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NO TILL AND TILLAGE UNDER SUBSURFACE DRIP IRRIGATION

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Abstract

Subsurface Drip Irrigation is the preferred irrigation method when water is limited because of its ability to spread a small irrigation depth uniformly over a great surface area. Subsurface drip irrigation is used to maximize the net return per unit of water. Reduced and no tillage is a practice that can be implemented to further reduce costs and improve profit. The main objective of this paper was to study the effect of no till and reduced tillage with Subsurface Drip Irrigation Systems during two years in Far West Texas. The experiment consisted of 10 plots. Each treatment was replicated 5 times. Each plot had an area of 0.57 acres, consisting of 4 rows spaced at 40 inches and with a row length of 1820 ft. The cost of the tillage practices for the no till was $65.5 and $59.85 for the reduced tillage in 2000, and $40.35 for the no till and $54.255 for the reduced tillage in 2001. The cotton lint yield was 1065 lbs/acre for the no till and 986 lbs/acre for the reduced tillage in 2000, and 1217 lbs/ac for the no till and 1232 lbs/ac for the reduced till in 2001. There was no statistical difference on yield and final income for the two treatments during the two years studied. The best lint yield and water use efficiency results were obtained with reduced tillage although its costs were higher in 2001. The cost presented some variations during the two years as farmers looked for ways to reduce costs.

Introduction

Subsurface irrigation is the preferred irrigation method when water is limited because of its ability to spread a small irrigation depth uniformly over a great surface area. In West Texas where the main water source comes from aquifers, Subsurface Drip Irrigation Systems (SDI) has become a necessity to irrigate cotton. To assure the economics of the system besides installing SDI, farmers have implemented several agronomic practices to improve water use efficiency. Those practices intend to reduce evaporation, deep percolation, and runoff. One of the practices that reduce evaporation is to use closer row spacing. In West Texas, it is common to use 30 inches spacing or ultra-narrow cotton with spacing of less than 20 inches (Unruh and Enciso, 2000). One practice that reduces deep percolation is the use of high frequency irrigation (Bordovsky, 1998; Enciso et al., 2001). One additional practice that has been used to reduce evaporation is to mulch the soil by reducing tillage. Since the cotton crop is a low residue crop, it may not provide enough residues to protect the soil and reduce evaporation, and erosion. However, reduced tillage practices may further reduce tillage costs and to reduce soil evaporation. The main objective of this study in using no till and reduce tillage with Subsurface Drip Irrigation Systems, was to reduce costs and to see its effect on water use efficiency. No till, besides in influencing on water use efficiency may have an impact on the reduction of the cost and profit improvement.

Material and Methods

To study the influence of reduce tillage on costs with Subsurface Drip Irrigation Systems, two treatments were studied no till and reduced till during two years 2000 and 2001. The treatments were replicated four times. A Subsurface Drip Irrigation system was installed at 80 in drip spacing and 12 in drip depth. The emitters were spaced every 24 in and each emitter had a discharge of 0.4 GPH. The cotton variety Deltapine 458 with the stacked gene Bollgard Bt and Roundup ready was planted on May 26th of 2000, and on May 5th on 2001 at Mitchell Jansa farm. The dates of the different tillage practices, and the tillage practices carried on for the no till and reduce tillage treatments are shown in Table 1. The experiment consisted of 10 plots; each plot had an area of 0.57 acres, consisting of 4 rows spaced at 40 inches and with a row length of 1820 ft. 5 plots were used for the no till and 5 for the reduced tillage experiments. Each plot was mechanically harvested. The plant population for both treatments was about 115,700 plants per ha. In the reduced till, the stalks were pulled, the soil plowed, and then cultivated two times to kill weeds. In contrast, for the no till treatment ROUNDUP ready was used to kill weeds and hand hoe method to kill volunteer cotton. In the St. Lawrence area the stalks don't need to be pulled because the freeze kills the stalks. In other regions that are further south and warmer than that St. Lawrence area, like is the case of the Rio Grand area, they need to pull the stalks to avoid re-growth of the plant. Considering the extreme soil conditions reached with deficit irrigation the main water sensor recommended for this area are gypsum blocks, neutron gauge, and time domain reflectometers. Soil moisture was monitored with gypsum blocks during the season, because of its practicality, safety and economy.

Results and Conclusions

The cost of the tillage practices for no till treatment was $65.50 and $59.85 for the minimum tillage in 2000, and $40.35 for the no till and $54.255 for the reduced tillage in 2001. The higher cost for the no till treatment in 2000 was due to the chemicals used to control weeds and to chop volunteer cotton by hand hoe. In 2001 the cost was lower because cheaper chemicals were used to control weed and just two applications were necessary. The total seed weight yield for the reduced till was 4074 lbs/acre and 4186 for the no till in 2000, and 4587 lbs/ac for both treatments in 2001. The percent lint was 24.26% for the no till and 25.44% for the reduced tillage in 2000, and 26.50% for the no till and 26.88% for the reduced tillage. The cotton lint yield is plotted in Fig. 2. It can be observed that the yield was higher for the no till treatment in both years. It was 79 lbs/ac higher in 2000, and 15 lbs/ac higher in 2001. The total cotton price considering quality was $601 per acre for the no till and $645 per acre for the reduced tillagel in 2000, and $615 per acre for the no till and $629.5 per acre in 2001. The water use efficiency was 4% higher for both years for the reduced till treatments as can be seen in Fig. 3. There was no statistical difference between the two treatments in cotton lint yield and total gross return. The soil moisture content was shown in Figure 1 for both treatments. There was no difference in moisture content for both treatments. The soil dry first at the soil surface and then at the bottom of the soil. The limit of the readings for the gypsum blocks is 200 centibars. This represents a water content close to the permanent wilting point of the soil. The cotton plants continued to extract water under this limit. The soil reached 200 centibars approximately at 1 feet of depth on July 21th, and at 2 feet on July 28th, and at 3 feet on August 4th. It will be important to take readings with a neutron gauge to detect lower moisture contents that are representative of this water limiting areas where deficit irrigation is widely practiced. The best lint yield and water use efficiency results were obtained with reduced tillage although its costs were higher in 2001. It seems that reduced tillage with mechanical cultivations improves soil conditions. It is necessary to continue to experiments to get final conclusions.

References

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Table 1. Dates when the no till and minimum tillage were carried on. Saint Lawrence Farms, TX. 1999-2001.

Date	No Till	Minimum till	$/ac
		1999-2000	
December 1999	Flail shred	Flail shred	6.00
December	----------	Stalk pull, rip and bed	9.00
April 6, 2000	----------	Plow (rebedded)	7.00
April 26	Sprayed roundup (2 pts/ac)	------------	12.00
May 6	Sprayed Gramoxone (2 pts/ac)	------------	9.25
May 26	Planted	Planted	7.00
June 14	-----------	Cultivated	5.50
June 21	Sprayed roundup (1 pt/ac)	Sprayed roundup	5.60
July 3	Hand hoe volunteer cotton	-------------	.40
July 13	------------	Cultivated	5.50
September 23	Desiccated	Desiccated	5.00
October 4	Harvested	Harvested	9.25
		2000-2001	
December 6, 2000	Shredded	Shredded	6.00
January 6, 2001	------------	Stalkpull, rip and bed	7.50
February 19	Sprayed 2, 4-D (1Qt/ac)	Sprayed 2, 4-D (1Qt/ac)	7.50
April 30	------------	Chopped and listed	6.50
May, 5	Planted 458 B/R	Planted 458 B/R	7.00
June, 11	Sprayed roundup	------------	5.60
June, 20	------------	Cultivated	5.50
September, 25	Dessicated	Dessicated	5.00
October 4	Harvested	Harvested	9.25

Table 2. Irrigation information for the experiment. Saint Lawrence Farms, TX. 2000.

Date	No Till	Till
	1999-2000	
GPM/acre	1.44	1.44
Pre-irrigation (in)	11.2	11.2
Summer (in)	9.0	9.0
Fertilization	62 lbs/ac of N Pre-season	62 lbs/ac of N Pre-season
	48 lbs/ac of N In-season	48 lbs/ac of N In-season
	2000-2001	
Pre-irrigation (in)	8.2	8.2
Summer irrigation (in)	4.5	4.5
Fertilization	57 lbs/ac of N Pre-season	57 lbs/ac of N Pre-season
	63 lbs/ac of N In-season	63 lbs/ac of N In-season

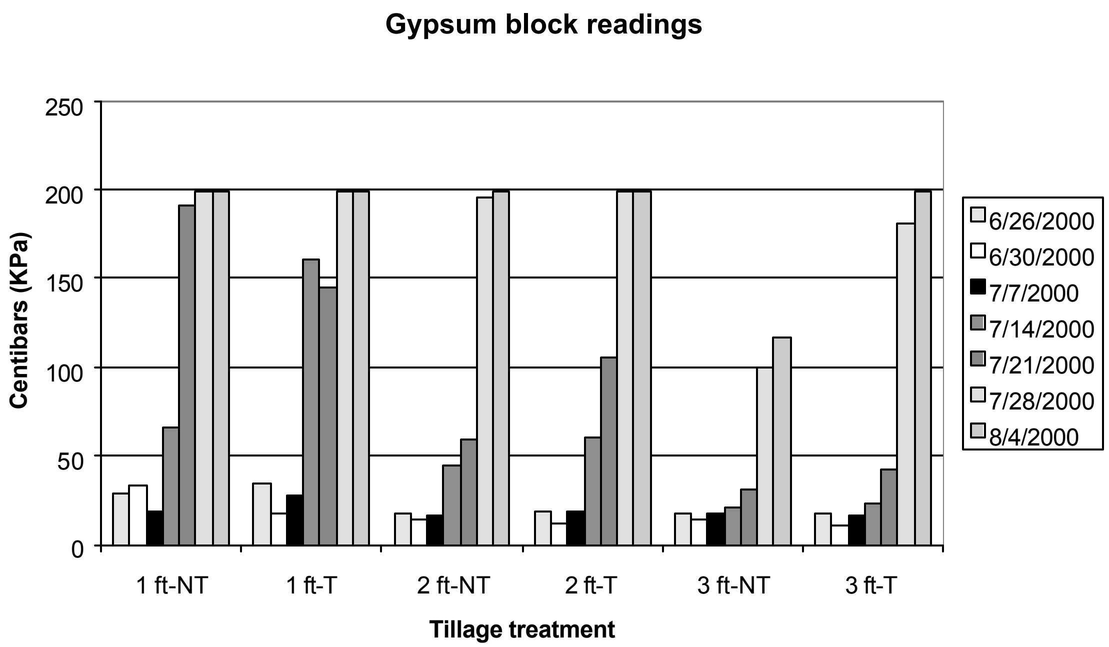

Figure 1. Gypsum block readings for the no till (NT) and Reduce tillage treatment (T) and for different dates and soil depths. Saint Lawrence Farms, TX. 2000.

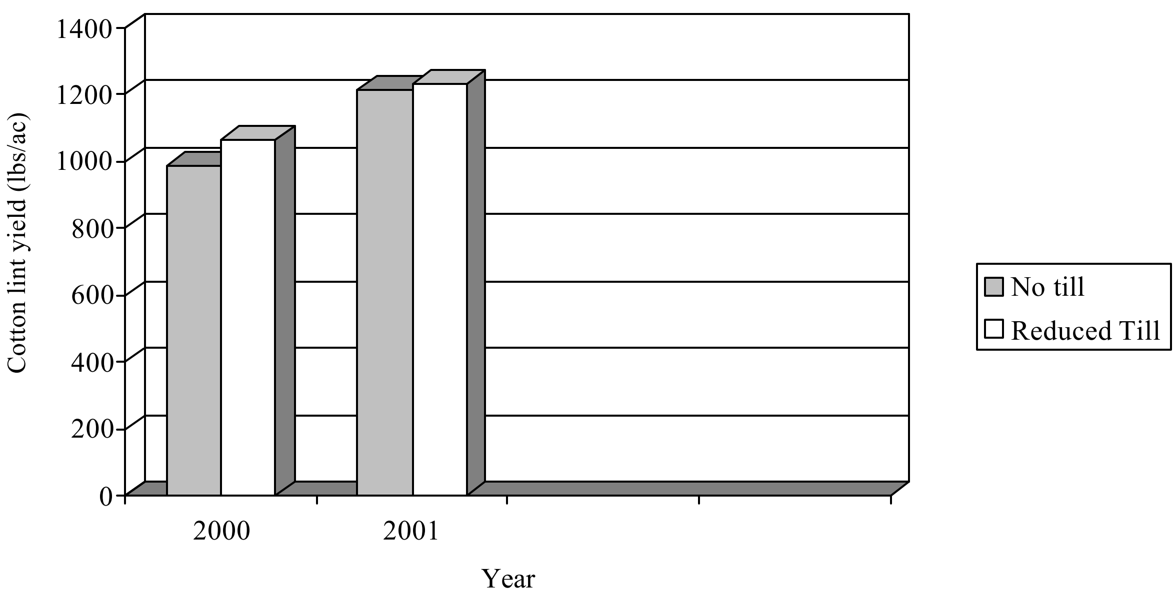

Figure 2. Cotton lint yield for the no till and Reduce tillage treatment. Saint Lawrence Farms, TX. 2000-2001.

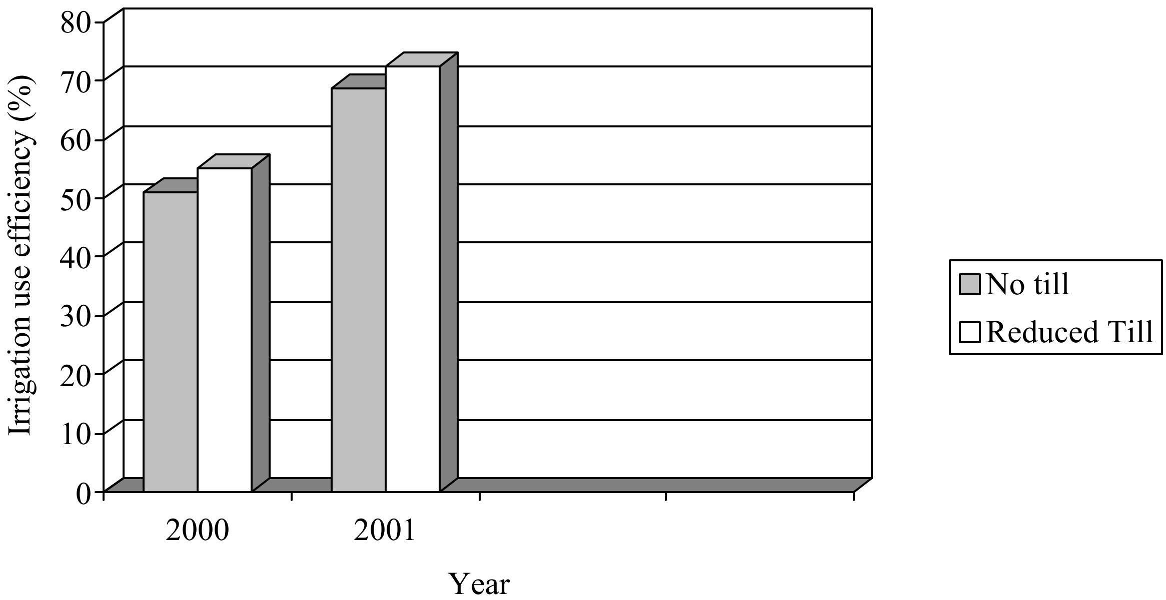

Figure 3. Irrigation use efficiency for the no till and reduce tillage treatment. Saint Lawrence Farms, TX. 2000-2001.