Manure Management Trials using the Pre-Sidedress N Soil Test

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During winter 1997, the Ohio State University Extension Agronomy and Waste Management Teams considered the idea of conducting county-level field trials to refine manure management techniques used by farmers in Ohio. The teams decided to investigate using the pre-sidedress nitrogen soil test (PSNT) as a guide to adding extra N to fields that had received manure prior to cropping. Don Eckert, from the School of Natural Resources, proposed that agents conduct simple studies in which plots receiving manure would be tested for nitrate-N when corn was one-foot tall, and yields from those plots compared to yields from adjacent plots receiving adequate N for optimum yield. Relative yield (yield on manure-only plots divided by that on non-N-limiting plots) would be related to soil nitrate concentration. The objective was to determine whether a soil nitrate concentration existed above which corn would not respond to additional nitrogen (i.e., relative yield was close to 100%). Jim Skeeles, Lorain County agent, agreed to coordinate project efforts.

Four county Extension agents participated in the full project, laying out plots on private farms, collecting soils for analysis, and reporting yields at harvest. The agents were Steve Bartels (Butler County), Mike Haubner (Clark County), John Smith (Auglaize County), and Barry Ward (Marion County). Seneca Soil and Water Conservation District (SWCD) also participated in the study; however, yields were not reported. All field operations were conducted by cooperating farmers (and the Ohio Agricultural Research and Development Center's Western Branch farm crew at one site in Clark County). Soil samples, taken to a depth of one foot when corn was one-foot tall, were air-dried and analyzed for water-extractable nitrate by the Ohio State University Research-Extension Analytical Laboratory using ion chromatography.

Experimental sites were located on important soil series of western Ohio (Table 1). All received moderate to high rates of manure (dairy, cattle, or hog), applied within six months of planting. Manure was broadcast at three sites and injected in bands in Auglaize County. The corn planted on sampled plots in Butler and Marion Counties received some fertilizer N in addition to manure. Records indicate that plots in Clark and Auglaize Counties received only manure.

Table 1. Aspects of County Studies of the Role of the PSNT in Manure Management.

County	Soil	Manure Type	Manure Rate	Time of Application	Additional Nitrogen
Auglaize	Blount	Dairy, liquid	20,000 gal. injected	Fall	None
Butler	Celina/Crosby	Dairy, 30% solid	4 tons	Spring	43 lb. in row
Clark	Crosby/Brookston	Hog/Site 1	23,000 gal.	Spring	None
		Hog/Site 2	10-23,000 gal.	Spring	None
		Cattle/Site 3	10000 gal.	Spring	30 gal 28% N
Marion	Pewamo	Dairy, liquid/dry	5,000 gal. liquid plus solids	Spring	75 lb. broadcast with herbicides

There was no relationship between actual yields and PSNT nitrate-N concentrations, when all data were pooled (Figure 1). Yields at Clark County sites did increase as PSNT nitrate concentration increased ($r = 0.95$), but the relationship was not maintained when data from the other counties were included. This is likely due to the small number of cases in other counties, and perhaps variability in yield potential between sites and plots within sites. When relative yields were calculated by dividing individual plot yields by the highest yield at the site, there was also some relationship between relative yields and PSNT nitrate in Clark County ($r = 0.91$) but not in the data set as a whole (Figure 2). Relative yields greater than 90% were obtained at PSNT-nitrate concentrations ranging from 7 to 24 ppm; however, relative yields lower than 85% were also obtained across the same range. There was no way to determine an overall nitrate sufficiency level (above which corn would not respond to additional N) from the data collected in this study.

There could be several reasons why the data from this group of studies were inconclusive. One is the repeated observation at Ohio Agricultural Research and Development Center experiment stations that critical PSNT-nitrate concentrations can vary somewhat from site to site in a given year, and year to year at a given site, when experiments were conducted using manufactured fertilizer rather than manure. Such an effect could be operating in this situation, also. Another likely possibility is that rather high rates of manure were used in the studies, making it difficult to generate anything resembling a response curve from the pooled data. In addition, the very wet weather during the spring probably slowed N mineralization and nitrification, leading to a situation where nitrate concentrations measured in June underestimated the quantity of N eventually provided by the manure. Differing rainfall and drainage at the different sites could have compounded these effects and the resulting variability. "Normally," one would expect higher nitrate concentrations from the quantities of manure applied than were seen in the soil samples tested. If the teams decide to repeat these studies, two modifications might help produce more useful data.

One is to recruit more agents and cooperators, so more data points are available. Increasing the quantity of data available increases the probability of generating significant and useful relationships. The other suggestion would be to reduce the rates of manure used on some sites, perhaps using a low and high rate at a location, and obtaining soil tests and yields from both. This will increase the probability of obtaining data that will generate a response curve and allow identification of a sufficiency level for PSNT-nitrate.

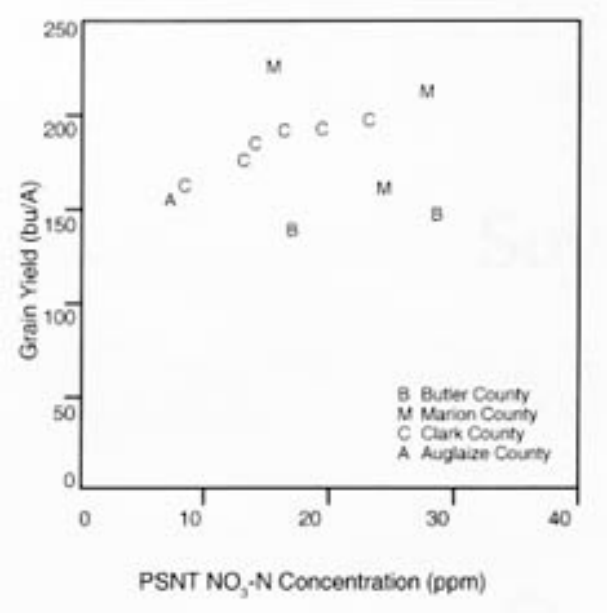

Figure 1. Yield v: nitrate-N concentration on manured plots.

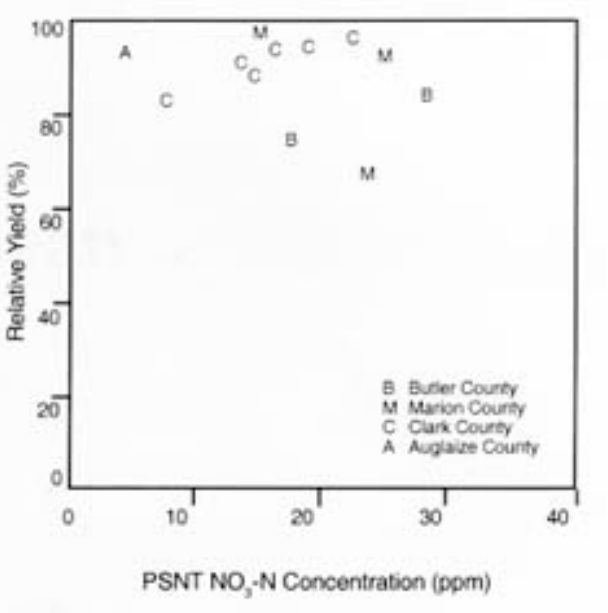

Figure 2. Relative yield v. nitrate-N concentration on manured plots.