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AVOCADO IRRIGATION

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Irrigation has been proclaimed (1) as the most important cultural operation in growing avocados. Avocados are sensitive to both extremes of soil moisture. If the soil is too wet, root rot from Phytophthora cinnamomi becomes a hazard. If the soil is allowed to become too dry, the leaves may burn on a hot day. Even a modest drying initiates the all too familiar tip burn found in many orchards. The need for frequent and careful irrigation has induced growers to pay closer attention to and spend more money on their irrigation systems and operations than on any other aspect of avocado culture.

Irrigation Management

Frequent irrigation has become a common practice to maintain a dilute soil solution[1] and reduce tip burn ([1]*Soil water with its dissolved plant nutrients and other salts including chlorides.* Fifteen to twenty years ago the common irrigation frequency for avocados was at 2- to 4-week intervals (2). Theoretically, there was adequate soil moisture capacity to sustain the trees for that interval in a climate that is warm but not severe. Tip burn was common and was known to be caused by absorption of chlorides from the soil solution. Suggestions that shorter intervals between irrigations might be helpful were accepted by some growers who found that the practice significantly reduced their tip burn. Others soon followed and the practice of 7- to 10-day intervals between irrigations during summer is now used by most growers.

Many growers have installed tensiometers to help guide their decisions on irrigation intervals. Tensiometer readings of about 40 centibars are obtained prior to irrigation in summer with an interval of about 7 days (3). While tensiometer users generally maintain their 7- to 10-day intervals in summer, they have found that intervals can and should be extended during other parts of the year (3). The interval is much less predictable in other parts of the year, but by using their tensiometer readings in the 40 to 50 range as a guide, they have been able to irrigate when needed and avoid unnecessary irrigations that might be harmful.

The hazard which all avocado growers fear is root rot caused by Phytophthora cinnamomi. The occurrence and spread of this disease is commonly associated with excessive soil wetness. Tensiometers have the ability to measure accurately the soil condition of excessive wetness associated with root rot. By paying attention to the tensiometer readings, a grower can adjust his irrigations in a way to avoid the very wet conditions which are dangerous. Readings from 0 to 5 are particularly bad and should be avoided. Readings from 5 to 10 are borderline and should be minimized, though they cannot always be avoided.

Irrigation Methods

Irrigation systems have undergone changes as great as those in irrigation schedules. Furrow irrigation was common in the earlier orchards, particularly if they were on relatively level ground. Many orchards were not on level ground and furrow irrigation systems were installed nearly on the contour so that water would flow gently from the head to the tail end of the furrows. This created odd orchard patterns making harvest and other cultural operations difficult. As urban development displaced orchards from the earlier positions, new orchards became established on soils having steep slopes. Contouring for furrow irrigation was increasingly difficult and a greater proportion of orchards were irrigated with sprinklers.

Early sprinkler systems consisted of portable lateral lines with rotating sprinklers, moved several times during each irrigation. Some systems had permanent buried lines with tall risers extending above the trees but spacings were wide and sprinklers large to provide adequate coverage. Runoff from application rates higher than soil infiltration rates was sometimes a problem.

Low volume under-tree sprinklers selling at low cost produced a new trend. The small sprinklers applied water slowly to one tree at a time and could operate for 12 to 24 hours without being moved. To keep the number of sprinklers per acre at a reasonably low figure but also to minimize the labor of moving, a system called "hose-pull" was devised. Flexible hoses similar to a garden hose are attached to risers on buried plastic main lines. Each hose carries 2 to 4 sprinklers in tandem separated by a distance equal to the tree spacing. After each period of irrigation, the hoses are pulled by hand to a new location along the tree row. Each hose operates in 4 to 8 different positions so that the number of sprinklers needed ranges from one-eighth to one-fourth the number of trees. The person pulling the hoses to move the sprinklers can walk mainly on dry ground while making the moves. Irrigation labor requirements are much reduced by this system.

Solid set permanently installed sprinklers have become common on most new avocado orchards. All main and lateral lines are buried with a riser beside each tree. Such systems have a sprinkler for every tree, consequently a high installed cost. When the trees are small, a low cost fixed jet sprinkler called a "spitter" may be used to keep initial capital and operating costs somewhat lower. Later, as the trees grow and their root systems spread, the spitter is replaced with a rotating sprinkler. The high cost of such systems is compensated by the reduced labor required for irrigating and the facility with which the individual owner can do his own irrigating.

A new concept called "trickle" irrigation has been developed in Israel. Plastic polythene lines pass along the tree rows on the ground surface. They connect to a riser much like a hose-pull system. The line contains one or more special orifices beside each tree from which water drips or trickles at a very slow rate. Only a limited volume of soil is wetted but the frequency and duration of application periods insures that the soil will not dry appreciably. Labor requirements for irrigation should be very low. Whether avocados growing in California conditions will respond favorably to this system is not known, but will be tested in a planned field trial.

New Innovations

New innovations appear at an increasing rate in response to the trend in labor availability and cost and as fertile minds work with new scientific and engineering devices. At present, remote control valves are available to lessen further the labor requirement of permanent underground systems. Such valves can be wired to controllers on which irrigation for an entire orchard can be programmed in advance for several irrigations if desired. Since schedule needs change with the weather, the programs should be altered as needed.

To go one step further, the need for altering programs can be eliminated by wiring soil-water sensors to the controller. They insure that the program placed in the controller will function as often as needed to maintain suitable soil water conditions in the root zone of the trees, but will cease when the need has been satisfied and will not allow irrigation until the need has risen again. Such control would be particularly helpful during seasons of low water use when the correct schedule is difficult to obtain by guessing and excess water might be harmful.

Automation can proceed no faster than advances in reliability of irrigation systems that apply the water. Present practice of most growers is to patrol each line of sprinklers after the water is turned on to insure that all sprinklers are operating properly. It is not unusual to find at each irrigation a few sprinklers either plugged with debris or failing to rotate properly. Growers are unwilling to allow such malfunctions to remain uncorrected more than a short time. They contend that the need to check and correct promptly such disorders eliminates any possibility for unattended automatic irrigation systems. Unless systems can operate unattended for one or more irrigations, there is little economic benefit from automation even though it might improve the timing.

The road to progress is not likely to stop long for such roadblocks. Water cleaning devices are available now for removing the type of materials carried in water that would cause plugged sprinklers and probably should be a part of every sprinkler irrigation system. Clean water would also reduce the incidence of sprinklers failing to rotate. Improvement in sprinkler bearings and rotation mechanisms can be expected to eliminate most other mechanical and hydraulic reasons for non-rotation.

No automatic system can be expected to perform without periodic checks and maintenance. It would include a short manual operation of all sprinklers to observe their performance and correct any malfunctions noticed. The astute grower will learn to anticipate future malfunctions by relating current observations of conditions and symptoms to those preceding malfunctions in the past. He will then take corrective steps before the failure occurs. These symptoms would include slower than usual rotation rates for sprinklers and tree branch or weed growth that might subsequently interfere with a sprinkler or its water distribution.

Orchard fertilization is a separate cultural operation occurring one or more times each year. Solid granular materials are spread by having an applicator pass over the ground, usually tractor driven. Fertilizer injection systems have become available that inject liquid fertilizer materials into the irrigation water during an irrigation. Good injection systems can meter the appropriate amount of fertilizer into the irrigation water so that the application rate is well controlled. With a good irrigation system, it is also uniformly distributed. Since the operating cost is small after the capital investment, several applications of lesser concentration can be made that can have advantages over a single concentrated application. One distinct advantage would be the reduction in machinery traffic through the orchard and the soil compaction caused by traffic. Irrigation systems will continue to be developed having higher capital costs, higher operating efficiency, and lower labor requirements.

LITERATURE CITED

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