DRIP IRRIGATION *for Plants Grown*

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Drip and spray irrigation systems permit precise placement of a measured amount of water to soil. Designed for frequent, slow application of water, these systems make it possible to adjust the volume of water applied to soil in order to replace that which is removed from the soil through evaporation and plant transpiration (evapotranspiration). Use of drip and spray irrigation systems should lead to reduced water runoff from soils and more efficient use of water and nutrients needed for plant growth.

Data on evapotranspiration (ET), available water per container, and the influence of irrigation practices on salinity are needed in order to formulate sound management practices for use of drip or spray systems with plants grown in containers. Experiments were conducted at the University of California South Coast Field Station to obtain this information.

Evapotranspiration

A standard U.S. Weather Bureau Class A evaporation pan and white and black Livingston atmometers were used to estimate ET. Actual evapotranspiration for ornamental plants growing in 1-gallon containers was measured by weighing container, plant, and soil before and following irrigation. These estimates and actual ET measurements were made from June through November 1974. All tests were with containers on bare ground exposed to full sunlight. At the beginning and end of each trial, test plants were measured to determine their height and widest diameter.

Variations noted. Evapotranspiration varied according to plant species and position of a plant within its test bed. Also, considerable variation from plant to plant in similar locations within a test bed was noted. Data obtained from these trials quantify observations by practical horticulturists for many years.

Differences in ET noted between plant species during the trials cannot be attributed solely to plant size or shape or both. The results of the first trial, June 3-13, 1974 showed that a hibiscus plant had nearly the same ET as a larger Shamel ash plant. A shiny leaf coprosma plant had the highest ET but was not the largest in size.

Later, in July, ET from an average upright Monterey pine was the same as that from an average spreading natal plum plant. Both were almost the same size with respect to exposed area (height times width).

The amount of water used daily approached the total water available in the soil. Available moisture was not determined for each trial. However, other experiments with the same soil mixture indicate that approximately 400 milliliters of water were available from each 1-gallon plant container.

Wind was another factor that affected ET. Santana winds occurred during some of the experiments in the fall of 1974. Under santana conditions, ET and evaporation from atmometers increased dramatically. For example, for the plant *Pyracantha coccinea*, the following data were recorded:

Evapotranspiration
- Normal winds — 135 ml/container/day
- Santana winds — 280 ml/container/day
- Ratio santana conditions/normal conditions = 2:1

Evaporation from white atmometer
- Normal conditions — 18 ml/day
- Santana conditions — 68 ml/day
- Ratio santana conditions/ normal conditions = 8:3.

Similar results were recorded for three other plant species. Although the ET measured varied with the plant species, the dramatic increase in ET under santana conditions was consistent for all species studied. Also noted was a greater increase in evaporation from the white atmometer as compared to ET from the plant.

Correlation of ET with evaporation measures. There was a significant correlation between actual ET and evaporation from the Class A evaporation pan and the white and black atmometers. Typical coefficients of correlation are reflected by the data obtained for the plant *Callistemon citrinus:*

Actual ET
- to evaporation pan — 0.848
- to white atmometer — 0.769
- to black atmometer — 0.736

These correlation coefficients are statistically significant at the 1 percent level. The same was not true when black minus white atmometer

in Containers

For the most efficient use of drip irrigation for plants grown in containers, attention must be paid to evapotranspiration and distribution of and amount of salinity in the soil.

data were used, presumably a measurement only of solar radiation influences. Significant correlations were noted only during the first trial in June. In all later trials, this measure did not correlate significantly with the actual ET. Apparently factors other than light were more important. Typical data were as follows:

Coprosma repens — 0.914 (significant at the 0.005 level)
Callistemon citrinus — 0.392 (not statistically significant)

Soil salinity in containers and irrigation method

Results from earlier work on short-term crops grown in containers indicated that excellent plant growth occurred with drip irrigation. Analyses of salinity patterns within the soil mass for these crops suggested that salinity might be a potential problem for longer-term crops. At the South East Field Station, an experiment was begun to study salinity buildup and to answer the following questions:

(1) Can soil salinity be controlled to a reasonable degree when drip irrigation is used by applying water in excess of that suggested by the standard leaching requirement formula?

(2) Will increases in soil salinity with drip irrigation be sufficient either to injure the plant or to reduce its growth?

Salinity. Distribution and amount of salinity differed with the irrigation system used. In containers under overhead irrigation, salinity increased from the top to the bottom of the soil ball. Lateral distribution of salts from the core to the side was about the same.

Under spray and drip irrigation, salinity was least in the core of the soil mass and most in the surface and outer zones of the soil mass. While the distribution of salts was the same for both spray and drip systems, the amount of salinity was less with spray than with drip.

Increasing the amount of water applied through the drip irrigation system did not materially influence salinity levels. Thus, the answer to our first question asked seemed to be: for drip irrigation of containers, increasing the amount of water flowing through the soil will not satisfactorily control salinity. It appears that the rate of application (*i.e.*, the volume of water per unit time) and distribution of water over the soil surface are more important, as was shown by the lower levels of salinity when overhead sprinkling or spray irrigation were used. Flushing salts out of the soil appeared to be correlated to the rate and pathway of water flow through the ball of soil in the container.

Plant growth. Would the buildup of salinity in the soil under drip irrigation, even with daily water applications, result in plant growth inhibition or alteration? The answer to this question is yes, based on the data from these trials and earlier experiments. Varietal differences were noted, but, in general, plants under drip irrigation for a lengthy period and without periodic flushing to leach salts from the soil were smaller at the end of 10 months than similar plants under overhead or trickle irrigation. This effect seemed to be due to the retarding effect of high salinity on plant growth, not to nutrient content of the plants. Visible injury due to high salinity was not noted.

Differences in plant root distribution within the root ball were noted. In general, under drip irrigation, more roots were found in the center of the root ball. For plants under overhead irrigation, more roots were found on the edge of the root ball.

Conclusions

Drip irrigation presents horticulturists with a method of precisely controlling the irrigation of plants grown in containers. The amount of water applied and the timing of irrigation may be controlled by devices such as Livingston atmometers because the evaporation of water from these atmometers correlates closely with ET from the containers. Allowances for differences in plant species will be necessary.

Control of salinity within the soil poses some problems when drip irrigation is used. Periodic leaching of the soil will be necessary when drip irrigation is used, because varying the amount of water during normal irrigation will not control salinity adequately. Leaching appears to be accomplished best by uniformly applying water over the entire soil surface. The frequency of leaching necessary surely will depend on the salt content of the irrigation water and on the fertilization practices used.

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