The North African Journal of Scientific Publishing (NAJSP)
مجلة شمال إفريقيا للنشر العلمي (NAJSP)
E-ISSN: 2959-4820
Volume 4, Issue 1, 2026
Page No: 195-202
Website: https://najsp.com/index.php/home/index
SJIFactor 2024: 5.49 | معامل التأثير العربي (AIF) 2025: 0.69 | ISI 2024: 0.696

Effects of Plastic Mulching on Soil Moisture and Vegetative Growth of Young Olive Trees in Semi-Arid Mediterranean Conditions

Omran Ali Ahmed Amshaher[1*], Ghieth Ali Omar Alsakloul[2]
[1]Department of Soil and Water, Faculty of Agriculture, University of Sirte, Sirte, Libya
[2]Department of Botany, Faculty of Agriculture, University of Sirte, Sirte, Libya

تأثير التغطية بالبلاستيك على حفظ رطوبة التربة والنمو الخضر لأشجار الزيتون الصغيرة في ظل ظروف بيئة البحر الأبيض المتوسط شبة الجافة

عمران علي حمد امشهر[1*]، غيث علي عمر الصكلول[2]
[1]قسم التربة والمياه، كلية الزراعة، جامعة سرت، سرت، ليبيا
[2]قسم النبات، كلية الزراعة، جامعة سرت، سرت، ليبيا

*Corresponding author: Omran.ali16@su.edu.ly

Received: January 02, 2026 | Accepted: February 04, 2026 | Published: February 13, 2026

Abstract:
The cultivation of young olive trees in semi-arid environments is affected by two factors: soil moisture and cultivar selection. This study was carried out to evaluate the effects of plastic mulching on conservation of soil moisture and the early vegetative growth. Two olive cultivars were experiments, Coratina (C_1) and Koroneiki (C_2), in the Sirte region of central Libya. Two yeas sapling were planted and watered using a drip irrigation system. Various vegetative growth parameters include average height, stem diameter, canopy width, and number of shoots, were recorded at nine-month intervals. Both the cultivar selection and mulching were shown to possess a significant impact on growth under the Sirte environmental conditions. Statistical analysis exposed that, Coratina appeared superior vegetative growth compared to Koroneiki. Olive cultivars' growth was enhanced through use plastic mulching by up to 12% for tree height and up to 14 % for both canopy width and stem diameter. As well, number of shoots increase for both cultivar (C_1) (C_2) 10 shoots. Furthermore, mulched plots displayed a higher abundance of soil moisture across both depth profiles. Especially in upper layer 0-30 cm due to y reduce surface evaporation. However, the result illustrated that, Coratina trees consumed soil moisture more rapidly, corresponding to its greater growth vigor and higher transpiration demands. These findings demonstrate that plastic mulching plays crucial role in improving water use and enhance juvenile tree growth. The effective application of plastic mulching in Libya may have significant implications for other semi-arid Mediterranean climates.

Keywords: Olive cultivars, juvenile growth, plastic mulch, soil moisture, Coratina and Koroneiki, semi-arid Mediterranean.

الملخص:
تتأثر زراعة ونمو شتلات الزيتون في البيئات الجافة والشبه الجافة بعاملين اساسين هما: رطوبة التربة واختيار الصنف. جريت هذه الدراسة لتقييم تاثير تغطية التربة بالبلاستيك حول اشجار الزيتون اليافعة في حفظ الرطوبة وتحسين النمو الخضري. في هذه التجربة تم استخدام صنفين من شتلات الزينون وهما: كوراتينا (C_1) وكورناكي (C_2) بعمر سنتين. تم استخدام الري بالتنقيط بمعدل ع لتر كل ٤٨ ساعة. خلال هذه التجربة تم تسجيل عدة مؤشرات التي تدل على النمو الخضري من بينها: متوسط الارتفاع، وقطر الساق، وعرض المجموع الخضري، وعدد الأفرع. أظهرت نتائج الدراسة ان تغطية التربة با البلاستيكية كان لها تأثير معنوي واضح في النمو تحت الظروف البيئية لمنطقة سرت. في جميع المعاملات اظهر التحليل الإحصائي أن صنف كوراتينا تفوقا في نموه الخضري مقارنة بصنف كورناكي. حيث تحسن نمو كلا الصنفين باستخدام التغطية البلاستيكية بنسبة وصلت إلى 12% في ارتفاع الأشجار، ونحو 14% لكل من عرض المجموع الخضري وقطر الساق. كذلك زاد عدد الأفرع في كلا الصنفين. إضافة إلى ذلك، أظهرت النتائج ان التربة المغطاة بالبلاستيك قد احتفظت برطوبة في كلا العمقين، خاصة في الطبقة السطحية (0-30 سم)، وهذا ناتج عن تقليل نسبة البخر من سطح التربة. اخيرا، تبين هذه النتائج ان اختيار الصنف يعلب دورا جوهرية في البيئات الجافة التي تعاني من نذره المياه، كما ان استخدام التغطية حول الاشجار تعتبر وسيلة فعالة لحفظ رطوبة التربة.

الكلمات المفتاحية: النمو الخضري، التغطية البلاستيكية، رطوبة التربة، كوراتينا، كورناكي، شبه الجاف.

Introduction:

Olive (Olea europaea L.) cultivation is a fundamental pillar and is considered the backbone of Mediterranean agriculture. It provides vital rural and pro-urban income. (Amare & Desta, 2021; Sghaier et al., 2019).Besides, olive trees provide valuable ecosystem services such as carbon sequestration, erosion control, and overall landscape saving(Hegazi et al., 2024; Parri et al., 2023). Globally, demand for table olives and olive oil has been increasing due to health benefits. In rural and pro-urban areas farmers are expanding orchards into semi-arid and marginal regions. But, the main change in semi-arid Mediterranean is its harsh climate; witch characteristic low rainfall and high evaporation. Moreover, these areas suffer from frequent water scarcity and soil degradation (Ding et al., 2023; Hegazi et al., 2024).

Whilst mature olive trees has ability to withstand drought quite well, young trees can not to withstand these conditions(Ding et al., 2023; El-Beltagi et al., 2022). Due to their shallow root systems strongly reach deeper soil moisture and are exposed to the sun. As well, the competition in the surface layer from weeds can stunt young olive development. (Demo & Bogale, 2024; Golmohammadi et al., 2020). Many practise were used to face these challenges ,mulching is widely employed to suppress weeds, justify soil temperatures, and reduce soil evaporation (Abbate et al., 2023; Casas et al., 2022).

Although ,many studies have confirmed that mulching around trees improves soil moisture and promotes vegetation growth (Casas et al., 2022; Trabelsi et al., 2024), most research has focused on organic or hydro-mulches. Consequently, the effect of plastic mulching according to semi-arid field conditions remains undiscovered (Abbate et al., 2023; Casas et al., 2022). Furthermore, the successful orchard establishment requires both cultivar selection and pairing with moisture-optimizing. Where trees vary significantly in drought offord, due to root architecture, hydraulic traits, and carbon allocation(Demo & Bogale, 2024; Rico et al., 2023). For instance, Coratina trees are characteristic for their high oil and phenolic content, beside afford water-stress. In contrast, Koroneiki trees maintain active photosynthesis and growth under limited moisture(Demo & Bogale, 2024; Dias et al., 2024).

Insufficiently studied details quantitative field data showing whether certain young cultivars can benefit from soil moisture under plastic mulch conditions more than others. (Abbate et al., 2023; Demo & Bogale, 2024; Dias et al., 2024). Finally, understanding this strategy is a crucial step to improving field design. Thus, this study investigates the effect of integrating plastic mulch with specific olive cultivars (Coratina and Koroneiki trees) on both soil moisture and vegetative growth in a semi-arid field setting.

Materials and methods:

Experimental site description and climatic conditions:

This experiment study was carried out in a field located in Algratbea region of Sirte, which is a coastal city right in the center of Libya. Figure 1; illustrated the location of Libya in Continent of Africa and location of Sirte in Libya country which has a latitude of 30°30'1.4" N and a longitude of 30°19'10.9" E, roughly 46 meters above mean sea level.

Figure (1): Geographic location of the experimental site in the Algratbea area, Sirte, central Libya.

The study site actually has a semi-arid Mediterranean climate, which means hot, dry summers and mild, somewhat humid winters. Annual precipitation is usually quite low and often unpredictable, with most of it falling in the winter months; frequently, it simply isn't enough to meet what crops truly need. This limited rainfall, particularly when combined with high potential evapotranspiration, creates a constant lack of soil moisture that severely restricts plant growth, making very careful water management absolutely essential. Throughout the experimental period, local meteorological conditions (things like mean air temperature, relative humidity, and rainfall) were continuously monitored using an on-site calibrated weather station; as illustrated in Table 1.

Table (1): Monthly Metrology for Libya, during the experimental period (2025).

Months	Climate mean values, 2025				
	Temp Max C°	Temp Min C°	Temp Mean C°	RH %	Rain (mm/month)
March	20.9	12.5	16.7	56	14
April	23.9	15	19.4	53	4
May	26.6	17.7	22.1	55	4
June	29.1	20.2	24.6	60	0
July	30.8	22.5	26.6	64	0
August	31.3	23.4	27.3	65	0
September	30.5	22.8	26.6	61	5
October	29.2	18.6	23.9	64	23
November	24.5	14.5	19.5	61	23
December	20.1	10.7	15.4	66	50

Note: Temp Max C°: Maximum air temperature (°C); Temp Min C°: Minimum air temperature (°C); Temp Mean C°: Mean air temperature (°C); RH: Relative humidity (%); Rain: Average precipitation (mm/month)

Soil Characteristics and Moisture Monitoring:

To accurately represent the active olive root zone, soil samples was collected from the top surface 30 centimeters (specifically, the 0-30 cm depth). Before any analysis could begin, these samples underwent a preparation process: they were air-dried, sieved, and then oven-dried at 105 °C. For physical characterization, particle size distribution was classified using sieving according to the USDA criteria. Moreover, hydraulic conductivity was measured employing a constant-head permeameter. Beyond that, applied conventional saturation methods to determine several crucial moisture parameters include: field capacity, saturation levels, and the permanent wilting point. Finally, electrical conductivity (EC) was measured use Electrical Conductivity meter and PH using a digital pH meter. As well, concentrations of major cations and anions were measured, following the methodology outlined by (Richards et al.,1954)Sodium adsorption ratio (SAR) and the exchangeable sodium percentage (ESP) were measured according to (Richards et al.,1954) . A summary of all these primary physicochemical properties of experimental soil is presented in Table 2.

Table (2): Physicochemical properties of soil at the experimental site

Characteristics		Values
Particle size distribution (%)	Sand	67.0
	Silt	32.3
	Clay	0.70
Textural class is sandy		
Hydraulic conductivity, cm/hr		9.00
Field capacity, %		15.4
Saturation, %		30.0
Wilting point, %		7.50
pH		7.9

SAR		0.287
ESP		2.476
Cations, meq/100g	Na^+	1.4
	K^+	0.4
	Ca^{++}	16
	Mg^{++}	15.6
Anions, meq/100g	$CO3^-$	Nile
	HCO_3^-	3.2
	Cl^-	3.2
	SO_4^{--}	27

Based on Table 2 the experimental soil is classified to sandy soil in texture. which characterized by high hydraulic conductivity and infiltration. further evidenced by low field capacity and wilting point values. Chemically, the experimental analysis shows that the soil is slightly alkaline and non-saline.

Irrigation Water Characteristics and Management:

Irrigation water sourced (Great Man-Made River) was analyzed before application. Irrigation water was analyzed includes EC, pH, and total dissolved solids (TDS), using a multiparameter (Model: XYZ, Manufacturer: ABC, Country). Measurements indicated a pH of 7.4; EC of 1.25 dS/m, and total dissolved solids (TDS) of 800 mg/L. According to the U.S. Salinity Laboratory classification, the water classified as low to moderately saline and can be used safely for juvenile olive trees. in this study drip irrigation was applied and controlled to deliver 3 L per 48 hours. Finally, Soil moisture was periodically recorded for both depths 0- 30 cm and 30-60 cm.

Plant Material, orchard Management, and Vegetative Growth Assessment:

In this study 40 olive saplings (Olea europaea L.) were planted. The saplings were two years old. Two cultivars were chosen to include. Italian cultivar, named Coratina (C_1), and Greek cultivar, named Koroneiki (C_2). At planting, baseline morphological differences were obvious. where Coratina saplings averaging 1.50 m in height, 3.2 cm in stem diameter, and 0.70 m in canopy width, with 6 shoots per tree. On the other hand, Koroneiki saplings were smaller, averaging 1.20 m in height, 2.2 cm in stem diameter, 0.60 m in canopy width, and 5 shoots. The sapling was planted in 50-cm-diameter pits and t spaced 5 m apart. Agronomic management included a uniform fertilizer application of 80 g N, 30 g P_2O_5, and 50 g K_2O per tree.

Experimental Design and Mulching Application:

A factorial randomized complete block design (RCBD) was established. Two plant cultivars (C_1 and C_2) and plastic mulching (M_1) and a bare-soil control (M_0) were used. Three replicates, with five trees assigned per replicate, were done. In the mulched plots, tree basins were covered with 2-mm-thick black polyethylene sheets and carefully positioned to prevent contact with the trunk. In contrast, the non-mulch trees simply grew in bare soil. Throughout the experiment, soil moisture content, and essential growth indicators, such as tree height, the width of the canopy, the number of new shoots, and the stem diameter (which we measured 15 cm up from the soil).

Finally, once all the data was collected, and analyzed it using a factorial ANOVA. To pinpoint any significant differences between the treatment means. Least Significant Difference (LSD) test were applied, to setting significance level at $p \leq 0.05$.

Result and Discussion:

Effects of Cultivar and Plastic Mulching on Vegetative Growth of Young Olive Trees:

Yong olive trees' growth is affected by both genetic traits and root-zone water availability. Analysis of variance (ANOVA) showed that cultivar exerted the most fundamental effect on all measured parameters, including tree height ($F= 112.4$, $p < 0.001$), stem diameter ($F = 97.5$, $p< 0.001$), and canopy width ($F=85.2$, $p<0.001$). Plastic mulching improved vegetation grow parameters including height ($F=28.7$, $p< 0.01$), diameter ($F=18.6$, $p < 0.01$), and canopy width ($F=21.9$, $p<0.01$). Furthermore, the significant interaction effects ($p<0.05$ for all three metrics), indicate that the trees benefited from conserved soil moisture depend on plant cultivar.

Coratina trees demonstrated more vigorous vegetative growth than Koroneiki trees even in non-mulched soil. This aligns with previous observations of its inherently robust growth habit(Martinez et al., 2015; Rosati et al., 2024). However, the introduction of plastic mulch amplified this growth for both genotypes compared to bare soil conditions. Figure 2(a-d) illustrates the effect of Vegetative growth parameters of juvenile olive trees (15 December 2025).

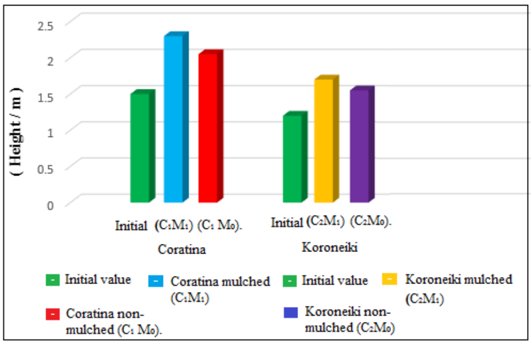

Figure 2 (a): Mean tree height (m) of Coratina (C_1) and Koroneiki (C_2) olive cultivars at the initial baseline measurement and following mulched (M_1) versus non-mulched (M_0) treatments.

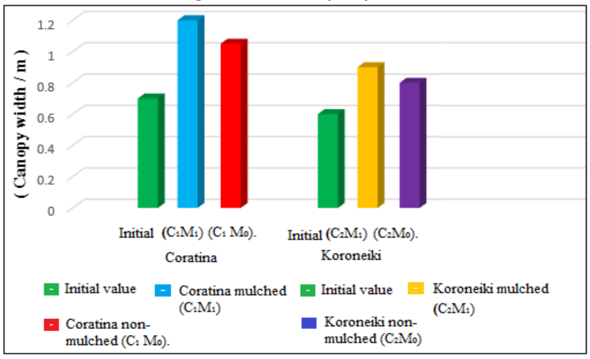

Figure 2 (b): Mean tree canopy width (m) of Coratina (C_1) and Koroneiki (C_2) olive cultivars at the initial baseline measurement and following mulched (M_1) versus non-mulched (M_0) treatments.

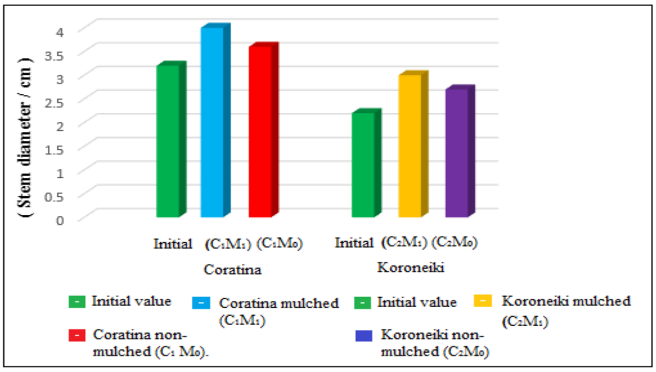

Figure 2 (c): Mean tree stem diameter (cm) of Coratina (C_1) and Koroneiki (C_2) olive cultivars at the initial baseline measurement and following mulched (M_1) versus non-mulched (M_0) treatments.

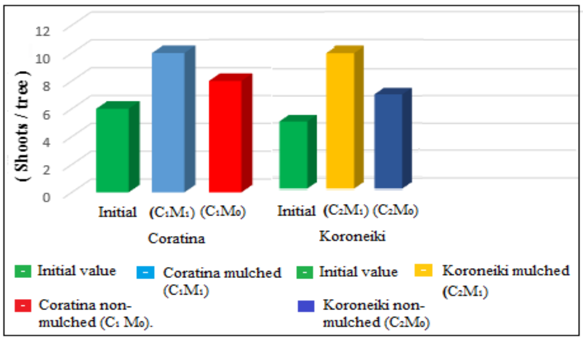

Figure 2 (d): Mean tree shoot (number) of Coratina (C_1) and Koroneiki (C_2) olive cultivars at the initial baseline measurement and following mulched (M_1) versus non-mulched (M_0) treatments.

As illustrated in Figure 2(a-d), plastic mulching consistently enhanced the vegetative growth of both cultivars. Coratina trees grown under mulch achieved a greater mean height (2.30 m), stem diameter (4.0 cm), canopy width (1.20 m) and 10 shoots than non-mulched controls (2.05 m, 3.60 cm, and 1.05 m, and 8 respectively). Koroneiki trees demonstrated a comparable trend; mulched trees reached 1.70

m in height, 3.0 cm in stem diameter, 0.90 m in canopy width and 10, compared to (1.55 m, 2.70 cm, and 0.80 m and 7 shoots) under non-mulched soil conditions.

In addition, plastic mulch improved Coratina trees' height 12% and 1 Koroneiki trees' 10%, besides proportional growth in stem diameter and canopy width. according to (Imperiale et al., 2025; Massenti et al., 2022). Some cultivars maintain high hydraulic conductance in aerial organs and support vegetative growth when soil moisture is available. However, mulched trees consistently outperformed their non-mulched counterparts. Due to reducing soil surface evaporation and moderating temperatures.

Effects of Plastic Mulching and Plant Cultivar on Soil Moisture and Water Uptake:

Soil moisture content was significantly affected by cultivar, mulching, and their interaction ($p<0.05$). Plastic mulch resulted in consistently higher volumetric water content across both the 0–30 cm and 30-60 cm soil profiles (Figure 3). Due to decreased soil evaporation throughout the growing season. This aligns with established studies (El-Beltagi et al., 2022; Zhu et al., 2021). Mulching effects were obvious in the upper layer 0-30 cm layer, compared to the deeper layer. Due to the diffusion of plant roots in this region. Temporally, plastic mulch retained soil moisture considerably longer between irrigation events, whereas non-mulched soils depleted rapidly. As reported by (Massenti et al., 2022) .

In July, the top soil moisture dropped in non-mulched plots to 4% less than the previous month. In contrast, mulched soils experienced only a ~2% reduction, where stabilizing at 22-24%. Deep soil layers (30-60 cm) illustrated smaller overall fluctuations but followed a similar trend. Non mulched plots registered 16%, while mulched plots retained 20%. This shows the effective acts of mulched as a hydrological buffer during a short dry period. Elsewhere, the mulching effect on plant cultivation and extraction patterns strongly drove moisture dynamics. Coratina (C_1) trees demonstrated high soil moisture consumption across both depths. This rapid consumption corresponds directly to Coratina's vigorous growth and higher transpiration demands. On the other hand, Koroneiki (C_2) trees demonstrated less moisture consumption in the soil profile. This indicates to a more conservative water-use strategy, which suits its moderate growth nature and inherent drought tolerance. In addition, vegetative growth of juvenile trees was enhanced due to the availability of soil moisture in the root zone which provided by plastic mulch. Finally, as reported by(Demo & Bogale, 2024; Liao et al., 2021),besides conserved soil moisture, mulching optimizes the root uptake efficiency.

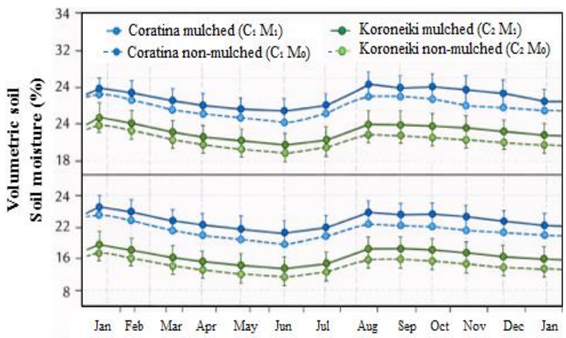

Figure (3): Volumetric soil moisture (%) for depths 0-30 and 30-60 cm for Coratina (C_1) and Koroneiki (C_2) olive saplings under mulched (M_1) and non-mulched (M_0) treatments (2025)

Conclusion:

The effective procedure to establishment of juvenile olive trees in semi-arid Mediterranean regions requires the selection plant cultivar and soil moisture management. This study finds that Coratina (C_1) inherently demonstrates a more powerful growth habit than Koroneiki (C_2). Due to its increase in height, stem diameter, canopy width, and shoots of the tree under all conditions. However, the apple of plastic mulch on young olives was effective in both cultivars during reduce of evaporative losses and conserving soil moisture in root zone. Furthermore, a distinct interactive effect emerged in Coratina cultivar, which demonstrates faster growing driven by higher transpiration demands, capitalized efficiently from the moisture conserved by the plastic mulch. Whereas the growing juvenile olive orchard precluded fruit yield evaluation, the development of growing and improvement of utilization of soil moisture are strong indicators to increase fruit yield. Therefore, integrating plant cultivar selection and plastic mulching are effective approach to optimize juvenile olive growing and conserve soil moisture in water-scarce regions.

References:

1. Abbate, C., Scavo, A., Pesce, G., Fontanazza, S., Restuccia, A., & Mauromicale, G. (2023). Soil Bioplastic Mulches for Agroecosystem Sustainability: A Comprehensive Review. Agriculture.

https://doi.org/10.3390/agriculture13010197
2. Amare, G., & Desta, B. (2021). Coloured plastic mulches : impact on soil properties and crop productivity. Chemical and Biological Technologies in Agriculture, 8, 1–9. https://doi.org/10.1186/s40538-020-00201-8
3. Brown, J. W., Hayward, H. E., Richards, A., Bernstein, L., Hatcher, J. T., Reeve, R. C., & Richards, L. A. (n.d.). Diagnosis and Improvement of. February 1954.
4. Casas, L., Ciaccia, C., Iovino, V., Ferlito, F., Torrisi, B., Lodolini, E., Giuffrida, A., Catania, R., Nicolosi, E., & Bella, S. (2022). Effects of Different Inter-Row Soil Management and Intra-Row Living Mulch on Spontaneous Flora, Beneficial Insects, and Growth of Young Olive Trees in Southern Italy. Plants, 11. https://doi.org/10.3390/plants11040545
5. Demo, A. H., & Bogale, G. A. (2024). Enhancing crop yield and conserving soil moisture through mulching practices in dryland agriculture. March, 1–14. https://doi.org/10.3389/fagro.2024.1361697
6. Dias, M. C., Figueiras, R., Sousa, M., Ferreira, M. P., Pinto, D. C. G. A., & Silva, A. M. S. (2024). Ascophyllum nodosum Extract Improves Olive Performance and Physiological Processes.
7. Dias, M. C. P., Figueiras, R., Sousa, M., Araújo, M., De Oliveira, J., Pinto, D., Silva, A., & Santos, C. (2024). Ascophyllum nodosum Extract Improves Olive Performance Under Water Deficit Through the Modulation of Molecular and Physiological Processes. Plants, 13. https://doi.org/10.3390/plants13202908
8. Ding, F., Li, S., Lu, J., Penn, C. J., Wang, Q.-W., Lin, G., Sardans, J., Penuelas, J., Wang, J., & Rillig, M. C. (2023). Consequences of 33 Years of Plastic Film Mulching and Nitrogen Fertilization on Maize Growth and Soil Quality. Environmental Science & Technology, 57(25), 9174–9183. https://doi.org/10.1021/acs.est.2c08878
9. El-Beltagi, H., Basit, A., Mohamed, H., Ali, I., Durrani, S., Kamel, E., Shalaby, T., Ramadan, K., Alkhateeb, A., & Ghazzawy, H. (2022). Mulching as a Sustainable Water and Soil Saving Practice in Agriculture: A Review. Agronomy. Agronomy, 12, 1881. https://doi.org/10.3390/agronomy12081881
10. Golmohammadi, M., Sofalian, O., Taheri, M., Ghanbari, A., & Rasoli, V. (2020). Changes in fruit yield and photosynthesis parameters in different olive cultivars (Olea europaea L .) under contrasting water regimes. 19(3), 135–147. https://doi.org/10.24326/asphc.2020.3.12
11. Hegazi, E. S. S., Allatif, A. M. A., & Abdel-fattah, A. A. (2024). Agricultural Sciences Response of Grafted Olive (Olea europaea L . Cv . Coratina) to Water Deficit Conditions Materials & Methods.
12. Imperiale, V., Caruso, T., Ioppolo, A., Carella, A., Massenti, R., & Marra, F. P. (2025). Water stress effect on hydraulic architecture, biomass partitioning, and gas exchange of four different olive cultivars. Frontiers in Plant Science, 16. https://doi.org/10.3389/fpls.2025.1630454
13. Liao, Y., Cao, H., Liu, X., Li, H., Hu, Q., & Xue, W. (2021). By increasing infiltration and reducing evaporation , mulching can improve the soil water environment and apple yield of orchards in semiarid areas. Agricultural Water Management, 253(26), 106936. https://doi.org/10.1016/j.agwat.2021.106936
14. Martinez, S., Moutier, N., & Garcia, G. (2015). Plasticity in Vegetative Growth over Contrasted Growing Sites of an F1 Olive Tree Progeny during Its Juvenile Phase. 1–19. https://doi.org/10.1371/journal.pone.0127539
15. Massenti, R., Scalisi, A., Marra, F. P., Caruso, T., Marino, G., & Bianco, R. Lo. (2022). Physiological and Structural Responses to Prolonged Water Deficit in Young Trees of Two Olive Cultivars. 1–17.
16. Parri, S., Romi, M., Hoshika, Y., Giovannelli, A., Dias, M. C., Piritore, C., Cai, G., & Cantini, C. (2023). Morpho-Physiological Responses of Three Italian Olive Tree (Olea europaea L .) Cultivars to Drought Stress.
17. Rico, E. I., De La Fuente, G. C. M., Morillas, A. O., & Ocaña, A. M. F. (2023). Physiological and biochemical study of the drought tolerance of 14 main olive cultivars in the Mediterranean basin. Photosynthesis Research, 159, 1–16. https://doi.org/10.1007/s11120-023-01052-8
18. Rosati, A., Paoletti, A., & Lodolini, E. M. (2024). Cultivar ideotype for intensive olive orchards : plant vigor , biomass partitioning , tree architecture and fruiting characteristics. January, 1–13. https://doi.org/10.3389/fpls.2024.1345182
19. Sghaier, A., Chehab, H., Aissaoui, F., & Naggaz, K. (2019). Effect of Three Irrigation Frequencies on Physiological-Biological Aspects of Young Olive Trees (Olea europaea L . cvs ' Koroneiki ' and ' Picholine '): Vegetative Growth , Leaf Turgor Pressure , and Fluorescence. 28(4), 2363–2370. https://doi.org/10.15244/pjoes/86124
20. Trabelsi, L., Mbarek, H. Ben, Ncube, B., Hassena, A. Ben, Zouari, M., Soua, N., Elloumi, O., Amar, F., Van Staden, J., & Gargouri, K. (2024). Impact of arid climate on ecophysiological characteristics and water utilization patterns of two olive cultivars (Olea europaea L.) in the Mediterranean dryland: a case study of 'Chemlali Sfax' and 'Koroneiki.' Euro-Mediterranean Journal for Environmental

Integration, 9, 1227–1242. https://doi.org/10.1007/s41207-024-00573-5

21. Zhu, G., Yong, L., Zhang, Z., Sun, Z., & Wan, Q. (2021). Catena Effects of plastic mulch on soil water migration in arid oasis farmland : Evidence of stable isotopes. Catena, 207(967), 105580. https://doi.org/10.1016/j.catena.2021.105580