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Response of Pistachio (Pistacia vera L.) cv. Musilly Seedlings Growth to Foliar Spray of Iron Chelate (Fe- EDDHA) and Nitrogen

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Abstract

This study was conducted during growing season of 2014 at Girdarash filed College of Agriculture, University of Salahaddin, Erbil, Iraqi Kurdistan Region to investigate the effect of foliar spray of three concentrations (0, 30and 60 mg.l^{-1}) of iron as iron chelate (Fe – EDDHA) containing (6% of iron) and three concentrations of Kakrorich (20% nitrogen) foliar spray with concentration (0, 3, 6 mg.l^{-1}) on growth characteristics of pistachio (*Pistacia vera* L.) cv. Musilly seedlings. A factorial experiment with three replicates was carried out in a Randomized Complete Block Design (R.C.B.D) using three seedlings for each experimental unit. The obtained results indicated that the growth characteristics increased with increasing the concentration of (Fe – EDDHA) and nitrogen as compared with control, foliar spray of iron element at (60 mgl^{-1}) caused significant increase in seedling hight, seedling diameter, leaves number, leaf area, leaves area/seedling, total chlorophyll content, root length, root fresh weight, root dry weight and dry matter percentage. At the same time, application of nitrogen fertilization at (6 mg.l^{-1}) gave the highest value of seedling high, leaf area, leaves area/seedling, root fresh weight. The highest significant values as interaction effect of iron chelate and nitrogen were found in seedling high, seedling diameter, leaves number, leaf area, leaf area per seedling, total chlorophyll content and dry matter.

Introduction

Pistachio *(Pistacia vera* L.) is deciduous Fruit that is drought resistant and tolerant to hot summer and dry weather, the genus Pistachio have eleven species, some of them are of high economic and cultural value in Mediterranean and Asian countries [1] and [2].

The propagation of pistachio by cuttings is rare due to the difficulty of rooting of cuttings. Therefore the grafting or budding on the rootstocks are the optimal choice for pistachio propagation [4]. The pistachios seedlings grow very slowly on dry conditions. That seedlings are grafted 5-7 years after transplanting [4].The slow growth of pistachio seedlings and relatively long period to the

seedling to be suitable for budding or transfer to be planted in newly established orchards, is a reason that lead to increased costs of production, there are many practices could be taken to stimulate the seedlings growth to reach appropriate size for budding, such as foliar spray of seedlings with micro nutrients like iron. The iron is the most important micro-nutrients required by plants for its important role in the formation of chlorophyll and the transfer of energy in the process of photosynthesis and respiration [5].

One of the most iron fertilizer used is the iron chelate as the chelating compounds are water soluble and to be accessible to plants, iron chelates are more easily translocate within the plant easy absorption and transportation by the plant as they do not decompose by soil, the Fe-EDDHA compound of iron chelating in common use in many plants [6], many researchers have studied the effect of iron on vegetative growth of trees and seedlings of pear [7] and peach [8].

Nitrogen is the most important nutrients for plants, where is involve in constituent of proteins, nucleic acids (DNA, RNA),chlorophyll and enzymes [9], results indicated that application of nitrogen as urea, significantly increased the leaves chlorophyll content, leaves area, trees height, main stem diameter, branches length in peach. [10], also the application of Acta Agro fertilizer(nitrogen nutrient) at (60 cm3.l-1) gave the highest values in a total number of leaves per plant, single leaf area and leaf area per seedling. [11].The objectives of this investigation were to study the effect of Iron element as iron chelate (Fe- EDDHA) and nitrogen on growth of (*Pistacia vera* L.) cv. Musilly seedlings to produce strong root system that grow quickly and to be ready for budding in a short period.

Materials and methods

This study was carried out at the growing season of 2014 at lath house in Girdarash field, College of Agriculture, University of Salahaddin, Erbil govenrnorate, Iraqi Kurdistan region, to study the effect of foliar application of iron element as iron chelate (Fe – EDDHA, Ethylene diamine di (o-hydroxy phenyl acetic acid) containing 6% of iron with three concentrations (Fe0= 0, Fe1= 30 and Fe2= 60 mg.l-1) and foliar application of Kakrorich containing 20% of nitrogen with three concentrations (N1=0, N2= 3 and N3= 6 mg.l-1) on some growth characteristics of Pistaciavera L. cultivar Musilly seedlings, the seedlings had one-year- old planted in black poly ethylene bags 20 kg (45 x 30 cm) filled with sandy loam soil, the seedlings were foliar sprayed with Fe- EDDHA and nitrogen three times; 10 and 25 April and 10 May 2014 and Tween 20 (0.01%) used as wetting agent, the same agriculture practices were applied to the treatments, at the end of September 2014 the data for the following parameters were recorded:

The increase of seedling high (cm) was measured using metric tap and increase of the seedling diameter (mm)measured by vernier (at a level of 5 cm above ground), the date for both parameters were recorded in the first week of April and in September, 2014 and the difference between the two measures was recorded, the number of leaves/ seedling was counted [12], the leaf area was measured by digital plan meter placom KP 90N [13] , Leaf area (cm2/seedling)[14], chlorophyll meter SPAD 502 was used to measure leaves' total chlorophyll content [13] and [15], the leaf fresh weight was determined for ten leaves of each experimental unit and the same leaves were used measure the leaves' dry weight [7] and [16]. The seedlings were cut at the soil surface and roots were separated from the soil by washing roots onto sieves then manual separating roots from remaining soils, the fresh roots were weighted then total root length in each sample was measured using metric tap, then, the roots were dried at 70◦C for 48 h.in an oven, and percentage of dry matter.

A factorial experiment with three replicates was carried out in a Randomized Complete Block Design (R.C.B.D) using three seedlings for each experimental unit, the observations were taken and results were compiled for treatment comparison. The data were statistically analyzed with a computer using SAS system (2005) and the difference between treatment means significantly tested with Duncun Multiple Range at 5% level [17].

Results and Discussion

The data from Table (1) shows that all growth characteristics values increased with increasing the (Fe–EDDHA) concentrations as compared with control, (Fe – EDDHA) The concentration 60 mg l-1 superior significantly in seedling high seedling high (37.08 cm), seedling diameter (1.28 mm), leaves number(37.95), leaf area (37.39 cm^2), leaves area/seedling (1379.6 cm^2) The SPAD reading was (60.54 SPAD), root length (47.95 cm), root fresh weight (38.57 g), root dry weight (28.65 g), and dry matter percentage (47.89 %), whereas no significant difference were found between (Fe – EDDHA) at the levels of (30 and 60 $mg.l^{-1}$) in leaf dry weight and the highest value of leaf fresh weight was found at the level of (30mg l^{-1}) of (Fe – EDDHA). The significant increase in vegetative growth of seedlings characteristics, which the iron is essential for the synthesis of chlorophyll and iron is required for synthesis of the porphyrine which leads to increase the process of photosynthesis [18], also iron is a part of cytochrome component responsible for the process of [8].respiration in plants as well as involves in the synthesis of chloroplasts and the component of proteins [19] leading to increasing in the biosyntheses materials (produced and accumulated), consequently, the growth was enhanced [20], similar results were found in pear and peach [7] and[8].

Table- 1: Effect of iron (Fe – EDDHA) on vegetative growth of pistachio seedlings

Fe ($mg.l^{-1}$)	Increasing of seedling hight *(cm)*	Increasing of seedling diameter *(mm)*	No. of leaves/ seedlings	Single leaf area *(cm2)*	Leaf area *(cm2/seedling)*	Total chlorophyll content	Leaf fresh weight *(g)*	Leaf dry weight *(g)*	Root length (*cm)*	Root fresh weight *(g)*	Root dry weight*(g)*	Dry matter *(%)*
Fe 0	30.49 c	1.03 b	24.82 c	31.67 b	763.23 c	53.48 c	9.81 b	4.37 b	44.18 b	31.62 c	20.19 c	24.90b
Fe 30	34.71 b	1.11 b	28.54 b	31.84 b	1008.50 b	55.83 b	11.26 a	5.00 a	43.92 b	35.98 b	24.80 b	44.41a
Fe 60	37.08 a	1.28 a	37.95 a	37.39 a	1379.60 a	60.54 a	10.19 b	4.88 a	47.95 a	38.57 a	28.65 a	47.89a

Means followed by the same letter within a column do not differ significantly according to Duncan's Multiple Range test at 5% level.

Table (2) shows that the foliar application of 60 g $l^{-1}$of nitrogen caused significant increase in seedling height (36.74 cm), seedling diameter (1.24 mm), leaves number (33.42),leaf area (37.41 cm^2), leaf area/seedling (1242.1 cm^2), SPAD value (57.85 SPAD), leaf fresh weight (10.80 g) leaf dry weight (5.11 g), , leaf dry weight (5.11 g), root length (47.40 cm), root fresh weight (37.17 g), root dry weight (26.05 g), and dry matter (47.32 %) .

The of total Chlorophyll content in leaves could be due to nitrogen is an integral part of chlorophyll manufacture through photosynthesis [20] and enhance more leaf area resulting in higher photo assimilates resulted in more dry matter accumulation and stimulate of vegetative growth of the plant [21] , these results are in harmony with those obtained by [22] and [23].

Table -2: Effect of nitrogen element on vegetative growth of pistachio seedlings

N ($mg.l^{-1}$)	Increasing of seedling high*(cm)*	Increasing of seedling diameter *(mm)*	No. of leaves/ seedlings	Single leaf area (cm2)	Leaf area (cm^2/seedling)	Total chlorophyll	Leaf fresh weight (g)	Leaf dry weigh t (g)	Root length (cm)	Root fresh weight (g)	Root dry weight (g)	Dry matter (%)
N 0	30.86 c	1.01 b	25.23 b	29.75 c	836.07 c	54.42 b	9.89 b	4.23 b	42.84 b	33.58 b	22.23 b	42.77 b
N 1	34.68 b	1.17 a	32.66 a	33.74 b	1072.7 b	57.58 a	10.57 a	4.91 a	45.81 a	32.65 b	25.34 a	46.45 a
N 2	36.74 a	1.24 a	33.42 a	37.41 a	1242.1 a	57.85 a	10.80 a	5.11 a	47.40 a	37.17 a	26.05 a	47.32 a

Means followed by the same letter within a column do not differ significantly according to Duncan's Multiple Range test at 5% level.

It is clear that interaction effects of nitrogen and iron chelate as (Fe – EDDHA) caused significant increase in growth characteristics of the seedlings (Table 3), the highest values in seedling high (39.74 cm), seedling diameter (1.30 mm), leaves number (39.50), leaf area (40.56 cm^2),Leaf area/seedling(1610.4 cm^2), total chlorophyll content (61.91 SPAD), root length (49.11 cm) and dry matter percentage(49.15 %) were recorded from treatment of (6.0 g nitrogen.l^{-1} and 60 $mg.l^{-1}$ (Fe – EDDHA), while the highest leaf fresh weight (11.99 g) and leaf dry weight (5.57 g) were found application of (6.0 g nitrogen.l-1 and 30$mg.l^{-1}$ (Fe – EDDHA). The reason is due to the combined effect of both nitrogen and iron chelate on growth characteristics.

Table- 3: Effect interaction of Iron (Fe – EDDHA) and nitrogen on vegetative growth of pistachio seedlings

Fe x N	Increasing of seedling hight *(cm)*	Increasing of seedling diameter *(mm)*	Leaves number	Single leaf area (cm^2)	Leaf area/ seedling(cm^2)	Total chlorophyll	Leaf fresh weight (g)	Leaf dry Weight (g)	Root length (cm)	Root fresh weight (g)	Root dry weight (g)	Dry matter %
Fe0N0	24.18 h	0.77 c	23.02 cd	29.77 c	684.8 cd	50.73 e	9.40 c	3.82 e	40.61 b	29.26 f	18.16 bd	40.64c
Fe0N1	33.30 f	1.13 ab	25.05 cd	30.42 c	764.0 bcd	54.50 cd	10.18 bc	4.71 bcd	45.52 a	30.56 e	20.81 c	46.27b
Fe0N2	34.00 e	1.20 ab	26.38 bc	34.83 b	840.9 bcd	55.21 cd	9.84 c	4.57 cd	46.42 a	34.69 c	21.60 c	46.44b
Fe1N0	32.49 G	1.03 b	17.02 d	24.29 d	571.41 d	54.24 d	10.43 ab	4.24 de	40.58 b	33.68 d	22.55 ac	40.65c
Fe1N1	35.16 d	1.07 ab	34.25 ab	34.38 b	1178.1 abc	56.81 bc	11.35 ab	5.21 ab	44.52a b	35.77 c	25.60 b	45.b
Fe1N2	36.49 b	1.23 ab	34.36 ab	36.85 b	1275.0 ab	56.43 bcd	11.99 a	5.57 a	46.68 a	38.50 ab	26.24 b	46.46 b
Fe2N0	35.92 bc	1.23 ab	35.66 a	35.19 b	1252.4 ab	58.28 b	9.83 c	4.64 bcd	47.34 a	37.79 b	25.97 b	47.20ab
Fe2N1	35.59 cd	1.30 a	38.69 a	36.43 b	1276.0 ab	61.43 a	10.17 bc	4.82 bcd	47.39 a	39.61 a	29.62 aa	47.39 a
Fe2N2	39.74 a	1.30 a	39.50 a	40.56 a	1610.4 a	61.91 a	10.56 bc	5.19 bc	49.11 a	38.32 ab	30.37 a	49.15 a

Means followed by the same letter within a column do not differ significantly according to Duncan's Multiple Range test at 5% level.

Conclusions

Based on results obtained from this study, the significant increase were recorded for vegetative growth characteristics of pistachio seedlings when the seedlings sprayed with iron chelate as (Fe – EDDHA) and nitrogen, the significant values were increased with increasing the concentration of (Fe – EDDHA) and nitrogen, the highest significant values were recorded at concentration of (60 mg.l-1) of (Fe – EDDHA) and at concentration of (6 gm.l-1) of nitrogen and the interaction effect of both concentration.

Justification for using fertilizers is reflected primarily in the production of hight-quality seedlings. Fertilizing with chelate as (Fe – EDDHA) and nitrogen gives satisfactory results in the seedling production, because these seedlings have well developed roots and close height to root-collar diameter ratio (slenderness ratio). This is of particular importance when seedlings are used for a forestation of poor-quality stands, which are most common, and therefore imposing the need for use of seedlings with better developed root system as compared to the above-ground part. When seedlings are used as rootstock, a large root collar diameter is desirable, as it facilitates application of different grafting methods.

References

[1] Khan, M. A. J. Haroon-ur-Rashid, Z. A. and Khattak, M. S. *"Different stratification techniques on seed germination of pistachio cv. Wild"*, Pakistan, J.Bio. Sci. 2(4),pp. 1412-1414. (1999).

[2] Al-Saghir, M.G. *"Phylogenetic Analysis of the Genus Pistacia L. (Anacardiaceae) Based on Morphological Data"*, Asian Journal of Plant Sciences, 9,pp. 28-35. (2010).

[3] Onay, A." Somatic Embryogensis from Mature Seed Cultures of *Pistaciaatlantica*" .Turk J Agric. 24 : 465-473.(2000).

[4] Arpacı, S., Aksu, Ö., and Tekin, H.*"Determination of the best suitable grafting method on different pistachio rootstock"*, In: Second International Symposium on Pistachios and Almonds, Davis (CA), 24-29 August, ActaHortic. 470,pp. 443-446.(1997).

[5] Pearson, R. C.and Goheen, A. C. *"Compendium of grape disease"*,4th Edition. The American phytopathological society .U.S.A .(1998).

[6] Mahmoud, A. O.*"Symptoms toxicity and lack of nutrients in fruits and vegetables"*, Bulletin guidance.Damascus AgricultureChamber. Syria.(2006).

[7] Awad, M. M. and Atawia, R. A. *"Effect of foliar sprays with some micronutrients on "Le-Conte" pear trees. 1: Tree growth and leaf mineral concentration"*,Annals.Agric. Sci. 40 (1), pp. 359-367. (1995).

[8] Al-Bamarny, S .F .A., Salman, M .A., Ibrahim, Z.R*" Effect of some chemical compounds on some characteristics of shoot and fruit of peach (Prunus persica* L . *) cv. Early Coronet"* .Meso .J .Agric .38 (Supplement1), pp. 35 – 44. (2010).

[9] Blevins, D. D. *"An overview of nitrogen metabolism in higher plants*". In: J. E. Poulton, J. T.Romeo and E. C. Conn (eds) Plant nitrogen Metabolism. Plenum, New York, pp 1-41. 1989.

[10] Al-Aa' reji, J. M. A."Effect of Organic Fertilizer, Urea and Sulphur onVegetative Growth and Concentration of some Nutrient of Young Peach Trees cv.Dixired. Tikrit University Journal of Agricultural Science .10(2), pp. 76-86. (2010)

[11] Dawood, Z. A., Ayad H. Alalaf and Ayad T. Sh.*"Effect of Foliar Spray of Iron Cheleate and ActaAcro Fertilizers on Growth of Pistaciavera L. Seedling"*, Journal of the Science Rafidain,(23): 2, pp.70 - 81. (2012)

[12] Patton, L. "Photosynthesis and growth of willow used for short rotation", Ph.D. Thesis submitted to the Univ. of Dublin (Trinity College). (C.F.). (1984).

[13] Hardim. J. A., Smith, M. W., Wecjier, P. R. and B. S. Cheary, B. S. "In Situ measurement of pecan leaf nitrogen concentration using a chlorophyll meter and vis-near infrared multispectral camera", HortSci. (47):7, pp. 955-960. (2012).

[14] Saieed N. T."Studies of variation in primary productivity growth and morphology in relation to the selective improvements of broad leaves trees spacing", Ph.D. Thesis, National Uni- Irland, (1990).

[15] Coste, S., Barolato, A., Leroy, C., Marcon, E., Renaud, A., Richardson, A. D., Roggy, J. C.,Schiman, H., Uddling, J. and Herault, B."Assessing foliar. Chlorophyll contents with the SPAD-502 chlorophyll meter: a calibration test with thirteen tree species of tropical rainforest in French Guiana", Ann. For. Sci. (67):607, pp. 1-5.(2010).

[16] Gobara, A. A."Response of Lecont Pear trees of foliar application of some nutrients", Egypt, J. Hort., 25:pp. 55-70. (1998).

[17] Al-Rawi, K, M, and Khalafalla A."Analysis of Experimental Agriculture Design".Dar Al-Kutub for Printing and Publishing Mosul Univ.(2000).

[18] Jundia, H. "Physiology of Fruit Trees", Dar Al- Arabiafor publication and distribution. Arabic Republic of Egypt.(2003).

[19] Al-Musli, M. A."Soil fertility and plant nutrition horticultural","Dar Ibn Al- Atheer for printing and publishing.Mosul University.Iraq.(2011).

[20] Marschner, P."Mineral Nutrition of Higher Plants", 3rd. Australia: Academic Press. (2012).

[21] Boroujerdnia, M. and Ansari, N. A. "Effect of Different Levels of Nitrogen Fertilizer and Cultivars on Growth, Yield and Yield Components of Romaine Lettuce (*Lactuca sativa* L.)", Middle Eastern and Russian Journal of Plant Science and Biotechnology ,(1):2, pp. 47-53.(2007).

[22] Al-Imam N. M. A. A. and Al-Brifkany, A. M. A. "Effect Of Nitrogen Fertilization And Foliar Application Of Boron On Fruit Set , Vegetative Growth And Yield Of Anna Apple Cultivar (Malus DomesticaBorkh)", Mesopotamia J. of Agric. (38):4, pp. 9-8 .(2010).

[23] Kandil, E. A., Fawzi, M. I. F. and Shahin M. F. M. "The Effect of some Slow Release Nitrogen Fertilizers on Growth, Nutrient Status and Fruiting of "MitGhamr", Peach Trees, Journal of American Science, (6):12, pp. 195-201. (2010).