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Effect of Water Requirements and Organic Fertilization on Olive Productivity and Some Leaves Mineral Content

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ABSTRACT

To investigate the effect of partial replacement of mineral nitrogen fertilizer (as ammonium sulphate) by farmyard–manure (as organic fertilizer), field experiment was carried out in the experimental station of National Research Centre in El- Nobaria area, Egypt, during two successive seasons 2012 and 2013. Five levels of fertilizers treatments were used { 100% chemical fertilizer (F_1), 75% chemical fertilizer +25% organic fertilizer(F_2), 50% chemical fertilizer +50% organic fertilizer(F_3), 25% chemical fertilizer +75% organic fertilizer(F_4) and 100% organic fertilizer (F_5) } combined with three different levels of water requirements 100%, 66% and 33% of ETc on some leaves nutrients concentration and yield of two olive cultivars (Kronaki as oil production and Picual as dual purpose) under drip irrigation system. The obtained results indicated that, decreasing irrigation water levels reduced leaves nitrogen, potassium and calcium concentration in both cultivars in the two seasons, increasing the ratio of organic fertilizer in fertilization treatments significantly decreased nitrogen concentration, while potassium concentration significantly increased. No trend were observed in leaves calcium concentration but treatment F_5 recorded the highest calcium concentration in the two seasons, 1.307and 2.011%, respectively. Phosphorus concentration significantly increased with increasing organic fertilizer in the two seasons. No significant difference were found between irrigation treatments on phosphorus concentration. Application of 50% chemical N fertilizer + 50% organic fertilizer under all irrigation water levels gave the highest fruit yield compared with the other fertilization treatments. On the other hand, decreasing the irrigation water levels from 100% to 66% of ETc didn't affect olive productivity.

Key words: Olive cultivars, mineral and organic nitrogen fertilization, water requirements, leaves mineral status.

Introduction

Olive tree (*Oleaeuropaea* L.), family Oleaceae is one of the most important and a widely distributed tree grown in many arid and semi-arid areas of the world. The production of olive in these areas is generally low due to the poor soil fertility and low water holding capacity. According to Xiloyannis *et al.* (1999), olive has three different adaptive strategies to cope with water stress: (a) by lowering the water content and water potentials of its tissues,(b) the tree stops shoot growth but not its photosynthetic activity under water stress conditions ; (c) osmotic adjustment, maintaining cell turgor and leaf activities.

In the Near East and North Africa countries the area cultivated with olives) was 3,772,989 ha and olive production was 4,044,696 MT. Oil production was 556,354 T (FAO, 2010).Tunisia is the largest southern Mediterranean countries producing olive and olive oil. Tunisia is the second largest country in the world after the European Union and the fourth post country after Spain, Italy and Greece (Gharbi *et al.*, 2014). Now, according to the latest statistics of the Egyptian Ministry of Agriculture in 2012 the total cultivated land with olive is 202,743 fed., 14,353 fed. of this area in the old land and 188,390 fed. in the new land., the total production is 563,070 T, 760,17 T are in old land while 487,053 T in new land.

Irrigation requirements for olive trees in arid regions ranged from 600 to 1000 mm Palomo *et al.* (2002). The limited water availability in the Mediterranean ecosystems and the current and predicted decrease of water resources are leading to the urgent need to reduce water use for irrigation in the arid and semi-arid regions. Optimization of olive oil quality and quantity can be achieved by water management that allows conditions of mild stress during pit hardening and induces stress during the oil accumulation stage, particularly prior to harvest, Naor *et al.* 2013. Hussein (2002 and 2008) reported that increasing irrigation levels significantly increased leaves and fruit contents of nutrients N,P, K, Ca, Mg, Fe, Mn, Cu, Zn and B.

The needs of olive trees with respect to N, P, and K are comparable to the needs of other fruit, Haifa (2015) showed that, the basic demand of N-P-K and B application per ha , in bearing orchards may supplied by addition of 200-350Kg N/ha, 50-70Kg P_2O_5 , 400-500Kg K_2O and 2.5-5.0 Kg B , respectively. Organic manures was added at the rate of 50 kg / tree every 2 – 3 years. The integration of organic and inorganic sources of

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nutrients not only supplied essential elements but also some positive interaction with chemical fertilizers to increase their efficiency and thereby reduce environment hazards.

This investigation aimed to study the substitution of chemical nitrogen fertilizers with FYM fertilizer under different irrigation water levels and its effect on olive productivity and mineral status.

Materials and Methods

A field experiment was conducted during season 2012 and 2013 at agricultural experimental station of the National Research Centre, at El-Nobaria area. The soil has been classified as sandy soil in texture, which having pH: 8.8, EC: 0.4 dSm^{-1}, OM: 0.21%, $CaCO_3$:7.4%. Two olive cultivars *Oleaeuropaea* L. cv. (Picual as Dual Purpose, and Kronaki as olive oil production) were used. The trees were 6-years-old with planting distances of 5×5 m. (168 tree per Fed.), which irrigated with drip irrigation. Irrigation system was single straight lateral with drip emitters' giving average of 0.7 L/min., located at 1 m from the trunk. Irrigation events were performed weekly.

The experimental design included three irrigation treatments: 100% of estimated crop evapotranspiration in mm/ day (ETc.) as control, 66% and 33%, of ETc. Irrigation was carried out according to the methodology proposed by Allen *et al.* (1998). Five N fertilization treatments were applied as follows : chemical fertilizers 100% (F_1), 75% chemical fertilizers + 25% organic fertilizers (F_2), 50% chemical fertilizers +50% organic fertilizers (F_3), 25% chemical fertilizers +75% organic fertilizers (F_4) and 100% organic fertilizers (F_5). Organic amendments application rates dependent on its total N content (1.14%) of the farmyard manure. The recommended doses of fertilizers for olive trees age 6 years according to the recommendations of Ministry of Agriculture are ; 4 kg ammonium sulphate 20 % N + 2 kg potassium sulphate 50% K_2O +1.5 kg mono supper phosphate 15.5% P_2O_5 per tree/ year . The fertilization treatments, ammonium sulphate and farmyard manure fertilizers or their mixtures were added in two equal portions, the half at middle of April and the other at middle of August. The experiment included 15 separate treatments (5 fertilization*3 irrigation) for every cultivar, in randomized block design with four replicates.

Leaves samples were collected from the middle of branches age 1 year in April, (at flowering stage). because the nutrient content are constant at early spring according to Therios, 2009 and prepared for chemical analysis according to Cottenie *et al.* (1982).The Olive fruits were harvested at ripening stage. Data were subjected to statistical analysis through analysis of variance (ANOVA) according to (Gomez and Gomez 1984).

Results and discussion

Leaves mineral content.

A lack of nitrogen (N) is the only common nutritional deficiency in olives. Potassium (K) and boron (B) deficiencies exist, but are very uncommon. Deficiencies of other nutrients are extremely uncommon. Another characteristic of olives is that the amount of each nutrient needed is usually much less than most other orchard trees. Critical nutrient levels are best measured with tissue testing of mature leaves from the middle of nonbearing current season shoots in July.

Measurements taken at other times of the year are meaningless, in most cases, because nutrient levels within the leaves are much less stable. Nitrogen is adequate at 1.5 to 2.0% and deficient below 1.4%. Potassium levels in leaves should be over 0.7% and are deficient below 0.4%.

Nitrogen

The data representing the effect of fertilization and irrigation treatments on leaves nitrogen concentration are listed in table (1). The results indicate that, nitrogen concentration decreased with reducing the percent of irrigation water requirements. Statistical analysis show that, while nitrogen concentration did not significantly affected with irrigation treatments in the first season , it is significantly decreased as a result of these treatment in the second season. Mengel and Kirkby (1987) reported that, increasing irrigation water levels significantly increased leaves nitrogen content of olive tree, this increment may be due to increasing water supply, which improved the root function and growth rate consequently enhanced nutrient absorption epically nitrogen and metabolic processes. Also, Attalla *et al.* (2011) showed that, leaves nitrogen content of Manzanillo cultivar increased with increasing the rate of irrigation water.

Concerning the effect of fertilization treatments, statistical analysis indicates that, leaves nitrogen concentration significantly decreased as a result of increasing the rate of organic fertilizers as substitution of chemical fertilizer. These results are confirmed with the finding of Monge *et al.* (2000) who reported that, organic wastes fertilization did not lead to significant increases in leaves mineral concentrations**.** On the contrary, AbdEllah (2005) reported that, olive leaves nitrogen content significantly increased by adding nitrogen

fertilization as ammonium nitrate and potassium sulphate this increment may be due to the presence of fertilizer at suitable level which improved the absorption and translocation of nitrogen by plants.

With regard to cultivars results show that, leaves nitrogen concentration of Kronaki cultivar is higher than that of Picual cultivar. Highly significant difference is found in nitrogen concentration between the two cultivars in both seasons. Hasan (2005) reported that, Kronaki olive cultivar exceeded in leaf nitrogen content as compared with Manzanillo and Aggizi olive cultivars.

Data show that increasing the ratio of organic fertilizer decrease nitrogen concentration under all irrigation treatments. The treatment F_1I_1 gave the highest nitrogen concentration 2. 823 and 3.305 %, while F_5I_3 recorded the lowest value 1.494 and 1.913% in the first and second seasons, respectively. There is no significant effect of these interaction on nitrogen concentration. Statistical analysis show that the interaction effect between irrigation, fertilization and cultivars on nitrogen concentration is not significant.

Table 1: Effect of irrigation and fertilization treatments on leaves nitrogen concentration of two olive cultivars in the two seasons.

Cultivars (V)	fertilization (F)	2012			Mean	2013			Mean
		Irrigation (I)				Irrigation (I)			
		100%	66%	33%		100%	66%	33%a	
Kronaki	F_1	3.092	2.697	2.497	2.763	3.687	2.687	2.675	3.020
	F_2	2.317	2.373	2.245	2.312	2.430	2.425	2.397	2.417
	F_3	2.377	2.330	2.082	2.263	2.492	2.400	2.220	2.371
	F_4	2.623	1.853	1.722	2.066	2.215	2.325	2.097	2.212
	F_5	1.703	1.530	1.475	1.569	1.872	2.062	1.990	1.975
Mean		2.423	2.156	2.004	2.195	2.54	2.380	2.276	2.399
Picual	F_1	2.553	2.297	2.563	2.471	2.922	2.607	2.312	2.614
	F_2	1.870	1.895	1.967	1.911	2.335	2.212	2.202	2.250
	F_3	1.702	1.605	1.908	1.738	2.182	2.240	2.240	2.221
	F_4	1.670	1.587	1.790	1.683	2.107	2.195	2.115	2.139
	F_5	1.430	1.555	1.512	1.499	2.000	2.142	1.835	1.993
Mean		1.845	1.788	1.948	1.860	2.309	2.279	2.141	2.243
	F_1	2.823	2.497	2.525	2.617	3.305	2.648	2.494	2.815
	F_2	2.094	2.134	2.106	2.111	2.383	2.319	2.30	2.333
	F_3	2.04	1.967	1.995	2.00	2.337	2.320	2.230	2.296
	F_4	2.146	1.720	1.756	1.874	2.161	2.260	2.106	2.176
	F_5	1.566	1.542	1.494	1.534	1.936	2.103	1.913	1.984
Grand mean		2.134	1.972	1.976		2.424	2.330	2.21	
L.S.D 0. 05 I = ns F=0.183*** V= 0.095*** I*V=0.165*** F*V= ns I*F*V= ns I*F= n F*V= ns						I =0.127* I*V= ns V= 0.113 ** I*F=0.261*** F=0.151*** I*F*V= ns			

Phosphorus

Data presented in table (2) reveal that, phosphorus concentration significantly increased as a result of increasing the ratio of added farmyard manure in both seasons. It is noticeable that, the highest value of phosphorus concentration in olive leaves (0.130%) is found under 100% of organic fertilizer treatment (F_5) comparing to the other fertilization treatments in both seasons. The leaves in the second season contain higher phosphorus concentration than in the first one. This may be due to the use of fertilization program for two years. Such results are in harmony with Fayed (2010) who reported that, phosphorus leaves content was significantly increased as a result of organic manures applications.

Regarding the effect of irrigation treatments, data show that, phosphorus concentration slightly increased by decreasing the amount of irrigation water. Statistical analysis indicated that, water requirements treatments had no significant effect on phosphorus concentration. While Hussein (2008), found that, increasing irrigation level from 25 to 35 m^3/tree / year, significantly increased phosphorus leaf content of olive tree 7 years old**.**

The interaction effect between irrigation and fertilization treatments show that, phosphorus concentration of leaves was significantly affected due to these interaction in the first season only**.** Data indicate that (F_5I_2) treatment give the highest phosphorus concentration (0.145%) in the first season and (0.152%) in the second season. While the lowest value was noticed under the treatment of (F_1I_2), representing 0.095 and 0.121 % in the first and second seasons, respectively**.** Hussein (2002) reported that, increasing irrigation levels and nitrogen fertilization significantly increased phosphorus concentration in the leaves of Hamed cultivar. Statistical analysis indicates that leaves phosphorus concentration significantly affected with the interaction between all studied factors (fertilization, irrigation and cultivars).

Table. 2: Effect of irrigation and fertilization treatments on leaf phosphorus concentration of two olive cultivars in the two seasons.

Cultivars (V)	fertilization (F)	2012			Mean	2013			Mean
		Irrigation (I)				Irrigation (I)			
		100%	66%	33%		100%	66%	33%a	
Kronaki	F_1	0.093	0.096	0.111	0.100	0.123	0.117	0.128	0.123
	F_2	0.110	0.112	0.093	0.105	0.118	0.135	0.118	0.124
	F_3	0.111	0.101	0.128	0.113	0.131	0.143	0.129	0.134
	F_4	0.116	0.127	0.125	0.123	0.142	0.130	0.144	0.139
	F_5	0.135	0.133	0.122	0.130	0.159	0.118	0.136	0.138
Mean		0.113	0.114	0.116	0.114	0.134	0.128	0.131	0.132
Picual	F_1	0.129	0.095	0.128	0.117	0.134	0.125	0.159	0.139
	F_2	0.112	0.103	0.116	0.110	0.124	0.140	0.155	0.140
	F_3	0.113	0.101	0.106	0.107	0.136	0.130	0.138	0.135
	F_4	0.105	0.132	0.119	0.119	0.129	0.163	0.134	0.142
	F_5	0.098	0.157	0.134	0.130	0.124	0.187	0.145	0.152
Mean		0.111	0.118	0.121	0.116	0.129	0.149	0.146	0.142
	F_1	0.111	0.095	0.119	0.109	0.128	0.121	0.144	0.131
	F_2	0.111	0.108	0.104	0.108	0.121	0.137	0.137	0.132
	F_3	0.112	0.101	0.117	0.110	0.134	0.137	0.134	0.135
	F_4	0.110	0.129	0.122	0.121	0.136	0.146	0.139	0.140
	F_5	0.116	0.145	0.128	0.130	0.142	0.152	0.141	0.145
Grand mean		0.112	0.116	0.118		0.132	0.139	0.139	
L.S.D 0.05	I = ns	F=0.009***	V= ns	F*V= ns		I = ns	F=0.009*V= 0.006 **	I*V= 0.010**	
	I*V= ns	I*F=0.016**		I*F*V=0.022**		I*F= ns	F*V= ns	I*F*V=0.023***	

Potassium

Data representing the effect of irrigation treatments on leaves potassium concentration are listed in table (3). In the two seasons, the mean values of potassium concentration significantly decreased with reducing the amount of irrigation water. It was 0.892, 0.876 and 0.840% in the first season. On the contrary, Lavee et al (2007) stated that, potassium concentration of Muhasan olive cultivar doesn't affected with reducing the irrigation water to 50% from control. Data also show that, the mean values of potassium concentration significantly increased with increasing the ratio of organic fertilizer in fertilization treatments, the highest value of potassium were recorded under F_5 treatment (0.888 and 1.321%) in the two seasons. Hegazy *et al.* (2007) reported that, potassium contents in olive leaves significantly increased with applying 100% poultry manure as organic fertilizer.

The interaction effect between irrigation and fertilization treatments on potassium concentration (irrespective of olive cultivars), data reveal that the highest potassium concentration value is record by the (F_5 I_1) treatment , (0.928 and 1.445%) in the first and second season , respectively .There is a clear trend of potassium concentration and there is a significant effect of the interaction between treatments obtained in the two seasons. This finding is in close agreement with those of Ali and El- Mekawy (2006) studied the combination effect between chemical fertilization, compost, and farmyard manure and their combination with three irrigation water rates on leaves potassium concentration, they reported that, there is no significant effect of this treatments on potassium concentration of Matricaria chamomilla cultivar.

Concerning the interaction effect between cultivars and fertilization treatments, data indicates that, potassium concentration significantly affected in the two seasons. These results are quite in agreement with the finding of Abou El-Khashab *et al.* (2005) who stated that, application of farmyard manure slowly increased potassium content during the two seasons compared with the other treatments .

Calcium

Data presented in table (4) reveal that, a significant increase in Leaves calcium concentration with increasing irrigation water amount, it was1.402, 1.268 and 1.067% in the first season and 2.152, 1.843 and 1.545 % in the second season. These results are in agreement with the findings of Sourour (2003) who reported that, irrigating olive trees every 15 days caused a significant decrease of leaves calcium concentration compared with irrigation every 20 days. Also, Hussein (2008) found that**,** increasing irrigation level from 25 to 35 m^3/tree / year, significantly increased leaves calcium content of olive tree 7 years old.

Concerning the effect of fertilization on leaves calcium concentration, organic treatment (F_5) gave the highest value of calcium concentration in the two seasons. The leaves calcium concentration significantly increased as a result of increasing the ratio of organic fertilizer in the different fertilization treatments in both seasons. Such results are confirmed with the findings of Sourour (2003) who indicated that nitrogen fertilization as ammonium nitrate significantly decreased calcium in leaves of Picual cultivar. In the first season Kronaki olive cultivar gave

high calcium concentration 1.325% compared with Picual olive cultivar 1.166%. While in the second season calcium concentration recorded 1.822 and 1.871% for Picual and Kronaki, respectively. Girigs (2005) found that Koronaki olive cultivar has the highest value of leaves calcium content during the growing seasons.

Table 3: Effect of irrigation and fertilization treatments on leaf potassium concentration of two olive cultivars in the two seasons.

Cultivars (V)	fertilization (F)	2012			Mean	2013			Mean
		Irrigation (I)				Irrigation (I)			
		100%	66%	33%		100%	66%	33%a	
Kronaki	F_1	0.851	0.830	0.805	0.829	1.183	1.005	0.942	1.043
	F_2	0.880	0.864	0.819	0.854	1.297	1.191	0.961	1.150
	F_3	0.896	0.883	0.843	0.874	1.382	1.211	1.004	1.199
	F_4	0.900	0.898	0.858	0.885	1.427	1.301	1.111	1.280
	F_5	0.931	0.906	0.875	0.904	1.596	1.406	1.241	1.414
Mean		0.892	0.876	0.840	0.869	1.377	1.223	1.052	1. 217
Picual	F_1	0.734	0.704	0.675	0.704	1.121	1.023	0.970	1.038
	F_2	0.767	0.744	0.721	0.744	1.154	1.069	0.994	1.072
	F_3	0.844	0.803	0.767	0.805	1.196	1.183	1.060	1.146
	F_4	0.860	0.832	0.898	0.863	1.221	1.177	1.126	1.174
	F_5	0.924	0.855	0.834	0.871	1.297	1.213	1.173	1.228
Mean		0.826	0.788	0.779	0.797	1.198	1.133	1.065	1.132
	F_1	0.793	0.767	0.740	0.767	1.152	1.014	0.956	1.041
	F_2	0.824	0.804	0.770	0.799	1.226	1.130	0.978	1.111
	F_3	0.870	0.843	0.805	0.839	1.289	1.197	1.032	1.173
	F_4	0.880	0.865	0.878	0.874	1.324	1.239	1.119	1.220
	F_5	0.928	0.881	0.855	0.888	1.445	1.305	1.207	1.321
Grand mean		0.859	0.832	0.810		1.287	1.178	1.058	
L.S.D 0.05 I = 0.0038*** F=0.004*** V= 0.002*** I*F=0.0076*** I =0.005*** F=0.004*** V= 0.0029 *** I*F=0.007*** I*V=0.0033*** F*V=0.042*** I*F*V=0.0073*** I*V=0.005*** F*V=0.0066*** I*F*V=0.0114***									

Table. 4: Effect of irrigation and fertilization treatments on leaf calcium concentration of two olive cultivars in the two seasons.

Cultivars (V)	fertilization (F)	2012			Mean	2013			Mean
		Irrigation (I)				Irrigation (I)			
		100%	66%	33%		100%	66%	33%a	
Kronaki	F_1	1.389	1.308	1.047	1.248	2.021	1.739	1.551	1.770
	F_2	1.417	1.317	1.182	1.305	1.904	1.739	1.645	1.763
	F_3	1.489	1.427	1.197	1.371	2.186	1.857	1.629	1.891
	F_4	1.411	1.387	1.104	1.301	2.233	1.974	1.535	1.914
	F_5	1.470	1.473	1.263	1.402	2.538	1.786	1.723	2.016
Mean		1.435	1.382	1.159	1.325	2.176	1.819	1.617	1.871
Picual	F_1	1.167	1.109	1.038	1.105	2.115	1.974	1.410	1.833
	F_2	1.392	1.089	0.912	1.131	2.279	1.786	1.442	1.836
	F_3	1.473	1.170	0.969	1.204	2.162	1.625	1.420	1.736
	F_4	1.414	1.191	0.927	1.177	1.827	1.761	1.516	1.701
	F_5	1.395	1.206	1.035	1.212	2.256	2.185	1.575	2.005
Mean		1.368	1.153	0.976	1.166	2.128	1.866	1.473	1.822
	F_1	1.278	1.209	1.043	1.176	2.068	1.857	1.481	1.802
	F_2	1.405	1.203	1.047	1.218	2.092	1.763	1.544	1.799
	F_3	1.481	1.299	1. 083	1.288	2.174	1.741	1.525	1.813
	F_4	1.413	1.289	1.016	1.239	2.030	1.868	1.526	1.808
	F_5	1.433	1.340	1.149	1.307	2.397	1.986	1.649	2.011
Grand mean		1.402	1.268	1.067		2.152	1.843	1.545	
L.S.D 0.05 I =0.041*** F=0.0058*** V=0.0012 *** I*F=0.010*** I =0.0016*** F=0.0033*** V=0.0022 I*F=0.0056*** I*V=0.0021*** F*V=0.0027*** I*F*V=0.0047*** F*V=0.0049** I*F*V=0.0085 I*V=0.0038***									

Under all fertilization treatments decreasing the amount of irrigation water reduced the mean values of calcium concentration. While generally under all different irrigation treatments increasing the ratio of organic fertilizer of the fertilization treatments increased the mean values of leaves calcium concentration. Hussein (2002) found that, increasing irrigation rate and nitrogen fertilization significantly increased leaves calcium contents

under drip irrigation system. Such increase may be attributed to increasing of vegetative growth and improvement of water and nutrient absorption.

Yield

Irrigation treatments (I_3) 33% of ETc gave the lowest yield value (5.653Kg/ tree) while the treatment I_2 (66% of ETc) gave the highest one (9.162 Kg/tree) , the data in table (5) show also that, fruit yield significantly decreased with reducing the irrigation water levels . Alegre *et al.* (1999) showed that, decreasing water requirements for olive trees Arbequina reduced the production and number of fruit per tree. In Tunisia Ben Ahmed *et al.* (2007) compared the effect of three irrigation treatments 0, 33 and 66% of crop evapotranspiration (ETc) on the yield of Chemlali olive cultivar 12-years-old grown under semi-arid conditions. Results revealed that, the average of olive production for trees grown under rain-fed conditions (26 Kg/ tree) was much lower than those which obtained when applying the different irrigation treatments 33% (35Kg /tree) and 66%(37 Kg /tree). Grijalva-Contreras *et al.* (2013) reported that, applying 50%of ETc significantly reduced fruit set and table olive yield, and application of 75% gave similar table olive yield compared with control (100% of ETc) .

The fertilization F3 (50% chemical fertilizer + 50% organic fertilizers) gave the highest yield 8.399 Kg/tree, these value decreased with increasing the ratio of chemical or organic fertilizers. Generally, statistical analysis show also that, fruit yield was significantly affected by fertilization treatments. Maksoud *et al.* (2012) revealed that, application of 30% of different organic composts increased the fruit yield of olive cultivar.

The results indicated a significant difference between the two olive cultivars of fruit yield. These results confirme with those of Samra *et al.* (2009) who reported that, Kronaki olive cultivar presented a highly significant yield per tree and per Feddan than Toffahi and Picual cultivar, the increased of yield may be due to this cultivar had a higher percent of fruit set with lower fruit dropping compared with Toffahi and Picual olive cultivars.

Concerning the interaction effect between irrigation and fertilization treatments, data indicate that, irrigation treatment (I_2) recorded the highest yield under all fertilization treatments. Patumi *et al.* (2002) reported that, using irrigation level of 66% of ETc significantly increased the fruit yield compared with control. Moreover, Pierantozzi *et al.* (2014) showed that, irrigated trees with (75% and 100% of ETc) produced highly significant fruit yield, and fruit yield of Arbequina cultivar more than. Manzanillo cultivar as compared to non-irrigated trees.

Table 5: Effect of irrigation and fertilization treatments on fruit yield of the two olive cultivars .

Cultivars	Fertilizers	Irrigation			Mean
		100%	66%	33%	
Kronaki	F1	9.550	9.250	5.600	8.133
	F2	9.700	10.105	6.600	8.802
	F3	9.950	10.40	6.950	9.100
	F4	8.397	9.722	6.350	8.157
	F5	8.040	9.55	5.900	7.830
Mean		9.127	9.806	6.280	8.400
Picual	F1	7.002	8.00	4.535	6.512
	F2	7.727	8.700	5.165	7.197
	F3	8.415	9.100	5.582	7.699
	F4	6.800	8.500	5.000	6.767
	F5	6.500	8.300	4.845	6.548
Mean		7.289	8.520	5.025	6.943
	F1	8.275	8.625	5.067	7.322
	F2	8.714	9.402	5.882	7.999
	F3	9.183	9.750	6.266	8.399
	F4	7.599	9.111	5.675	7.461
	F5	7.270	8.925	5.372	7.189
Grand mean		8.208	9.162	5.653	
L.S.D 0.05	I=0.192 *** F=0.295***	V=0.206***	I*F=0.511**	I*V=0.357* F*V= ns	I*F*V= ns

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