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Article

Application of Modern Water-Saving Technologies in Olive Plantations

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Abstract: This article examines the application of modern methods in the development of fruit crop agrotechnology in recent years, which have enabled high efficiency and increased productivity in certain fruit crops, ensuring protection from diseases and weeds, and, most importantly, the rational and scientific use of available resources. The growth and development characteristics of seedlings of the introduced olive cultivar "Arbequina" are studied.

Keywords: Olive Variety, Cutting, Callus, Adaptation, Temperature, Humidity, Illumination, Microclimate, Root

Introduction

The studies were carried out in 2024–2025 within the framework of project No. AL-652204415 titled "Development of agrotechnology for cultivating stress-resistant olive plants suitable for processing and preparation of oil and canned products from their fruits" at the Bandikhon experimental site located in the Kizirik district, belonging to the Academician Mahmud Mirzayev Research Institute of Horticulture and Viticulture [1].

Seedlings of the olive variety "Arbequena" were selected as the research object. The experiment was organized in two variants:

Variant 1 (control) – 100 olive seedlings planted in the plantation were irrigated by the traditional furrow irrigation method under open field conditions[2].
Variant 2 – innovative water-saving equipment was installed for the olive seedlings in the experimental field, and daily, phenological, and biometric measurements were carried out.

The research showed that water consumption for olive seedlings in the control variant was 400–600 m^3 per hectare, whereas in the variant with water-saving equipment the water consumption was 5–6 times lower, amounting to 80–90 m^3 per hectare[3].

Materials and Methods

The experiments were conducted according to the recommendations and methods presented in "Methodology of accounting and phenological observations in experiments with fruit and berry plants" developed by Kh.Ch. Buriev and others, "Metodika uchetov i nablyudeniy v opytakh s plodovymi i yagodnymi kulturami" by V.F. Moiseichenko , "Razmnozhenie plodovykh rasteniy metodom zelenogo cherenkovaniya pobegov" by M.T. Tarasenko , and the methodological guidelines of S.A. Ostroukhova on the cultivation of fruit and berry crop seedlings[4].

Results and Discussion

In 2024–2025, experimental trials were conducted on one-year-old seedlings of the "Arbequena" olive variety introduced from abroad and propagated in vitro. In the study, ensuring water balance in the olive plantation under experimentation was determined by the use of soil moisture reserves, precipitation, irrigation water applied, water consumption per centner of olive yield, and the amount of olive yield produced per 1 m^3 of water. In 2024, soil moisture in the experimental field was somewhat higher compared to 2025[5].

Observations showed that in furrow irrigation, the irrigation water accounted for 80.5% of the total water used, whereas under drip irrigation this indicator was 65.1%. In 2024, these values were 80.2% and 65.5%, respectively, and in 2025 they were 74.5% and 59.7%. The use of precipitation water amounted to 9.4–15.3% in 2024 and 16.9–26.7% in 2025. It was determined that for producing one centner of olives, the drip irrigation system required 1.9–2.0 times less total water consumption and 2.0–2.5 times less irrigation water, making it possible to establish additional olive plantations using the saved water resources (Fig. 1).

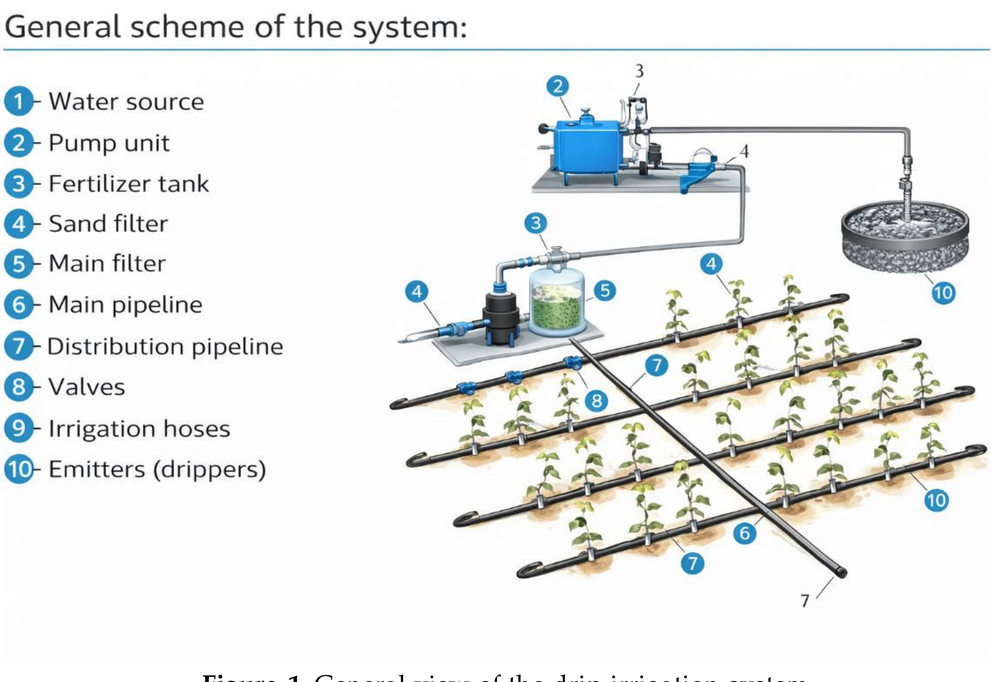

Figure 1. General view of the drip irrigation system

In the experimental field, the groundwater level was relatively close to the surface, and the soil had a medium loamy mechanical composition; due to the high capillarity of such soils, olive plants were able to partially utilize groundwater. It was determined that the introduction of drip irrigation as a water-saving technology makes it possible to save 40–50% of water compared to scientifically based irrigation norms and 2–2.5 times compared to water consumption in conventional production processes. The saved amount of water made it possible to irrigate crop areas twice as large compared to traditional irrigation. When the olive plantation was irrigated by the traditional furrow method, taking into account temperature fluctuations, irrigation was carried out 7–10 times, with a single irrigation rate ranging from 220 m^3/ha to 350 m^3/ha, while the amount of runoff water ranged from 25 m^3/ha to 65 m^3/ha. It should be emphasized that in the drip irrigation variants, the infiltration coefficient of irrigation water into the soil was high, and due to the absence of runoff, water consumption was reduced by 45–50% compared to the control[6].

In the control variant irrigated by furrows, the runoff water accounted for 6% to 10% of the seasonal irrigation water applied. In the drip irrigation variants, the absence of runoff and the complete absorption of nitrogen fertilizers applied through irrigation water into the soil layer improved the mineral nutrition level of the crop compared to the control, and it was also determined that mineral fertilizer consumption, especially nitrogen, could be reduced by 20–25%. In conventional furrow irrigation, uneven soil wetting and high water consumption increase the likelihood of leaching of synthetic fertilizers, which leads to high costs and low returns (Table 1).

Table 1. Effect of traditional and drip irrigation on the growth and development of 2-year-old olive seedlings in the experiment (2025)

Months	**Ways of irrigation**									
	Traditional irrigation					**Drip irrigation**				
	Number of irrigations	**Water consumption, m^3**	**Plant height, average, cm**	**Number of shoots, pcs**	**Additional organs, pcs**	**Irrigation duration, hours (1 hour – 6.83 m^3)**	**Water consumption, m^3**	**Plant height, cm**	**Number of shoots, pcs**	**Additional organs, pcs**
January	-	-	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-	-	-	-
March	1	220	65	1	-	8	54.6	63	1	-
April	2	440	68	1	3	8	54.6	65	1	2
May	2	440	74	2	5	10	68.3	72	3	3
June	3	660	78	2	7	12	81.9	83	3	8
July	3	660	83	3	6	14	95.6	88	4	6
August	2	440	86	4	4	12	81.9	103	8	5
September	2	440	88	6	3	9	61.5	110	9	4
October	2	440	90	6	3	7	47.8	115	10	3
November	-	-	90	6	-	6	40.9	115	10	2
December	-	-	90	6	-	2	13.6	115	10	-
Total	17	3740	81.2	-	-	-	-	-	-	-

From the above table, it can be concluded that the drip irrigation method creates favorable conditions for each olive seedling to receive water and dissolved nutrients uniformly, ensuring growth, development, and the accumulation of high yields. In this system, fertilizers and water are supplied according to plant demand, and research was conducted to determine the effect of drip irrigation using activated water and fertilizer mixtures on the growth and development of olive seedlings, to achieve high productivity, and to improve the phytosanitary condition of the experimental field. Phenological observations showed positive growth, development, and yield accumulation of olive seedlings in both traditionally irrigated rows and drip-irrigated rows. According to data obtained in August, the height of one-year-old seedlings under traditional irrigation averaged 90 cm with 4–5 lateral branches, whereas drip-irrigated one-year-old seedlings averaged 115 cm in height with 6–7 lateral branches[7]. In other words, compared with drip irrigation, traditionally irrigated rows showed seedling height lower by 25 cm and lateral branches lower by an average of 2–3. According to the research results, in 2–3-year-old olive seedlings under drip irrigation, plant height, branching, and formation of yield organs differed compared with traditional irrigation. It was proven that traditional irrigation of olive plantations required large amounts of water, whereas drip irrigation reduced water consumption. In addition, when mineral fertilizers are applied in solution form, they are fully absorbed by plants, rapidly soluble nitrogen fertilizers are not leached, and the concentration and environment of the soil solution remain optimal, increasing the rate and activity of nutrient uptake by the root system, which positively affected plant growth, development, and yield formation [8].

When water-saving technologies were applied in the experimental field, improvements in the phytosanitary condition of the site were observed. The introduction of drip irrigation in olive plantations created several advantages: in the soil layer where the roots of young seedlings develop, an optimal water–physical environment (microclimate) was formed; optimal moisture in the root zone was maintained evenly throughout the day; and water and nutrients were absorbed in amounts corresponding to plant requirements[9]. Under these conditions, excessive soil saturation or drying was completely eliminated. It was also found that phytosanitary conditions improved in rows where drip irrigation was applied in olive plantations. In particular, excessive weed growth prevents plants from fully utilizing mineral nutrients and serves as a habitat for various diseases and pests. It was observed that young seedlings were damaged when parasitic weeds covered them[10].

Our research showed that under traditional irrigation, the large amount of water used per hectare, deterioration of phytosanitary conditions, spread of diseases, and especially the increase in soil moisture to field capacity levels after irrigation led to the development of fungal and bacterial diseases, damage to olive seedlings, deterioration of soil water–physical properties, and increased rodent pests, which negatively affected the future yield of olive orchards. Under unfavorable conditions, olive seedlings experienced stress, forcing plants to spend energy overcoming stress rather than growth and yield formation. As a result, due to optimal irrigation and nutrition, olive yield increased by 25–35%, fruit ripening occurred 10–15 days earlier, and phenological phases passed more uniformly. When drip irrigation was applied, irrigation regimes matched plant water demand, water was delivered directly to the root zone, evaporation from soil decreased, weed growth was reduced, water did not spread across the field or percolate deeply, and no runoff occurred, resulting in water savings. The introduction of drip irrigation made it possible to save 20% to 80% of water compared to other irrigation methods [11].

In drip irrigation, water is delivered through hoses directly to plants, so only the area where crops are located is moistened, preventing soil compaction. As a result, there is no need for cultivation between rows or for forming irrigation furrows, and the field becomes easier to till. Since fertilizers are applied together with irrigation water, the need for machinery for fertilization is eliminated, labor and fuel costs are reduced by 50%, and manual labor for irrigation decreases. Because only the root zone is moistened in drip irrigation, salts do not accumulate in the soil, and irrigation efficiency reached 90–95%. In other irrigation methods (including furrow and sprinkler irrigation), this indicator does not exceed 70–75%, as reported in the literature[12].

In drip irrigation, dividing the field into sectors made it possible to use smaller pipe diameters and lower pump pressure, allowing the use of lower-capacity pumps and reducing costs. Considering that the soil structure of the experimental field is loamy, the introduction of drip irrigation in newly established olive plantations is an important measure. Under furrow irrigation, excessive soil moisture after irrigation leads to waterlogging, while long intervals between irrigations cause soil drying and dehydration of olive seedlings. During the next irrigation, plants again become waterlogged, followed by dehydration, resulting in stress conditions. As a result, plants expend energy overcoming stress and cannot develop uniformly, as observed in our studies. As recorded in our experiments, drip irrigation technology has several advantages over other irrigation methods, including increased crop productivity and improved yield quality, conservation of water resources, reduction of material and labor costs for agrotechnical measures, reduced fertilizer consumption, and prevention of soil erosion[13].

Considering the soil and climatic conditions of the selected area in olive orchards, the future use of aerosol irrigation can create favorable microclimatic conditions for loamy soils. Relative humidity around olive seedlings increases, air temperature decreases by +6 to +12°C during summer, irrigation norms range from 0.8–1.0 m^3/ha, and irrigation is carried out every two hours during the hottest part of the day, with water supplied in fine droplets of 400–600 μm diameter using special devices[14]. This method is especially effective in oasis conditions with dry air and hot winds, improving photosynthesis, increasing crop productivity, improving olive fruit quality, and reducing water consumption by 40–50%. In the experimental young olive orchards, leguminous intercrops (mung bean, bean) selected to improve soil fertility were sown between rows, preventing surface soil drying caused by hot summer winds on loamy soils[15].

Conclusion

1. In the experimental field, irrigation water in the furrow-irrigated rows accounted for 80.5% of the total water consumption, whereas under drip irrigation this indicator was 65.1%. In 2024, these values were 80.2% and 65.5%, and in 2025 they were 74.5% and 59.7%, respectively.
2. The use of precipitation water amounted to 9.4–15.3% in 2024 and 16.9–26.7% in 2025. Calculations showed that to produce one centner of olives, the drip irrigation system required 1.9–2.0 times less total water consumption and 2.0–2.5 times less irrigation water, making it possible to establish additional olive plantations using the saved water resources.
3. Taking into account the soil and climatic conditions of the selected site in olive orchards, the future use of aerosol irrigation creates a favorable microclimate for loamy soils. Relative humidity around olive seedlings increases, air temperature decreases by +6 to +12°C during summer, the irrigation norm is 0.8–1.0 m^3/ha, and irrigation is carried out every two hours during the hottest part of the day, with water supplied in fine droplets of 400–600 μm diameter using special devices. When this method is used for irrigating orchards, vegetables, forage, and industrial crops under oasis conditions with dry air and hot winds (garmsel), it improves photosynthesis, increases crop productivity, improves the quality of olive fruits, and reduces water consumption by 40–50%.

REFERENCES

[1] R. G. Allen, L. S. Pereira, D. Raes and M. Smith, *Crop Evapotranspiration – Guidelines for Computing Crop Water Requirements*, FAO Irrigation and Drainage Paper 56, Rome: FAO, 1998.

[2] M. Fereres and M. A. Soriano, "Deficit irrigation for reducing agricultural water use," *Journal of Experimental Botany*, vol. 58, no. 2, pp. 147–159, 2007.

[3] P. Steduto, T. C. Hsiao, E. Fereres and D. Raes, *Crop Yield Response to Water*, FAO Irrigation and Drainage Paper 66, Rome: FAO, 2012.

[4] J. Girona, M. Mata, J. del Campo, J. Arbonés, E. Bartra and J. Marsal, "The use of midday leaf water potential for scheduling deficit irrigation in vineyards," *Irrigation Science*, vol. 24, pp. 115–127, 2006.

[5] D. Playán and L. Mateos, "Modernization and optimization of irrigation systems to increase water productivity," *Agricultural Water Management*, vol. 80, pp. 100–116, 2006.

[6] M. A. Hanjra and M. E. Qureshi, "Global water crisis and future food security in an era of climate change," *Food Policy*, vol. 35, no. 5, pp. 365–377, 2010.

[7] A. Kassam, T. Friedrich, R. Derpsch and J. Kienzle, "Overview of the worldwide spread of conservation agriculture," *Field Actions Science Reports*, vol. 6, pp. 1–7, 2012.

[8] E. Fereres, D. Goldhamer and V. Sadras, "Yield response to water of fruit trees and vines," *Irrigation Science*, vol. 33, pp. 115–127, 2015.

[9] J. E. Fernández, "Understanding olive adaptation to abiotic stresses," *Environmental and Experimental Botany*, vol. 103, pp. 1–8, 2014.

[10] M. Tognetti, R. d'Andria, A. Lavini and G. Morelli, "The effect of deficit irrigation on seasonal variations of plant water use in Olea europaea L.," *Plant and Soil*, vol. 273, pp. 139–155, 2005.

[11] FAO, *The State of the World's Land and Water Resources for Food and Agriculture (SOLAW)*, Rome: FAO, 2021.

[12] World Bank, *Water in Agriculture: Improving Water Use Efficiency*, Washington, DC: World Bank, 2020.

[13] D. Molden (Ed.), *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture*, London: Earthscan, 2007.

[14] R. Chartzoulakis and M. Bertaki, "Sustainable water management in agriculture under climate change," *Agriculture and Agricultural Science Procedia*, vol. 4, pp. 88–98, 2015.

[15] L. Pereira, I. Cordery and I. Iacovides, *Improved Indicators of Water Use Performance and Productivity for Sustainable Water Conservation and Saving*, UNESCO, 2012.