2004 BELTWIDE COTTON CONFERENCES, SAN ANTONIO, TX – JANUARY 5-9

THE DOLLARS AND CENTS OF SUBSURFACE DRIP IRRIGATION (SDI) FOR COTTON IN THE SOUTHERN HIGH PLAINS OF TEXAS

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Abstract

Subsurface drip irrigation (SDI) has a foot-hold on the irrigation technology scene in the Southern Texas High Plains. The area of SDI has been expanding acres at an increasing rate each year and the trend will likely continue for the next couple of years. Field experiments were conducted from 1999 through 2001 to improve water management of irrigation systems in a semi-arid, deficit-irrigated production region in the Southern High Plains of Texas. The research evaluated the effects of pre-plant irrigation in terms of cotton lint yield, water use efficiency, and cotton fiber quality using spray, LEPA, and SDI delivery methods in treatments limited to irrigation capacities of 0.1 and 0.2 in/d (Bordovsky and Porter, 2003). Experiments were conducted at the Texas Agricultural Experiment Station at Halfway, TX, on moderately permeable Olton loam (fine, mixed, thermic Aridic Paleustolls) soils with slopes of less than 0.1%. From this data, production functions were developed in which lint yield was a function of water availability (soil moisture, seasonal rainfall, and irrigation), and type of delivery system. Enterprise budgets were developed utilizing the estimated production functions. Projected per irrigated acre net returns for SDI and LEPA were comparable at $123 versus $126, respectively. It was estimated that SDI increased lint yields by 47 pounds per acre over LEPA for the given irrigation, seasonal rainfall, and soil moisture availability conditions assumed. More importantly, SDI increased cotton fiber quality, receiving a $0.02 per pound price premium over LEPA. However, the economics of SDI is field dependent and thus, each application of SDI should be evaluated separately when evaluating the economics of SDI versus LEPA.

The cost of SDI may increase sharply as the field becomes irregularly shaped or elongated. Many factors influence the cost of SDI and producers should consult a dealer with design software to get an accurate estimate of cost before comparing the system with a LEPA center pivot system. SDI requires a higher level of management than LEPA to achieve the higher lint yields and increased cotton fiber quality found in this analysis.

Introduction

Field experiments were conducted from 1999 through 2001 to improve water management of irrigation systems in a semi-arid, deficit-irrigated production region in the Southern High Plains of Texas. The research evaluated the effects of pre-plant irrigation in terms of cotton lint yield, water use efficiency, and cotton fiber quality using spray, LEPA, and SDI delivery methods in treatments limited to irrigation capacities of 0.1 and 0.2 in/d (Bordovsky and Porter, 2003). Experiments were conducted at the Texas Agricultural Experiment Station at Halfway, TX, on moderately permeable Olton loam (fine, mixed, thermic Aridic Paleustolls) soils with slopes of less than 0.1%. From this data, production functions were developed in which lint yield was a function of water availability (soil moisture, seasonal rainfall, and irrigation), and type of delivery system. The objective of this analysis is to present a brief economic assessment of SDI. This will allow producers to understand the complexities and the strength and weakness of SDI, allowing them to make better decisions when implementing new technology into their production systems. A more in-depth economic evaluation of SDI, LEPA, and spray technology will be forthcoming at a latter date.

Procedures

The basis of this economic assessment is a simple budget comparison between LEPA and SDI. However, a simple budget is not easily developed for SDI given all the complexities of the system. Thus, this analysis puts SDI in the best light possible by assuming a straight forward system design, experienced management, and a lint yield and cotton fiber quality increase over LEPA.

The SDI system was assumed to be a 160 acre square field with the main manifold run directly down the center with tape running laterally from the manifold into multiple zones (Figure 1). It was assumed water and electricity was available to the center of the field and the investment cost included the additional pad for the filtration unit and additional electrical work for the pumping station beyond the SDI system. The pump and filtration system was assumed to be in the center of the field. The investment cost for SDI was developed by interviewing area irrigation dealers for prices of replacing a center pivot system with an SDI system. The system design chosen (square with a manifold down the middle), is the least costly design possible and any irregular shape of the field would increase the cost of SDI.

The LEPA system was assumed to be a 160 acre square field (120 acres under irrigation) with an 8” pivot, 1303 foot long system with drag hoses. It was assumed water was available to a pad in the center of the field and the investment cost was for the sprinkler system only. The investment cost for LEPA was developed by interviewing area irrigations dealers for prices of LEPA center pivot systems that were typical of what they would sell producers to replace an existing pivot system.

The installations of both systems were assumed to be turn-key installations. The turn-key cost per irrigated acre was $335 for LEPA and $726 for SDI. However, many producers had opted to install the tape on SDI systems; where the dealership provides the implement that buries the tape free of charge. This reduces the cost of SDI, but puts some of the risk of leaks and improper installation back on the producer.

Enterprise budgets were developed for both LEPA and SDI. The budgets represent a combination of data inputs from existing extension budgets, research management and inputs, and chemical dealer prices. These budgets provide a method to make comparisons between irrigation application technologies, but an individual would need to adjust these to fit the particular circumstance they are evaluating.

Results

Enterprise budgets for LEPA and SID were developed to compare the per acre net projected returns between the two irrigation application technologies (Tables 1 and 2). Both budgets are based on the operator applying 14 inches of irrigation water, with 6 inches of seasonal rainfall.

LEPA

LEPA had $855 gross income per irrigated acre based on a lint yield of 1,454 pounds at $0.50 per pound and 1.16 tons of cotton seed at $110 per ton. Pre-harvest per irrigated acre cost amounted to $346. Harvest costs were estimated at $246 per acre. Thus, interest on operating capital was calculated to be $21 using a 7 percent interest rate. Adding up the variable costs amounted to $614 per irrigated acre. Fixed costs per irrigated acre summed to $115, resulting in a net projected return of $126 per irrigated acre.

SDI

SDI had $912 gross income per acre based on a lint yield of 1,501 pounds at $0.52 per pound and 1.2 tons of cotton seed at $110 per ton. Pre-harvest per acre cost amounted to $355. Harvest costs were estimated at $245 per acre. Thus, interest on operating capital was calculated to be $21 using a 7 percent interest rate. Adding up the variable costs amounted to $622 per acre. Fixed costs per acre summed to $167, resulting in a net projected return of $123 per acre.

Comparison between LEPA and SDI Budgets

The SDI lint price of $0.52 reflects a $0.02 per pound premium over the LEPA system due to an increase in cotton fiber quality. The LEPA system had about $8 less variable cost per acre than SDI. However, the major difference comes in the cost of the technology, were the SDI system had $52 per acre higher total fixed costs. Thus when comparing cost of irrigated acres between the two system, they are almost identical with the LEPA system at $126 net projected returns per acre and the SDI system at $123 net projected returns per acre. If you account for the full 160 acres that the LEPA system is placed on, then the corners of the pivot system (40 acres) need to have some value placed on them. However, since the extension service budgets for dryland cotton had negative net returns per acre; it was assumed they would be unfarmed, thus lowering the net projected returns on the total 160 acres to $95 per acre for the LEPA system under a whole field scenario.

In contrast, if the field was irregularly shaped, the cost of the SDI system increases significantly, and could drop net returns for SDI below the $95 per acre whole field net returns of the LEPA system. The cost of the SDI system was more sensitive to the amount of water available than the LEPA system as different configurations for the sizes of pipes, joints, and valves came into play with the SDI system. Thus, it is important to use a design program for a particular field to estimate the materials and cost under the SDI system. Most dealers of SDI have the software which can quickly design and price a system for producers.

Concluding Remarks

Subsurface drip irrigation has a foot-hold on the irrigation technology scene in the Southern Texas High Plains. The area has been expanding acres at an increasing rate each year and the trend will likely continue for the next few years. SDI was shown to be profitable and comparable in returns to LEPA in this analysis. Amosson et al, 2001 found that choosing SDI over LEPA was not economically feasible because of its relatively high investment cost and small gain in water application efficiency. Center pivot sprinkler irrigation will not work on every field due to terrain and/or physical objects, thus, making

SDI a good option for irrigation in these cases. Where SDI might be very profitable on one field, the field across the road may have a very different outcome. The economics of SDI is field dependent and thus each application of SDI should be evaluated separately. To achieve the maximum economics from SDI, the level of management required is greater than LEPA and the operator must be willing to put in this increased management time to achieve the higher lint yields and greater cotton fiber quality in lint yields. These gains in lint yield and cotton fiber quality is what makes SDI economically feasible. Without the cotton fiber quality premium and lint yield increase, SDI is an economically inferior option when LEPA is an available option.

Investment in SDI (with nearly double the investment cost per acre over LEPA) may create some unique loan considerations for the producer. Since lenders are at greater risk, the majority of the cost of SDI being underground and irretrievable in the event of a default, securing funding for SDI might be harder. Also, the nature of installing SDI (on 80" spacing) is a long-term commitment of 10 years plus, which may limit future alternatives for the land in terns of alternative crops or crop/forage rations which may prove more profitable in the future.

A final comment on SDI deals with the future need of research. There needs to be more research into the economics of 40 inch spacing versus 80 inch spacing of SDI tape. The 40 inch spacing nearly doubles the cost per acre, but allows for a much more diverse set of management options in terms of crops and rotations. The 40 inch spacing also allows the producer to water-up cotton in extremely dry years as we just experienced in 2003. Thus, there needs to be more field experimental data collected to evaluate the economics of this narrower spacing.

References

Bordovsky, J.P., D. Porter. 2003. ASAE Annual International Meetings, Paper No. 032008. *Cotton Response to Pre-plant Irrigation Level and Irrigation capacity Using Spray, LEPA, and Subsurface Drip Irrigation.* Las Vegas, Nevada. July 27-30, 2003. 11 pages.

Amosson, Steve, L. New, L. Almas, F. Bretz, and T. Marek. 2001. *Economics of Irrigation Systems*. Bulletin B-6113. Texas Cooperative Extension Service, Texas A&M University, College Station, Texas. 14 pages.

Table 1. Estimated Costs and Returns per Acre for Cotton using LEPA Irrigation, 2003.

Item	Unit	Price	Quantity	Amount
Per Acre Gross Income				
Cotton lint	lb.	$0.50	1,454	$726.93
Cotton seed	ton	110.00	1.16	127.94
Per Acre Total Gross Income				**854.87**
Per Acre Variable Cost Description				
Pre-Harvest				
Seed -Roundup Ready	lb.	1.40	15.00	21.00
Seed Treatment	acre	12.00	1.00	12.00
Boll Weevil Assessment	acre	12.00	1.00	12.00
Crop Insurance	acre	20.00	1.00	20.00
Fertilizer				
Phosphorus	lb.	0.25	25.00	6.25
Nitrogen	lb.	0.25	120.00	30.00
Herbicide	acre	60.00	1.00	60.00
Insecticide	acre	10.00	1.00	10.00
Operator Labor	hour	8.00	2.00	16.00
Irrigation Labor	hour	8.00	0.90	7.17
Diesel Fuel-Tractors	gal	1.20	10.00	12.00
Gasoline-Pickup	gal	1.45	4.00	5.80
Irrigation Fuel	ac in	6.69	14.00	93.66
Repair & Maintenance				
Implements	acre	20.03	1.00	20.03
Tractors	acre	17.69	1.00	17.69
Pickup	acre	2.00	1.00	2.00
Irrigation System	acre	0.83	1.00	0.83
Per Acre Total Pre-Harvest				**346.43**
Harvest				
Harvest Aide	acre	25.00	1.00	25.00
Strip & Module	cwt.	1.25	63.24	79.05
Ginning	cwt.	2.25	63.24	142.30
Per Acre Total Harvest				**246.35**
Interest on Operating Capital	acre	296.39	7.00%	20.75
Per Acre Total Variable Cost				**$613.53**
Per Acre Fixed Cost Description				
Implements	acre	21.37	1.00	21.37
Tractors	acre	17.89	1.00	17.89
Pickup	acre	3.00	1.00	3.00
Irrigation	acre	27.85	1.00	27.85
Land	acre	45.00	1.00	45.00
Per Acre Total Fixed Cost				**$115.11**
Per Acre Total Of All Cost				**728.64**
Per Acre Net Projected Returns				**126.23**

Table 2. Estimated Costs and Returns per Acre for Cotton using Subsurface Drip Irrigation, 2003.

Item	Unit	Price	Quantity	Amount
Per Acre Gross Income				
Cotton lint	lb.	$0.52	1,501	$780.29
Cotton seed	ton	110.00	1.20	132.05
Per Acre Total Gross Income				**912.34**
Per Acre Variable Cost Description				
Pre-Harvest				
Seed -Roundup Ready	lb.	1.40	15.00	21.00
Seed Treatment	acre	12.00	1.00	12.00
Boll Weevil Assessment	acre	12.00	1.00	12.00
Crop Insurance	acre	20.00	1.00	20.00
Fertilizer				
Phosphorus	lb.	0.25	25.00	6.25
Nitrogen	lb.	0.25	120.00	30.00
Herbicide	acre	58.00	1.00	58.00
Insecticide	acre	10.00	1.00	10.00
Operator Labor	hour	8.00	2.00	16.00
Irrigation Labor	hour	8.00	0.88	7.04
Diesel Fuel-Tractors	gal	1.20	13.00	15.60
Gasoline-Pickup	gal	1.45	4.00	5.80
Irrigation Fuel	ac in	6.69	14.00	93.66
Repair & Maintenance				
Implements	acre	16.02	1.00	16.02
Tractors	acre	21.68	1.00	21.68
Pickup	acre	2.00	1.00	2.00
Irrigation System	acre	8.25	1.0000	8.25
Per Acre Total Pre-Harvest				**355.30**
Harvest				
Harvest Aide	acre	17.00	1.00	17.00
Strip & Module	cwt.	1.25	65.27	81.59
Ginning	cwt.	2.25	65.27	146.87
Per Acre Total Harvest				**245.46**
Interest on Operating Capital	acre	300.38	7.00%	21.03
Per Acre Total Variable Cost				**$621.79**
Per Acre Fixed Cost Description				
Implements	acre	23.87	1.0000	23.87
Tractors	acre	22.92	1.0000	22.92
Pickup	acre	3.00	1.0000	3.00
Irrigation	acre	72.60	1.0000	72.60
Land	acre	45.00	1.0000	45.00
Per Acre Total Fixed Cost				**$167.39**
Per Acre Total Of All Cost				**789.18**
Per Acre Net Projected Returns				**123.16**

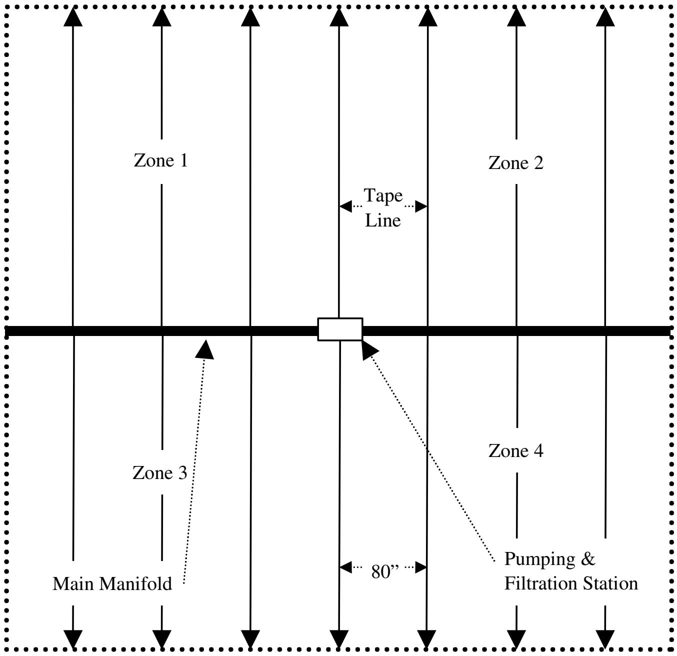

Figure 1. Schematic diagram of a 160 acre multi-zone field with the main manifold running down the center and tape lines running laterally out each side.