WATER TASK FORCE
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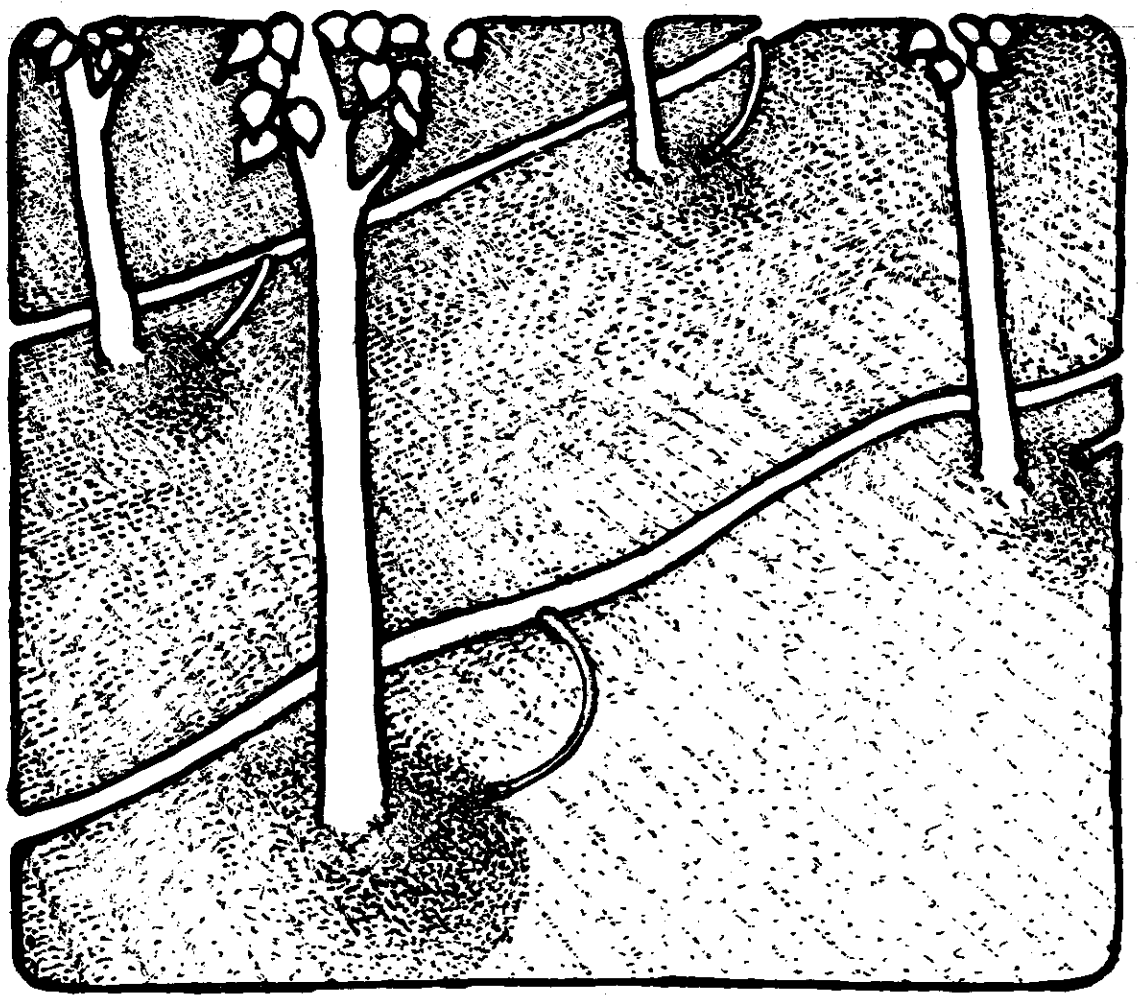
DOES DRIP (and other low-flow) IRRIGATION SAVE WATER?



Cooperative Extension **University of California**
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DOES DRIP (and other low-flow) IRRIGATION SAVE WATER?

Since the early 1970s, a new irrigation technology designed for very low rate of flow has been widely adopted in California agriculture. Most of the new systems use drip emitters—hence, the common name "drip irrigation"—but others employ misting devices and mini-sprinklers. In some situations this new technology has dramatically reduced the amount of irrigation water applied. As a result the question is now being asked whether low-rate-of-flow irrigation could be one important answer to California's water shortage problem.

In its early days, some promoters described low-flow irrigation as a panacea providing large yield increases and also remarkable water savings. This claim has proved to be exaggerated. Low-flow irrigation occasionally improves crop yields, mostly where there are serious soil problems (sandiness, soil layers, extreme variability). But on most soils, yields do not increase if the previous furrow or sprinkler irrigation was well managed.

Early claims for water savings also were too optimistic. However, experience has shown that, in many circumstances, well-managed low-flow irrigation can save water for the farmer by reducing certain kinds of losses—particularly runoff from the field, percolation below crop roots, and sometimes evaporation from the soil.

For individual growers, the amount of water saved may be significant. In a mature orchard or vineyard with no serious soil problems, it may be possible to apply 15 to 30 percent less water than with ordinary border or furrow irrigation. (Compared to sprinklers, water savings probably would be less.) Savings of 50 percent or more have been recorded on very sandy soils where previous percolation losses were excessive. These gains from low-flow irrigation are partly due to the modern design and better management that usually accompany any new system. Well-designed and well-managed sprinkler and surface irrigation systems also are efficient.

Where low-flow systems do save water for the grower, the gains result from (1) less runoff and deep percolation, (2) more uniform application of water from plant to plant, and (3) better irrigation scheduling with low-flow systems, which often are semi-automated. Because of these potential savings, many growers have converted to low-flow irrigation in areas where water is expensive or in short supply.

Types of Irrigation

California farmers use, in general, three types of irrigation systems:

Surface irrigation (furrow or border method), with water flowing over the ground.

Sprinkler irrigation, through systems of moveable or permanent pipes and sprinklers.

Low-flow irrigation, with water distributed over the field through plastic hoses and released very slowly through drippers or mini-sprinklers.

Because of their slow rate of flow, drip and similar systems operate for much longer periods of time. But the amount of water actually required by the crop is the same regardless of the type of irrigation system.

Increasing acreage

Today there are more than 500,000 acres of low-flow irrigation systems in California. (Total irrigated acreage: About 8 million.) An additional 30,000 to 40,000 acres are added each year. Water savings to individual farmers are only one reason for this changeover. Other possible advantages of low-flow irrigation are:

- Labor savings and convenience
- Potential for automated distribution of fertilizers and herbicides
- Energy savings, if the reduction in water pumped saves more energy than is needed to pressurize the low-flow system

Because of relatively high installation costs, low-flow systems have been limited largely to orchards and vineyards, where tubes and emitters can be left in place, and to vegetables, where high-value crops make it economically feasible to replace them yearly. However, new technology on the market is opening up potential for low-flow irrigation in cotton and other row crops. Also, design improvements and better management information have made existing systems more convenient and trouble-free.

Overall water savings potential

To return to the opening question: How important is low-flow irrigation as a potential means of extending California's total water supply? This depends partly on another question—whether the new technology, so far, has saved substantial amounts of water that then became available for use elsewhere. The answer is complex, for a number of reasons:

Some low-flow systems are used on steep or rolling land that formerly was not irrigated. For this reason, the new technology actually increased total water demand.

Recent developments in irrigation (scientific scheduling, better knowledge of crop water requirements) have shown that some acreages using conventional systems were underirrigated. Here, too, a changeover to well-managed drip irrigation could result in more water use, but also probably more crop production.

In most cases where low-flow irrigation replaces surface or sprinkler systems, substantial water savings on individual farms can result because of less surface runoff and less deep percolation.

However, this does not necessarily result in less basinwide water use—if, as often occurs, the "lost" water would have been recovered and reused anyway. If runoff and deep percolation are not recovered, basinwide water savings are possible by reducing those losses. For example, along the low-lying west side of the San Joaquin Valley, runoff and percolation may mix with saline drainage water and be lost.

Losses through crop plants

Can low-flow irrigation reduce other losses besides runoff and deep percolation, such as direct evaporation from the field and transpiration through plants? These two combined losses (evapotranspiration) account for most applied irrigation water.

As long as adequate water is supplied to the crop, the amount of transpiration is the same with all irrigation methods—so ordinarily there are no savings in transpiration with low-flow systems. Low-flow irrigation wets a smaller amount of soil surface, but it stays wet for a longer period of time—so direct evaporation losses may not be significantly reduced.

One important possible exception: Evapotranspiration savings can occur in new orchards and vineyards where small plants occupy only part of the ground. If conventional irrigation wets the entire soil surface, including that between the rows of young trees or vines, there will be excessive losses to soil evaporation as well as deep percolation. In this case, a low-flow system, which places water only near the plants, saves considerable water.

(In practice, farmers with surface irrigation systems often reduce these evaporative water losses simply by keeping furrows close to the young plants. With sprinklers, such losses are more difficult to avoid.)

Good management needed

Simply installing a low-flow system does not guarantee water savings. Like other types of irrigation, low-flow depends to a large extent on management to achieve water-use efficiency. Furthermore, with good management and on soils without serious problems, both surface and sprinkler irrigation also can be very efficient.

The opportunity to save significant amounts of water by installing low-flow irrigation is found mainly where well-managed systems are used in the following situations:

- In place of outdated or poorly managed sprinkler and surface systems
- On problem soils (sandy, layered, steep) where the excess runoff and percolation is not recovered and reused
- In immature plantings, in place of other systems that wet the entire soil surface

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