 B	0.34 B		1.00 A	1.00 A	0.86 B		0.88 B	0.93 A	0.85 C		0.04 A	0.04 A	0.04 A	
	2014 season																			
Ammonium Sulphat (S1)	1.94 a	1.63 ef	1.86 bc	1.81 A'	0.36 b	0.39 a	0.35 b	0.37 A'	1.1 b	1.16 a	1.09 b	1.12 A'	0.98 ef	1.20 a	1.15 b	1.10 A´	0.12 d	0.15 a	0.12 d	0.13 A'
Ammonium Nitrate (S2)	1.82 c	1.90 ab	1.72 d	1.80 A'	0.33 cd	0.32 de	0.35 bc	0.33 B´	1.0 c	0.99 c	1.10 b	1.03 B´	1.05 cd	1.10 bc	0.95 f	1.03 C'	0.13 cd	0.13 cd	0.14 a-c	0.13 A´
Urea (S3)	1.60 f	1.68 de	1.58 f	1.62 B'	0.35 bc	0.30 e	0.36 b	0.34 B'	1.09 b	1.00 c	1.04 bc	1.04 B'	1.03 de	1.08 cd	1.07 cd	1.06 B´	0.13 b-d	0.12 cd	0.15 ab	0.13 A'
Mean	1.79 A	1.74 B	1.72 B		0.35 A	0.34 B	0.36 A		1.06 A	1.05 A	1.08 A		1.01 C	1.12 A	1.07 B		.125 A	0.13 A	0.14 A	

In each month in each season, means of each of nitrogen source, nitrogen rates or their interactions having the same letters are not significantly different at 5% level.

Regarding potassium content, Ammonium sulfate (S_1) gave the highest significant values of Potassium content. In the two seasons. With respect to nitrogen rate, the first and second rate of nitrogen (R_1&R_2) (70&140g N /tree / year) gave the highest significant values of Potassium content, in the first season. While there was no significant difference between values of K content, in the second season. Regarding the interaction treatment (S_1 R_1) and (S_1R_2) gave the highest significant values of K content during the first and second season, respectively.

Concerning calcium content, the significant highest values were obtained the Ammonium sulphate. On the other hand, the second rate of nitrogen (R_2) (140g N /tree / year) gave the highest significant values of calcium content. In the two seasons .Regarding the interaction treatments (S_1 R_2) and (S_3R_2) gave the highest significant values of Calcium content, in the first season. While treatment (S_1R_2) gave the highest significant values of Calcium content, in the second season.

Sodium content was affected significantly by nitrogen sources in the first season only and urea gave the highest significant values of Na content. While sodium content, was not affected significantly by nitrogen rates in the two seasons. Regarding the interaction treatment (S3R3) gave the highest significant values during the two seasons.

B-Effect on leaf micronutrients content. Results in Table (8) show the effect of some sources and rates on(Fe, Zn and Mn)content in leaves of pomegranate young tress during 2013 and 2014 seasons .In the two seasons micronutrients (Fe, Zn and Mn) were significantly affected by sources , rates and their interaction .

Regarding iron content, Ammonium sulfate (S_1) gave the highest significant values of iron content in leaves. In the both two seasons. With respect to nitrogen rate, the first and third rate of nitrogen (R_1, R_3)(70&210g N /tree / year) gave the highest significant values of iron content ,in the two growing seasons. Regarding the interaction treatment (S_1 R_1) & (S_1R_3) gave the highest significant values of Potassium content, in the two seasons.

Concerning zinc content, the significant highest values were obtained by Ammonium sulphate (S_1) and urea (S_3), in the first season. However, in the second season Ammonium sulphate (S_1) only gave the highest significant values of zinc content. With respect to nitrogen rate, the second rate of nitrogen (R_2) (140g N /tree / year) gave the highest significant values of zinc content, in the two growing seasons. Regarding the interaction treatment (S_1 R_1) gave the highest significant values of zinc content, in the first season. While in the second season treatment (S_1 R_2) gave the highest significant values of zinc content.

Regarding manganese content, the significant highest values were obtained by Urea (S_3) in the two growing seasons. With respect to nitrogen rates, the second rate of nitrogen (R_2)(140g N /tree / year) gave the highest significant values of manganese content ,in the first season. However, in the second season the third rate of nitrogen (R_3)(210g N /tree / year) gave the highest significant values of manganese content .Regarding the interaction treatment (S_3 R_3) gave the highest significant values of manganese content , in the two growing seasons.

In this respect, Sabbah *et al* (1997) on Valencia Orange trees found that leaf analysis, data showed that the application of ammonium sulfate as a nitrogen source produced a significant increase in the leaf nitrogen content

as compared with applying urea. Furthermore, increasing nitrogen rates resulted in a significant increase in leaf nitrogen content than that of the control. No obvious effect was found in leaf macro or micronutrient contents between both sources of nitrogen applications. On the other hand, slight increase in leaf Fe and Mn contents, and marked decrease in leaf K and Na contents as compared with the control. However, leaf P, Ca and Zn contents were unaffected by the different rates of nitrogen application

Table 8: Effect of some sources and rates of nitrogen on Leaf micronutrient (Fe, Zn and Mn) content of wonderful pomegranate young tress during 2013 and 2014 seasons.

Sources of Nitrogen	Rates of Nitrogen Fertilization (g N / tree)											
	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean	70 (R1)	140 (R2)	210 (R3)	Mean
	Fe (ppm)				Zn (ppm)				Mn (ppm)			
	2013 season											
Ammonium Sulphat (S1)	113.4 a	87.1 d	113.7 a	104.7 A´	48.43 a	35.7 c	27.4 e	37.2 A´	59.4 g	86.7 d	83.5 e	76.5 C'
Ammonium Nitrate (S2)	94.3 c	92.2 c	86.0 d	90.8 B'	23 f	45.1 b	25.2 ef	31.1 B'	84.5 de	90.5 c	68.2 f	81 B´
Urea (S3)	91.4 c	86.3 d	100 b	92.6 B´	31.3 d	44.6 b	35.2 c	37 A´	66.7 f	94.5 b	108.8 a	90 A'
Mean	99.7A	88.5B	99.9A		34.3B	41.8A	29.3C		70.2C	90.6A	86.8B	
	2014 season											
Ammonium Sulphat (S1)	231.0 a	178.8 c	232.2 a	214.0 A'	98.23 f	190.6 a	160.6 b	149.8 A'	91.2 e	152.7 d	151.8 d	131.9 C´
Ammonium Nitrate (S2)	192.0 b	191.2 b	192.8 b	192.0 B´	152.7 c	113.9 e	96.8 f	121.1 B´	181.8 b	84.8 f	146.7 d	137.8 B'
Urea (S3)	191.5 b	195.7 b	195.4 b	194.2 B'	99.9 f	100.4 f	130.1 d	110.1 C'	96.57 e	159.9 c	213.8 a	156.8 A´
Mean	204.8 A	188.6 B	206.8 A		116.9 C	135.0 A	129.2 B		123.2 C	132.5 B	170.7 A	

In each month in each season, means of each of nitrogen source, nitrogen rates or their interactions having the same letters are not significantly different at 5% level.

Conclusion:

From the foregoing data, it could be concluded that fertilizing young "Wonderful" pomegranate trees with ammonium sulphate at a rate of 70g N /tree/year gave the greatest stem diameter , shoot length, N , P , K , Fe and Zn leaf content ,whereas fertilizing with ammonium sulphate at a rate of 140g N/tree/year achieved the highest leaf area and leaf Ca content . Meanwhile , increasing ammonium nitrate rate to 210g N/tree/year ganed the best total chlorophyll in leaves ,however with urea at rate of 210g N/tree/year gave the greatest leaf Mn content .So it could by recommended by fertilizing young wonderful pomegranate trees by ammonium sulphate at a rate of 70g N /tree/year.

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