VARIABLE RATE NITROGEN FERTILIZER FOR CORN GROWN IN KENTUCKY

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Abstract

In Kentucky, nitrogen recommendations for corn have historically been based on soil type, soil drainage class, and previous crop rather than on an anticipated yield or yield potential. Because of the growing popularity of yield monitors and GPS technology, corn producers are now accurately mapping yield variations within fields. A three year study was conducted in the karst region of western Kentucky to determine if past yield history (collected with a yield monitor using GPS) could be used as a basis to vary N application rate within a field. In one area of the field, constant rates of N were applied across the field where highly variable (average) historical yield had been measured. In a second area, variable N rates were applied based on the historical yield. Results show that optimum N rate was not related to yield potential, and that variable rate N application based on past yield was not an agronomically sound practice.

Introduction

At present, Kentucky farmers apply nitrogen (N) to corn at constant rates on all their fields. Most farmers use the same N rate within each field as well as on all fields. Farmers indicate that they use this method to ensure high corn yields on all parts of the field, even though they do not expect all parts of the field to be able to use the highest rates of N. The amount of N needed by a corn crop during the season will depend, to a large extent, on the yield obtained for that year. Recent research has shown that the yield potential of corn fields in the karst areas of Kentucky can vary greatly within a field and is mostly dependent on soil type, drainage, and past erosion.

Farmers who have a history of yield mapping using GPS and GIS procedures can identify the areas of the fields that have high, medium, or low yield potential. By using yield maps to establish past corn yield history in a field, it was hoped that N could be varied within the field to match the yield productivity of the crop in different parts of the field.

Methods and Materials

Trials were established on fields in Trigg County on the Wayne McAtee Farm in 2000, 2001 and 2002 to determine if yield maps could be used to vary the N rate within a field. The soil types (Crider, Pembroke, Nolin, and Huntington) are typical of those found in the karst areas of Kentucky. Replicated N rate strips were established in the field that had historical areas of low, medium, and high corn yields. One trial with different N rates that were constant through the entire strip was established in part of the field. A second trial was established in another part of the field where the N rates were varied along the strip using the previously mapped yield zones as the basis on which to vary the N rates. Yield maps (three-year average) using GPS-GIS technology were used to establish yield zones of less than 100, 100 to 120, 120 to 140, 140 to 160, and greater than 160 bu/ac. N application was varied according to yield using three different treatments. They were 0.9 lb N/bu, 1.2 lb N/bu, and a reverse rate. The reverse rate used 100 lb/ac N on the three highest yielding zones and 175 lb/ac on the two lowest yielding zones.

Results and Discussion

The results in Table 1 indicate that there is no basis for making N recommendations based only on past yield history. This was true, even though the yields ranged from 80 to 190 bu/ac. The nitrogen rates needed for optimal yields were almost the same in the high yielding areas as in the low yielding areas. These data strongly indicate that the corn yield response to N is independent of the yield potential within the field.

Table 2 shows the average yield for each N treatment in the constant rate trials that were applied across the different yield zones in each strip. The amount of nitrogen needed to achieve maximum yields was relatively low compared to the standard University of Kentucky recommendations (125 to 150 lb/ac N). This indicates that the cropping system in this field (with no manure history) is supplying a high amount of natural N to the corn crop. The lack of yield increase with N rates above about 100 lb/ac supports the above conclusion that the response to N is independent of the yield potential within the field. The profit for N applied increased each year. This is due to the base (lowest N rate) being lower each year, which resulted in a greater yield increase as compared to the base rate.

Table 3 shows the yields of corn that was fertilized with variable N rates. There was no significant difference in yield among any of the methods. Treatment V1 used 0.9 lb N/bu of proven yield, and treatment V2 used 1.2 lb N/bu of proven yield applied to the different yield zones in each strip. There was no difference in the yields between the two treatments indicating that 0.9 lb/N/bu was enough N. The V3 treatment reversed the other two methods. In this case, a high N rate (175 lb/ac) was applied to the low areas of proven yield, and a low rate of N (100 lb/ac) was applied to the high proven yield areas. The yields were just as good as the other two methods. This lends more support to the fact that variable N rates of these well-drained soils is not agronomically sound. It appears that N recommendations, proven with research and based on tillage type, soil drainage class, and previous crop, are still the most accurate.

Conclusions

1. In the karst soils, the amount of N needed for maximum yields is the same in all parts of the field regardless of yield potential.
2. Using yield maps to vary the N rate within a field with highly variable yield areas is not agronomically sound. A single rate would be more economically and agronomically sound.
3. N is mineralized at high rates in these soils and needs to be taken into account when making N recommendations.
4. N recommendations, proven with research and based on tillage type, soil drainage class. and previous crop, are still the most accurate

Table1. Yield response to N rates within different yield zones.

		Yield (bu/ac)		
		Historic Yield Zone		
Year	**N Rate (lb/ac)**	**Low**	**Medium**	**High**
2000	100	84	108	182
	120	90	106	180
	170	95	109	188
2001	36	98	145	168
	106	106	159	175
	136	103	160	178
	166	105	161	177
2002	0	58	60	67
	80	115	114	117
	120	130	120	115
	160	122	124	121

Table 2. Corn yield as affected by different N rates applied at constant rates in strips with different yield zones.

Year	N Rate (lb/ac)	Yield (Bu/ac)	Profit for N[1] ($/ac)
2000	100	134.5	0
	120	136.0	-1.25
	170	140.5	-2.50
		$LSD_{(0.10)}$ = NS	
2001	36	139.6	0
	106	150.9	+11.00
	136	151.7	+5.25
	166	150.0	-6.50
		$LSD_{(0.10)}$ = 6.0	
2002	0	61.5	0
	80	115.3	+114.5
	120	121.6	+120.25
	160	122.3	+112.00
		$LSD_{(0.10)}$ = 8.1	

[1]Corn = $2.50 N = $0.25/lb

Table 3. Effect of different variable N rate methods on corn yield.

Year	Treatment[1]	Average N added (lb/ac)	Yield (bu/ac)
2001	V1	86	157.1
	V2	121	156.2
	Reverse	94	160.2
			$LSD_{(0.10)}$ = NS
2002	V1	134	135
	V2	185	139
	Reverse	106	136
			$LSD_{(0.10)}$ = NS

[1] V1 = 0.9 lbs N lbs/ac, V2 = 1.2 lbs N/ac, and reverse = low N on high yield areas and high N on low yield areas

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