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Trial shows benefits of drip

Trees irrigated with drip systems tend to crop earlier.

GERALDINE WARNER



A drip irrigation system uses less water and can lead to better yields and quality of fruit than a sprinkler system, a long-term study at the University of Idaho shows. The study, led by Dr. Esmail Fallahi, was done in a high-density Fuji apple block at the Parma Research and Extension Center.

Fallahi compared five different irrigation methods: Full irrigation with sprinklers; partial root-zone drying with a sprinkler system; full drip irrigation; deficit drip irrigation; and partial root-zone drying with a drip system. The area receives about 12 inches of precipitation annually; around 2.5 inches falls as rain during the growing season.

He looked at tree growth, yields, and fruit quality over a five-year period and concluded that a full drip irrigation system, with water applied according to the evapotranspiration rate, was better than the other systems for modern, high-density apple orchards.

The research block was established in 2002, with one row of Fuji trees dedicated to each of the five irrigation regimes. The trees were trained to a vertical axis system, and the crop was both chemically thinned and hand thinned.

In May, before the first irrigation of the year, soil moisture was measured with sensors and trees were watered to the soil saturation point. After that, water requirements were calculated based on the evapotranspiration rate, adjusted according to the percentage of ground shaded by the tree canopy at different stages of growth. The trees reached maturity in the third year.

The irrigation treatments were:

Full sprinklers: Trees were irrigated with microjet sprinklers once a week at the full evapotranspiration rate.

Partial root-zone drying sprinklers: Microjet sprinklers covered a semicircle on either side of the tree row. The trees were irrigated once every two weeks only on one side of the row. At each irrigation, alternate sides of the row received 50 percent of the full sprinkler amount.

Full drip: Drip lines were installed on each side of the trees, and trees were irrigated twice a week with the full evapotranspiration rate, adjusted for ground shading.

Deficit drip: Trees were irrigated on both sides twice weekly with 65 percent of the full drip rate.

Partial root-zone drying drip: Trees received the same amount of water as the deficit drip, but were irrigated every two weeks on alternate sides.

Fallahi tracked water application, tree growth, yields, and fruit quality (size, color, russet, sunburn, soluble solids, starch degradation, firmness, and watercore) for all the treatments.

Water: Water use increased in all the treatments as the trees matured. Overall, trees with the full sprinkler treatment received more water than any of the drip treatments. After the trees reached maturity, the full sprinkler trees received almost 38 inches of water per season on average, compared with less than 25 inches for the full drip.

Although the deficit drip and partial root-zone drying drip received only 65 percent as much water as the full drip, the trees showed very little water stress. However, all the trees that received reduced amounts of water—whether through sprinklers or drip—had smaller canopies and earlier leaf drop in the fall.

Tree growth and yield: Trees with any of the drip systems tended to be more precocious and had higher yields per tree and greater yield efficiency than the full sprinkler system in the first three years. Trees under water stress (particularly the deficit and partial root-zone drying drip treatments) had more fruiting spurs, leading to higher production in the early years. However, the full sprinkler treatment had the highest per-tree yields after the trees matured, because of the larger canopy, and the deficit drip trees had the least.

Fruit weight: Trees receiving the full irrigation treatment (whether sprinkler or drip) had the largest apples. This suggests that trees need irrigation at full evapotranspiration rates to produce large fruit, which is particularly important for varieties with a natural tendency to produce small fruit, such as Gala, Fallahi reports.

The partial root-zone drip trees produced larger fruit than those with deficit irrigation, even though the amount of water applied was similar. This suggests that it is more beneficial to apply the entire amount of water to alternating sides every other week than to both sides more frequently because with partial-root-zone irrigation the water will reach roots at a greater depth.

Trees with the partial root-zone drip treatment always had larger fruit than those with partial root-zone sprinkler irrigation, although they received less water each season. This is because the sprinkler system covers a wider but shallower area around the trees and more water might have evaporated than with the drip system, according to Fallahi.

Color: There was no consistent effect of the irrigation treatment on fruit color, though the fruit from the partial root-zone sprinkler system had slightly better color some years, perhaps because of a less dense canopy and better light penetration.

Russet: The reduced-water treatments had less russet than the other treatments, possibly because the trees were smaller with less dense foliage.

Sunburn: Fruit from both the full irrigation systems had less sunburn than the treatments with reduced water applications. The trees had larger canopies and more foliage than the others, which provided greater protection of the fruit from the sun.

Soluble solids: Fruit from the partial root-zone sprinkler treatment had the highest soluble solids, particularly when the trees were young, possibly because of smaller fruit size.

Firmness: Fruit firmness was not affected by the irrigation regime.

Watercore: Fruit from the full drip system always had watercore, which could be a positive or negative attribute, depending on the variety. In Fuji, watercore might be desirable.

Fallahi concluded that a full drip irrigation system is the best choice for high-density apple orchards. The study showed that Fuji apple trees can be maintained with less water (65 percent of full evapotranspiration rate). In this case, the partial root-zone drying (with irrigation alternating between sides) would be preferable to a deficit irrigation treatment with water applied to both sides.

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