LEPA Runoff Project Report

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Introduction:

Low Energy Precision Application (LEPA) sprinkler systems produce high application rates because of the small wetted diameters of the nozzles. On sloping ground this can cause considerable runoff. A study was initiated in 1990 to provide the producer with effective guidelines for managing LEPA systems on slopes greater than 1 percent.

Procedures:

Corn was planted on May 19 in a circle. Various tillage treatments and spray modes were used to determine which combination reduces runoff the most. 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 (Figure 1). Dikes, small reservoirs dug into the soil surface, and deep ripping are used to hold water until it can infiltrate into 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).

Tillage Treatment	Bubble Spray	Flat Spray
	Rip	Control
	Dike	Dike/Rip
	Dike/Rip	Rip
	Control	Dike

Figure 1. Tillage treatment and spray mode plot for a typical replication.

The flat spray spreads the water out over a greater area (approximately 5 ft.).

Aluminum access tubes were installed for use with a neutron probe to determine soil water content. Soil water measurements were taken weekly to calculate the change in soil water over the season.

The first irrigation was on June 15 and plots were irrigated approximately once a week there after. The irrigation

application amount was kept below one inch, the current recommendation for flat slopes. Borders were installed across the field to prevent water from one treatment from running onto any treatment further down hill.

Fourty feet of row were hand harvested from each plot on October 8. Yields were adjusted to 15.5 percent moisture and reported in bushels per acre.

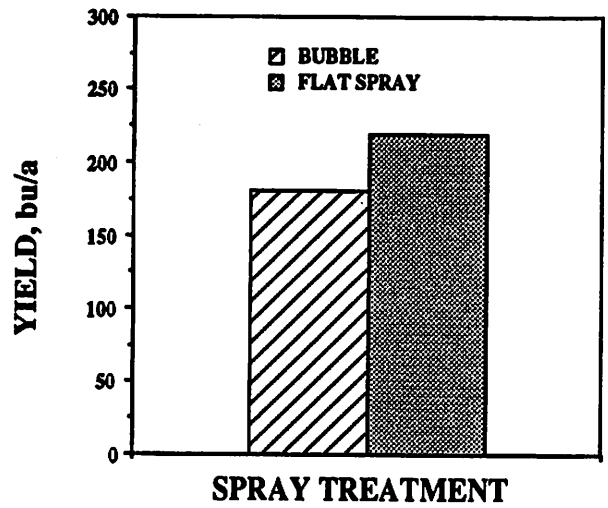

Figure 2. Average yield for spray treatment.

Table 1. Effect of spray mode and tillage treatment on corn yield (bu/a).

Tillage Treatment	Spray Mode "Bubble"	Flat Spray	Average
Control	168.1	210.8	189.5 b*
Dike	174.7	214.0	194.4 a b
Rip	176.0	224.6	200.3 a b
Dike/Rip	204.4	225.9	215.2 a
Average	180.8b	218.8a	

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

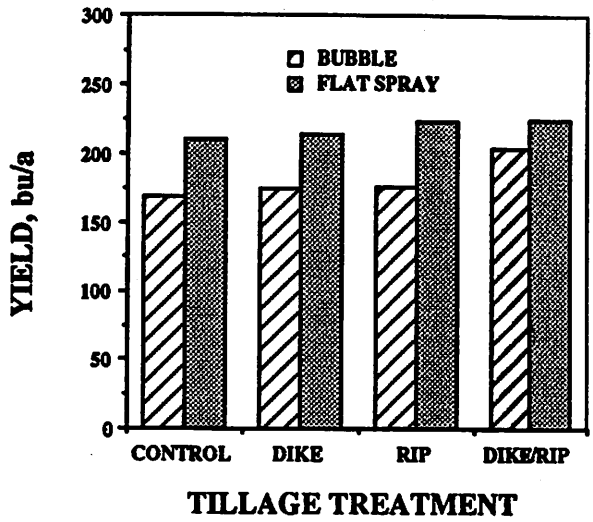

Figure 3. Average yields for tillage treatment and spray mode.

Discussion:

Runoff rates were so high in the "bubble" mode that corn yields were reduced (Figure 2). Ripping and furrow diking increased yields slightly (Table 1). Diking with ripping increased yields the most (Figure 3). Furrow diking, by itself, did little to increase corn production on these slopes. This may have happened because the furrow dikes were too shallow to hold the water applied and they washed out early in the season.

Diking with ripping had the greatest effect on yields when the "bubble" mode was used. This could be because of the increased intake rate due to ripping and because this treatment had the best reservoirs. The flat spray mode showed less sensitivity to tillage treatment because of the larger area wetted as compared to the "bubble" mode.

The seasonal soil water change for the period between June 27 and October 10 is given in Table 2.

Table 2. Change in soil water content, in inches, for 5 ft. of profile.

Tillage Treatment	Spray Mode Bubble	Flat	AVG
Control	-5.3*	-4.4	-4.9
Dike	-5.3	-2.1	-3.7
Rip	-4.7	-2.8	-3.8
Dike/Rip	-3.1	-2.4	-2.8
AVG	-4.6	-2.9	

* A negative value shows soil water was extracted from the profile by the crop.

Total water applied is shown in Table 3. This includes the seasonal soil water change, irrigation (21.1 inches) and rainfall (9.3 inches) amounts. Not all of the water applied was available for use by the crop due to runoff from the plot area.

Table 3. Total water applied (soil water extracted + irrigation + rainfall) in inches.

Tillage Treatment	Spray Mode Bubble	Flat	AVG
Control	35.7	34.8	35.3
Dike	35.7	32.5	34.1
Rip	35.1	33.2	34.2
Dike/Rip	33.5	32.8	33.2
AVG	35.0	33.3	

The total water and irrigation water applied were used to calculate total water use efficiency (TWUE) and irrigation water use efficiency (IWUE). Both are shown in Table 4. Water use efficiency is defined as the corn yield divided by the appropriate water quantity.

Table 4. Irrigation water use efficiency (IWUE) and (total water use efficiency) (TWUE) in bushels per acre-inch.

Tillage Treatment	Spray Mode Bubble	Flat	AVG
Control	8.0 (4.7)	10.0 (6.1)	9.0 (5.4)
Dike	8.3 (4.9)	10.1 (6.6)	9.2 (5.7)
Rip	8.3 (5.0)	10.6 (6.8)	9.5 (5.9)
Dike/Rip	9.7 (6.1)	10.7 (6.9)	10.2 (6.5)
AVG	8.6 (5.2)	10.4 (6.6)	

Conclusions:

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. Diking with ripping worked best on the slopes studied (1 to 6 percent). The flat spray mode was more effective than reservoir tillage. The combination of flat spray mode and reservoir tillage produced the highest yields.