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. The main objective of this paper was to study the effect of no till and reduced tillage with Subsurface Drip Irrigation Systems. 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. The cotton lint yield was 1065 lbs/acre for the no till and 986 lbs/acre for the reduced tillage. There was no statistical difference on yield and final income for the two treatments. This experiment needs to be continued for two more years to observe changes in physical properties and water retention between the soil. The gypsum blocks can not be used to monitor soil moisture content through the end of the season in these deficit irrigation conditions, because the soil reached almost permanent wilting point on July 28th of 2000, at a depth of 2 ft.

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. Deep tillage has been used to reduce compaction of the soil (Khalilian et al., 2000). 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, two main treatments were studied no till and reduced till. The cotton variety Deltapine 458 with the stacked gene Bollgard Bt and Roundup ready was planted on May 26th of 2000 at Mitchel Janza 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. 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. 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. 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.

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Results and Conclusions

The cost of the tillage practices for No Till was $65.50 and $59.85 for the minimum tillage. The higher cost for the No till was due to the chemicals used to control weeds and to chop volunteer cotton by hand hoe. The total seed weight yield for the reduced till was 4074 lbs/acre and 4186 for the no till. The percent lint was 24.26% for the no till and 25.44% for the reduced tillage. The cotton lint yield was 986 lbs/acre for the reduced tillage and 1065 for the no tillage. The total cotton price considering quality was 537 $/acre for the reduced tillage and $576 per acre for the no till. Although the no till treatment resulted in a slight higher yield the cost was also higher. . There was no statistical difference between the two treatments. The study needs to be continued for at least two more years to observe the change in physical characteristics of the soil and in water content. 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.

References

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Table 1. Dates when the no till and minimum tillage were carried on. Saint Lawrence Farms, TX. 2000.

Date	No Till	Minimum till	$/ac
December 1999	Flail shred	Flail shred	6.00
December 1999	----------	Stalk pull, rip and bed	9.00
April 6, 2000	----------	Plow (rebedded)	7.00
April 26, 2000	Sprayed roundup		
	2 pts/ac	------------	12.00
May 6, 2000	Sprayed Gramoxone		
	2 pts/ac	------------	9.25
May 26, 2000	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	-------------	11.40
July 13	------------	Cultivated	5.50
September 23	Desiccated	Desiccated	5.00
October 4	Harvested	Harvested	9.25

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

GPM/acre	1.44	
Prewater	11.2 in	
Summer	9.0	
Mapping date	August 17, 2000	
Dripline characteristics:	24 inch spacing between emitters and 80 inches between lines 0.4 GPH per dripper	
Fertilization	62 units of Nitrogen Pre-season 48 units of Nitrogen In-season	62 units of Nitrogen Pre-season 48 units of Nitrogen In-season
Row spacing:	40 inches	

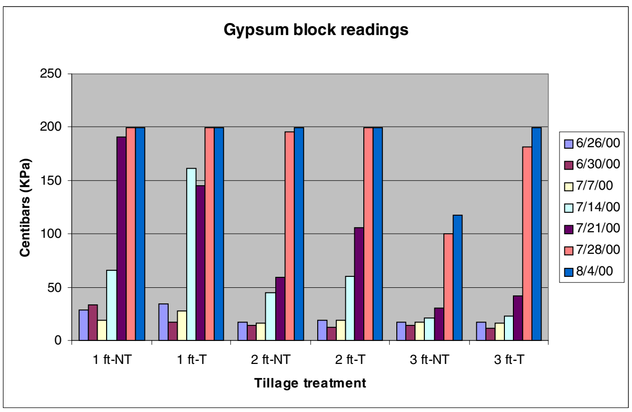

Figure 1. Gypsum block readings for the no till (NT) and Reduce tillage treatment (T) and for different dates and soil depths. Saint Lawrence Farms, TX. 2000.