ASSESSMENT OF SPRINKLER IRRIGATION SYSTEMS USED FOR PEANUT IRRIGATION IN MEDITERRANEAN ZONE, TURKEY

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Abstract

This study was conducted to evaluate irrigation practices of sprinkler-irrigated peanut farms at Kadirli-Osmaniye province of Turkey. The seasonal number of irrigation in the examined farms varied from 3 to 5. Sprinklers with double nozzle had flow rates ranging from 1.5 to 2.2 m^3/h. The average rate of sprinkler precipitation was found as 13 mm/h with a 20 h of water application under four irrigation events to the peanut during whole growth cycles, and seasonal applied irrigation water was around 314 mm. Average net grain yield was between 3.15 and 3.50 t/ha. Total labor and irrigation energy costs were 200 USD/ha and 158 USD/ha, respectively. The sprinkler irrigation system was found well suited for peanut irrigation. High quality management of irrigation water resources is necessarily prerequisites for sustainable agro-production particularly at water shortage agro-zones.

Key words: Peanut, Sprinkler Irrigation Systems, Irrigation Cost, Water Management

Agriculture is the maximum freshwater withdrawal in the world general and water resources should be used more consciously particularly in water shortage ecosystems. Correct irrigation program is necessarily prerequisites for effective utilization of current water resources (Shahnazari *et al.* 2007). Nearly 70% of water resources are used for irrigation purpose in Turkey, and water shortage is very important role to play in agricultural production particularly at arid or semi-arid environments. In those regions irrigation has great contribution on agro-production (Yavuz *et al.* 2014). Pressurized irrigation systems have resulted better water distribution uniformity as well as water economy leading to high and quality yields under well management (Jalal Jalal and Acar, 2018). Sprinkler irrigation system is well adapted for various soil, topography and field crops. It is obvious that due to the causing high water application efficiency, more cultivated areas could be brought under irrigation by using sprinkler irrigation method under proper management (Acar and Sevinçer, 2020). Beside that deficit irrigation is another applicable alternative to improve water productivity in water scant climates (Acar *et al.* 2014). Efficient energy usage is of great interest in reducing the expense of agro-production, i.e. irrigation absorbs the most energy, with a share of approximately 44% of total inputs in drip-irrigated potato farming in Konya plain. Savings in energy or irrigation water are vital important for increasing the water productivity particularly water limited environments such as Konya plain of Turkey (Yavuz *et al.* 2016; Yavuz *et al.* 2020). In next 20-30 year, about 70-100% agro-production increase will be needed and that increase will be obtained as 80-90% and 10-20% from current and improved soils, respectively (Sri Ranjitha *et al.* 2018).

In Turkey, peanuts are cultivated for use as appetizers in most and sprinkler irrigation systems are applied to irrigate peanut plants in the Mediterranean region of Turkey. Miningou *et al.* (2021) stressed that peanut cultivar should have high techno-demands such as reliable shelling rate, high seed weight, and minimum or almost none grain damages. The peanut growing cycles vary from 90 to 115 days, and from 120 to 140 days for early and late varieties, respectively. Depending on the ecosystem, water needs of such plant range between 500 and 700 mm (Barbieri *et al.* 2017).

In peanut farming, production depends on cultivar, soil properties such as water intake rate, useful water holding capacity, the level of water and fertilizer applications, and application efficiency of current irrigation system. While the lack of water in the root zone during the vegetation period had little effect on plant growth, the water deficit in the pod filling cycle significantly affected the seed yield and quality negatively (Nautiyal and Narendra, 2004).

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Proper irrigation system design and management have direct effect on high water distribution uniformity consequently maximal peanut production. Acar and Sevinçer (2020) suggested that ideal yield is relevant to correct design, high quality installation of sprinkler irrigation systems, timely and precise maintenance-repair activities, favorable environments as well as adequate agricultural water management. Kuti *et al.* (2019) stated that, among all environmental conditions, wind speed plays a very important role in affecting the water distribution performance of sprinkler irrigation systems. Some authors (Dehkordi, 2014) had agreement that up to 5 m/s wind speed could be acceptable upper threshold boundary for resulting reliable water homogeneity in sprinkler irrigation systems. Jain *et al.* (2018) examined different irrigation interval effects of drip and surface irrigation on water saving level in peanut production under Gujarat, India for three years field experiment. They found that almost 37% water saving could be accomplished by preference of drip irrigation system over furrow irrigation.

Although it is possible to meet some studies relevant to effects of variety, fertilizer program, planting density and cultural practices on yield and quality of peanut, few studies, but no details, about agricultural water management of peanut were available in the literatures. The aim of the present study is, therefore, to assess the irrigation practices of peanut plants at farm levels under the sprinkler irrigation systems for Osmaniye province of Turkey.

MATERIAL AND METHOD

This research was performed in the Osmaniye province, Mediterranean region, of Turkey. In research farms, soils and environment conditions are very favorable for all agro-activities including peanut farming. Due to the rapid increase in market price in recent, peanut farming is getting popularity in this province. In study, 13 farms representing whole peanut growing areas were researched. The main source of irrigation water supply is canals taking water from dam nearby to the study areas (figure 1).

In our study, all peanut production has performed as main crop and sowing date of peanut varied from 1 st to 20 th May. Hand-moved sprinkler irrigation systems operating by tractors have used for peanut irrigation in region. In current study, sprinkler spacing, applied water, seed yield, seasonal diesel and labor costs were researched.

Figure 1 **Water supply canals**

RESULTS AND DISCUSSIONS

Technical Characteristics of Sprinkler Irrigation Systems

Like the other whole irrigation methods, it is obvious that key challenge in the sprinkler irrigation method is also to apply water to crops as uniformly as possible. In can be overcome by accurate design, high quality system installations and proper management at farm levels.

In the examined irrigation systems used of peanut irrigation, the diameter and length of the main lines were 125 mm and 90-288 m, respectively. The lateral diameter and lengths were 75 mm and 108-336 m, respectively. Sprinkler spacing in whole farms were 12x12 m. The flow rates of sprinklers varied from 1.5 m^3/h to 2.2 m^3 / h with double nozzle. In accordance of sprinkler flow rates and sprinkler arrangements of 12x12 m, precipitation rates ranged between 10.4 mm/h and 15.3 mm/h with average of around 13 mm/h. In field observations, we have observed that all farmers have had a great deal of experience with sprinkler irrigation systems on farms, such that all sprinklers had generated reliable distribution of water over cropped land (*figure 2*).

Applied Water

In general, about 1.5 h water was applied by sprinkler system for more uniform standing. In examined farms, including one-irrigation process during emerging cycle, around 4 irrigations were processed for sprinkler-irrigated peanut production. In addition, peanut harvest was performed at certain soil moisture content for getting better production so before the harvest practice, about 0.5 h irrigation water applied onto peanut crops by sprinkler irrigation system. As a result, average 20 h irrigation water was applied to the peanut during the whole growing period. In study 54 mm (1 mm in May, 24 mm in June, 28 mm in July and 1 mm in August) precipitation was received during the vegetation periods May-August 2019. In examined the amount of precipitations, all of them stored within the soil

profile as effective rainfall for crops. By addition of 54 mm rainfall, total applied water was 314 mm (20 h irrigation duration x 13 mm/h sprinkler rate + 54 mm) in research farms. The irrigation interval was about 18-day in period of maximal plant cover. Sri Ranjithi *et al.* (2018) reported seasonal irrigation water for peanut as about 300 mm by drip irrigation system and finding of current study is nearly inline with result of those authors. Barbieri *et al.* (2017) reported as average of 601 mm, resulting maximum yield, for peanut cultivar under water application namely 110% of reference crop evapotranspiration by sprinkler irrigation. Wright *et al.* (2015) stated seasonal water requirement of peanut plant as around 650 mm and this amount is met by rainfall, irrigation and soil moisture reservoir.

Table 1

Characteristics of sprinkler irrigation systems

Farms	Main line		Lateral		Sprinkler Spacing
	Dia-meter (mm)	Length (m)	Dia-meter (mm)	Length (m)	(m x m)
1	125	180	75	288	(12x12)
2	125	120	75	108	(12x12)
3	125	288	75	240	(12x12)
4	125	210	75	180	(12x12)
5	125	240	75	192	(12x12)
6	125	120	75	144	(12x12)
7	125	108	75	108	(12x12)
8	125	180	75	156	(12x12)
9	125	252	75	192	(12x12)
10	125	228	75	204	(12x12)
11	125	240	75	336	(12x12)
12	125	90	75	144	(12x12)
13	125	156	75	168	(12x12)

Figure 2 **Sprinkler irrigation system for irrigation of peanut in research site**

They added that timing of rainfall or irrigation is the most important factor affecting both the yield and quality of peanut plants. In irrigation program, knowing effective root zone depth is very important. In our observation, roots are very intense at upper 45 cm soil depth and have reached to the 100 cm in soil profile so 50 cm soil depth can be acceptable as effective root zone depth for irrigation scheduling of peanut in region.

Seasonal irrigation water is less comparison to the other field crops such as maize and cotton in study region. Therefore, peanut production seems friendship of environment and could be strongly recommended due to the facilitating sustainable use water resources particularly at water shortage zones.

Seed Yield

Seed yield of peanut with no cover was found to be 3.15-3.5 t/ha under sprinkler irrigation. In region, energy source of pumps with hand-moved sprinkler irrigation system was diesel. In one research performed by Soni *et al.* (2016), pressurized irrigation system resulted 5-50% higher grain yield of peanut by comparison to the surface irrigation system uses. Similarly Abdelraouf *et al.* (2016) reported seed yield of different designated drip irrigated peanut around 5.15 t/ha at El-Nubama, Egypt, for sandy soil condition. Sri Ranjithi *et al.* (2018) demonstrated about 4 t/ha pod yield at drip irrigation with applied water equal to the 1.0 of Pan Evaporation. Boydak *et al.* (2021) reported the highest yield as around 5.3 and 7.1 t/ha for 2004 and 2005, respectively under full-irrigation treatment with sprinkler irrigation by 120 kg/ha N application at clay soil condition. Barbieri *et al.* (2017) suggested water level of 110% of ETo to get maximum grain as 6 t/ha or pod as 9 t/ha yields for sprinkler irrigated peanut. The possible reason of yield variations in studies could be differences in cultivars, irrigation technique, and its managerial quality as well as environmental conditions. Wright *et al.* (2015) reported that adequate water availability through the root zone as well as high quality management led the greatest grain yield and quality consequently best returns in peanut production. There are plenty advantages of irrigation on peanut plants such as enhancing the yield and quality, and reducing risk of net income of farmers.

Labor Cost

In region no matter how agro-machinery is used, human labor is also needed. In all of the examined farms harvesting process has done by using digger or puller. After plants are removed from the soil with plow, they are turned upside down by the labors in the fields. In case of hoeing

by manually for free of weeds, the average capacity of labor was around 0.1 ha /day and average daily cost for this process was around 8.8 USD/ labor. In current study, including other farming activities, total labor cost was calculated as 200 USD/ ha.

Seasonal Diesel Cost for Irrigation

This study was conducted at a total farming area of approximately 75 ha, and pumps were worked by tractor tail shaft for supplying pressure in sprinkler irrigation systems. As a result of our calculation, diesel consumption for each irrigation process was found around 46 L/ha. By considering of total 4 irrigation events, seasonal diesel consumption was 184 L/ha. In 2019, diesel cost for one L was about 6.3 TL so diesel energy cost was 1160 TL/ha or 158 USD/ha (1 USD = 7.32 TL). On the other hand, diesel energy use is not friendship of ecosystems so application of electric energy as a power supply could be strongly recommended for sustainable environments as well as more regular pressure supply for the sprinkler irrigation systems. In that regard farmers should be subsidized in construction of electric power units.

CONCLUSIONS

The main target of all farmers is to get maximum return with minimum production costs so peanut farming seems high gain in study region. The more uniform water application by sprinkler irrigation systems is possible under well management. Due to the low amount of water consumption, and high water application efficiency of sprinkler irrigation system, cultivated areas of the peanut could be increased to bring more areas into production with same amount of water for sustainable water resources. In addition, farmers should be subsidized for electrical power plant constructions for reducing energy cost of irrigation consequently better economical returns, and conserving the ecosystems.

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