

IRRIGATION AFFECT ON OLIVE YIELD AND SOME RECOMMANDATIONS FOR WELL INCOMES OF PRODUCERS

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Abstract

The aim of study was to evaluate irrigation effect on olive fruit yield as well as giving some practical recommendations for better incomes of farmers. Olive trees have focused on widely in Mediterranean region. There are two main reasons of olive tree plantation in such areas: first, almost whole parts of trees are used for different purposes, and second, sloped lands, in general not suitable for field crop production, is a good alternative for olive plantation. Although fruit yield is lower in rain-fed farming, most olive trees have been under rain-fed condition. By comparison to rain-fed farming, fruit yield is about two fold higher in irrigated olive trees. In Mediterranean region, fruit yield was observed as about 50% lower in 2013 than 2012 in irrigated lands. The main reason was periodicity that is very common event in olive trees. One of the main problems faced in olive gardens especially Mediterranean region was that some drip systems have been taken out since they have not properly designated, installed and managed even some farmers have used surface irrigation methods. To increase fruit yield, water should never be deficit in critical periods especially in stages of seed hardening and fruit color formation. Almost none or very few table olive factories are present in Mediterranean region of Turkey so farmers have to sell fruits to oil factories with a low price. This has resulted reducing incomes of farmers. For high production, irrigation program should be based on by considering crop growth stages. In addition, high efficient irrigation systems such as drip and mini-sprinkler should be used with well management especially in water shortage areas.

Key words: Irrigation, olive, fruit yield, water shortage, production.

1. INTRODUCTION

Agriculture plays an important role in socio-economic development in Turkey. The agriculture expansion is mainly relied on available natural resources, especially on water.

There is an increasing interest in olive tree and its products in many areas of the world. The reasons for such popularity are not only agronomic and therefore economic, but also related to the environment and human health. The tolerance of olive tree to drought and its capacity to grow in shallow, poor quality soils, make the species among the most interesting for cultivation in arid and semi-arid areas (Fernandez & Moreno 1999).

Olive trees grow well in warm temperatures, and cannot tolerate extreme climatic condition. Harvesting and processing of olives are performed about between November and March in Mediterranean regions.

Plant can suffer severe damage from temperatures below -12 °C, or at higher temperature if exposure is longer. High temperatures before and during bloom may reduce fruit productivity substantially (Hartmann & Opitz 1980).

It is a symbol crop in the Mediterranean region and is moderately salt tolerant plant. Spain, Italy, Morocco, Greece and Turkey are the main five olive plantation countries, having over 6 260 000 ha. In Turkey olive planted land was about 742 700 ha in 2010 but it was reached up about 805 500 ha in 2012 (FAO 2012).

Olive trees are also landscape outdoor plants in luxury houses as well as comfortable hotels for the Mediterranean Countries. Since, they have charming green color in whole year. Even, it stands about 2000 years without deteriorations and irrigation, only based on rain-fed. Olive plant is also accepted as Holy plant for Muslim world.

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The most common Turkish olives are Memeli, Domat and Izmir Sofralik, grown in the Marmara, Aegean, Mediterranean and Southeast Anatolia regions. Small sized black olives are mostly eaten for breakfast in Turkey. The olive most commonly used for olive oil in Turkey is called Edremit. 'Ayvalık' and 'Gemlik' olive trees compose 20% and 11% respectively of olive trees in Turkey, with Memecik olive trees being the most common as 45% (Öztürk et al. 2009).

In olive plants, yield components are shoot growth, fruit load, fruit size and distribution, and oil content. Proper irrigation is important for shoot growth or bloom, fruit sizing and total yield. About 90% of the world production of olive fruit is for oil extraction, the remaining 10% for table olives with an average yield of 2.1 ton/ha (FAO 2011).

Agriculture is the highest consumer of water in the Mediterranean region and more than 80% of available water resources are allocated to irrigation (Laraus 2004). Celano et al. (1999) stated that olive trees respond efficiently to irrigation management.

The long term observations showed that 600 – 800 mm rainfall is necessary for higher fruit yield. Yield of olive trees depends mainly on environmental resources and the agronomic techniques. In areas characterized by Mediterranean climate, low water availability is generally the major limiting factor. In the Mediterranean region water availability is generally limited and the distribution of precipitation is concentrated in winter, while in many areas almost total absence of summer rainfall exposes the plant to severe and prolonged deficits. This condition results reduction of yield potential and vegetative growth.

It is necessary in intensive plantations with densely planted trees for maximum production as well as better income. One of the most important reasons of olive plantation increment is using of about whole parts of the trees such as olive oil, table olive, and soap industry as well as using branches and trunks in heating. In addition, long harvest period was also favorable advantage for farmers.

When using different micro irrigation systems which apply different application irrigation methods the trickle irrigation systems may be considered as appropriate under well management to maintain best morphological characters for olive trees, uniform water distribution, sufficient available moisture, acceptable soil salinity levels in the trees root zone, and high yield efficiency.

The aim of study is to evaluate irrigation or water stress effect on olive fruit yields and giving the some recommendations for better incomes of olive producers.

2. IMPORTANCE OF IRRIGATION FOR OLIVE PLANTS

Irrigation is required when: the rainfall in the area is inadequate, there is enough rainfall distributed only during the winter, leaving soil without humidity in the critical periods of spring and autumn and soil is sandy or gravelly with low water retaining capacity. Growth stages of olive tree are considered for a correct water management in orchard. Fruit size and number of fruits per plant are positively affected by irrigation. During the fruit development stages, water stress entails a slow-down in growth which, if it persists throughout the period of cell enlargement growth, causes in small fruits. Fruit yields are low, ranging from less than 1 up to 5 tones/ha of olives. In areas of annual rainfall higher than 600 mm, production can be maintained under rain-fed conditions. Irrigation plays an important role to stabilizing yields in the years of low rainfall. Irrigation is becoming common in the intensive orchards as it allows early onset of production as well as high yields (averages up to 10-15 tone/ha) under optimal conditions. It is essential in following cases for olive trees (Jasim 2013): - When the rainfall in the area is low, - When the soil is sandy or gravelly with low water holding capacity, and In table olive varieties where large fruit size is required.

Irrigation also enhances the effectiveness of fertilization and pruning. It may minimize phenomenon of alternate bearing. Best management practices for olive irrigation will likely depend on ability to maintain mild to moderate levels of water stress during at least some parts of the growing season (Ben-Gal et al. 2009). Oil content in rain-fed condition was similar or even greater than irrigated trees. Such increase in fruit oil content in water-stressed trials may be explained by release of stress during the last period of oil accumulation in fall and by the lower fruit numbers per tree (Patumi et al. 1999). Clinton et al. (2004) stated that maximum yield requires a uniform moisture distribution and maintaining high and none-fluctuated soil moisture within the root zone. Nassar (2009) compared the effects of different irrigation techniques on some quality parameters of olive trees (*Olea europaea* L, *Calamata* cv.) and reported that efficiency of trickle irrigation system in olive trees growing where the trees height (cm) increased by 10 and 9.2%, stem diameter (mm) increased by 6 and 14%, shoot

number per tree increased by 8 and 14%, leaves number per tree increased by 13 and 17%, shadow area (cm²) increased by 6 and 13% compared with bubbler and micro irrigation system respectively.

In coastal parts of Mediterranean region of Turkey, depending on the climate, irrigation has started about in 15 May-1 June and ended in 15-30 September. In our present research, it was observed that irrigation had positive effect on fruit yield and quality. The fruit yield was found two fold in irrigated trees than rain-fed plants. By comparison to 2012 and 2013 fruit yield in Mediterranean region of Turkey, it was observed that yield was about 50% lower in 2013 than 2012 in irrigated lands. In mature, about 10 years old olive tree, the average yield was 40 kg/tree in 2012, but it was 20 kg/tree in 2013 in irrigated olives. The reason of lower amount of fruit yield might be related to periodicity event in 2013. In addition to higher fruit yield, fruit size was found greater in irrigated olive plants.

Irrigated olive orchards were observed more productive by increasing shoot growth, flowering, and fruit set and reduced biennial bearing and fruit drop (Inglese et al. 1996). Water availability also improved the commercial value of table olives by increasing fruit size (Proietti & Antognozzi 1996). Our research findings are in-line with the previous studies conducted by Inglese et al. (1996) and Proietti & Antognozzi (1996). In our research regions, high temperatures and dry winds mostly result little fruit formation, dropping young leaves as well as low quality fruits on the plants. Depending upon the regions, olive plants are very sensitive to water stress especially in periods of seed hardening. To obtain high amount of fruit yield with qualified, irrigation applications should never be postponed especially in stages of seed hardening and fruit color formation. Table 1 shows critical periods of soil moisture contents for olive plants.

Table 1. Critical periods of olive plants to low soil moisture contents (Anonymous 2007).

Olive Growth Stages	Effect of Low Soil Moisture Content
-Shoot growth	-Reduced shoot growth
-Flower bud development	-Reduced flower formation
-Bloom	-Incomplete flowering
-Fruit set	-Poor fruit set, increased alternate bearing
-Fruit growth stage 1: cell division	-Reduced fruit size due to decreased cell division
-Fruit growth stage 2: pit hardening	-Minimal impact on fruit size
-Fruit growth stage 3: cell enlargement	-Reduced fruit size due to decreased cell expansion
-Oil accumulation	-Reduced fruit oil content

A research conducted in California, Spain, Italy, Israel and other locations showed that the most appropriate timing for applying water stress is during pit hardening in the second stage of fruit growth. However, this will result only minimal water savings (Anonymous 2007). To obtain sustainable olive production, soil water should be measured first correctly and then right amount of water should be applied. It is also very important to determine the water requirements of olive plants according to growth stages. In our research site, it was observed that none farmers have measured the soil moisture contents for determination of irrigation time. They usually have decided by their local experiences such as measurement air temperature or looking at to the leaves of olive trees. Therefore, they have required practical guide for irrigation water management of olive trees. In Mediterranean countries, almost climate is similar so irrigation program, resulting practical solutions, should be made and recommended for olive producers. For well irrigation water management, it is very beneficial to get information from people who are experts in olive irrigation.

3. STRATEGIES FOR WELL INCOMES OF OLIVE FARMERS

In 2013, olive oil or olive fruit prices increased about 20% due to the lower fruit yield as well as low olive oil production. Even, in local perspective some customers could not find the olive needs or they have bought less oil. Those situations have negatively affected producers. In some farms, little or almost none fruits were

harvested so that under those circumstances olive farming seems not sustainable. Like Adana province of Turkey, water management in agriculture has governed by private organizations and seasonal irrigation water cost was about 20 USD per ha in 2013. For efficient water use in agriculture water cost should be allocated by m³ basis. The other problem in such organizations is that almost none qualified workers are employed about irrigation water management. Therefore, they should have employed person having well experienced about agricultural water management. In addition, comparison to EU countries, none-processed olive fruit price was lower in Turkey. Farmers had to sell olive fruits even good quality for oil as about 1,37 US\$/kg and 1,60 US\$/kg in 2012 and 2013 growing seasons, respectively. To improve incomes of farmers, new cooperatives and related organizations should be built and they may also be supported by both government and farmers. In Mediterranean coastal parts of Turkey, almost none factories processing table olive are present. Thus, farmers have to sell olive fruits for only olive oil production. Especially in Mediterranean region of Turkey, farmers do not require advisory service from the person who is very specialist in olive farming. They mainly have continued production by conventional systems or by their own capabilities. The other one of the main problems in olive gardens in Mediterranean region of Turkey that some of the drip systems have taken out since they have not properly designated and installed. Although good quality irrigation water is applied, most systems have not worked properly. Therefore, in some gardens, farmers have still applied water to the plants by use of surface irrigation systems such basin irrigation. Drip irrigation system should be planned and installed by professional person for efficient irrigation. In such system, timely maintenance and repair should be recommended for uniform water distributions to the whole plants. In addition, there is no government subsidize for farmers about new planting of olive gardens. In most, olive production has been rain-fed farming especially in Mediterranean region of Turkey since water resources are limited or far from the olive planted lands. Taking water from far results higher irrigation or production cost. Government subsidize is available in application of pressure irrigation techniques for olive irrigated lands and such subsidize should be continued.

4. CONCLUSION AND RECOMMENDATIONS

Irrigation plays an important role for stabilizing yields in the years of low rainfall. Unstable price was found one of the most important factors limiting increase of olive planted lands. The optimization of irrigation management practices needs more studies to be done on olive tree response to water stress. For obtaining proper irrigation program, different growth stages of olive trees should be determined correctly since those stages may vary region to region. For better irrigation water management, it is advisable to get practical information from people who are experts in olive irrigation. If the farmers' goal is to get high and qualified yield, full irrigation is highly advisably but, if the target is to put more area into irrigation in water shortage areas, deficit irrigation can be recommended by considering the critical growth stages of olive trees.

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