On-farm Nitrogen Rate and Time of Application for Corn Comparisons

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Background

Farmers growing corn in grain crop rotations are constantly evolving their soil fertility programs. Nitrogen management is of particular importance due to its relatively large requirement by corn and its elusiveness in soil. Some corn growers have pushed nitrogen application rates above University of Wisconsin Extension (UWEX) recommendations in pursuit of maximum yields. While striving for maximum yields may be a rational goal, farmers need to ensure they are not over-applying nitrogen and other inputs so as to minimize losses to groundwater and maximize corn production profits. This is the objective of eleven on-farm nitrogen rate and time of application comparisons conducted in Dane, Rock and Columbia Counties from 1999-2002.

Up-to-date research conducted at UW research stations suggests that 160 pounds of nitrogen (N) per-acre remains the economic optimum rate for most silt loam soils in southern Wisconsin. This is in contrast to the old rule of thumb that it takes approximately 1.1 lb of N per-bushel of expected yield. The Wisconsin recommendations have been derived by comparing corn yield response to various N rates on a range of soil types across the state. These experiments show that the optimum N rate tends to be similar in a high yield year as in a low yield year. This is because corn plants take-up N more efficiently when soil and weather conditions favor high yield, therefore requiring less soil-applied N per unit of yield. When conditions are less favorable, uptake efficiency is lower and more N is required per-unit of yield. Today, Wisconsin's N recommendations for corn, as reported on a soil test report, are based on soil organic matter content and the estimated productivity of the field's predominant soil type (see table 1). Still, these research-based guidelines are only recommendations and need to be adapted to local conditions, which is a large part of what these on-farm comparisons are all about.

Project Methods

Six farm operations in south-central Wisconsin are putting the UWEX nitrogen rate and time of application guidelines to the test in side-by-side, field-length comparisons. The cooperating farms are all cash-grain oriented, having good management and ranging in size from 850 acres to 2400 acres. The farms are located near Arlington, Cottage Grove, Sun Prairie, Stoughton, DeForest and Janesville (Rock County Farm).

Nitrogen programs compared vary across the farms based on each cooperator's current practices and objectives. They include nitrogen rates at, above and below the recommendations as well as fall vs. spring applications, preplant vs. sidedress applications and split applications. All of the comparisons involve corn-soybean or corn-corn-soybean

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rotations. Each nitrogen program (treatment) in each comparison is replicated two or three times. Partial budgets have been prepared comparing the economics of each treatment based on that farm's cost for N fertilizers, application costs and price received for corn.

Results Summary

In-season split applications have been the focus at the Arlington and Sun Prairie farms. These farms compared various combinations of preplant and sidedressed N applications in 2nd-year corn. Total rates varied from below, equal to and above the UW recommendation of 160 lbs for these fields. At Arlington, economics favored delaying 30 to 60 lbs of N until sidedress in two of three years. In 1999, average yields ranged from 183 to 188 bushels per-acre, and an N rate of 120 lbs/ acre (90 lbs N preplant + 30 lbs N sidedressed) provided the greatest profit. In 2000, yields were not sustained at the lower rates, but 20 bushels per-acre were gained by split-applying 150 lbs N/acre (90 lbs N preplant + 60 lbs sidedressed) compared with 150 lbs N all preplant. Yields ranged from 146 to 170 bushels per-acre in 2000. Results from 2001, however, showed no advantage to split-application, with all treatments yielding between 190 and 192 bushels per-acre.

At the Sun Prairie farm, results were mixed with respect to time of application. However, as at the Arlington farm, boosting the nitrogen rate to 180 lbs or higher did not result in significantly higher yields, and economics favored rates at or below 150 lbs N per-acre. Yields in 2000 and 2001 ranged from 183 to 217 bushels per-acre.

Spring vs. fall N applications were compared at the Cottage Grove and Janesville farms in 2001 and 2002. Spring-fall comparisons were also conducted at farms near Stoughton and DeForest in 2002. Again, N rates were varied. Results from these comparisons were mixed as well, particularly in 2002. Very low rainfall for most of the 2002 growing season likely presented soil moisture-related differences that would not ordinarily be expressed.

No yield differences were seen between spring and fall applications at similar rates in 2001. In 2002, however, treatments with fall applications tended to out-yield spring-only applications at Janesville and DeForest. The DeForest farm yields appear significantly higher where 100 lbs N in fall + 40 lbs N with the planter had an average yield of 160 bushels per-acre compared to 140 lbs N all with the planter having an average yield of 144 bushels per-acre. The Stoughton farm site, however, had reduced yields associated with the treatments including fall applications - 184 bushels per-acre average across the fall treatments vs. 194 bushels per-acre for the spring-based treatments. Yields at the Cottage Grove farm were equal in both years between spring and fall applications, but included only one rate of 209 lbs N per-acre.

As with the in-season N application comparisons, increasing N rates above the 160 lb recommendation in the fall-spring comparisons were never associated with significantly higher yields. As a result, per-acre profit was highest for those treatments at or below 160 lbs N per-acre.

A more complete paper including data from each on-farm comparison will be available at the conference presentation or can be obtained from Kevin Shelley at the University of Wisconsin Nutrient and Pest Management Program: 1-800-994-5853; kshelley@facstaff.wisc.edu.

Table 1: Nitrogen recommendations for corn.

Soil Organic Matter	Medium & Fine Textured Soils Yield Potential [1]		Sandy Soils	
	Low/Medium	High/Very High	Non-irrigated	Irrigated
- - %- -	- lbs N/acre -			
< 2	150	180	120	200
2 – 9.9	120	160	110	160
10 – 20	90	120	100	120
> 20	80	80	80	80

[1] To determine a soil's yield potential, consult the UWEX publication Soil test recommendations for field, vegetable and fruit crops (A2809) or contact your agronomist or county agent.