

Evaluating Water-Use Efficiency and Growth Responses of Lettuce Under Subsurface vs. Surface Drip Irrigation in a Controlled Environment

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Abstract

Throughout history, humans have relied heavily on agricultural products for survival. As technology continues to advance, new methods have emerged to improve the sustainability and efficiency of crop production. These methods include optimizing soil composition, adjusting irrigation schedules and delivery methods, and improving seed quality, all with the goal of increasing yield. This study explores the effectiveness of subsurface irrigation compared to traditional surface drip irrigation, with a focus on water conservation while maintaining healthy plant growth.

Using baby heirloom lettuce as the test crop, both irrigation systems were designed and monitored under controlled indoor conditions. Soil moisture sensors dynamically adjusted irrigation schedules based on real-time readings, allowing for responsive and data-driven water delivery. Through this approach, the study evaluates how subsurface irrigation combined with sensor-based control can improve irrigation efficiency and sustainability.

Results indicate that subsurface irrigation promotes healthier plant growth compared to surface drip irrigation, although it requires slightly more water overall. These results offer insights into sustainable, technology-enabled farming practices that can help growers optimize their efficiency and resource use worldwide.

