

# Evaluation of shoot growth and fruit characteristics of eight olive cultivars under low irrigation condition

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**Abstract:** Mediterranean climate are suitable for cultivation of olive . Olive tree was resistant to unfavorable environmental conditions, especially drought stress. In this research compatibility of different olive cultivars in low irrigation conditions was studied. Eight olive cultivars including Abu-Salt, Lucas, Mari Tarom, Khadiri, Mari Gorgan, Manzanillo, Konservalia and Fuji were cultivated at Kazeroon Olive Research Station in Fars province in Iran. In the a randomized complete block design with 3 replications vegetative growth of and fruit characteristics were evaluated. The results showed that Konservalia cultivar had moderate shoot growth under low irrigation conditions. The yearly growth of the branch was 37 cm, the average diameter of the trunk was 26 cm and the mean width of canopy was 123 cm. Konservalia had a good productivity and was superior to most of the cultivars Mean fruit weight of this cultivar was 4 grams and produced about 5 kg fruit per tree.

**Key word:** olive, drought, cultivars, yield, vegetative growth

## 1 introduction

Olive (*Olea europae* L.) is a tropical and ever green plant. This tree have a good adaptivity to different climatic conditions. Cultivation of Olive tree in arid and semi-tropical regions with high temperature and low rainfall causes some problems in shoot growth, fruit quality, yield and oil content. Different varieties of olive have a different reaction to change in climate condition [6]. Studies in recent years have shown that canning olive varieties are better adapted and have better fruit quality in warm region than oil cultivars, while oil production in fruit is affected by high temperature and genetic factors [13]. In addition to heat, lack of water in these areas is the factors that can affect the growth of the plant and fruit quality. Many studies have been done on the growth of olive tree under low irrigation conditions and its effect on yield and oil productivity. Drought stress could affect flowering, fruit growth and harvest time [17, 20]. Reducing irrigation affects fruit characteristics, such as dry weight and oil percentage [17]. Also showed that the decrease in irrigation water resulted in a decrease in fresh weight and fruit size [19]. There were also reports on the effects

of drought stress on other plant characteristics such as photosynthesis [23, 4] skin thickness [18] fruit quality [12] and performance of tree [16]. The studies of olive cultivation in other countries or olive areas shows that olive mainly cultured in rain fed conditions with use of supplemental irrigation water .

## 2 Materials and methods

This research was carried out at the Kazeroon Research Station with a height of 900 meters above sea level for 8 years. The region has a semi-tropical climate with a maximum temperature of 45 degrees centigrade, and rarely frost in the cold seasons. Soil of region was silty clay loam. Other soil characteristics are given in Table 1.

Seedlings of eight olive cultivars including Abu-Salt, Locus, Mari Tarom, Khadiri, Mary Gorgan, Tufaei, Manzanillo and Konservalia cultivars were cultivated in a randomized complete block design with 3 replications with 6 × 8 m intervals. In the first year, trees were irrigated by drip irrigation system with seven-day irrigation intervals with 64 liters per tree. In the second and

third year, irrigation intervals increased to 15 and 30 days, so that from the fourth year, only in early July, the trees were once irrigated. Vegetative characteristics such as yearly shoot growth, trunk diameter, canopy width and lateral branches growth were measured. Also, fruits characteristics included fruit weight, kernel weight, fruit length and diameter, volume of fruit

, seed to pulp ratio and yield were measured. The results of each year evaluated and compared by using the MSTATC software and the mean of the traits were compared with Duncan test. After the end of the experiment, the combined data analysis was carried out over eight years and finally the most suitable cultivar was selected.

**Table 1 Physical and chemical soil properties Kazeroon olive research station**

pH	EC (ds/m)	T.N.V (%)	Cu (mg/kg)	Fe (mg/kg)	Mn (mg/kg)	Zn (mg/kg)	K (mg/kg)	P (mg/kg)
7.8	0.8	28	0.4	7.5	5.5	0.7	265	9

### 3 Results and discussion

#### 3.1 Vegetative growth

Khadiri cultivar had the highest annual growth (42.30 cm), which had a significant difference with all cultivars except Konservalia (in 5%). Mari Gorgan had the lowest annual growth (20.95 cm). In this experiment, tofahi had a the highest trunk diameter of 83.9 cm, which had not significant differences(5%) with Monzanillo (6.65 cm) and Konservalia (8.46 cm)

The highest increase in canopy width was for Manzanillo (31.36 cm) which had significant different with Abu-Salt and Mary Gorgan cultivars at 5% level. The highest length of shoots was in the Tofahi and Konservalia (23.28cm), which had a significant difference (at 5% level) with Locus, Khadiri, Abu Salt and Mari of Gorgan. Evaluation of vegetative growth of cultivars in experimental area, shows that

vegetative growth can be influenced by genetic factors (variety type) and growth conditions such as water supply and temperature. Reducing irrigation causes the leaf stomata to be closed and affect photosynthesis activity [8] and finally reduced vegetative growth [2]. The response of olive cultivars to different irrigation regimes was different [3,15]. In our experiment Konservalia and Manzanillo less affected to drought stress than Abu Sastal. Reduction of vegetative growth can be related to factors such as chlorophyll content in leaf, reducing photosynthesis rate [21], as well as reducing the osmotic condition in drought stress

**Table 2 Vegetative characteristics of 8 olive cultivars in low irrigated condition**

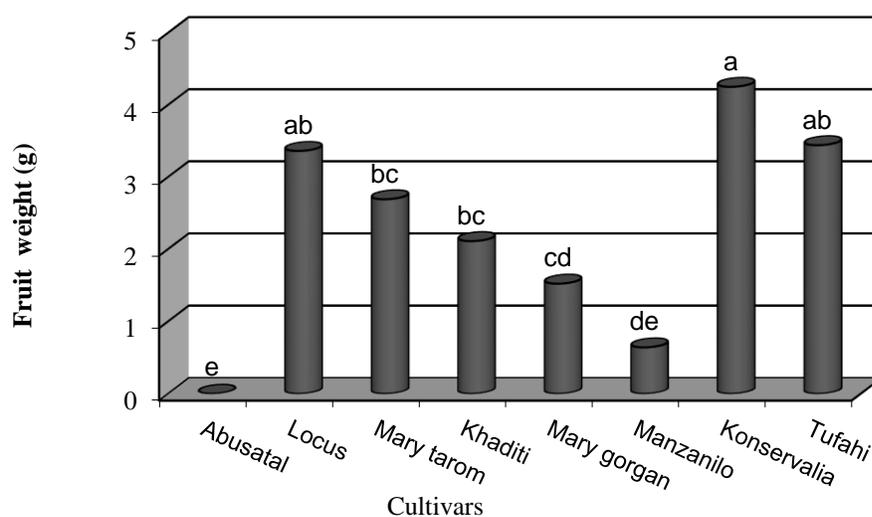
cultivar	Shoot growth (cm)	Canopy diameter (mm)	Trunk diameter (cm)	Increaseing tree hight (cm)
Abusatal	14.65 Ef*	62.30 efg	5.33 c	29.37 bc
Locus	18.29bcd	74.71 a-e	5.41 c	23.75 c
Mary tarom	20.66ab	79.85 a-d	7.33 b	30.38 b
Khadiri	17.49 b-f	74.59 a-e	5.17 c	42.30 a
Mary gorgan	14.47 f	58.94 g	4.48 c	20.99 c
Manzanilo	21.43 ab	86.31 a	9.65 a	30.79 b
Konservalia	23.38 a	77.22 a-e	8.46 ab	36.80 ab
Tufahi	23.38 a	75.93 a-e	9.83 a	29.98 b

\* Values with different letters (in column) are significantly different at 5% level of probability using Duncans test .

### 3.2 Fruit characteristics

Konservalia had the highest fruit weight (4.25g), which had no significant difference (at 5% level) with Tufahi and locus, but it had a significant difference with other cultivars (Fig. 1) Konservaia has a good adaptation to the warm climatic condition of Fars province, so it is also suitable for planting in this region in irrigated conditions [9]. This cultivar in other areas has also favorable fruit growth and yield,

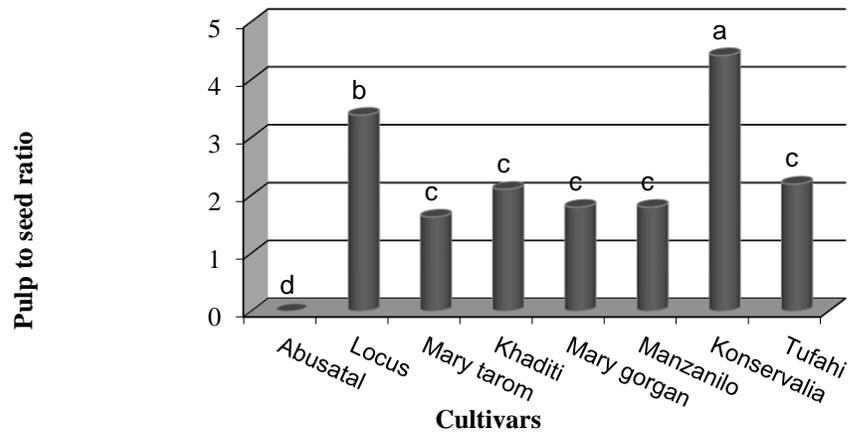
with suitable fruit size [7]. In this regard, some researcher reported that Konservaia is one of the cultivars adopted to drought condition [7,5]. Although some reports showed that drought stress has reduced fruit yields [1,11] and photosynthesis efficiency [5,22], which ultimately affects the amount of carbohydrate production and reduces fruit size and yield.



**Fig. 1 Mean fruit weights of 8 olive cultivars in low irrigation conditions.**

In relation to other fruit characteristics, the results showed that there were significant differences in among the cultivars, so that the highest fruit length was 2.40 cm in Mari Taron, with significant differences with Khadiri and Manzanilo cultivars. The highest diameter and volume of fruit were found in Konservalia cultivar, which was 1.86 cm and

4.4 cm<sup>3</sup> respectively (Table 3). The results of this study show that under low irrigated condition, the Konservalia had the best compatibility among the cultivars. Abu Salt was very sensitive to dehydration and did not produce an economical product.

**Table 3 fruit characteristics of 8 olive cultivars in low irrigation condition**

cultivar	Fruit	Fruit length	seed weight	Fruit value
Abusatal	0.0 e	0.0 d	0.0 d	0.0 e
Locus	1.83 a	2.33 ab	0.85 ab	3.4 ab
Mary tarom	1.33 bc	2.4 a	1 a	2.6 bc
Khadiri	1.36 bc	2 b	0.86 ab	2 bcd
Mary gorgan	1.1 cd	2.03 ab	0.54 bc	1.7 cd
Manzanilo	0.86 d	1.4 c	0.23 cd	0.73 de
Konservalia	1.86 a	2.25 ab	0.78 ab	4.4 a
Tufahi	1.46 b	2.31 ab	1.05 a	3.13 ab

\*Values with different letters (in column) are significantly different at 5% level of probability using Duncans test

**Fig. 2 Pulp to seed ratio of fruites of 8 olive cultivars in low irrigation condition.**

Pulp to seed ratio was also an important feature of canned olive cultivars. Konservalia had the highest ratio with significant difference with other cultivars.

Regarding the fruit production of cultivated cultivars, the results showed that the konservalia with the average yield of 5 kg fruit/tree had the highest yield, which showed a significant difference with other cultivars. Other cultivars did not have a good performance and their fruit production was very low, so that Abu Sastal did not produce any fruit in low irrigated condition. (fig.3)

Reduction in yield as a result of reduced water content has been reported[16]. During drought stress period, amount of proline and soluble carbohydrates in the olive tree increases[5]. This related to varieties. Also, during the drought stress, photosynthesis activity and osmotic pressure of the cell decreased and changes occurred in the leaf cell anatomy[10, 24]. Also drought stress reduces chlorophyll content of leaves and consequently the activity of photosynthesis decreases, which directly affects shoot growth and yield of tree [23].

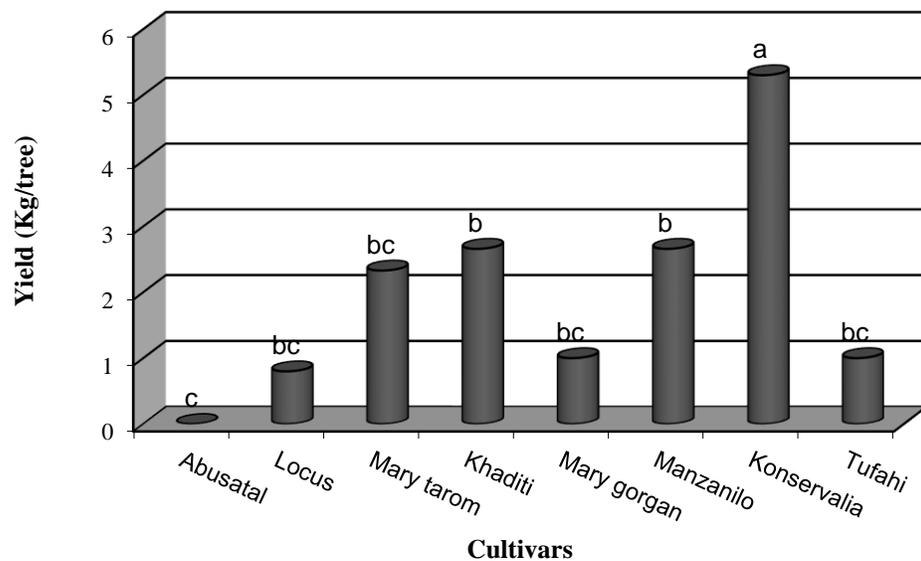


Fig 3. Comparisons of fruit yields of 8 olive cultivars in low irrigation conditions.

#### 4 Conclusion

Konservalia is one of the cultivars which has a good adaptation to the warm and dry conditions of Iran [6]. Evaluation of the fruit quality and productivity of this cultivar under low water conditions also indicate high tolerance of this cultivar to drought stress, while other cultivars produced very

little fruit in this condition. Adaptation of Konservalia to warm condition of Iran also in irrigation conditions[9] and in other location [13]. Konservalia with medium growth and suitable fruit weight (about 4 g) and pulp/seed ratio about 4 have the desirable characteristics of cultivar for

canning or oil production in semi-arid regions of Iran. However, some of the cultivars were severely subjected to low water conditions, so that Abu Sastl was considered as one of the most desirable cultivars in this region in irrigated condition [9], However, under low water conditions,

vegetative growth rate fell sharply and did not produce fruit. Therefore, different varieties of olive have great differences in terms of irrigation regims. this results were same to reports by other researcher [5,16] .

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