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Effect of Spraying Different N Sources on Growth Performance of Picual Olive Seedlings

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Abstract: This study was conducted on Picual olive seedlings grown at the greenhouse of National Research Center, Dokki, Giza governorate, Egypt. This investigation was performed to study the effect of applying crystalon (20: 20: 20 NPK) at four rates (0, 25, 37.5 and 50% g N/year/plant) as soil application twice monthly (from March till October) parallel with monthly N sprays during the growing season at of different N sources i.e. urea, ammonium nitrate, calcium nitrate and crystalon at 0.5% for each. At the end of the season, percentage of plant height increment, leaves number per plant, shoots number per plant, stem diameter, leaves dry weight (%), roots number, root length were determined and recorded. The obtained results showed that combination of soil application with crystalon at 50g N/year and foliar application with urea at 0.5% led to markedly increment of plant height, leaves number and roots number more than other treatments. Meanwhile, shoots number was clearly higher with soil application of crystalon at 50 g N/year + foliar application with crystalon at 0.5%. Also, crystalon application as soil application at 37.5 g N/year + foliar application with crysalon at 0.5% improved root growth and recorded higher increasing in root length in comparison with the other applications. Finally, stem diameter and leaf dry weight had high values with soil application at 50 g N/year + foliar application with calcium nitrate at 0.5%. Generally, these results indicated that applying crystalon at 37.5g/year combined with urea spray at 0.5% was the most effective on growth performance. In addition, the foliar application could reinforce fertilization programs and enhancement it's efficiency.

Key words: Picual olive · Growth performance · Nitrogen sources · NPK · Crystalon · Foliar application

INTRODUCTION

Olive (*Olea europaea*) is a long-lived tree that ranges in height from 8-15 m, depending on environmental conditions [1]. While, it is capable of persisting in most environments, olive is most prolific in semi-arid to sub-humid warm temperate regions, in sandy loam soil of moderate depth [2]. Olive is considered one of the important fruit crops in Egypt, the Egyptian olive production reached about 507053 tons produced from 110764 feddan(one feddan = 4200m^2) and the total area reached about 135692 feddan [3]. Around 30% of total olive area is grown in newly reclaimed lands. Olive trees are semi-wild, hardy, tough plants that will tolerate poor growing conditions, especially low fertility, better than almost any other fruit trees. The good soils and deep fertile soils that would be important for above-standard growth and production for other orchard crops are actually a negative for olives. In fertile soils, olives tend to be excessively vigorous vegetatively and produce little fruit. Olive trees tend to produce better fruit under conditions of low vigor including minimal nutrient without being deficient. The supply of nutrients via the roots is restricted under drought and salinized soils because of the negative effect of drought and salinity on nutrient availability. The efficacy of foliar fertilization is higher than that of soil one in these situations, because of the direct supply of the required nutrient to the location of demand in the leaves and its relatively quick absorption (e.g. 0.5-2h for N and 10-24h for K) and the independence of root activity and soil water availability [4]. At early growth stages, foliar fertilization could increase N, P and K supplies at the time when the root system is not well developed [5]. The foliar application is an attractive solution especially in arid zone under rainfall deficient conditions where the lack of water in summer reduces drastically nutrient absorption by the tree [6]. In this respect, foliar application is helpful to satisfy plant requirement and has a high efficiency [7]. Moreover, foliar fertilization reduces nutrient accumulation in soil, run-off

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and groundwater, where they contribute to salinity and nitrate contamination, with negative consequences to humans and the environment. Soil-applied with fertilizers should be replaced in part with foliar-applied fertilizers. Foliar fertilizers can meet the crop's nutrient demand when soil temperature, moisture, pH, salinity renders or soil-applied fertilizers are ineffective. Applying nutrients directly to leaves ensures that the plant's photosynthetic machinery is not compromised by low availability of an essential nutrient [8]. Nitrogen is the most important mineral element in fertilization programs because plants usually need N in greater amounts than other mineral nutrients [9]. In this concerning, urea is the major nitrogen (N) form supplied as fertilizer in agriculture, but it is also an important N metabolite in plants [10]. Most olive nursery plants are produced in containers [11]. Fertilization is particularly critical in containerized nursery plants because roots are confined in a limited amount of soil with rapid vegetative growth. Under these conditions, foliar fertilizers may play an important role in fertilization programs of containerized olive nursery plants.

The present investigation was conducted to identify the optimum level and method of application of nitrogen to enhance growth performance of Picual seedlings and maximizing nitrogen usage efficiency.

MATERIALS AND METHODS

This study was carried out on healthy and almost uniform Picual olive seedlings cultivated in black polyethylene bags with 30 cm diameter fooled 10 kg washed sand mixed very good with 2.5 kg cattle manure in the experimental research green house of National Research Center at Dokki, Giza governorate, Egypt. The investigation aimed to study the effect of applying NPK (crystalon 20: 20: 20 NPK) as soil application at four rates (0, 25, 37.5 and 50 g/year) and foliar applications of four different N sources (urea, ammonium nitrate, calcium nitrate and crystalon) at 0.5% for each one. The following treatments were investigated:

- NPK (crystalon 20: 20: 20 NPK) applied as soil application, 16 doses from March to October at four rates i.e. 0, 25, 37.5 and 50 g as actual N from crystalon.
- Foliar applications of four N sources applied at (0.5%) once time per month from March till October, at forms of (urea, ammonium nitrate, calcium nitrate and crystalon).

Treatments were arranged in randomized complete block design with four replicates for each treatment and each replicate was represented by three seedlings. At the end of October, plants of each treatment were removed genteelly with their root system to estimate and record the following data:

- Percentage of seedling height increment.
- Leaves number per plant.
- Lateral shoots number per plant
- Stem diameter (mm).
- Leaf dry weight (%).
- Root number.
- Root length (cm).

Statistical Analysis: The data were subjected to analysis of variance and the method of Duncan's was used to differentiate means [12].

RESULTS

Percentage of Increment Seedling Height: Data presented in Table 1 revealed that soil application with crystalon at 37.5g/year produced significantly 251.1% increment in percentage of seedling height comparing with the other soil applications (control, 25g and 50g). At the same time, foliar application with urea at 0.5% markedly increased plants height (270.9%) in comparison with the other spraying treatments including the control. Meanwhile, interaction between spraying urea at 0.5 and soil application at 50g N/year obviously enhanced plant height 295%.

Leaves Number per Plant: It was found from Table 2, that there was no significant difference for effect of soil applications on leaves number. However, spraying urea at 0.5% markedly increased leaves number (143.8) in comparison with the other spraying forms. Also, Data in Table 2 indicated that combing between soil application at (37.5 or 50g) and urea sprays at 0.5% resulted in markedly increment in leaves number (153) than the other treatments.

Lateral Shoots Number per Plant: Response of lateral shoots number to different doses of soil applications or foliar applications didn't significantly differ among these treatments.

Table 1: Effect of soil NPK and foliar nitrogen applications on percentage of height increment of "Picual" seedlings

	Foliar application with different N sources					
Soil application	Control	Urea 0.5%	Ammonium nitrate 0.5%	Calcium nitrate 0.5%	NPK 0.5%	Mean
0 g N/year	110 l	246.7 e	213.5 h	230 f	226.7g	205.4 D
25 g N/year	142 k	251 d	230 fg	232 f	250 d	221 C
37.5 g N/year	173.5 i	291 b	290 b	227.5 g	273.3 c	251.1 A
50 g N/year	163.7 j	295 a	293 ab	216.7 h	274 c	248.5 B
Mean	147.3 D	270.9 A	256.6 B	226.5 C	256 B	

Table 2: Effect of soil NPK and foliar nitrogen applications on leaves number of "Picual" seedlings

	Foliar application with different N sources					
Soil application	Control	Urea 0.5%	Ammonium nitrate 0.5%	Calcium nitrate 0.5%	NPK 0.5%	Mean
0 g N/year	51 j	134 c	122 d	105 f	115 e	105.4 B
25 g N/year	67 i	137 c	135 c	109 f	133 c	116.2 A
37.5 g N/year	72 h	151 a	141 b	102 f	134 c	120 A
50 g N/year	73 h	153 a	143 b	92 g	135 c	119.2 A
Mean	65.75 E	143.8 A	135.25 B	102 D	129.25 C	

Table 3: Effect of soil NPK and foliar nitrogen applications on lateral shoot number of "Picual" seedlings

	Foliar application with different N sources					
Soil application	Control	Urea 0.5%	Ammonium nitrate 0.5%	Calcium nitrate 0.5%	NPK 0.5%	Mean
0 g N/year	3	3	3	3	3	3
25 g N/year	3	3	3	3	4	3.2
37.5 g N/year	3	4	3	4	5	3.8
50 g N/year	3	4	3	3	5	3.6
Mean	3	3.5	3	3.2	4.2	

Table 4: Effect of soil NPK and foliar nitrogen applications on stem diameter of "Picual" seedlings

	Foliar application with different N sources					
Soil application	Control	Urea 0.5%	Ammonium nitrate 0.5%	Calcium nitrate 0.5%	NPK 0.5%	Mean
0 g N/year	2.3 g	2.5 ef	2.5 ef	2.5 ef	2.4 fg	2.44 C
25 g N/year	2.3 g	2.7 e	2.7 e	2.9 d	2.9 d	2.7 B
37.5 g N/year	2.4 fg	2.9 d	2.7 e	3.3 b	3.2 bc	2.9 A
50 g N/year	2.3 g	3.1 c	2.6 e	3.6 a	3.3 b	2.98 A
Mean	2.32 C	2.8 B	2.62 B	3.07 A	2.95 A	

Table 5: Effect of soil NPK and foliar nitrogen applications on leaf dry weight of "Picual" seedlings

	Foliar application with different N sources					
Soil application	Control	Urea 0.5%	Ammonium nitrate 0.5%	Calcium nitrate 0.5%	NPK 0.5%	Mean
0 g N/year	48.9 j	58.7 fg	59.7 ef	62.6 b	55.2	57 C
25 g N/year	51.2 i	59.3 f	61.8 c	62.9 ab	57.1 h	58.5 B
37.5 g N/year	55.6 g	61 d	62.5 b	63.5 a	59.3 f	60.4 A
50 g N/year	57.3 h	61.9 c	63 a	63.2 a	60.1 e	61.1 A
Mean	53.2 E	60.2 C	61.7 B	63 A	57.9 D	

Table 6: Effect of soil NPK and foliar nitrogen applications on root number of "Picual" seedlings

	Foliar application with different N sources					
Soil application	Control	Urea 0.5%	Ammonium nitrate 0.5%	Calcium nitrate 0.5%	NPK 0.5%	Mean
0 g N/year	4 bc	5 ab	4 bc	4 bc	4 bc	4.2 A
25 g N/year	5 ab	5 ab	4 bc	3 c	3 c	4 A
37.5 g N/year	6 a	5 ab	4 bc	5 ab	5 ab	5 A
50 g N/year	4 bc	6 a	4 bc	4 bc	5 ab	4.6 A
Mean	4.75 A	5.25 A	4 A	4 A	4.25 A	

Table 7: Effects of soil NPK and foliar nitrogen applications on root length of "Picual" seedlings

	Foliar application with different N sources					
Soil application	Control	Urea 0.5%	Ammonium nitrate 0.5%	Calcium nitrate 0.5%	NPK 0.5%	Mean
0 g N/year	19 cd	16.5 e	26.5 b	25 b	19 cd	21.2 A
25 g N/year	10.5 g	20.5 c	22.5 c	20.5 c	14.5	17.7 B
37.5 g N/year	19.5 c	15.5 ef	19 c d	17.5 de	31 a	20.5 A
50 g N/year	16.5 e	15.5 ef	15 f	18 d	18 d	16.6 B
Mean	16.4 B	17 B	20.7 A	20.2 A	20.6 A	

Stem Diameter: As shown in Table 4, stem diameter was varied according to the source of applied fertilizer. In this respect, stem diameter significantly responded to the increase in crystalon rate. On the contrary, spraying calcium nitrate or crystalon at 0.5% increased the stem diameter and recorded (3.07 and 2.95 cm), respectively. The highest value of stem diameter was recorded from olive seedlings fertilized with the high rate of soil application (crystalon as 50g N/year) plus spraying calcium nitrate at 0.5%.

Leaves Dry Weight (%): Obviously Table 5 cleared that leaf dry matter percentage of Picual olive seedlings responded to soil or foliar applications when applied individually. Whereas, leaf dry matter percentage increased significantly by increasing soil application from 0 to 50g/year as crystalon and ranged from 57 gm to 61.1 gm, respectively. Spraying calcium nitrate at 0.5% produced high leaf dry weight comparing with the other foliar applications. Meanwhile, the highest leaf dry matter percentage was recorded from seedlings fertilized with high NPK rate (50g N/year) with spraying calcium nitrate at 0.5%.

Root Number: Results in Table 6 indicated that root number values were increased insignificantly with increasing soil fertilizer rates. Also, foliar applications had no significant differences concerning their effects on root number. The highest root number was recorded from treatment of soil application at 50g N /year + foliar sprays with urea at 0.5%.

Root Length: Data in Table 7 clearly demonstrated that there was no specific trend in response to soil application, whereas soil application of NPK at 37.5g N/year produced higher root length without significant differences than the control treatment. Regards the effect of foliar applications with ammonium nitrate, calcium nitrate and crystalon (NPK) at 0.5%, they formed a high value of root length (20.7, 20.2 and 20.6 respectively). Meanwhile, combination between soil application at 37.5g N/year and foliar application with crystalon at 0.5% recoded the highest root length value.

DISCUSSION

From the above mentioned results, it could be noticed that all tested growth parameters were affected by different treatments except lateral shoot number values. Growth performance (percentage of seedling height increment, leaves number per, lateral shoots number, stem diameter, leaf dry weight %, root number and root length) was enhanced with increasing soil application concentration (0 to 50g N/year). Whereas, soil application with crystalon at 37.5g N/year was the best treatment since it led to the highest significant value of the following vegetative parameters: percentage of seedling height increment, lateral shoot number, root number and root length. Meanwhile, it didn't differ significantly than the highest concentration (50g N/year) concerning leaves number, stem diameter, leaf dry weight. These results are harmony with those found by Nawaf and Yara [13] who stated that "young olive trees benefit from low levels of

NPK and additional fertilizers would not be significant". However, NPK are considering being essential elements for plant growth and development. Moreover, Bonomelli *et al.* [14] stated that "during the first growing season, cherry plants on dwarfing Gisela 6 rootstock have low N demand and low N uptake efficiency". In regards to foliar application with different forms of nitrogen, spraying urea at 0.5% on olive seedlings cv. Picual gave better results for percentage of height increment, leaves number and root number. For the meantime, spraying calcium nitrate was the most effective treatment compared with the others, concerning stem diameter, leaf dry weight and root length. These results partially agreed with Sheo [15] who mentioned that, the seedling growth of Karun Jamir (*C. aurantium*) and Cleopatra mandarin (*C. reshni*) was significantly increased by spraying urea and GA_3 alone or in combination. Ameliorative effects of Ca $(NO_3)_2$ on plant growth were reported by Al-Harbi [16], Türkmen *et al.* [17, 18] and Belind *et al.* [19] since, calcium controls plant growth, ion exchange properties and enzyme activity. In other studies, there were negative effects of high Ca doses (100 and 200 mg/kg soil) on growth criteria [20], since it has been known that calcium is also a salt resource for soils [20]. This result may be attributed to the roles of calcium in plants, since addition of calcium may increase use efficiency and availability of nitrogen to plant and therefore increase growth, yield and root growth as reported by Belind *et al*. [19] on avocado.

CONCLUSION

Foliar application can play important role and be very profitable in deficient case of nutrient elements. These elements will be rapidly taken up by the trees and the levels will increase dramatically in the leaves. Moreover, this technique could be enhancing the efficiency of soil application.

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