California Avocado Society 1979 Yearbook 63: 47-49

HISTORY AND PRESENT TRENDS OF DRIP IRRIGATION

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It has been ten years since drip irrigation was introduced into California to be used on commercial agricultural crops. The initial work was started in an avocado orchard in San Diego County, and from this small five-acre experimental orchard the acreage has increased tremendously. During these ten years many growers, manufacturers, irrigation dealers, representatives, researchers, and extension personnel have conducted widespread experiments. Many crops are under test with drip irrigation. Manufacturers of various types of irrigation equipment have come into the field to produce emitters, pressure regulators, fertilizer tanks, fertilizer pumps, and other hardware required in the drip irrigation system.

Irrigation meetings were held by the University of California Extension Service to disseminate information on drip irrigation as field experience and research data became available. Acreage in 1969 was just minimal as far as field grown agricultural crops were concerned. Nurserymen, greenhouse operations, and flower growers were utilizing the spaghetti type trickle irrigation.

Drip irrigation caught on in San Diego County among avocado growers because of high cost water, fairly saline water, and hillside plantings. All of these conditions seemed to fit right in with drip irrigation. Most avocado orchards in San Diego County are planted on hillsides. This is for economic reasons as well as for cultural reasons. The avocado is sensitive to frost; and, therefore, the higher on the hillsides the trees are planted, the more chance they have of natural frost protection. No frost protection equipment is utilized in avocado orchards. Another reason for selecting hillsides is that land is cheaper and the possibility of urban encroachment is less than in the areas where land is flat or relatively flat. Hillsides are cleared of natural brush and orchards planted. There are no longer small acreages going in, such as was the case when the industry was beginning 20 to 30 years ago. Today, the smallest is usually 5 to 10 acres but most of them are 30, 50, and even as high as 500 acres when the operation has been syndicated.

Two types of irrigation systems are installed in these orchards, the conventional spitter system that can be converted to sprinklers and the drip system. There are different ways the drip irrigation system is being installed. Some will use conventional buried PVC rigid pipe with a riser to each tree, and a plastic hose with emitters attached to the riser. Another method is to lay the hose on the ground in one continuous line near the trunk of the tree with three or four emitters placed at each tree site.

Growth of the drip irrigation method can be seen by comparing a few figures. In 1970, shortly after the avocado experiment was installed, a drip irrigation seminar was held in

Escondido. One year after the introduction of drip irrigation to San Diego, 600 interested people attended the seminar to hear the drip irrigation story. At this meeting, 18 manufacturers of drip irrigation equipment displayed their products. Seminars were held in 1971, 1972, and 1973. The 1973 seminar drew an estimated 1,200 to 1,500 people from all over California and from many states of the U.S.A., as well as foreign countries. Thirty-four manufacturers of drip irrigation equipment had exhibits at the meeting. Because of the tremendous increase in California and the U.S.A., San Diego was invited to host the Second International Drip Irrigation Congress. In July, 1974, the Second International Drip Irrigation Congress was held in San Diego, with over 2,000 persons attending from 29 countries. There were about 70 exhibitors.

A more complete list of agriculture crops now using drip irrigation is necessary to tell the story of this new method of irrigation. Drip irrigation will not fit every agriculture crop, or every situation, or every grower's personal likes. However, at the present time, there are more crops being tested with this method of irrigation than crops not being tested. Following is a list of the known crops using drip irrigation: avocados, grapes (table and wine), strawberries, grapefruit, lemons, limes, navel oranges, Valencia oranges, tangerines, tangelos, macadamia nuts, papaya, peaches, pears, persimmons, walnuts, apples, boysenberries, tomatoes, cucumbers, celery, potatoes, peppers, melons, corn, asparagus, egg plant, peas, lettuce, ornamental trees and shrubs, bedding plants, cactus and succulents, bulbs, carnations, gladioli, poinsettias, avocado nurseries, citrus nurseries, chrysanthemums, ground covers on highway road cuts, street medians, turf (both in the home and golf courses), Christmas trees, forestry trees, radishes, apricots, pistachio, plums, cherries, almonds, pecans, sugar cane, pineapple, cotton, sorghum, alfalfa, pasture, wheat, coffee, bananas, mangos, olives, figs, passion fruit, and many more minor fruit and vegetable plants.

The field research work in California caused great interest for people from other areas of the United States and foreign countries. Visitors from both government agencies and private industry made trips to San Diego and California to view the work. Many manufacturers came to observe how drip irrigation can be adapted to commercial agriculture. Key personnel from foreign countries doing research work on drip irrigation visited us. Dr. Dan Goldberg and Dr. Baruch Gornat of Israel, and Fergus Black of Australia, are three of the better known researchers on the international scene. People came from France, Germany, Switzerland, Italy, many countries of Africa, Israel, New Zealand, Australia, Canada, Indonesia, India, and Mexico.

Equipment used in drip irrigation systems is very important. There are many pieces of equipment required. They include plastic hose or pipe, spaghetti hose, emitters, pressure regulators, pressure gauges, valves, fertilizer tanks, filters — both sand and screen, time clocks, tensiometers, evaporative pans, meters, and fertilizer injectors.

One of the most important items in the hardware for drip irrigation systems is the filter. Filtration is a must and many growers now feel that extra money put into filtration will give them the required performance from their emitters. One grower has two of the largest sand filters backed up by two large screen type filters. In a recent check of his orchard, which encompasses approximately 87 acres of avocados, 25 acres of eleven-year-old trees, 27 acres of seven-year-old trees, and 35 acres of four-year-old trees, he found only 11 emitters out of 30,000 not functioning. He attributes the good

performance to proper filtration.

Increasing numbers of installations are going in with complete automation. This is either with the use of an automatic timer that can be set for daily operation at a certain hour of the day, or the more sophisticated unit that is controlled by electrified tensiometers under the trees and having an electrical impulse trigger off the system when the soil moisture reaches a certain dryness. For instance, tensiometers are set to go on at 15 centibars. When the soil has dried to this point, the tensiometer sends a signal to the control head, and this in turn registers in the automatic timer so when the scheduled time arrives for the system to go on, it automatically does so because both the automatic timer and the tensiometer tells the system to turn on. The automatic timer is set for operation at 9 o'clock in the evening and again at 4 o'clock in the morning. The 4 o'clock time is in case the two-hour scheduled watering is not sufficient to move the tensiometer below the point where it would automatically shut off the system.

Pressure regulation is very important. The difference of discharge of water from one emitter to the other must be kept to a minimum. On hillside plantings, this becomes extremely important and critical. In designing systems, engineers must be careful to make allowances for difference in elevation, either by pipe size difference or the installation of numerous pressure regulating devices so the same amount of water comes out of the emitter at the bottom of the orchard as at the top. Also, the fill up time of the system, as well as the drain out time, should be fitted into the calculations so one set of trees does not get more water than another portion of the orchard.

There are many emitters on the market today. They fall into three main categories: the moving parts type, the adjustable type, and the fixed discharge type. Examples of the three types are as follows: moving parts, Spears, Rebat; adjustable, Salco; and the nonadjustable, Drip-Eze, Netafim, and Vortex.

Drip irrigation in California would not be at the stage of development it is today if it had not been for the fine cooperation between growers, manufacturers, USDA research personnel, and the University of California. There are so many individuals that have contributed to the development of drip irrigation that it is difficult to list everyone without omitting someone who has played an important part in its development. This was a project where everybody had to learn together. We experimented in the field with various crops, manufacturers experimented with manufacturing techniques and equipment design, researchers put together all known irrigation principles to try to come up with a satisfactory program for experimentation, and the growers were willing to donate land, trees, money, and time to see if this new system had any merit.

It appears that drip irrigation has caused considerable interest among many people in many countries, growing many crops. It is another method of applying water to plants. In many cases it has been a refinement in the use of water. Where water is of poor quality due to high salts, there is a better manipulation of the salt in the soil. Where terrain is a factor, drip irrigation makes irrigation relatively simple. Where labor is a factor, both in availability and cost, a fully automated drip irrigation system eliminates the need for labor except on a very limited scale. With proper development, drip irrigation could be the most efficient, effective, and ecologically sound type of irrigation that is known today.