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Research Paper

Effect of Some Levels of Water, Media Cultures and Phosphorus Fertilizer on Leaf Nutrition's of Pistachio (*P. vera*) Transplants

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Abstract: *The study was carried out during 2009 at the nursery of Horticulture/ Faculty of Agriculture and forestry - Duhok University -Kurdistan Region. To investigate response of two years old of pistachio transplants grown in two levels of irrigation (25 and 50 %) of soil available water capacities were depleted, three varying culture media (1:1, 2:1river loamy soil : peatmoss besides check treatment loamy river soil only and five concentration of phosphorus fertilizers (0,100, 200, 300, 400mg.P.L^{-1}. Pots^{-1}). The parameters were studied (N, Protein, P, K, Ca, Mg, F, Zn, Mn and Total Chlorophyll content). The results showed that the irrigation of transplant at 25% significantly increased P, Zn and total chlorophyll (0.49%, 44.83ppm and 46.01%) respectively. While, at 50% irrigation significantly increased N, Protein, K, Ca, Fe and Mn (2.48%,15.53%,2.34%,2.29%,179.1and 87.30ppm) respectively. While, media cultures (2:1) affected significantly on N, Protein, K, Ca and Fe (2.55, 15.94,2.87,2.55% and 195.55ppm) respectively. However, P concentration 200mg increased N, Protein, P Ca while,300mg P increased Fe, Zn, Mn and total Chlorophyll (2.66, 16.64, 0.47, 2.47%, 203.12, 48.49, 94.24ppm and 47.53%) respectively. However, all interactions led to significant increase all parameters.*

Keywords: Pistachio, Media Culture, Water Stress, Nutrition.

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1. Introduction:

There are about 11 pistachio species *(Pistacia spp*. L). Only *P. vera* is commercially grown, since it produces most pistachio production comes from arid zone in countries nearly uniform marketable fruit size. Which constitute the main pistachio exporting countries through worldwide Pistachio plants grow best in deep, river loamy soils [3], [23]. Pistachio trees are long-lived, tap-rooted and can grow to 20-30 feet tall. Like any other fruit or nut tree, well-drained soils are needed for optimum growth. Pistachios are drought tolerant, but for commercial crop production there must be adequate soil moisture during**.** Growers believe that pistachio is drought resistance trees. However, pistachio

requires ample amounts of water for satisfactory growth [10]. Studies with different plant species have shown consistently that growth was directly related to water availabilities. The effect of soil moisture tensions on the growth of some pistachio cultivar was previously studied by [21]. [20] and [11]. I n other deciduous fruits, many studies were done to show the effect of water stress on growth characteristics of many trees among them walnut [9], Peach [12], Fig [18] and [4] and Apple [19].
Their result indicated that increasing the available soil water increased stem length, number of leaves, average leaf area and also fresh and dry weight. The reduction in the plant growth parameters values under water stress condition was found also in pomegranate fruits [10]. Drought resistance in olive possesses the capacity to withstand the effects of water shortage for relatively long period without serious injury, [15], and [13]. Several evidences indicate that there are changes in the photosynthetic pigments and their mechanisms in the chloroplasts and the change in ultra structure may occur under water stress.
Phosphorus is a macronutrient which constitutes the energy reservoir molecules and is also necessary in the production of wood and fruits [10]. The effect of 5 levels of phosphorus 15.5, 31,62 and 124mg/kg) on peach seedling, indicated that top dry matter increased in response to the lowest rate of added phosphorus [8]. Phosphorus foliar spray at 400 and 600mg increased stem length, number of new leaves/plant and stem diameter, leaf area and plant dry weight [4 and 11].
The aim of the present work is to find out the effect of water levels, Phosphorus, and media culture on some macro and micro elements in leaves of transplanting pistachio. Pistachio transplants' grown in the nursery of Horticulture/ Agriculture college- Duhok University–Kurdistan region.

2. Materials and Methods:

The study was carried out in the nursery of Horti./ Agri. Duhok Univ. Kurdistan Region-Iraq. Uniform and healthy pistachio transplant of two years old during 2009. The experiments were started in April 10th 2009, as transplants were grown in pots each of (7.5kg) weight, filled with three media cultures (river loamy soil, 1/1 river loamy soil to peat moss and 2:1 river loamy soil to peat moss), plants were irrigated while 25% and 50%, of soil available water depleted (figer.1, 2, 3) [20 and 6]. Five p_2o_5 concentrations (0,100, 200, 300, 400mg.P.L^{-1}.Pots^{-1}) were applied to the pots. The following measurements were recorded on 10th October 2009.

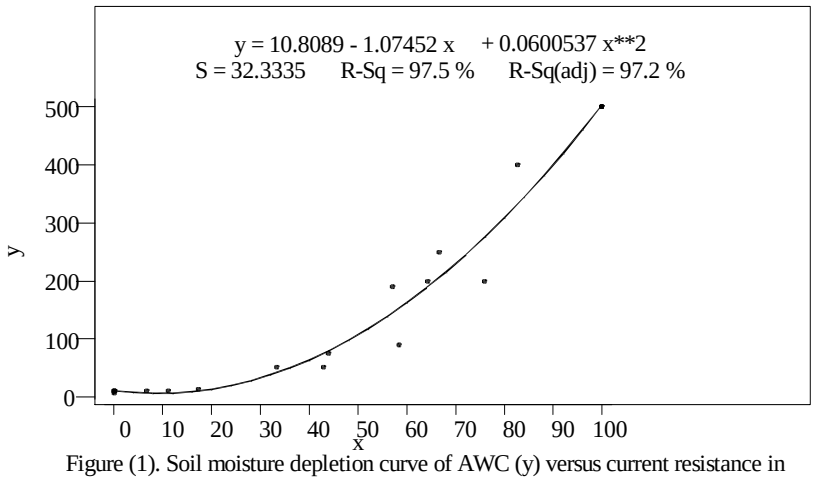

Figure (1). Soil moisture depletion curve of AWC (y) versus current resistance in (OHM) (x) for pots of river loam soil

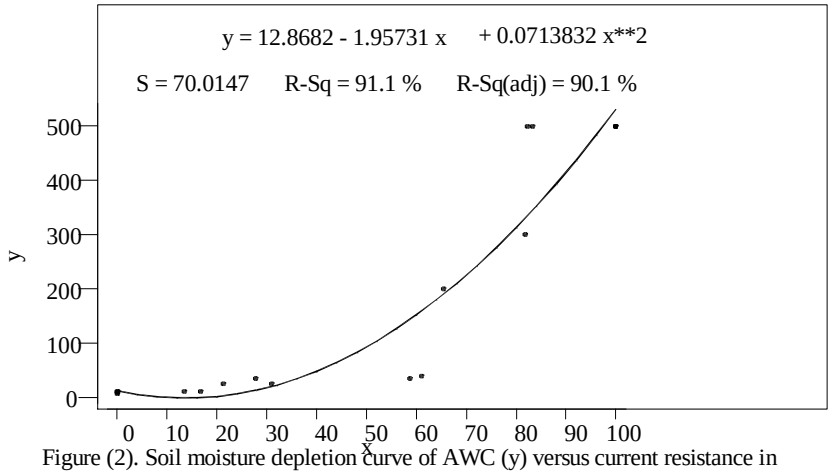

Figure (2). Soil moisture depletion curve of AWC (y) versus current resistance in (OHM) (x) for pots of 1/1 river loamy to peatmoss mixture soil

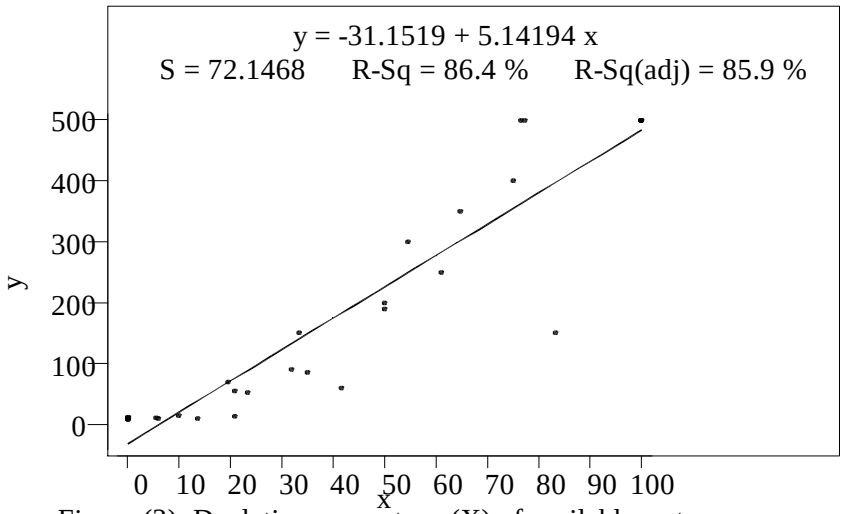

Figure (3): Depletion percentage (X) of available water capacity AWC of 2/1 peatmoss/river loamy versus curent

Leaf Mineral Concentration (%):

Leaf samples were collected in 15th of August. Each sample consisted of 10 full expanded leaves, taken from the middle of the shoots and then washed several times with tap water, then with 0.1N HCl for 20s. Thereafter they were rinsed with distilled water to remove dust particles [17] and then dried at 70^0c to constant weight. Dry matters of leaves were used in the chemical analysis to determine the mineral content of leaves. 0.4 g from each experimental unit was digested with diacid H_2SO_4:$HClo_4$ (4:1) [14; 17 and 7]. The leaves concentration of the following minerals was determined according to the methods described with [2] and [5]:

1- Nitrogen(%) was determined with Micro Kjeldahl.
2-.Phosphorus(%) was determined with colorimetric methods using Spectrophotometer Pharmacia LKB.
3- Potassium(%) was determined with using Flam photometer.
4-Calcium and magnesium(%) were determined with using titration methods with versenate EDTA.

5- Total chlorophyll content % were determined with using Spectrophotometer Pharmacia LKB
6-Iron, Zinc and Cupper (ppm) were determined with using Atomic Absorption Spectrophotometer.

Statistical Analysis:

The obtained data were tabulated and statistically analyzed by computer using [22]. Experiments conducted in this study followed a Complete Randomized Block Design in factorial experiment; the experiment comprised of 30 treatments with three replicates each replicate was presented by three pots one pots contains four transplants. The differences between various treatment means were tested with Duncun multiple range test at 5% level. [22].

Results and Discussions:

1-Nitrogen(%):

The obtained results of water regime (Table 1) revealed that pistachio transplant with two levels of water, significantly affected in leaf nitrogen concentration 2.48. While, pistachio transplants treated with media culture substantially increased nitrogen concentration (2.55) at 2:1 river loamy soil to peat moss significantly. However, results showed that P concentration 200mg.p.L^{-1}.$Pots^{-1}$ was the paramount, as it gave the highest nitrogen concentration (2.66) whereas; untreated treatment was the worst treatment (1.87). The interaction between water regime and media culture displayed that 25% water plus 2:1river loamy soil to peat moss appeared to be the most potent treatment gave the highest nitrogen concentration (2.62). Results of water level and P concentration interaction manifested that 50% water with 400mg.p.pod^{-1} resulted in the highest increase in stem length (2.71). However, the lowest stem length was observed with 25% water in control. Results of media culture and P concentration interaction revealed that 1:1 river loamy soil to peat moss with P at concentration 200mg.p.L^{-1}.Pot^{-1} resulted in the nitrogen concentration (2.81). Results of water levels, media culture and P concentration interactions indicated that 50%water plus media culture1:1 and 200mg.p.L^{-1}.Pot^{-1} concentration was the most effective treatment as it displayed the highest nitrogen concentration (2.86). While, the lowest coincide with 25%water plus 1:1river loamy soil to peat moss at untreated treatment (1.40).

Table (1) Effect of water level, media culture, phosphorus concentrations and their interactions on leaf nitrogen (%) concentration of pistachio transplant.

A	B	C					A × B
		C1	C2	C3	C4	C5	
A1	B1	1.52m	1.94l	2.44f-j	2.42g-j	2.30jk	2.12d
	B2	1.50m	2.34i-k	2.76a-d	2.60b-h	2.82ab	2.38c
	B3	2.35h-k	2.33i-k	2.83ab	2.76a-d	2.84ab	2.62a
A2	B1	2.12kl	2.34i-k	2.67a-f	2.78a-c	2.88a	2.56ab

	B2	1.42m	2.64a-g	2.86a	2.54e-j	2.73a-e	2.42c
	B3	2.47f-j	2.44f-i	2.40g-j	2.56c-i	2.51e-j	2.48bc
		A × C					A Effect
A1		1.76e	2.20c	2.68a	2.59ab	2.65a	2.38b
A2		1.97d	2.47b	2.64a	2.62a	2.71a	2.48a
							B Effect
B ×C	B1	1.82h	2.14g	2.56c-e	2.60cd	2.59cd	2.34b
	B2	1.36i	2.49d-f	2.81a	2.57c-e	2.78ab	2.40b
	B3	2.41ef	2.38f	2.62b-d	2.66a-d	2.68a-c	2.55a
C effect		1.87c	2.34b	2.66a	2.61a	2.68a	

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

2-Protein:

Table (2) revealed that pistachio transplants treated with two levels of water resulted in a significant increase in Protein (15.53) at 50% water as compared to the 25%. However, pistachio transplants treated with media culture substantially increased in Protein (15.94) at 2:1river loamy soil to peatmoss. While, P concentration significant increase in Protein (16.64), particularly at 200mg.p.L^{-1}.Pots-^{1} as compared to control(11.66). The obtained results of both water regime and media culture revealed that treating pistachio transplants resulted in a significant increase in Protein (16.39), particularly at 25% plus 2:1sand to peatmoss as compared to control. However, water levels with P concentrations substantially increased Protein (16.35) specially at 25%water plus200mg.p.L^{-1}.$Pots^{-1}$ as compared to control. While, results indicated that the combination between media culture and P concentration displayed that 1:1river loamy soil/peatmoss and 200mg.p.L^{-1}.Pot^{-1} appeared to be the most potent treatment, as it gave the highest Protein (17.57). Results of water regime, media culture, P concentrations and their interactions manifested that treating pistachio transplants with (50% water, 1:1river loamy soil/peatmoss plus 400mg.L^{-1}.$pots^{-1}$ gave the highest Protein (18.0). However, the lowest Protein was observed with (25% water, 1:1river loamy soil/peatmoss plus untreated check (8.77).

Table (2): Effect of water level, media culture, phosphorus concentrations and their interactions on Protein of pistachio transplant.

A	B	C					A × B
		C1	C12	C3	C4	C5	

A1	B1	9.50m	12.11L	15.27f-j	15.11g-j	14.37jk	13.27d
	B2	8.77m	15.04g-j	17.25a-d	16.23c-h	17.63a-c	14.98c
	B3	14.71h-j	14.56i-k	17.72a-c	17.25a-d	17.73a-c	16.39a
A2	B1	13.25kl	14.65i-k	16.69a-f	17.38a-d	18.00a	15.99ab
	B2	8.80m	16.44b-g	17.88ab	15.86e-j	17.10a-e	15.10c
	B3	15.46f-j	15.25f-j	15.02g-j	15.98e-i	15.71e-j	15.48bc
		A × C					A Effect
A1		10.99e	13.90c	16.75a	16.20ab	16.58a	14.88b
A2		12.32d	15.45b	16.53a	16.40a	16.94a	15.53a
							B Effect
B ×C	B1	11.38g	13.38f	15.98cd	16.24c	16.19c	14.63b
	B2	8.51h	15.74c-e	17.57a	16.04cd	17.36ab	15.04b
	B3	15.08de	14.91e	16.37bc	16.62a-c	16.72a-c	15.94a
C effect		11.66c	14.68b	16.64a	16.30a	16.76a	

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

3. Phosphor Concentration (%):

The obtained results (Table 3) revealed that treated pistachio transplant water levels significantly increased in leaf Phosphor concentrations (0.49). Pistachio transplant treated with media culture none affected in leaf Phosphor concentrations. However, phosphorus concentrations profoundly, exceeded leaf Phosphor concentrations in 200mg.p.L^{-1}.$pots^{-1}$. The combination between water levels and Phosphorus concentrations displayed that 25% water mixed with 200 mg.p.L^{-1}.$pots^{-1}$ appeared to be the most effective treatment, as it gave the highest leaf Phosphor concentrations 0.59%). Results of water levels, media cultures and P concentrations interaction revealed that pistachio transplant treated with 25%water+ 1:1river loamy soil to peatmoss plus 200 mg.p.L^{-1}.$pots^{-1}$ was the most potent treatment as it gave highest leaf Phosphor concentrations (0.77%). While the lowest leaf Phosphor concentrations was coincide with 50%water+ 1:1river loamy soil to peatmoss and 400 mg.p.L^{-1}.$pots^{-1}$ (19%).

4. Potasuim Concentration (%):

The obtained results of both levels of water (Table4) revealed that irrigated pistachio transplants with 50%water resulted in significant increase in leaf potassium concentrations(2.34%). Pistachio transplants treated with media cultures significantly increased leaf area (2.38%) specially in 2:1river loamy soil to peatmoss in relation to other treatment. While, at P concentrations leaf potassium concentrations increased significantly (2.51%) at 400mg.p.L-1.pots-1 compared to untreated check (1.85%). Results indicated that the combination between water levels and media cultures displayed that 50% water and 2:1river loamy soil to peat appeared to the most potent treatment, as it gave the highest leaf potassium concentrations (2.93%). However, the worst results were accompanied with 25%water and river loamy soil (1.35%).

Results of water levels and P concentrations interaction manifested that pistachio transplants treated with 50% water and 400mg.L^{-1}.$pots^{-1}$ gave the highest leaf potassium concentrations (2.83%). However, the lowest leaf potassium concentrations were observed with 25%water plus control (1.70%).

Results of P and media cultures interaction revealed that pistachio transplants treated with P at concentration 400mg and 2:1river loamy soil/peatmoss resulted in the highest leaf potassium concentrations (3.50%). Results of P, media cultures, and water levels interaction indicated that 50%water +2:1river loamy soil/peatmoss and 400mg.L^{-1}.$pots^{-1}$ was the most potent treatment of leaf potassium concentrations (3.82%). While the lowest leaf area was coincide with 25% water and river loamy soil and untreated (0.63%).

Table (3) Effect of water level, media culture, phosphorus concentrations and their interactions on Phosphor concentrations of pistachio leaf transplant.

A	B	C					A × B
		C1	C12	C3	C4	C5	
A1	B1	0.35f-j	0.68a-c	0.71ab	0.36f-j	0.60a-e	0.54a
	B2	0.29h-j	0.34g-j	0.77a	0.54b-e	0.62a-d	0.51a
	B3	0.55b-e	0.35f-j	0.28h-j	0.68a-c	0.31g-j	0.43b
A2	B1	0.44d-h	0.22j	0.34g-j	0.28h-j	0.52c-f	0.36b
	B2	0.24j	0.58b-e	0.26ij	0.66a-c	0.19j	0.39b
	B3	0.55b-e	0.25ij	0.48d-g	0.43e-i	0.22j	0.39b
		A × C					A Effect
A1		0.40d-f	0.46b-d	0.59a	0.53ab	0.51a-c	0.49a
A2		0.41c-e	0.35ef	0.36ef	0.46b-d	0.31f	0.38b
							B Effect
B ×C	B1	0.40c-e	0.45b-d	0.53	0.32ef	0.56ab	0.45a
	B2	0.27f	0.46b-d	0.51a-c	0.60a	0.41c-e	0.45a
	B3	0.55ab	0.30ef	0.38d-f	0.56ab	0.26f	0.41a
C effect		0.41b	0.40b	0.47a	0.49a	0.41b	

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

Table (4): Effect of water level, media culture, phosphorus concentrations and their interactions on leaf potassium concentrations of pistachio transplant.

A	B	C					A × B
		C1	C12	C3	C4	C5	
A1	B1	0.63n	1.59j-l	1.84i-k	1.59j-l	1.11m	1.35e
	B2	1.85i-k	1.80i-k	1.63j-l	1.81i-k	2.32h	1.88d
	B3	2.62e-g	2.93cd	2.66d-f	2.63e-g	3.18c	2.80b
A2	B1	1.98i	2.00i	1.54kl	1.65j-l	1.88ij	1.81d
	B2	2.03i	1.44L	2.35gh	2.77d-f	2.78d-f	2.27c

	B3	2.00i	2.49f-h	2.81de	3.54b	3.82a	2.93a
		A × C					A Effect
A1		1.70f	2.11c-e	2.04de	2.01e	2.20cd	2.01b
A2		2.00e	1.98e	2.23c	2.65b	2.83a	2.34a
							B Effect
B ×C	B1	1.31i	1.79fg	1.69gh	1.62gh	1.49hi	1.58c
	B2	1.94ef	1.62gh	1.99e	2.29d	2.55c	2.08b
	B3	2.31d	2.71c	2.73c	3.09b	3.50a	2.87a
C effect		1.85d	2.04c	2.14c	2.33b	2.51a	

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

5. Calcium Concentration (%):

Results in (Table 5) revealed that water levels significantly increased leaf calcium concentration (2.29%). The obtained results of media culture displayed that treated pistachio transplants significantly increased leaf calcium concentration (2.55%) at 2:1river loamy soil/peatmoss. However, P concentrations substantially increased leaves calcium concentration (2.47%) specially at 200 $mg.p.L^{-1}.pots^{-1}$ as compared to control(1.54%). Results indicated that interaction between water regime, media cultures and leaves calcium concentration increased at 50%water plus 2:1river loamy soil/peatmoss (3.12%**).** Results indicated that the combination between water levels and P concentration displayed that 50% water and 200 $mg.p.L^{-1}.pots^{-1}$ appeared to be the most potent treatment, as it gave the highest leaf calcium concentration (2.59%). Results of P and media cultures interaction revealed that pistachio transplants treated with P at concentration 400mg and 2:1river loamy soil/peatmoss resulted in the highest leaf calcium concentration (3.10%). Results of P, media cultures, and water levels interaction indicated that 50% water plus 2:1river loamy soil/peatmoss and 200 $mg.p.L^{-1}.pots^{-1}$ was the most potent treatment of leaf calcium concentration (3.67%). While the lowest leaf fresh weight was coincide with that50%water +river loamy soil and 100 $mg.p.L^{-1}.pots^{-1}$ (1.21%).

Table (5): Effect of water level, media culture, phosphorus concentrations and their interactions on leaf calcium concentration of pistachio transplant.

A	B	C					A × B
		C1	C12	C3	C4	C5	
A1	B1	1.45h-j	2.26ef	2.25ef	1.97g	1.52h	1.89d
	B2	1.49hi	1.33h-j	2.46de	1.55h	1.25ij	1.62e
	B3	1.42h-j	1.33h-j	2.35ef	2.19f	2.65cd	1.99c
A2	B1	1.45h-j	1.21j	1.40h-j	1.84g	1.42h-j	1.46f
	B2	1.49hi	2.32ef	2.71c	2.26ef	2.74c	2.30b
	B3	1.42h-j	3.43b	3.67a	3.53ab	3.54ab	3.12a
		A × C					A Effect

A1		1.45e	1.64d	2.36b	1.90c	1.81c	1.83b
A2		1.45e	2.32b	2.59a	2.54a	2.57a	2.29a
							B Effect
B ×C	B1	1.45h	1.74g	1.82fg	1.91ef	1.47h	1.68c
	B2	1.49h	1.83fg	2.59c	1.91ef	1.99e	1.96b
	B3	1.42h	2.38d	3.01ab	2.86b	3.10a	2.55a
C effect		1.45d	1.98c	2.47a	2.22b	2.19b	

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

6. Magnesium Concentration (%):

Results in (Table 6) revealed that water levels non affected on leaf Magnesium Concentrations. The obtained results of media cultures displayed that treated pistachio transplant with 2:1river loamy soil/peatmoss resulted in significant increase in leaf Magnesium Concentrations (1.66%). Pistachio transplant treated with P concentrations significantly increased leaf Magnesium Concentrations (1.43%), especially when 400 mg.p.L^{-1}.$pots^{-1}$ was applied as compared to non treatment. The obtained results revealed that 25%water +2:1river loamy soil/peatmoss was superior over that of 50% water + river loamy soil in leaf Magnesium Concentrations (1.73%).

The interactions between water levels and phosphorus concentration displayed that 25%water and 400mg.p.L^{-1}.$pots^{-1}$ appeared to be the most potent treatment (1.44%). While the lowest leaf Magnesium Concentrations (1.03%) was coincide with 50%water +0 mg.L^{-1}.$pots^{-1}$. Results of media cultures and P concentrations interaction manifested that treated with 1:1river loamy soil/peatmoss and 400 mg.p.L^{-1}.$pots^{-1}$ resulted in the highest leaf dry weight(1.82%). Results of water levels, media cultures, P concentrations and their interaction manifested that pistachio transplant treated with that 25% water +1:1river loamy soil/peatmoss and 300mg.p.L^{-1}.$pots^{-1}$ was the most potent treatment as it gave the highest leaf Magnesium Concentrations (1.89%).

Table (6): Effect of water level, media culture, phosphorus concentrations and their interactions on leaf Magnesium Concentrations of pistachio transplant.

A	B	C					A × B
		C1	C12	C3	C4	C5	
A1	B1	0.09r	0.22rq	0.39p	0.54o	0.59no	0.37e
	B2	1.16L	1.74b-e	1.72c-f	1.89a	1.84a-c	1.67b
	B3	1.75ab	1.43jk	1.64d-g	1.76b-d	1.89a	1.73a
A2	B1	0.28pq	0.62no	0.87m	0.64no	0.72n	0.63d
	B2	1.34k	1.44i-k	1.55g-j	1.56g-j	1.81bc	1.54c
	B3	1.47h-k	1.53g-j	1.60e-h	1.58f-i	1.71c-f	1.58c
		A × C					A Effect
A1		1.07ef	1.13de	1.25c	1.40ab	1.44a	1.26a
A2		1.03f	1.19cd	1.34b	1.26c	1.41ab	1.25a

		B × C					B Effect
B ×C	B1	0.19j	0.42i	0.63h	0.59h	0.66h	0.50c
	B2	1.25g	1.59e	1.64c-e	1.73a-c	1.82a	1.60b
	B3	1.71b-d	1.48f	1.62de	1.67c-e	1.80ab	1.66a
C effect		1.05d	1.16c	1.30b	1.33b	1.43a	

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

7. Iron Concentration (ppm)

Results in (Table 7) revealed that water levels significantly increased leaf Iron concentrations (179.10). The obtained results of media culture displayed that treated pistachio transplants significantly increased leaf Iron concentration (195.55) at 2:1river loamy soil/peatmoss. However, P concentrations substantially increased leaves Iron concentration (203.12) specially at 300 mg.p.L^{-1}.$pots^{-1}$ as compared to Control (128.06). Results indicated that interaction between water regime, media cultures and leaves Iron concentration increased at 50%water plus 2:1river loamy soil/peatmoss (202.21**).**Results indicated that the combination between water levels and P concentration displayed that 50% water and 300 mg.p.L^{-1}.$pots^{-1}$ appeared to be the most potent treatment, as it gave the highest leaf Iron concentration (211.81). Results of P and media cultures interaction revealed that pistachio transplants treated with P at concentration 200mg and 2:1river loamy soil/peatmoss resulted in the highest leaf Iron concentration (236.07%). Results of P, media cultures, and water levels interaction indicated that 50% water plus 2:1river loamy soil/peatmoss and 300 mg.p.L^{-1}.$pots^{-1}$ was the most potent treatment of leaf Iron concentration (250.47). While the lowest leaf Iron was coincide with that25%water +2:1river loamy soil/peatmoss and 0 mg.p.L^{-1}.$pots^{-1}$ (116.63).

Table (7): Effect of water level, media culture, phosphorus concentrations and their interactions on leaf Iron concentrations (ppm) of pistachio transplant.

A	B	C					A × B
		C1	C12	C3	C4	C5	
A1	B1	129.15op	153.44m	164.59L	171.84jk	166.13kL	157.03e
	B2	145.54n	175.13j	220.97d	198.81f	192.49gh	186.59b
	B3	116.63r	166.14kL	227.97c	212.60e	221.07d	188.88b
A2	B1	123.93pq	165.20kL	171.34j-L	188.17hi	199.61f	169.65c
	B2	134.38o	145.87n	165.15kL	196.80fg	185.02i	165.45d
	B3	118.70qr	165.61kL	244.18b	250.47a	232.11c	202.21a
		A × C					A Effect
A1		130.44f	164.90d	204.51b	194.42c	193.23c	177.50b
A2		125.67g	158.89e	193.55c	211.81a	205.58b	179.10a
							B Effect
B ×C	B1	126.54k	159.32i	167.96h	180.01g	182.87g	163.34c
	B2	139.96j	160.50i	193.06e	197.81d	188.75f	176.02b

	B3	117.67L	165.87h	236.07a	231.53b	226.59c	195.55a
C effect		128.06d	161.90c	199.03b	203.12a	199.40b	

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

8. Zinc Concentrations (ppm):

Results in (Table 8) revealed that water levels significantly increased leaf Zinc concentration (44.83). The obtained results of media culture displayed that treated pistachio transplants significantly increased leaf Zinc concentration (53.01) at 1:1river loamy soil/peatmoss. However, P concentrations substantially increased leaves Zinc concentration (48.53) especially at 400 $mg.p.L^{-1}.pots^{-1}$ as compared to control (30.34). Results indicated that interaction between water regime, media cultures and leaves Zinc concentration increased at 25%water plus 1:1river loamy soil/peatmoss (61.06**).** Results indicated that the combination between water levels and P concentration displayed that 25% water and 400 $mg.p.L^{-1}.pots^{-1}$ appeared to be the most potent treatment, as it gave the highest leaf Zinc concentration (54.16). Results of P and media cultures interaction revealed that pistachio transplants treated with P at concentration 400mg and 1:1river loamy soil/peatmoss resulted in the highest leaf Zinc concentration (65.86). Results of P, media cultures, and water levels interaction indicated that 25% water plus 1:1river loamy soil/peatmoss and 400 $mg.p.L^{-1}.pots^{-1}$ was the most potent treatment of leaf Zinc concentration (80.59). While the lowest leaf Zinc concentration was coincide with that25%water +1:1river loamy soil/peatmoss and check treatment (27.67).

Table (8): Effect of water level, media culture, phosphorus concentrations and their interactions on Zinc leaf concentrations of pistachio transplant.

A	B	C					A × B
		C1	C12	C3	C4	C5	
A1	B1	27.67o	42.13hi	46.35e-h	44.14g-i	46.48e-h	41.35c
	B2	34.14k-m	53.61d	63.97c	72.98b	80.59a	61.06a
	B3	28.76m-o	31.83k-o	30.90k-o	33.51k-m	35.41j-L	32.08e
A2	B1	27.90no	33.31k-n	36.25jk	48.91d-g	43.19hi	37.91d
	B2	33.80k-m	44.55f-i	45.38f-h	49.94d-f	51.13de	44.96b
	B3	29.79L-o	39.76ij	46.01e-h	41.43hi	34.38k-m	38.28d
		A × C					A Effect
A1		30.19f	42.52d	47.07c	50.21b	54.16a	44.83a
A2		30.50f	39.21e	42.55d	46.76c	42.90d	40.38b
							B Effect
B ×C	B1	27.79i	37.72f-h	41.30f	46.53de	44.84e	39.63b
	B2	33.97h	49.08d	54.68c	61.46b	65.86a	53.01a
	B3	29.28i	35.80gh	38.46fg	37.47gh	34.90gh	35.18c
C effect		3034d	40.87c	44.81b	48.49a	48.53a	

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

9. Manganese Concentrations (ppm):

Results in (Table 9) revealed that water levels significantly increased leaf Manganese concentration (87.30). The obtained results of media culture displayed that treated pistachio transplants significantly increased leaf Manganese concentration (90.11) at river loamy soil. However, P concentrations substantially increased leaves Manganese concentration (94.24) specially at 300 $mg.p.L^{-1}.pots^{-1}$ as compared to control(71.37). Results indicated that interaction between water regime, media cultures and leaves Manganese concentration increased at 50%water plus river loamy soil (92.57**).** Results indicated that the combination between water levels and P concentration displayed that 50% water and 300 $mg.p.L^{-1}.pots^{-1}$ appeared to be the most potent treatment, as it gave the highest leaf Manganese concentration (97.98). Results of P and media cultures interaction revealed that pistachio transplants treated with P at concentration 300mg and river loamy soil resulted in the highest leaf Manganese concentration (101.23). Results of P, media cultures, and water levels interaction indicated that 50% water plus river loamy soil and 400 $mg.p.L^{-1}.pots^{-1}$ was the most potent treatment of leaf Manganese concentration (104.39). While the lowest leaf Manganese concentration was coincide with that25%water +1:1river loamy soil and control treatment (64.39).

Table (9): Effect of water level, media culture, phosphorus concentrations and their interactions on leaf Manganese concentrations of pistachio transplant.

A	B	C					A × B
		C1	C12	C3	C4	C5	
A1	B1	71.79L	81.16i-k	88.14f-h	100.58a-c	96.52b-e	87.64b
	B2	6438m	64.89m	72.64L	77.26j-L	85.59g-i	72.95d
	B3	71.61L	83.95hi	87.13g-i	93.69d-f	100.22a-c	87.32b
A2	B1	73.47L	83.89hi	99.23a-d	101.88ab	104.39a	92.57a
	B2	74.94L	75.33j-L	81.67h-j	91.17e-g	94.63c-e	83.55c
	B3	72.05L	83.29h-j	87.49g-i	100.89a-c	85.25g-i	85.79bc
		A × C					A Effect
A1		69.26f	76.67e	82.64d	90.51c	94.11b	82.64b
A2		73.49be	80.84d	89.46c	97.98a	94.76b	87.30a
							B Effect
B ×C	B1	72.63h	82.53f	93.69bc	101.23a	100.46a	90.11a
	B2	69.66h	70.11h	77.16g	84.22ef	90.11cd	78.25c
	B3	71.83h	83.62ef	87.31de	97.29ab	92.74c	86.56b
C effect		7137d	78.75c	86.05b	94.24a	94.43a	

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

10. Chlorophyll Content (%):

Results in (Table 10) revealed that water levels significantly increased total Chlorophyll Content (46.01%). The obtained results of media culture displayed that treated pistachio transplants significantly increased total Chlorophyll Content (46.40%) at river loamy soil. However, P

concentrations substantially increased total Chlorophyll Content (47.53%) specially at 300 mg.p.L^{-1}.$pots^{-1}$ as compared to control (40.98%). Results indicated that interaction between water regime, media cultures and total Chlorophyll Content increased at 25%water plus 2:1river loamy soil/peatmoss (46.85%**).** Results indicated that the combination between water levels and P concentration displayed that 25% water and 300mg.p.L^{-1}.$pots^{-1}$ appeared to be the most potent treatment, as it gave the highest total Chlorophyll Content (47.66%). Results of P and media cultures interaction revealed that pistachio transplants treated with P at concentration 400mg and river loamy soil resulted in the highest total Chlorophyll Content (48.70%). Results of P, media cultures, and water levels interaction indicated that 25% water plus 2:1river loamy soil/peatmoss and 300mg.p.L^{-1}.$pots^{-1}$ was the most potent treatment of total Chlorophyll Content (50.33%). While the lowest leaf fresh weight was coincide with that25%water +2:1river loamy soil/peatmoss and check treatment (39.73%).

Table (10): Effect of water level, media culture, phosphorus concentrations and their interactions on total Chlorophyll Content (%) of pistachio transplant.

A	B	C					A × B
		C1	C12	C3	C4	C5	
A1	B1	41.87i-k	46.33d-g	48.60a-d	46.50b-g	47.87a-e	46.23a
	B2	41.33jk	46.63b-g	45.40e-h	46.13d-g	45.20e-h	44.94b
	B3	39.73k	49.53ab	48.60a-d	50.33a	46.07d-g	46.85a
A2	B1	41.87i-k	46.43c-g	47.27b-f	47.73a-e	49.53ab	46.57a
	B2	41.33jk	48.57a-d	47.13b-f	49.47a-c	47.10b-f	46.72a
	B3	39.73k	42.60h-k	44.40f-i	43.93g-j	41.30jk	42.39c
		A × C					A Effect
A1		40.98c	47.50ab	47.53ab	47.66a	46.38ab	46.01a
A2		40.98c	45.87ab	46.27ab	47.04ab	45.98ab	45.23b
							B Effect
B ×C	B1	41.87d	46.38b	47.93ab	47.12ab	48.70a	46.40a
	B2	41.33de	47.60ab	46.27b	47.80ab	46.15b	45.83a
	B3	39.73e	46.07b	46.50b	47.13ab	43.68c	44.62b
C effect		40.98c	46.68ab	46.90ab	47.35a	46.18b	

Means within a column, row and their interactions followed with the same letters are not significantly different from each others according to Duncans multiple ranges test at 5% level.

Increase in N, Protein, P, K, Ca and Fe, Zn, Mn and total chlorophyll were attributed to medium mixture of 2:1river loamy soil to peatmoss which provided optimal root growth ambient conditions of aeration, water availabilities, pH, organic content and adequate phosphorus and other nutrients. Water stress was found to affect every aspect of plant growth. Some of these effects were related to decrease in turgid. Water potential and osmotic potential, water availability. Several of evidences indicate that there are changes in the photosynthetic pigments and mechanisms in the chloroplasts and that change in ultra structure may occur under water stress. Phosphorus is a macronutrient that is used in the sugar phosphates that store energy and is also necessary in the production of wood. [21,20,9,12,18,19,15,13and1].

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