Figure 1. **Soil appears moist at the lower left of this grapefruit tree. Note also that the water line emerges from the soil and the emitter discharges water onto the soil surface.**

Is Drip Irrigation For Arizona?

*by D. D. Fangmeier**

The decreasing availability and rising costs of water and labor are causing growers to consider replacing their surface irrigation systems. Drip irrigation is frequently mentioned as a possible alternative.

Drip systems deliver water in pipes or tubes to the vicinity of a plant where the discharge is controlled by a special valve called an emitter. Because drip systems require an extensive pipe network, tree crops appear to be best suited to this method of irrigation. The piping will interfere least with the field operations of tree crop production and can remain in place for many years.

The purpose of an irrigation system is to provide sufficient soil moisture for optimum plant growth while minimizing water losses. Drip irrigation systems provide better water control and only the actual root volume is irrigated.

Drip irrigation systems may cost from $150 to $500 per acre, therefore, a high value crop which will respond to the soil moisture control provided by drip irrigation is needed. Tree and vegetable crops match this requirement, however, tree crops are more compatible with the piping system. As an example, a grapefruit tree being drip irrigated is shown in Figure 1.

Do drip irrigated trees actually use less water? Most likely not if sufficient water is applied to maintain optimum growth and yield. So how is a water savings achieved with a drip system? It is chiefly attained with young trees by irrigating only the soil volume where roots are developing. Also, by applying smaller amounts of water, deep percolation below the root zone is reduced and tail water run-off is eliminated. A small area around each emitter is wetted with lateral and vertical movement occurring through the soil. Soils vary in the characteristics of such water movement so it is necessary to determine the spacing of the emitters for each soil. Figure 2 shows a cross-section of the wetted soil volume under a small tree growing in a medium textured soil.

Associate Agricultural Engineer, Arizona Agricultural Experiment Station.

Applying water to a limited soil volume will result in a salt accumulation in the soil where water is extracted by the plant roots. Repeated wetting of the same volume may leave an even higher salt accumulation at the outer edge of this wetted volume. Thus, additional water may be needed on occasion to remove these accumulated salts from the ro[ot] zone.

At the Salt River Valley Citrus Branch Experiment Station, a small basin with a mulch was placed around each tree, (Figure 3). A 95 percent water savings occurred on young trees compared to adjacent surface irrigated trees. The water savings will decrease as the trees mature and the roots remove water from a larger portion of the surface irrigated soil. Estimates vary from 20 to 50 percent water savings on mature trees.

Now we can explain how a grower can use 1 acre-foot per acre of water in a field per year with a drip system while consumptive use records[1] indicate 4 acre-feet per acre are required by surface irrigation of mature trees. The 1 acre-foot per acre quantity was based on the entire field area. If the computation is made using only the area under which roots are found, then the number might actually be higher than 4 acre-feet per acre irrigated. This was found to be the case in a study at the Salt River Valley Citrus Branch Experiment Station[2], where the irrigated area was approximately that encircled by the drip line of the tree. The drip system thus saves water by irrigating only the required soil volume under the tree and reducing losses, but not by causing the tree to use less.

How is a labor savings achieved with a drip irrigation system? These systems distribute the water through pipes. Therefore, water control can be attained by simply opening and closing valves. Automatic controls, timers and other equipment are readily available for pipe systems, which can reduce the labor requirements.

There are some pitfalls in the above reasoning. A drip system usually consists of a pump, filters, meter, control valves, pipe and emitters. The emitter is the most troublesome part of the system. Many designs are currently available, but most have small openings which are subject to plugging. Some emitters have a long flow passage which allows a larger opening, others are self-flushing, but are more expensive. Because of the plugging problem, the water must be clean which usually requires a filter. The filter for a 50 acre field may cost several hundred dollars and require cleaning. Without a filter emitters can become plugged and cleaning could require more labor than necessary for surface irrigation. Even with filtered water, emitters must be checked periodically because we are not confident of their operation.

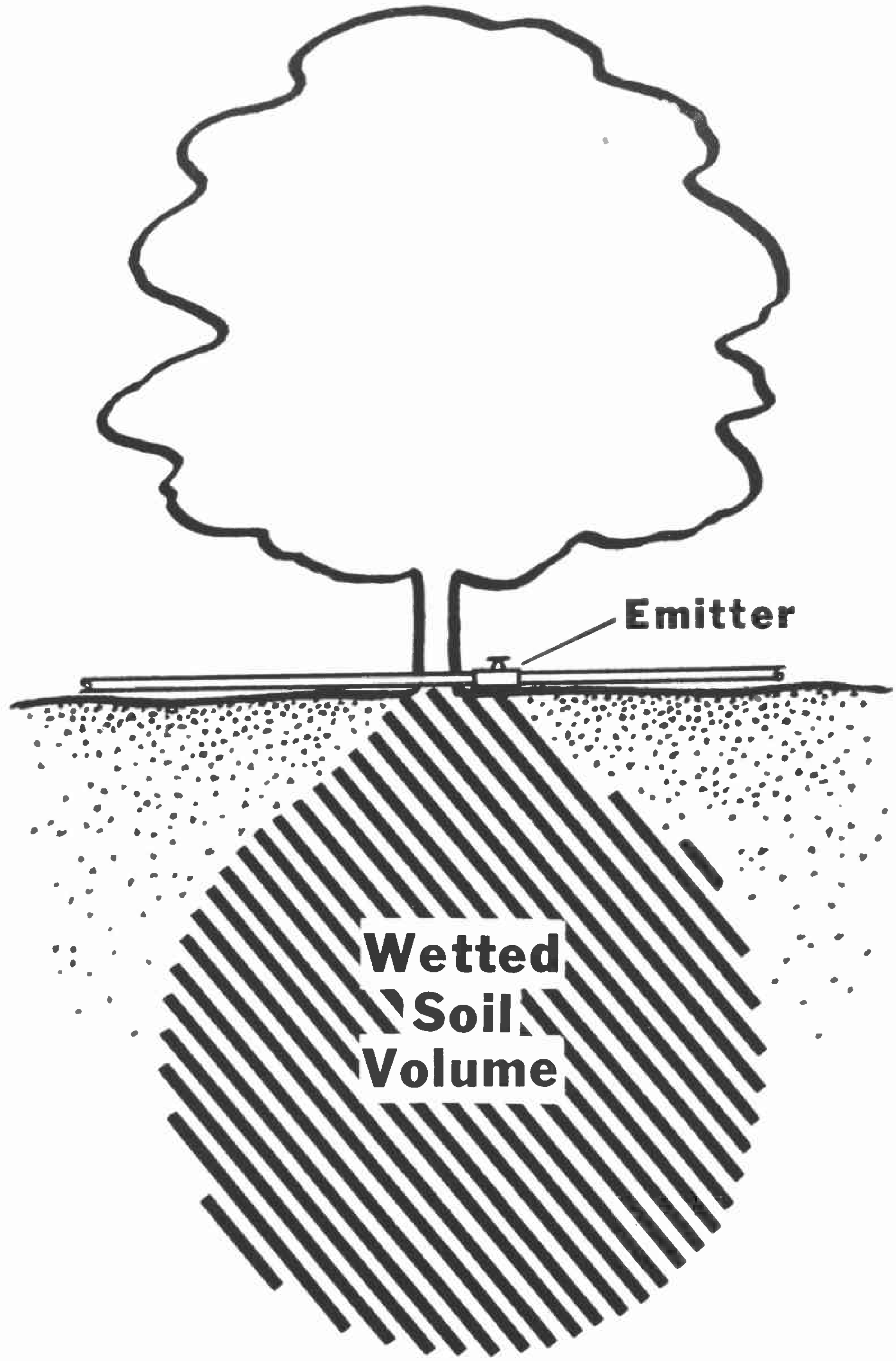

Figure 2. This schematic drawing shows a typical cross-section of the wetted soil as produced by a single emitter under the small tree.

The meter may appear to be a luxury, but with a system designed to supply a minimum amount of water, we must be certain of the quantity supplied. The meter may also be used to detect plugged emitters. The reduced flow can be observed on the meter.

A yield and quality increase probably will be necessary to pay for the additional cost of a drip system. Some believe that yields can be increased using a drip irrigation system because of better control of the soil moisture.

Changing from a surface irrigation system to drip irrigation may present some additional problems, particularly if the same water supply is used for both. Surface irrigation requires large flows for short periods of time. Drip irrigation requires small

(Please turn to Page 15)

Drip Irrigation

(from Page 7)

flows for a longer time and more frequently. Therefore, a plan must be developed to manage the water so it is available to both systems. If the system is changed on mature trees, there is the danger of not supplying sufficient water to the soil where most of the roots are located. The trees will require some time to develop their root systems to match the new irrigation system.

More information is needed on certain critical aspects. In addition to those noted, we need to know the quantity of water required per day or per week by a tree during various seasons and stages of growth. Current estimates are based on consumptive use requirements for surface irrigation. Design criteria need to be established for various types of emitters, soils, tree spacings and age. Researchers at the University of Arizona and other locations plus growers are trying to obtain information to answer these questions.

The question in the title "Is Drip Irrigation for Arizona?", is best answered by, "Yes, if certain conditions exist." These conditions are: high value crops, high water and labor costs, limited water supply, capital available, and a willingness to try to overcome the uncertainties involved. Other considerations include development of new areas where land leveling costs would be very expensive and other factors the grower may deem important. If the decision is made to use drip irrigation, try a small acreage to see if it performs as expected.

Figure 3. Water delivered to small tree basin containing a mulch was an effective means of conserving water. Water can be delivered in pipes through larger openings as pictured below reducing the problem of plugging the holes as has been experienced with emitters.

References

[1] *Erie, L. J., O. F. French, and K. Harris, "Consumptive Use of Water by Crops in Arizona," Tech. Bull. 169, Arizona Agricultural Experiment Station, The University of Arizona, Sept., 1965.*

[2] *Fangmeier, D. D., et al., "Subsurface Irrigation of Citrus," Progressive Agriculture in Arizona, Vol. XXI No. 3 pp. 14-15, May-June, 1970.*