NETWORKS OF PRECISION FARMING TRIALS TO EVALUATE AND IMPROVE NITROGEN MANAGEMENT FOR CORN

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Abstract

Most research to improve nitrogen (N) management has been conducted at relatively few locations on experimental farms. The advent of precision farming technologies offers the potential for producers to collect data on their farms. The objective of this paper is to describe how organized networks of producers using precision farming technologies can evaluate and improve N management practices. Pairs of N management practices were evaluated across many farms. Treatments were applied in alternating and replicated strips. Grain yields were measured by combines equipped with yield monitors and GPS. The results suggest that producers can identify N management practices that are superior to practices currently described as "best management practices". The results demonstrate that groups of producers working together can identify N management practices that increase their profits while reducing the potential for losses of N to the environment.

Introduction

Research to improve nitrogen (N) management is usually conducted on small plots on experimental farms at few locations. Producers are often reluctant to accept the results because information is extrapolated from very limited conditions to the wide range in conditions usually encountered during crop production.

Many producers have invested in precision farming technologies to improve management practices on their fields. Little attention has been given, however, to how producers can be organized to evaluate and improve N management used in their current production system.

The objective of this paper is to describe how organized networks of producers using precision farming technologies can evaluate and improve N management practices. Producers need to be proactive on evaluation of management practices and government guidelines because the personnel at most relevant government institutions and agencies have not been trained to evaluate guidelines. Evaluation of guidelines is usually confused with research. This is a noteworthy issue because the government is the major source of funding for work in this area and because most relevant programs prohibit funding of research.

Methods

Two-treatment precision farming trials were conducted to evaluate N management practices on the fields of producers. The treatments usually compared the producer's normal N management practice and an alternative practice in alternating and replicated strips going the length of a field (often about 2,000 ft). Examples of some of the 2-treatment trials are given in Table 1. The

width of a strip was dependant on the size of the application and harvest equipment used by the producer. The most common widths were 16 rows for 8-row corn heads and 12 rows for 6-row corn heads. Grain yields were measured in each strip by combines equipped with yield monitors and GPS. Effort was made to reduce errors in the yield data by using GIS to trim ends and problem areas. Also, producers were instructed to properly calibrate yield monitors prior to harvesting the trial, maintain a constant combine speed throughout each strip, and denote the treatment for each strip using the yield monitor.

All management practices except those related to N were the ones normally used by the producer and representative of management practices commonly used in the Midwest. To aid in interpretation of the results, relevant information was collected concerning hybrids, planting density and spacing, tillage systems, and pest management.

Communications between the producers and researchers were maintained by email, internet, cellular phones (often from the field), and meetings with groups of producers. The groups formed within local areas. These local groups met at least once a year to review and discuss results from the last crop season and to plan for the next crop season. The specific type and number of trials were determined by the interests of the producers and willingness to establish trials.

A state-wide conference hosted by the Iowa Soybean Association was held annually in Ames, IA. The program brought together researchers, producers, crop consultants, industry representatives, personnel from state and federal agencies, and politicians to share the information generated by the on-farm network. Registration is free for producers who participated in the trials. Summaries of materials presented at the 2004 conference are available online at: http://www.iasoybeans.com/isa/nconf/NConference.htm.

Results

A brief summary of the trials is presented in Table 2. Table 3 gives a summary of key results and conclusions.

Overall Conclusions

Networks of producers working together can evaluate and improve N management practices used in their area and on their farms. The results suggest that producers can identify N management practices that are superior to practices currently described as "best management practices". Soil fertility professionals working with these networks can develop recommendations that increase profits for producers and reduce degradation of the environment.

Acknowledgement

The Iowa Soybean Association provided leadership in developing and managing the network of producers who participated in these studies.

Table 1. Names of 2-treatment comparisons conducted and rationale for these trials in the On-farm N Network.

Name of comparison	Rationale
Spring N +/-50	Reducing rates of N fertilization offers one possible way to reduce losses of nitrate from agricultural fields to water supplies. A group of crop producers worked together to assess the economic impact of reducing rates of N fertilization by 50 lb N/acre (approximately a one-third reduction) below their normal rate. This study was limited to spring-applied N on corn following soybean.
75/125	Recent studies in Iowa suggest that 100 lb N/acre applied after crops have emerged may be a reasonable recommendation for corn after soybean in situations where a simple recommendation is required. The underlying idea is that 75 and 125 lb N/acre should be equally profitable based on averages across many sites and years, so a recommendation of 100 lb N/acre had a reasonable margin for safety at most sites. A group of producers tested this idea by comparing yields obtained at 75 and 125 lb N/acre.
Injected manure +/-50	Direct injection of manure into the soil (or dribbling on the soil and immediately covering with soil) is a relatively new practice used to minimize the problem of odor from liquid swine manure. A key question relates to the amount of fertilizer N usually needed after manure is applied this way for corn after soybean. A group of producers gathered information on this topic by applying strips of additional fertilizer N on fields where manure was applied.
Surface manure +/-50	Manure has long been applied to the surface of soil by methods that involve no incorporation or incorporation only after periods from hours to weeks. It has been difficult to assess the amounts fertilizer N needed after manure was applied this way. A group of producers worked together to learn more about the amounts of N needed on fields where manure was applied to the surface by applying additional fertilizer N in strips.
+/- Inhibitor (I)	Many producers ask if it is profitable to use N-Serve on their farms. To answer this question, on-farm trials measured yield responses to N-Serve under conditions normally encountered in their operation. At sites where the anhydrous ammonia was applied in the spring the mean rate of fertilization was 110 lb N/acre and at sites where the anhydrous ammonia was applied in the fall the mean rate was 147 lb N/acre.

Table 2. Summary data collected in 2-treatment trials conducted in the On-farm N Network.

Name of comparison	Number of sites	Recommended rate*	Mean rate of N		Mean yield of corn	
			Treatment 1	Treatment 2	Treatment 1	Treatment 2
		lb N/acre	----- lb N/acre -----		----- bu/acre -----	
Spring N +/-50	76	172	102	153	177	181
75/125	34	159	78	126	166	170
Injected manure +/-50	50	170	175**	plus 63	171	174
Surface manure +/-50	8	154	149**	plus 79	162	175
+/- Inhibitor (I)	11	176	134	134+I	180	181

* Recommended rate based on yield goals and credits (yield X 1.2 - 40) using the actual yield as the goal.

** Amount of N applied as manure calculated from analysis.

Figure 1. Maps show (A) yield and (B) yield response for a 2-treatment trial in the On-farm N Network. The mean yield response was 4.5 bu/acre, which is small when compared to the amount of variability within the trial. Yield responses showed no clear pattern in this field.

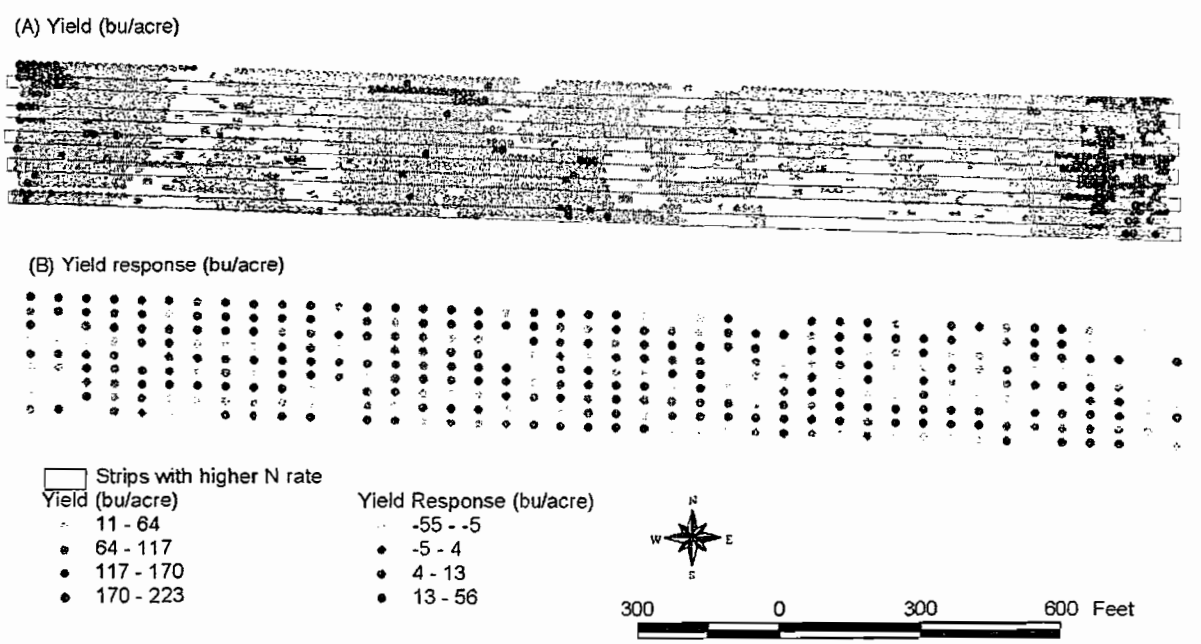

Table 3. Summary of conclusions for 2-treatment trials in the On-farm N Network.

Name of comparison	Key results and conclusions
Spring N +/-50	Most producers were applying less N than called for by recommendations based on "yield goals and credits". The value of the mean yield difference between the normal rate and the reduced rate was approximately equal to the cost of the additional fertilizer. This means most producers who participated in this study could have reduced N rates by 50 lb N/acre with no loss of profits. Although applying the extra fertilizer was profitable at some sites, these profits could be obtained only if the responsive sites could be identified before fertilizers are applied. The results show the specific conditions under which N rates can, and cannot, be profitably reduced. Reducing the rates of N application by 50 lb N/acre reduced amounts of N harvested in the grain by only 3 lb N/acre. The amounts that could be lost to the environment, therefore, were reduced by 47 lb N/acre.
75/125	The 75 and 125 lb N/acre rates were equally profitable. 100 lb N/acre is a reasonable recommendation when a simple recommendation is needed for corn after soybean. More complex recommendations for variable rate applications could be derived from spatial patterns of yield response within fields. The optimal rate of N seemed to vary with landscape position and (or) soil organic matter concentrations. The higher rate seemed more profitable where organic matter concentrations were relatively low and the lower rate seemed more profitable where the organic matter concentrations were relatively high.
Injected manure +/-50	The mean yield response was not enough to pay for fertilization. Applicators that incorporate manure make manure a reliable source of N for corn. Rates of manure-N application were higher than rates of fertilizer-N application. This indicates that producers had less confidence in manure as a source of N.
Surface manure +/-50	The mean yield response returned 3 times the cost of fertilization. Fertilization was profitable at 6 of the 8 sites. Manure applied by this method was not a reliable source of N for corn. The findings suggest producers should test these soils for nitrate in late spring and apply additional fertilizer N as called for by the test.
+/- Inhibitor (I)	The mean yield response from N-Serve was not enough to pay for the inhibitor. Results are consistent with other studies that show 100 lb N/acre is enough for corn after soybean.

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