

Letter

Special Focus: Organic Production

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Soil nitrate testing adds value to animal manures

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Because many farmers assume that nitrogen (N) fertilizers are needed for manured cornfields, they tend to question the value of using the late-spring test for soil nitrate. Recent studies supported by the Leopold Center, however, show that unless the test is used, farmers should question the value of additional N fertilization on these soils. The research shows that manures are better fertilizers than is generally believed.

Research involving 148 N-response trials was conducted over the past four years in fields that had been manured by farmers using their normal management practices. The studies were

distributed across 25 Iowa counties to provide variety in soil types and weather conditions. The fields were selected to include great diversity in manure types and application times, rates, and methods. Except for withholding normal applications of commercially prepared N fertilizers, the study managed the test areas no differently than the surrounding manured fields.

Sixteen plots were established at each site when corn plants were 6 to 12 inches tall. The surface foot of soil was sampled to measure nitrate concentrations. Immediately after the soils were sampled, commercial fertilizer was topdressed at various rates (0, 30, 60, and 90 lb N/acre) and grain yields were measured.

The effects of N fertilization on profits were analyzed for each of several fertilizer and grain price scenarios. The prices were selected to represent those often found in Iowa. Yield responses to added N treatments were expressed in terms of net return to added N, which was calculated by subtracting the value of grain produced on plots *without* added N and the costs of N fertilization from the value of grain on plots *with* added N. An application cost of \$2.50/acre was used in all calculations.

Study answers questions

Statistical analyses of net returns to fertilization determined whether additions of N increased, decreased, or had no detectable effect on profits for the farmer. The number of sites in each of those categories varied with prices for fertilizer and grain, but

VALUING MANURE

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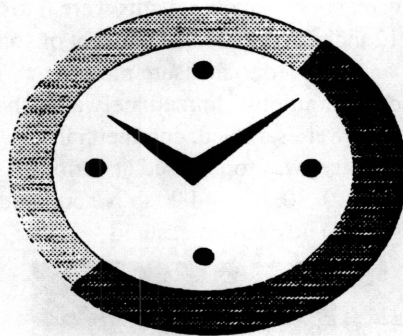
Members of Greene County FFA assisted ISU researcher Alfred Blackmer in identifying plots, conducting spring sampling, and harvesting and sampling corn stalks in a project that is showing the late-spring soil nitrate test's value for improving N management on manured soils. (Photo courtesy A. Blackmer)

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N-



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VALUING MANURE

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approximately equal numbers of sites fell into each category at average prices during the study (Fig. 1). *These findings demonstrate that commercial N fertilization often does not pay for itself on manured soils.*

With the less favorable prices, a decision to apply no fertilizer to all sites would have been more profitable than a decision to apply 30, 60, or 90 lb N/acre to these sites. Under the more favorable price scenarios, application of the 60-lb rate to all sites would have been more profitable than applying higher or lower rates to all sites. These observations indicate that *N fertilization reduced profits for a high percentage of the farmers in this study.*

Information concerning the cooperating farmers' normal fertilization practices was not recorded, but casual conversations suggested that the majority of them usually apply rates greater than 100 lb N/acre to their manured soils. This observation is consistent with other information indicating that most farmers give little or no credit for the N in animal manures when selecting rates of fertilization.

Those who defend current rates of N fertilization on manured soils often assume that animal manures are unreliable sources of nutrients for crop production because substantial portions of the N in manure can be lost between the time of application and the time N is needed by crops. There also is uncertainty concerning the rate at which the N in manures is converted to plant-available forms.

But the late-spring soil test now gives farmers the ability to assess amounts of plant-available N in their soils. This test involves sampling the surface foot of soil when corn plants are 6 to 12 inches tall. This time is late enough to reflect losses of N during the spring, but it is early enough that more N can be applied if needed. Although the test has been available for several years, few of the cooperating farmers had been using this test to guide N fertilization on their fields.

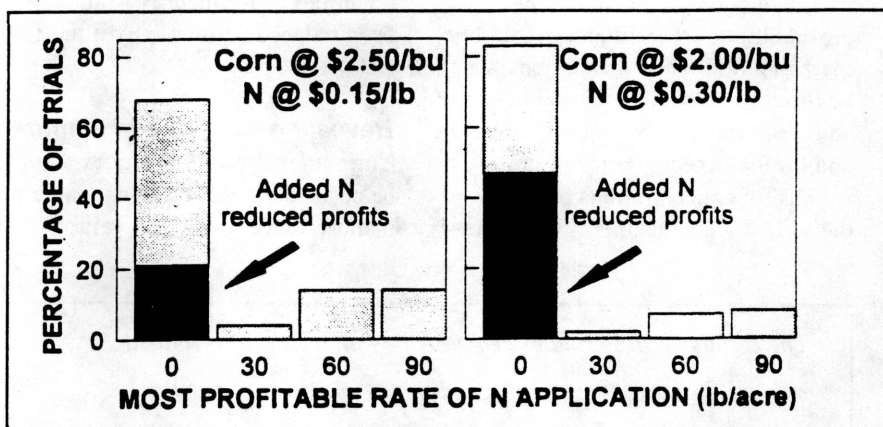


Fig. 1. Frequency distribution of optimal rates of N application across 148 trials on manured cornfields with two price scenarios. Trials having 0 lb N/acre as optimal are partitioned between sites where added N had statistically significant negative effects on profits and sites where positive or negative effects were too small to detect.

Improved recommendations

Analyses of data from all sites showed that use of the late-spring test in accordance with the current guidelines would have *increased* profits for the farmers in *all* price scenarios considered. At the less favorable price scenario, application of commercial N at a single rate to all sites would have resulted in economic loss. By using the soil test to identify sites needing commercial N, fertilization became profitable (see Table 1). With more favorable prices, use of the soil test would have substantially increased net returns from fertilization for most farmers. The increased profits would be realized by avoiding expenditures for unneeded fertilizer.

Information gathered in the study is being used to improve the N fertilizer recommendations that accompany the soil test. These efforts are based on the assumption that a set of recommendations that would have maximized profits in this large study should be appropriate for manured soils throughout Iowa.

Observed relationships between soil nitrate concentrations and net returns to fertilization provide a basis for improving N recommendations because they indicate situations where additions of N are likely to increase profits and where they are not (see Fig. 2). They also indicate the rate of fertilization most likely to maximize profits at any given concentration of soil nitrate.

Table 1. Mean net returns to commercial fertilization across 148 trials on manured soils

Recommendation	Mean net returns to added N	
	Corn @\$2.00 N @ \$.30	Corn @\$2.50 N @ \$.15
	\$ per acre	
0 lb N/acre to all soils	0.0	0.0
30 lb N/acre to all soils	-2.1	4.8
60 lb N/acre to all soils	-5.4	7.3
90 lb N/acre to all soils	-12.8	4.7
<u>Based on soil test*</u>	<u>4.9</u>	<u>13.4</u>

*Net returns to fertilization were \$15.4/acre and \$21.7/acre on the fertilized soils

Calculations showed that the profitability of N fertilization could be increased if N recommendations were adjusted for excessive rainfall before soil sampling, for the price of fertilizer, and for the expected price of grain, as well as for concentrations of nitrate in the soil. Such adjustments would have

quantities of fertilizer N would have been reduced substantially if the soil test had been used.

Revealing the value of manure

Current fertilization practices seem to be based on the assumption that animal manures have little or no value as a

busy. These arguments are evidence that the value of manure is not recognized. In fact, testing these soils requires *less* time and is *more* profitable.

The late-spring test should help farmers identify manure management practices that reduce the number of fields needing commercial fertilizers. Soil test users will probably find that properly applied animal manures are very reliable fertilizers. Farmers may even find that manures applied by some methods are reliable enough that *neither* soil testing nor commercial fertilizer is needed except under unusual weather conditions. An ongoing research project funded by the Leopold Center is exploring this possibility.

The results of these studies demonstrate that the value of animal manure, like any other resource, depends on how it is managed. Farmers using the soil test and other emerging technologies can save money by avoiding unnecessary fertilization, effectively adding value to animal manures. It seems likely that enough value can be added to transform animal manures from a troublesome waste into a resource that plays a major role in keeping Iowa agriculture competitive in the next century.

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substantially increased the profitability of N fertilization if they had been used in this study. **It is expected that user-friendly recommendations that enable producers to make these adjustments will be available in time for use with the late-spring test in 1996.**

Although N recommendations based on the soil test maximize profits for the producer, they also substantially reduce average inputs of fertilizer N. The set of recommendations used in Table 1, for example, would have resulted in mean fertilization rates of only 25 lb N/acre with the less favorable prices and 39 lb N/acre with the more favorable prices. Although these averages are calculated across all 148 sites included in this study, fertilization would have been recommended for only about a third of the sites.

The resulting decrease in potential losses of fertilizer N to the environment is also noteworthy. Calculations showed, for example, that fertilizer-induced increases in plant growth accounted for 11% of the N applied when 90 lb N/acre was applied to all sites. Although only about 30% of the N would have been accounted for when N was applied by using the improved recommendations, the unaccounted-for

fertilizer in modern agriculture. There seems to be no other explanation for the tendency of some farmers to reduce their profits by applying unneeded fertilizers after animal manures have been applied. A commonly cited reason for fertilizing manured soils is that the manure was applied unevenly or by methods that did not minimize losses of N, and the most common excuse for not using the late-spring test on manured soils is that farmers are too

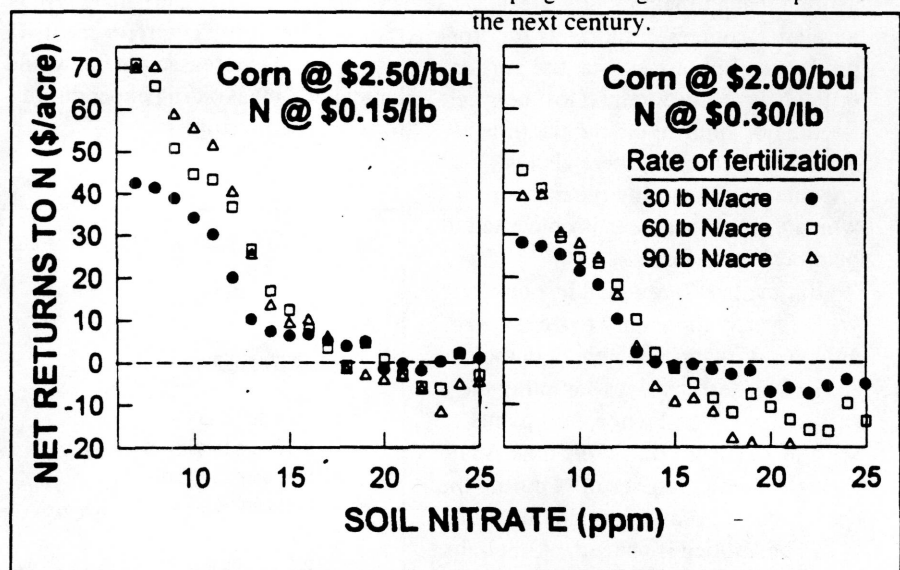


Fig. 2. Relationships between concentrations of soil nitrate in late spring and mean net returns to N fertilizer applied immediately after the soils in 148 trials were sampled for nitrate.