



# Soil moisture management in pistachio orchards using perforated PVC pipes and its impact on some water and production parameters

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## Abstract

Water resources for pistachio cultivation are limited, particularly in Kerman Province, Iran, necessitating efficient water use and modern irrigation methods. This research investigates the application of subsurface irrigation systems employing perforated PVC pipes for mature pistachio trees. The study was conducted over two years (2020 and 2021) in a two-hectare orchard located in the Anar region. Four factors were investigated: Pipe insertion depth (40 and 60 cm), pipe diameter (110 and 160 mm), hole size in pipes (9 and 12 mm), and hole spacing (15 and 25 cm). Using a split-split plot design, a completely randomized block design with three replications resulted in 16 experimental treatments (T1 to T16). Each treatment received the same water volume (50% of the flood irrigation requirement, roughly 5000 m<sup>3</sup> ha<sup>-1</sup> over the growth stage) with a 24-day irrigation period. Soil moisture content was assessed at various depths across two successive irrigation events in July and August utilizing a Time Domain Reflectometry (TDR) device. Additionally, water use efficiency was evaluated based on the dry yield and the amount of irrigation water consumed, considering two scenarios: with and without the volume of water required for leaching. Statistical analysis with MSTAT-C software (version 5.4) and mean comparison using the LSD test at a 5% significance level was performed, with soil moisture distribution visualized using Surfer software (version 15). Results showed that both individual and combined design variables significantly impacted on dry yield, water use efficiency, and soil moisture distribution in the pistachio root zone. The most effective individual variables were a 40 cm Pipe insertion depth, 12 mm hole diameter, and 15 cm hole spacing, with an optimal pipe diameter of 110 mm. Treatments T5, T6, and T3 yielded the best combined results. Proper selection of irrigation system design variables increased soil moisture content in the maximum root density zone (40–80 cm) by 6.2% and 12% at 2 and 23 days post-irrigation, respectively. The findings underscore the critical role of optimizing subsurface irrigation system design variables in enhancing water use efficiency and soil moisture retention for pistachio cultivation in water-scarce regions.

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## Introduction

Pistachio (*Pistacia vera* L.) is one of the most important exportable products in arid areas of Iran, mainly in Kerman Province, where water resources are limited and the climate is characterized by high temperatures and low precipitation. The distribution of non-fertile, fertile, and total pistachio cultivation areas within the province constitutes 5.5%, 46.8%, and 41.1% of the overall pistachio cultivation area in Iran, respectively (B.S.I. T. 2022). Development of pistachio using surface irrigation has contributed to severe decline of the groundwater table in the pistachio growing areas of Iran. Traditional irrigation methods, such as flood irrigation, are inefficient, often resulting in water wastage, soil erosion, and lower water productivity and irrigation efficiency (Qadir et al. 2014). Tree growth, nut yield, and quality may be significantly influenced by water