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ECONOMICS OF SUBSURFACE DRIP-LINE SPACING FOR COTTON

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Abstract

The drip-line spacing is a major design decision, and it depends mainly on the texture of the soil, water quality, and the cost. An experiment was conducted over three years to evaluate the yield response to water and different drip line spacing. Partial budget and investment analysis results were used to compare two drip-line spacing (40 and 80-in.). After a three year study, there is not a clear trend to conclude that the 40-in. line spacing resulted better than the 80-in. spacing. However, it is important to mention that there was a germination problem with the 80-in. drip line spacing during one year of the study. The average total gross return for the three years of the study was $810.5 for the 40-in. line spacing and $805.0 for the 80-in. line spacing. Considering the higher initial cost of the 40-in. drip line spacing, about 18% higher returns were obtained for the 40-in. drip line spacing.

Introduction

The design of an irrigation implies taking several decision such as the thickness of the drip tape, the drip- line spacing emitter spacing, and drip flow rate. In West Texas most of the farmers prefer drip tape with thickness greater than 13mil, because they have lasted more than 15 years. The drip spacing mostly used in cotton is 24-in. spacing. Irrigation designers tend to use lower flow rates and wider emitter spacing, so they can have longer drip lines and bigger zones, and consequently reduce the system cost. The flow rates per emitter have been reduced from 0.4 to 0.18 GPH. The drip-line spacing is a major decision, and it depends mainly on the texture of the soil, water quality, and the cost (Camp, 2000). In medium to heavy soils, a common drip spacing in West Texas is between 40 and 80-in. spacing (Enciso et. al., 2002). The 40-in. spacing is more used in places where farmer has saline groundwater (more than 2100 ppm of TDS). An experiment was conducted over three years to evaluate the yield response to water. Partial budget and investment analysis results were presented to compare two drip-line spacing treatments.

Material and Methods

A research plot irrigated with a SDI system was installed in Saint Lawrence to collect yield and water use data on a cooperator farm where water is supplied from a saline aquifer. The experiment represents typical conditions encountered in some water resources of West Texas. The water has an Electrical Conductivity (EC) of 4500-5800 micromhos/cm (3200 to 4200 ppm) and a Sodium Adsorption Ration (SAR) of 6.3 to 7. The lint yield and gross return were obtained for two drip spacing treatments (40 and 80-in. spacing) during the years 2001, 2002, and 2003. The area is semi-arid and received less than 16 in. per year. The experiment consisted of a complete randomized experiment with two treatments (40 and 80 in.) and four replications. Each plot consisted of four cotton rows spaced at 40-in. and 919 ft long representing an area of 1.13 ac. The cotton variety 458 Deltapine was planted during the three years of the experiment with a plant density of 54,000 plants per acre. The drip irrigation system had emitters installed every 24 in., and applied 0.24 GPH. The thickness of the drip tape was 13.5 mil. The system could apply 0.06 in. per hr. The cost of installation and materials was obtained from Brian Frerich of Eco-Drip for an average system, and the data is shown in Table 1. This table also shows the cost for the different spacing treatment systems. Nitrogen (N32) was applied in two applications: 51 lbs in the first and 43 lbs in the second application. The soil was a clay loam soil with good drainage (29% sand, 42% silt, and 29% clay). Harvest data were gathered from within each plot mechanically by harvesting four rows. Seed cotton was weighed for each replication, and a portion (about 1.32 lbs) was ginned at the Texas A&M Agricultural Research and Extension Center in Lubbock, TX. Lint was analyzed for fiber quality at the International Textile Center of Lubbock. The lint yield, seed yield, loan value and total gross return data was analyzed with a general linear model with mean separation by the least square difference (SAS Institute, 1991). The budgets were generated using the computer program Budpro for windows (Bevers, et. al., 1997).

Results

The lint yield, seed yield, and total gross return results are shown in Table 2. It can be observed that for the year 2001, drip-line spacing had an effect on lint yield, seed yield, and total gross return. Lint yield, seed yield and total gross return resulted statistically higher for the 40-in. than the 80-in. line spacing indicating higher yields for closer line spacing. In 2002, only two out of four rows of the 80-in. spacing treatment germinated. The yield of the 2 rows was adjusted by multiplying it by two and compared with the 40-in. spacing treatment. The reason that only half of the rows germinated could be that there was not enough moisture in the bed to germinate the seed, probably due to a small pre-irrigation depth. Considering this adjusted yield, drip space did not have an effect on lint yield, seed yield, and totals gross return in 2002. In 2003, lint yield, seed yield, and total gross return resulted higher for the 80-in. spacing than the 40-in line spacing. The average total gross return for the three years of the study was $810.5 for the 40-in. line spacing and $805.0 for the 80-in. line-spacing. The annual return per acre above total cost was $239.1 for the 40-in spacing and $288.2 for the 80-in drip line spacing treatment.

Conclusions

After the three years study, there is not a clear trend to conclude that the 40-in. line spacing resulted better than the 80-in. spacing. However, it is important to mention that there was a germination problem with the 80-in. drip line spacing during one year of the study. The average total gross return for the three years of the study was $810.5 for the 40-in. line spacing and $805.0 for the 80-in. line spacing. Considering the higher initial cost of the 40-in. drip line spacing, about 18% higher returns were obtained for the 40-in. drip line spacing treatment.

References

Bevers, S., J. Smith, L. Falconer, J. Pena, B. Pinchak and R. Gill, 1997. BudPro For Windows, Users Guide. Texas Cooperative Extension, College Station, Texas.

Camp, C.R., F.R. Lamm, R.G. Evans, and C.J. Phene. 2000. Subsurface Drip Irrigation - Past, Present and Future. Proceedings of the 4th Decennial National Irrigation Symposium. November 14-16, 2000. Phoenix, Arizona. Pp 363-372. St. Joseph, Mich.:ASEA.

Enciso, J, B.L. Unruh, J.C. Henggeler, W.L. Multer. 2002. Effect of Row Pattern and Spacing on Water Use Efficiency for Subsurface Drip Irrigated Cotton. Transactions of the ASAE. Vo. 45 No. 5: 1397-1403.

Frerich, H., 2001, Personal Communication, Eco-Drip Inc., President, Garden City, Texas.

SAS Institute. 1991. SAS/STAT user's guide. Release 6.03 ed. SAS Institute, Cary, N.C.

Table 1. Economic comparison of 40 and 80 in drip spacing. The costs are expressed in dollars per acre.

Component	Spacing (in) 40	80
Yield	1269.8	1243.8
Water applied (in), (Rainfall+Irrigation).	18.7	18.7
Gross returns	$810.50	$805.00
Seed	$35.25	$35.25
Fertilizer	$25.65	$25.65
Chemical	$32.80	$32.80
Irrigation cost	$152.90	$152.90
Insurance	$18.00	$18.00
Labor cost	$19.13	$19.13
Fuel	$12.22	$12.22
Custom application	$3.50	$3.50
Interest	$9.89	$9.89
Gin, bag, tie, haul modules	$99.11	$97.08
Harvest – fuel, lube, repair, chemicals	$24.25	$24.25
Total Variable Cost	**$432.70**	**$430.67**
Returns/Acre above Variable Cost	**$377.80**	**$374.33**
Cost of materials	280	180
Installation cost	775	475
Cost of the irrigation system	1055	655
Fixed cost	**$138.70**	**$86.12**
Returns/Acre above Total Cost	**$239.1**	**$288.21**
Breakeven price of Lint cotton to cover total costs assuming these yields	**$0.45**	**$0.415**

Table 2. Lint yield, seed yield, and total gross return for the 40 and 80 in. drip-line spacing treatment for 2001, 2002, and 2003.

Drip spacing (in)	Lint yield (lbs/ac)			Seed yield (lbs/ac)			Total Gross return ($/ac)		
	2001	**2002**	**2003**	**2001**	**2002**	**2003**	**2001**	**2002**	**2003**
40	1321.1 a	1174.8	1313.5 b	2091.1 a	1734.5	1919.4 b	827.0 a	745.03	859.3 b
80	1133.6 b	1168.3	1429.5 a	1819.8 b	1788.2	2141.4 a	714.0 b	760.9	940.2 a
F	0.0001	0.8282	0.0006	0.0001	0.1931	0.0011	0.0001	0.4369	0.0003
LSD	54.93	--------	60.63	101.91	-----	124.38	82.18	-----	86.33