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Corn Responds Best To Spokewheel Injected UAN In Ridge-till Trials

Minnesota scientists seek optimal N efficiency and minimal ammonia volatilization in four-year study.

Summary: *Grain yield, total N uptake, and net economic return were generally optimized by point injecting UAN and preplant injecting anhydrous ammonia, compared with band and broadcast applications of UAN. Split applications did not produce higher yields, N uptake, or net economic return than single preemergence injections of N. The reported three-year average was highest with preemergence point injection of UAN into the ridge. These results suggest that a single preemergence spokewheel injection of UAN into the ridge, or a preplant anhydrous ammonia injection into the valleys can be successfully used to optimize N management in corn that follows soybeans. Nitrogen efficiency*

will be enhanced and ammonia volatilization reduced.

Interest by researchers in ridge-till for row crop production continues because of its potential for conserving soil and water, and reducing costs of machinery, labor, and herbicides. Ridge-till, a very reduced-till system, allows early planting of corn and soybeans on poorly drained soils of the Midwest.

In ridge-till, N placement options are limited for corn because of the absence of primary and secondary tillage, except for ridge scraping at planting and ridge building at cultivation. Consequently, many farmers use a "weed and feed" program where UAN (10 to 15 gal/A) serves as a carrier for herbicides and is band-applied on the crop row at planting. Remainder of the N is usually injected as anhydrous ammonia or sidedressed at cultivation as UAN.

Although several N application methods have been evaluated over the years by researchers, none of these studies compared a wide range of N application methods and timing options for corn following soybeans in a ridge-till system. What has facilitated more placement and timing flexibility for N management in conservation tillage systems is development in 1989 of the spokewheel injector by Baker and associates. This injector places fertilizer directly into the root zone with little crop residue incorporation and minimal soil disturbance.

Objectives of this study were:

- Evaluate the spokewheel injector as a tool for precise UAN placement in a ridge-till system where corn follows soybeans
- Evaluate the effects of N placement (band vs. broadcast vs. injection) and timing (single vs. split) on corn yield, net economic return to N, N uptake, and N recovery.

Weather favorable

Growing season conditions in 1986 and 1987 were ideal. Precipitation was slightly higher than normal. Temperatures were average to warmer than average. Although May to September rainfall was 36 percent below normal in 1989, and June rainfall was 57 percent below normal, timely rains coupled with the absence of high-stress temperatures produced good crops. UAN was moved into the soil profile to minimize volatilization losses of ammonia. Rainfall was also adequate each year to move sidedressed UAN into the active root zone. Because of very dry and abnormally hot conditions in 1988, yields were very low (less than 85 bu/A). Therefore, 1988 was

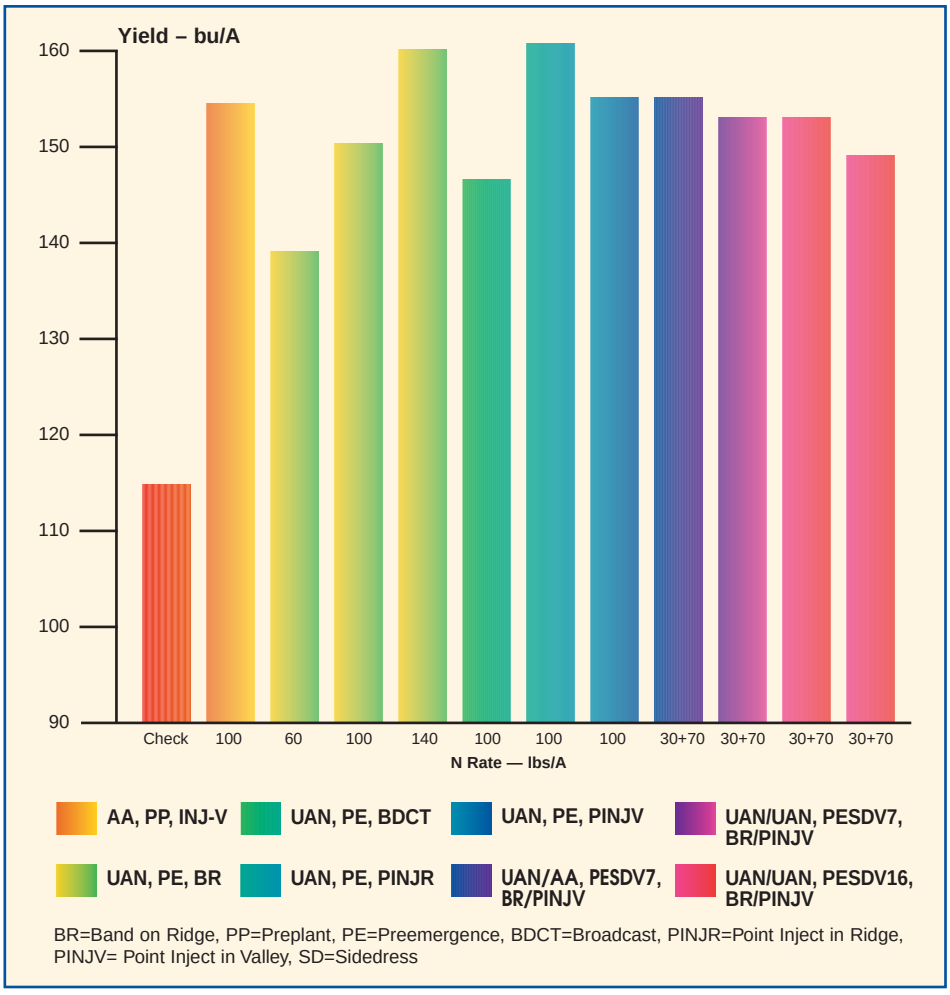

Figure 1. Effect of N rate, source, timing and application method on corn yield; three-year average, Randall, et al., University of Minnesota.

considered an aberration and not included in this report.

Grain yield

Corn grain yields were improved above control in all three reported years. Optimal yields were produced at the 100-lb/A N rate in two of three years. Note in Figure 1 how the highest three-year average was attained where 100 lbs/A of UAN was spokewheel injected at preemergence into the ridge.

No significant differences in grain yield were found between N sources or among methods and times of application in 1987 and 1989.

In 1986, spokewheel injection of UAN into the ridge at preemergence produced 19 bu/A more of corn than anhydrous ammonia injected preplant into the valley. Similarly, for reasons unknown, yields from both preemergence spokewheel injections of UAN were higher than for surface band treatments. Split applications of UAN, and UAN plus anhydrous ammonia produced average yields 7.7 bu/A less than single preemergence applications of UAN. This may have been due to an inadequate rate of band-applied N (30 lbs/A) on the row at preemergence when the majority of split-applied N (70 lbs/A) was applied at late sidedress. Therefore, preemergence rate was raised to 40 lbs/A in 1987 and 1989.

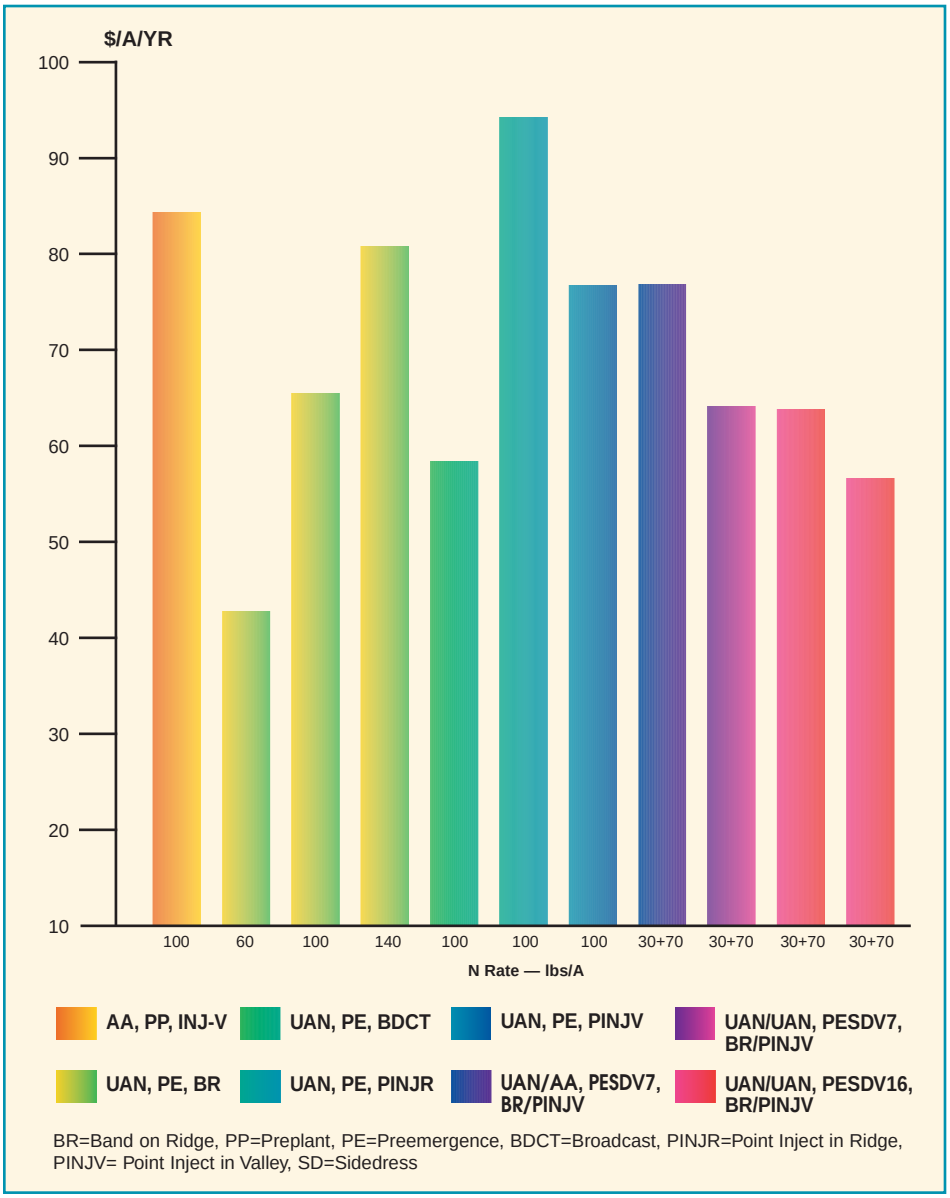

Figure 2. Net economic return to N as influenced by N rate, source, timing, and application method; three-year average, Randall, et al., University of Minnesota.

Economic return

As can be seen in Figure 2, the highest net economic return to nitrogen occurred where UAN was spokewheel injected at preemergence into the ridge at the rate of 100 lbs/A.

Split applications of N did not result in improved net economic return above single applications.

When banding UAN on the ridge, economic return was improved substantially as the N rate increased from 60 to 140 lbs/A.

Calculation of net economic return was based on the three-year average of corn grain yield. Corn was priced at $2.75/bu, anhydrous ammonia at $0.20/lb, and UAN at $0.28/lb. Application cost per time for anhydrous was $5/A. For UAN it was $5/A banded, $4/A broadcast, and $6/A for spokewheel.

N uptake

Total above-ground plant uptake of N was increased above the control in all

three years. UAN banded on the ridge at the 140-lb N rate produced the greatest uptake.

Similar to grain yield, few and very slight differences in total uptake were found between N sources or among the times and methods of application in 1987 and 1989.

In 1986, however, total N uptake was consistently greater for UAN spokewheel injected at preemergence than either preplant anhydrous or UAN band applied at preemergence. Because of the positive effect of spokewheel injected UAN at preemergence, total N uptake was greater with single applications of UAN compared with split applications of UAN and anhydrous ammonia.

Three-year averages for the 100-lb/A treatments showed greatest N uptake with spokewheel injection of UAN directly into the ridge prior to emergence. In general, spokewheel injection of UAN, regardless of placement, gave greater total N uptake than did surface banding UAN on the row.

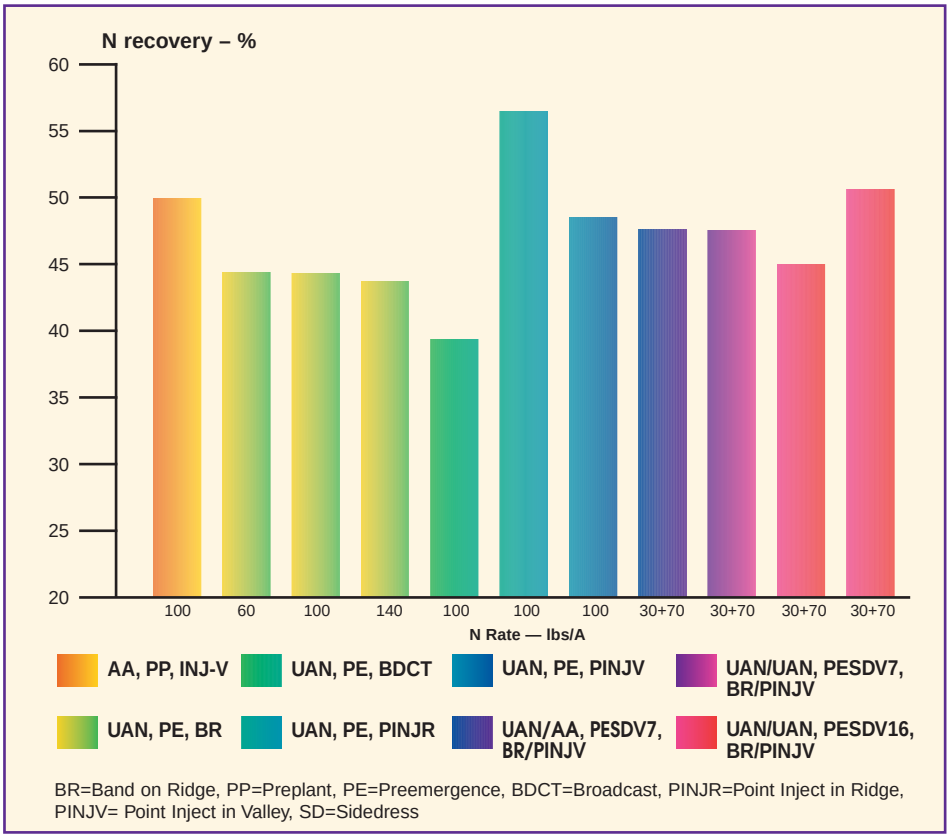

Figure 3. N recovery as influenced by N rate, source, timing, and application method; three-year average, Randall, et al., University of Minnesota.

N recovery

Apparent recovery of N was highest (57 percent) with the single spokewheel injection of UAN into the ridge at preemergence (Figure 3), outperforming injected anhydrous ammonia by 7 percent and 18 percent higher than broadcast UAN.

Apparent recovery was calculated on total N uptake of a treatment minus total N uptake in the control divided by the total N application rate.

Procedure

Site. Research was conducted from 1986 through 1989 at the Southern Experiment Station in Waseca, MN.

Soil was a poorly drained Webster clay loam with about 5.5 percent organic matter. Since levels tested high, no additional P or K was applied.

Rotation. Corn followed soybeans each year.

Ridges were built when soybean height was about 24 inches. Soybean residue was evenly distributed across the experimental area with a straw spreader mounted on the combine at harvest. Ridge height before planting averaged about 5 inches.

Plant density. Pioneer 3737 was planted each year in 30-inch wide rows at 30,400 plants/A. Less than 0.5 inches of soil was removed from the ridges during planting.

Weed control was achieved each year by broadcasting a tank mix of alachlor and cyanazine at preemergence.

Experimental design was a randomized, complete block with either four or five replicates.

Plot size was 10 feet wide by 55 feet long.

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