LEPA Project Report

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Introduction:

Low Energy Precision Application (LEPA) and other in-canopy nozzle systems have the potential to be efficient (90-98%). However, these systems can have high runoff, especially the LEPA bubble mode, which could off set the increased efficiency. Three separate studies have been conducted to help determine management strategies for LEPA and in-canopy spray nozzles. A frequency and amount study was conducted (1989-91) to determine the effect of irrigation frequency and irrigation amount on yield. A spray mode and tillage study was conducted (1990-91) to determine the effect of spray made and tillage on yield. The last study was an in-canopy nozzle spacing study that was initiated in 1991.

Procedures:

The spray mode and tillage study was done to determine which combination captures and uses the applied water best and which results in the highest yield. The silt loam soil in each study allows the crop to root down about 5 ft. Each foot of soil contains about 2 inches of available water.

Slopes ranged from 1 to 6 percent, and averaged 3 percent. Tillage treatments included furrow diking (forming basin reservoirs between rows), in-furrow ripping, and a combination of ripping and furrow diking (a dammer-diker). Dikes and small reservoirs dug into the soil surface are used to hold water until it can infiltrate into the soil. Ripping generally increases the intake rate of the soil.

All treatments were irrigated by the "bubble" and flat spray modes. The "bubble" mode concentrates the water into a small area directly beneath the nozzle (approximately 1.3 ft. in diameter). The flat spray spreads the water out over a greater area (approximately 5 ft.). Individual irrigation amounts were usually between 0.75 and 1.00 inches.

The frequency and amount studies included irrigation treatments of 0.4, 0.7, 1.0 and 1.3 times evapotranspiration (ET-estimated crop water use). The rated flow was changed for the nozzles by the respective percentage. Irrigation frequencies of 3.5, 7 and 10.5 days were also used. All plots were furrow diked.

The 3.5 day frequency was used to study the effects of high frequency applications. LEPA systems will probably require amounts less than one inch because of high

runoff potential. The 10.5 day frequency results in very high water applications for LEPA, thus, the 10.5 day treatment resembles low frequency irrigation like furrow irrigation.

A limited in-canopy flat spray nozzle spacing study was initiated in 1991. LEPA nozzles were set in the flat spray mode about 24 inches off the ground on a 5 ft. spacing. Senninger Low Drift Nozzles (LDN) were placed at the same height, but on a 10 ft. spacing. All plots were furrow diked.

Discussion:

Spray Mode/Tillage Study

Runoff rates were not measured, but were so high in the "bubble" mode that corn yields were reduced (Table 1). The soil was "wet" when tillage treatments were installed in 1991 and "dry" in 1990. Ripping tended to be more beneficial when done in dry soil and when the spray mode was used. Ripping when the soil was "wet" might have made a channel for the water to run off especially when the bubble mode was used.

Furrow diking increased yields better in 1991 and was comparable to diking with ripping. Dikes were poorly installed in 1990. Diking with ripping increased yields the most.

Diking with ripping had the greatest effect on yields when the "bubble" mode was used. This could be because the intake rate increased due to ripping and because this treatment's reservoirs were below the soil surface. The flat spray mode showed less sensitivity to tillage treat-

Table 1. Tillage/spray mode study yields for corn (bu/a).

Tillage Treatment	Spray Mode: Bubble	Flat	Avg.*
1990			
Control	168	211	190
Dike	175	214	194
Rip	176	225	200
Dike/Rip	204	226	215
Avg.	181	219	
1991			
Control	146	217	182
Dike	151	232	192
Rip	142	222	182
Dike/Rip	169	231	200
Avg.	152	225	
2 year average			
Control	157	214	186b
Dike	163	223	193b
Rip	159	223	191b
Dike/Rip	187	228	207a
Avg.	167b	222a	

*Different letters indicate values are significantly different at the 0.05 level.

Table 2. Effect of irrigation frequency and amount on corn yield (bu/a). Three year average for 1989, 90 and 91.

ET	Irrigation Frequency, Days: 3.5	7	10.5	Avg.*
0.4	156	154	158	156c
0.7	180	194	175	183b
1.0	210	203	200	204a
1.3	207	214	194	205a
Avg.	188ab	191a	182b	

*Different letters indicate values are significantly different at the 0.05 level.

ment because of the larger area wetted as compared to the "bubble" mode.

Frequency/Amount Study

Table 2 shows the 3 year average (1989-91) corn yield results from the frequency and amount study. Yield from the 3.5 and 7 day frequencies was not different. Yield from the 10.5 day frequency tended to be lower. Over irrigating by 30 percent did not increase yield. Yield was significantly reduced by under irrigation.

Spray Nozzle Spacing Study

Corn yield for the 5 ft. flat spray spacing was 205 bu/a and 212 bu/a for the 10 ft. spacing.

Economic Considerations

The current cost to convert an existing system to LEPA is approximately $10,000. It is hard to justify conversion unless fuel costs are high and water is limiting (ie the producer is currently under irrigating). It is possible however, to pay off the difference in cost between spray heads and LEPA heads (approximately $5,000) for new installations in a 3 to 5 year period depending on fuel costs and corn prices.

Conclusions:

An irrigation frequency of 3.5 days did not affect corn yield. A frequency of 10.5 days tended to reduce yield even when fully irrigated. High frequency irrigation did not affect yields. Therefore, switching to a LEPA system and applying smaller amounts to minimize runoff should not affect yields adversely. Corn yield was reduced 10 percent for a 30 percent reduction in irrigation water applied. Yield is significantly reduced by under irrigation and is not significantly increased by over irrigation.

Corn yield from in-canopy flat spray nozzles spaced 5 and 10 ft. apart was not different (205 bu/a). The 10 ft. spacing appears to be effective in meeting the water needs of the rows 45 inches from the nozzles. However, this was from only one year of data. Additional years of study are needed to verify these results.

Corn yield was significantly reduced on slopes greater than 1 percent using the bubble mode as compared to the flat spray mode. The bubble mode would work well under conditions where the reservoirs can hold all the water applied. Reservoir tillage is effective in reducing runoff and holding water where it was applied. Increasing the surface storage (furrow diking or pitting with a dammer-diker) increased yield and was generally more effective than ripping. The benefits from ripping were variable and were best if the soil was ripped when it was "dry". Diking with ripping worked best on the slopes studied (1 to 6 percent). The flat spray mode was more effective in reducing runoff than reservoir tillage. The combination of flat spray mode and reservoir tillage produced the highest yields.

LEPA is easier to justify when purchasing a new sprinkler because the cost difference is smaller (approximately $5,000). Converting an existing system to LEPA is much harder to justify unless water costs are high and the producer is currently under irrigating the crop.