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AN ECONOMIC EVALUATION OF USING DRIP IRRIGATION IN FLORIDA PECAN ORCHARDS[1]

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Abstract. **The year-to-year yield variation in producing pecans and the variability of rainfall in Florida have resulted in increased interest in irrigated pecan orchards. Drip irrigation is the most popular method of irrigation being considered by Florida producers. Efficient use of water is possible with a drip system. With drip irrigation the water is applied very slowly at low pressures. The moisture needs of the pecan tree are satisfied by applying the water to a small portion of the root zone and allowing the tree to distribute the moisture to its various parts. Drip irrigation systems are relatively expensive and require a close evaluation of the purchase decision.**

Weather data collected at the Marianna Agricultural Research Center were used to show the average monthly rainfall and the probability of the occurrence of dry periods. Fixed and operating costs for installing and using a 100-acre drip irrigation system were estimated. Yield results for drip irrigation were averaged and analyzed to determine if irrigating pecans was profitable.

Drip irrigation is another management tool available to Florida pecan producers to eliminate some of the risk and uncertainty involved in pecan production. Florida pecan producers can use this analysis along with their cash flow evaluations to determine if the purchase of a drip irrigation system is justified.

Increased interest in pecan production has resulted in many Florida producers or potential producers closely evaluating different management practices. The farm value of pecans has been increasing in Florida along with the costs of production (6). Many pecan producers are interested in commercial pecan production as an alternative to crops they have previously been producing or as an income generating crop that allows time for non-farm employment. Other producers buy existing orchards with the intent of improving the management and realizing a profit from their investment.

Approximately one half of the pecan crop produced in Florida comes from improved varieties of trees. Most of the orchards of the improved varieties are established and maintained under a well-planned management program. Under a management program that utilizes available cultural techniques, the wide year-to-year variations that are common in most pecan producing states of the Southeast are minimized.

Irrigation is a production management tool that many pecan producers are interested in as a means of increasing yields and reducing risks. Irrigation is a part of the developing technology in the pecan industry in the Southeast. There has been a tremendous amount of time and effort expended in the research and development of pecan irrigation in the past 10 years (5).

Pecan producers in Florida and other areas of the Southeast have experienced drought conditions in two out of the last five years. Even in years of average rainfall there are periods of drought which may limit pecan production. Because of the high investment in the pecan crop many Florida producers are considering installing irrigation systems to eliminate some of the risk of no rainfall during the critical growth stages. Irrigation will also reduce the year-to-year yield variations and will improve the quality of the pecans (2, 3). The purpose of this study is to provide the annual cost required for a drip irrigation system and to determine the feasibility of incurring the necessary investment. An analysis of the economic feasibility of producing pecans using a drip irrigation system is provided. Investment, fixed, and operating costs are analyzed.

Drip Irrigation

Many different irrigation systems are presently being used in pecan orchards with drip irrigation becoming the most popular method. Problems with physical, mechanical and chemical filteration limited the acceptance of drip irrigation for a number of years. In recent years, however, filtering systems have been developed that eliminate or lessen many of the problems associated with filteration.

Drip irrigation may be defined as the maintenance of an adequate section of the root zone of a tree at full soil moisture capacity during the growing and productive cycle of the life of the tree (11). In a drip irrigation system water is applied through a low pressure distribution system that provides water to trees at a low rate.

Drip irrigation is based on the concept that the optimum use of available water and maximum tree performance is obtained through preventing soil moisture stress by maintaining favorable soil moisture in a portion of the tree root system. Usually the water is applied to a root zone portion of 40% or less and the tree will distribute the moisture to its various parts. The water is supplied often enough so that the tree is never under moisture stress. There is root proliferation in the wetted zone of the soil so that the water requirements of the tree are met from this small wetted zone. The slow application stops before there is loss from leaching through the root zone. Since water is applied slowly, a larger area can be watered using very small pipes. The emitters used to meter the water out of the supply tubers are of many different designs which reduce the water pressure from the line pressure to enable the water to drip like a leaking faucet (10, 11).

Reports from researchers and growers indicate that drip irrigation has the following potential advantages:

1. increased yields,
2. accelerated growth,
3. adequate moisture in root zone all the time,
4. crops are not subjected to cycles of soil moisture ranges varying from saturation to wilting point,
5. conservation of water,
6. area between rows remain dry which reduces weed growth and allows field work during irrigation,
7. no runoff on hillsides or rolling ground,
8. improved quality of crops,
9. use of poorer quality water with less damage to crops, and
10. efficient fertigation (8).

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Amounts and Distribution of Rainfall

Both the amount and distribution of rainfall are important when considering pecan irrigation. Rainfall data collected at the Marianna ARC during the 1971-81 drip irrigation operating months are shown in Table 1. The

Table 1. Monthly rainfall at the Marianna ARC, 1971-81.

Year	Month						
	Apr.	May	June	July	Aug.	Sept.	Oct.
	inches						
1971	3.17	3.03	3.85	5.20	6.76	2.47	1.84
1972	0.38	2.87	8.89	3.78	5.39	2.14	2.44
1973	7.60	6.87	3.63	11.12	4.51	5.40	0.27
1974	3.40	3.78	1.56	3.29	8.01	4.68	0.84
1975	10.35	3.97	4.10	13.71	5.40	3.81	4.35
1976	1.87	8.89	3.08	3.03	3.47	5.47	6.18
1977	0.88	0.60	6.36	3.55	5.22	9.83	2.59
1978	4.65	6.73	3.79	7.25	4.90	0.98	0.20
1979	7.75	6.22	1.31	7.49	6.30	11.51	0.53
1980	9.29	4.50	3.50	5.87	2.53	4.56	4.71
1981	3.03	2.73	4.74	4.02	2.53	2.44	1.25
Average	4.76	4.56	4.07	6.21	5.00	4.84	2.34

average rainfall shown in Table 1 may imply that adequate rainfall is available during the growing season for pecans in Florida. However, average rainfall does not describe the distribution of rainfall which is also important. Table 2

Table 2. Probability of occurrence of dry periods of various lengths.[z]

Days of dry period	Percent probability of dry period
April 1-October 31	
5	99
10	99
15	83
20	54
25	33
30	18
35	3
40	1

[z]Probabilities based on precipitation data collected at the Marianna ARC during the years 1952 through September of 1981. A dry period is defined to be a set of consecutive days each with less than .4 inches of precipitation.

shows the high probability of potential stress producing dry periods during the pecan growing season.

Drip Irrigation Costs

The fixed and operating costs were estimated for a drip irrigation system for a 100-acre pecan orchard. The analysis of a 100-acre system was used for simplicity purposes. A typical layout of a drip system for a 100-acre rectangular pecan orchard is shown in Figure 1. The realization that

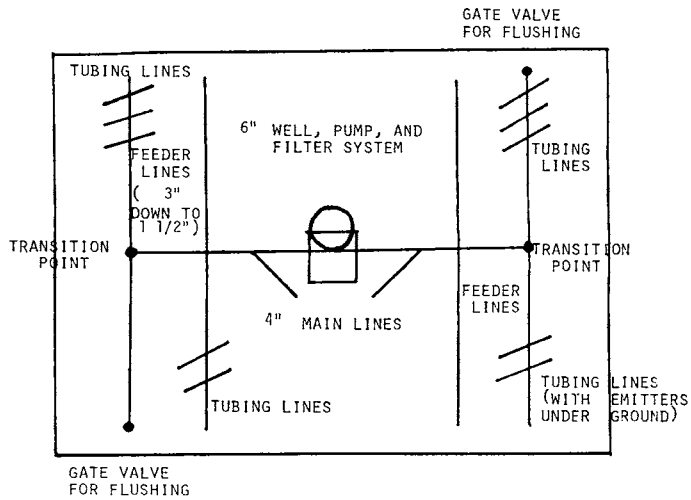

Fig. 1. Typical layout for a 100-acre drip irrigation system installed in a rectangular field.

all orchards are not this size or shape is acknowledged. For comparative purposes this illustration is useful. Most dealers will quote the installation charge to be between $400 and $600 per acre depending on the acreage and orchard layout. The system analyzed in this paper resulted in an installation charge of $43,700 or $437 per acre (Table 3). The fixed costs are incurred regardless of the amount of equipment use. The annual fixed costs were based on current prices obtained from dealers and include installation (labor) charges. Fixed costs include depreciation, interest, repairs, taxes and insurance. Depreciation spreads investment cost over the productive life of the system and was calculated using the straight line method. Salvage value was assumed

Table 3. Estimated fixed costs for a 100-acre drip irrigation system, North Florida, 1981.[z]

Item	Drip equipment[y]	PVC pipe and fittings	Filters and controls	Values and miscellaneous materials	Well and pump[x]	Total
	dollars					
New cost	14,600.00	15,350.00	5,200.00	3,150.00	5,400.00	43,700.00
Average cost[w]	7,300.00	7,675.00	2,600.00	1,575.00	2.700.00	—
Years life	20	20	8	20	20	—
Depreciation[v]	657.00	690.75	585.00	141.75	270.00	2,344.50
Interest[u]	1,168.00	1,228.00	416.00	252.00	432.00	3,496.00
Repairs[t]	146.00	153.50	52.00	31.50	54.00	437.00
Taxes[s]	109.50	115.12	39.00	23.62	40.50	327.74
Insurance[r]	175.20	184.20	62.40	37.80	64.80	524.40
Total cost[q]	2,255.70	2,371.57	1,154.40	486.67	861.30	7,129.64
Fixed costs/acre	22.56	23.72	11.54	4.87	8.61	71.30

[z]Installation charges (labor) are included in the cost of the system.
[y]Includes tubing, emitters, and fittings.
[x]Assumes a 6" well drilled to a depth of 200 feet with a 20 hr submersible pump with flexible fingers.
[w]New cost divided by 2, which represents the average capital expenditures over the life of the investment.
[v]New cost minus 10% salvage value divided by years life (no salvage value for well and pump).
[u]Average cost times 16%, which represents the annual opportunity of capital invested in the system.
[t]New cost times 1%.
[s]Average cost times .015 (15 mills).
[r]$12.00 per thousand of new cost.
[q]Sum of depreciation, interest, repairs, taxes and insurance.

to be 10% of new cost, except for the well, which was assumed to have no salvage value. The useful life of the system was based on the manufacturers' recommendations and engineering data. The other fixed costs are interest, the opportunity cost of capital invested in resources; repairs, such as major overhauls performed during the off-season; taxes, such as ad valorem taxes which must be paid regardless of use; and insurance on fixed resources whether covered by an actual policy or borne by the owner (12).

The total annual costs for a 100-acre drip irrigation system are $7,129.64 or $71.30 per acre as shown in Table 3. The fixed costs are considered as the costs of ownership, and they occur regardless of the level of use of the system.

Operating costs were determined by engineering data (1) and records of pecan producers. Current prices were used for labor, electricity, parts, and interest as shown in Table 4. The per acre operating costs are $36.61 for the drip irrigation system.

Table 4. Estimated per acre operating costs for a 100-acre drip irrigation system, North Florida, 1981.[z]

Item	Per acre cost
	..dollars..
Labor[y]	7.00
Parts for repairing[x]	2.00
Bleach for flushing	.50
Electricity[w]	24.40
Interest[v]	2.71
Total operating costs	36.71

[z]Costs are based on six months of operation per year.
[y]Two hours per acre for cleaning filters and separators, injecting chlorine through system, and making repairs.
[x]New tubing, flush valves, and transition point repairs.
[w]Based on a 6.5¢ kilowatt charge.
[v]Based on 6 months at 16%.

Total drip irrigation costs are equal to the sum of the fixed costs and operating costs. For the 100-acre drip system, the total per acre irrigation costs are $107.91 ($71.30 + $36.61).

Fixed costs as described above are based on the economic life of the investment and assume that the producer has the capital needed to purchase the system. This method is valid for allocating costs, however, producers often must pay for equipment in a shorter time period than the economic life. From a cash flow standpoint, the producer must consider his annual payment rather than annual cost based on economic life. Different capital availability situations for producers will affect the annual cash flow, which is an important consideration in the decision making process for most producers (7).

Lending agencies offer a variety of financing methods and an appropriate one is equal-amortization of the loan over seven years. If $43,700 is amortized over seven years at 16%, the annual payment is $10,820.56. This would result in an annual per acre cost of $108.21.

Irrigation Response

Much research has been done in Georgia evaluating the yield response of pecans to irrigation. Since Georgia conditions are very similar to Florida, the pecan producers in Florida should realize similar responses to irrigation. Yield data collected by Goodyear (9) suggests that an increase of 400 pounds of nuts per acre is realized from irrigation. Research by Daniell (3, 4) at two different locations in South Georgia has resulted in increased yields of 318 pounds per acre and 281 pounds per acre. Farm yield data collected by Thompson (9) suggests an increase of 470 pounds per acre for drip irrigation in the pecan orchard. The results of these four tests indicate that irrigation may account for an increase of approximately 370 pounds of pecans per acre (Table 5). The differences in yield response will depend on location, management and tree varieties.

Table 5. Yield response of pecans to drip irrigation in South Georgia.

Test	Yield response
1	400
2	318
3	281
4	470
Average	370

The average price for improved varieties of pecans in Florida in 1980 was $ .75 per pound. At an increase in yield of 370 pounds per acre, this would result in increased receipts of $277.50 per acre which would cover the total irrigation costs of $107.91. At a price of $ .75 per pound for pecans an increase in yield of 144 pounds per acre would be needed to cover the per year costs of irrigation.

Discussion

Pecan production is very important to many farm operators and farm managers in Florida. Due to the variability of rainfall and year-to-year pecan yields, much interest has been generated in the use of drip irrigation as a management tool in pecan production. Drip irrigation delivers water at a low pressure through small emitters providing available water to trees at low rates.

Test results have indicated that yield responses to drip irrigation averaging 370 pounds per acre are possible. The cost analysis indicated that drip irrigation is economical in that added yearly fixed and operating costs are covered by the increases in yield.

Drip irrigation may be thought of as a type of insurance policy to guard against dry years such as 1977 and 1980. Drip irrigation will reduce crop risk by diminishing the effects of bad years and will insure against possible cash flow problems. Year-to-year variations in yield will also be reduced by irrigation and the quality of the pecans will improve. Less nuts will be needed per pound and the percentage of meat yield will increase and these advantages will be reflected in higher prices.

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