DRIP IRRIGATION OF CITRUS—PANEL

DRIP IRRIGATION IN TEXAS CITRUS

Calvin G. Lyons, Jr.[1]

Interest in drip irrigation in the Texas citrus industry began in the mid to late 1960's as information from California, Mexico, Israel and Australia began to reach our growers through magazine articles and personal observations of growers who had seen drip systems. The promise of water savings, faster growth, higher yields and the elimination or reduction of irrigation labor made this irrigation system seem ideal for the Lower Rio Grande Valley of texas.

There was very little rainfall in the spring and summer of 1971 and the water supply to citrus growers became severely limited. Those who had used up the allotted 2 acre-feet (24 ha-cm) had to purchase water rights from fallow land. Several growers and research organizations installed drip systems to determine their feasibility in the Lower Rio Grande Valley because drip irrigation promised to enable them to live within their water allotments.

First, the number of emitters required and whether or not subsurface systems would work had to be determined. Subsurface systems seemed ideal in theory but they have not been satisfactory because of clogging. Therefore, most are now using above-ground systems. The number of emitters recommended by the various companies at the time varied from 1 per tree to an emitter every 3 ft (91 cm) in the line. These recommendations seemed to be inversely proportional to the cost of the emitters. The companies selling the more expensive ones recommended fewer emitters, and those selling the less expensive emitters called for more. Most installations have 2 or 4 emitters per mature tree and 1 or 2 per young tree. Some work has indicated that 1 emitter will do a fairly good job but a larger number is desirable because of possible malfunction. The tree suffers severely when the emitter fails and there is only 1 per tree while the failure of 1 has less effect with 2, 3 or 4 emitters.

Filtration turned out to be the main problem, as in other areas. Many kinds of filters are being tried. Our major problem is suspended clay because all the irrigation water comes from the Rio Grande River. A test has shown that there is up to 0.1 oz of clay per gallon (0.75 mg per liter) of water. The minute size of these particles prevents almost any type of filter from working effectively. The clay particles go through sand filters, 200-mesh screens and clog up cartridge filters. They then settle out in the lateral lines and emitters where the water moves slower. This settling causes emitter blockage and apparently increases friction loss in the lateral lines. The only effective measure in dealing with this problem to date is periodic flushing of the main and lateral lines. Growers having reservoirs or supply canals that allow settling of the clay before it enters the lines have had fewer problems than those who take their water directly from a main canal where agitation keeps the clay in suspension.

Many other problems have come up causing the plugging of emitters and damage to lines—coyotes, rats, and rabbits chewing up the lines, and clams and slime mold growing in the lateral lines. Little can be done against animal damage, but growers have been fairly successful in removing slime mold growth periodically by acidifying the water at the filter with sulfuric acid or chlorinating the water.

The sulfuric acid also lowers the pH of our calcareous soils and makes iron more available.

Growers with large systems have found that there are many grades of polyethylene pipe. The cheapest may not be the best. One problem has been stress cracking at splices. It has become necessary in some cases to replace all lateral lines because of this problem. Pipe sources and possible guarantees should be checked out before purchasing.

[1] Area Extension Horticulturist, Texas Agricultural Extension Service, Texas A&M University System, Area Research and Extension Center, Weslaco.

Table 1. Average class 'A' pan evaporation at Weslaco, Texas.[z]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
mm/day	2.54	3.05	4.32	5.33	5.84	6.86	7.11	6.86	5.08	4.32	3.56	2.29
in./day	.10	.12	.17	.21	.23	.27	.28	.27	.20	.17	.14	.09

[z]Adapted from Bulletin 797, "Water Evaporation Studies in Texas", Texas Agricultural Experiment Station - Texas Agricultural Extension Service, Texas A & M University, November 1954.

System design seems to have presented few problems because several good publications are available and most drip irrigation companies provide free engineering advice to their clients. Rarely have problems been due to faulty design. The filtration system consisted of a 100-mesh screen with an in-line 200-mesh screen on each lateral line in one case. The screen soon had to be removed because of clogging.

We almost always run into trouble when discussing emitter types because each company feels that theirs is best. The Texas Agricultural Extension Service suggests that potential buyers check with growers in the area who have systems and find out which emitter they prefer. The decision is then based on first hand knowledge, and Extension personnel do not recommend a particular system, as many workable ones are on the market.

Research findings comparing salt uptake from both flood- and drip-irrigated plots show that no significant differences occur in the uptake of chlorides. These findings held true even in a study where water of 1,500 ppm chloride was used. The latter study was done on young grapefruit trees on various rootstocks and no detrimental effects that could be attributed to irrigation methods could be determined during the trial. There is no difference in the uptake of chlorides, thus the main advantage of drip irrigation with salty water would be that less salt is deposited in the orchard soils, and less rainfall is needed for leaching.

Most growers are utilizing charts like Tables 1 and 2 and base their water application on averages rather than trying to compute daily or weekly water usage. This has worked well. Good growers pay close attention to their groves and the weather, and when conditions warrant they adjust the amount of water applied.

When groves are converted to drip irrigation, some growers feel that a yield increase is realized. In a few cases this may be true. Comparisons of annual yields from surrounding groves (Table 3) and research findings do not

Table 2. Gallons of water required per tree per day to supply 0.7 of pan evaporation.

Average daily evaporation		Gallons per day Diameter of drip line of tree[z]				
(in.)	(mm)	5'	10'	15'	20'	25'
.10	2.54	.9	3.4	8	14	21
.12	3.05	1.0	4.1	9	16	26
.14	3.56	1.2	4.8	11	19	30
.16	4.06	1.4	5.5	12	22	34
.18	4.57	1.5	6.2	14	25	39
.20	5.08	1.7	6.9	15	27	43
.22	5.58	1.9	7.5	17	30	47
.24	6.10	2.1	8.2	18	33	51
.26	6.60	2.2	8.9	20	36	56
.28	7.11	2.4	9.6	22	38	60
.30	7.62	2.6	10.3	23	41	64

[z]Diameters are approximately 1.5, 3.0, 4.5, 6.0 and 7.5 m, respectively.

Table 3. Yield of grapefruit from 4 flood-irrigated groves surrounding a drip-irrigated grove.

Grove	Type of irrigation	Seasonal yield (tons/acre)[z] 71-72	72-73	73-74	74-75
354	Flood	12.7	14.1	16.5	7.3
363	Flood	16.2	19.2	18.7	13.4
353	Flood	17.7	18.1	19.5	14.9
364	Flood	17.7	19.4	16.8	10.4
353	Drip	10.6	12.3	13.6	6.5

[z]1 ton/acre = about 2.5 tons/ha.

substantiate these reports. The lack of substantiating data for yield increases has, to some extent, reduced the interest in more acres of drip irrigation.

By injecting fertilizer in the water, Texas growers have been able to save approximately 40% of what they had been using. Emitter malfunction must be at a minimum when fertilizer is applied or some tree will suffer from lack of nitrogen.

The use of saline water for drip irrigation has been reported from other areas. It would be advantageous if well water, which contains from 700 to 3,500 ppm total salts in the Lower Rio Grande Valley, could be used. Some growers are now using water of up to 2,000 ppm total salts for drip irrigation with no apparent detrimental effects.

Chemical weed control has been made more efficient by drip irrigation because flood irrigation tends to leach herbicides and introduces more weed seed with each watering. Drip lines above ground do, however, require chemical weed control in the tree row. Mechanical cultivation around drip leads to much repair work.

SUMMARY

Drip irrigation has not come into use in Texas citrus groves as fast as in other areas. There are several reasons for this:

1) The primary reason is probably low water cost and lack of dramatic yield increases. Water costs approximately $6.00 per irrigation-acre ($15.00/ha), hence there is no economic incentive to use drip irrigation on established groves.
2) Filtration problems make the grower reluctant to switch to drip irrigation. Line flushing and emitter checking is necessary on a regular basis.
3) Finally, some groves do not have a steady supply of water, or electrical power is not near enough to afford an economical installation.

Drip irrigation can save water, fertilizer and herbicides in Texas citrus groves and can make cultural operations more effective. Drip irrigation offers small grove owners an irrigation that does not require a steady supply of labor. Growers who have drip irrigation are very happy with it and some are increasing their acreage. The majority, however, are waiting until they have more concrete evidence on long-term performance and cost.