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Citrus Notes
Tulare County

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Irrigation System Uniformity

Significant non-uniformity in your microirrigation system has a number of different costs. Some emitters are delivering less water than expected. On hot days the trees serviced by these emitters will be stressed. Because these trees receive less water than anticipated, they receive less fertilizer when it is applied through the irrigation system. On the other hand, some emitters will be delivering more than the anticipated gallonage. What are the costs in this case? Continual over-irrigation may produce a saturated soil condition in the root zone leading to loss of roots. As this condition develops water and nutrient transport is less efficient with effect on tree vigor, production and increasing susceptibility to root disease. Over-irrigation results in application of more nutrient than planned with excessive cost and leached nutrient. Performing a uniformity evaluation on your system is simple and well worth the time to perform it. Non-uniformity in the system may not be obvious but it does have costs.

EVALUATING UNIFORMITY OF LOW VOLUME IRRIGATION

Adapted from Marsh, Strohman, Brendler and Handley, Vaux,
Pickering by John Pehrson, Extension Subtropical Horticulturist, Lindcove Field Station

Mechanical methods of irrigation such as mini-sprinklers and drippers were selected in part to achieve more uniform water distribution and application efficiency.

Handley, Vaux and Pickering measured emission uniformity on 112 low volume irrigation systems during 1981 in the southern San Joaquin Valley, in many citrus orchards, and determined their emission uniformity, EU, average to be 80.3% (Calif. Agriculture, Vol. 37, 1&2).

Moderate lack of uniformity requires that more water be applied through the system to compensate for the poor performing emitters otherwise the trees served by these emitters will be receiving considerably less than their requirement. For some systems this amount can be 50% to 100% more than highly uniform systems.

A fairly simple evaluation of uniformity requires field measurements and some calculations. The necessary equipment includes a graduated cylinder and a stopwatch for measuring emitter output. There are three steps to the evaluation.

1. Randomly select hose lines and emitters,
2. Collect measurements from these sites,
3. Analyze data with corresponding formulas.

Plan to obtain from 50 to 100 individual emitter measurements from 10 to 20 hose lines after the system has been operating for 30 minutes or so and is stabilized. It should be working at its usual pressure.

Collect the output of each emitter using a stopwatch for timing. Sixty second increments are convenient for drip type emitters, 15 or 30 second times are easier for sprinkler or sprayer types since volumes of water may be cumbersome for the one minute collections. The graduated cylinder used to collect the output must have enough volume with sufficient graduations to read the measurement. For large orifice emitters it may be easier to collect in a large cylinder and transfer to a smaller one for accuracy. The process should avoid distortions

to lines and emitters. A two-person team, one to catch and measure water, one to time the catchment and record data, works well.

When the field measurements are completed the data can be analyzed for emission uniformity, EU, and a term called water factor, WF. Begin calculations with the averages for emitters along individual hoses and an overall average or mean, $\overline{X}$. Where hose averages deviate more than 10% from the overall average some remedial effort is needed. The most frequent remedy involves pressure regulations.

The next calculation, EU, is the ratio of the lowest 25% of the emitters to the overall mean:

$$EU = 100\ X\ (\text{Ave. low } 25\% \div \overline{X})$$

If there could be a perfectly uniform system, EU would be 100. With decreasing uniformity this value becomes less than 100.

The water factor, WF, is more complicated requiring the computation of the statistical value called standard deviation or σ. It also uses "t" values derived from probability theory. For 90% irrigation uniformity measurements, the value of "t" is approximately 1.30. It is used in the following formula:

$$WF = 1/1-(t\_\_/\overline{X})$$

To obtain σ, the standard deviation, it is necessary to use the following:

$$\sigma = \sqrt{\sum x2 - \frac{(\sum x)2}{n} \div (n-1)} \qquad \sigma = \sqrt{\Sigma x^2 - (\Sigma x)^2/n \div (n-1)}$$

Where x = a measurement, n = number of measurements, $\sum x$ = sum of all measurements and $\sum x^2$ sum of the square of each measurement. When a WF_{90} is calculated it will estimate the extra volume of water necessary to have 90% of all emitters deliver a target quantity and compensate for lack of uniformity. It is often necessary to add 10% for a system of 90% uniformity and variation of +/-5%; a less uniform system will need more.

Fuller Rose Beetle and Korean Export

The South Korean announcement that it will not accept shipment of California citrus in which they find eggs of Fuller Rose Beetle has major implications for growers. Fortunately, previous research findings on the insect provide information on its biology including larval stage spent in the soil, emergence periods of the adult from the soil and laying of the eggs under the sepal (button) of the fruit. The insect is wingless so it must gain access to the tree at the skirts, the trunk or weed growth at the skirts of the tree. Several management options are available with skirt pruning of the tree the foundation of management of the insect. The Korean authorities have stated that they will not accept loads in which they find eggs of the beetle, and that they will not allow treatment of the fruit if eggs are found. The importance of this market to the California citrus industry makes effective management of this pest a very serious issue. Decisions as to whether fruit from an orchard might be exported to Korean should be made early by the grower and their packer, so that control of fuller rose beetle in the orchard can be completed at the appropriate time. Detailed information on Fuller Rose Beetle can be viewed at the following website: http://cetulare.ucdavis.edu.

Decline in juvenile trees

Two orchards with rapidly declining trees were inspected during April. In one case the trees were eight year Cara Cara navel on Carrizo rootstock in which widely scattered trees rapidly lost leaves then collapsed. The second orchard was three year old Powell navel on Carrizo rootstock. In this case some tree canopies rapidly took on a yellow color and several trees declined. Decline in young trees was reported in the fall edition of the Topics in Subtropics newsletter. Decline has been observed in Tulare and Kern counties in several navel cultivars, Satsuma and blood orange. Affected orchards have generally been propagated on trifoliate or one of the citranges such as Carrizo or C35. Declining trees generally exhibit staining at the budunion and in some cases a groove is present. Orchards affected have frequently been young. Reference in the article is made to the widespread decline witnessed in the San Joaquin Valley in the 1980's of frost nucellar navel on trifoliate rootstock. Affected trees generally exhibited a

groove at the budunion which girdled the tree. Affected trees in the current situation appear to decline as a result of girdling as well. As reported in the previously mentioned article, the current decline is being thoroughly investigated.

The article in the Topics newsletter can be accessed on the Tulare County Cooperative Extension website at: http://cetulare.ucdavis.edu, go to newsletters, click on Topics in Subtropics, then go to issue Volume 10 No. 3., or you may also click on the following link:
http://ucanr.edu/topics_in_subtropics_volume 10 no. 3.

Alternate Bearing

Very light bloom was observed in some orchards this spring. Recent research by Dr. Carol Lovatt on alternate bearing in Pixie mandarin offers some food for thought for this. Findings of the research on Pixie mandarin are thought to be applicable to sweet orange as well. On crop (heavy fruit set) and Off crops (light fruit set) are the result of favorable or limiting weather conditions. Once the alternating on/off cycle is established the factors involved in maintaining the cycle were the focus of the research- on/off crop sets and their impact on tree phenology. Results from the research found that in on-crop years (heavy bloom and crop set) the young developing fruit suppressed summer and fall vegetative shoot production. These shoots contribute to spring bloom the following spring. In addition, the later mature fruit is held the greater the suppression on spring and fall shoot production.

Removal of fruit in on crop years reduces the depressive effect on summer and fall shoot production. Removal of fruit is most effective if done by late spring, early summer. Removal has positive effect on growth of remaining new fruit as well. Removal should be done uniformly over the tree. The goal is a light pruning to promote summer vegetative shoots. How many fruit to remove or how much to prune in on crop trees? The concept to remember is that next year's crop will be produced predominantly on current season spring and summer shoots that did not set fruit or from which fruit have been removed by hand or pruning early in the season. For the Pixie mandarins studied 60% of the spring shoots in the on year are contributed by the previous year spring shoots, 32% by summer shoots of the previous year and 8% by fall shoots of the previous year. On crop suppresses summer and fall vegetative shoots-next spring only shoots from the previous spring are available to produce inflorescences/bloom. A report on the research can be accessed on the Tulare County Cooperative Extension website at:
http://cetulare.ucdavis.edu, go to newsletters, click on Topics in Subtropics, then go to issue Volume 10 No. 3, or you may also click on the following link:
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