STARTERS, NITROGEN MANAGEMENT, AND NITROGEN CALIBRATION: LOCALIZING MANAGEMENT PRACTICES

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When I first started consulting with some of the fertilizer dealerships in my area, they hired me to make them different from the dealership down the road. The best way to do this was to become a local expert on scientifically-based best management practices for growing corn and soybeans in my territory. This included knowing how best to manage nutrients to grow productive and profitable crops. University and soil test laboratory recommendations provided a good starting point. However, these data were also available to the dealership down the road. To be different, I needed local data to help me understand if and how university and laboratory recommendations needed to be adjusted to fit local conditions. The best way to begin to identify best local management practices was to create a database of the management practices used by farmers in my area.

Creating a Local Database of Agronomic Information

Before starting the database, I consulted with the statistician in Purdue University's agronomy department. I told him what I wanted to do, and he suggested that data be collected from strips in farmer's fields. Various measurements were to be performed in these strips and the corn harvested by weigh wagon. This would ensure that quality data would be collected. He also said that I should commit myself to 10 years of data collection, to increase the number of observations and to take measurements over a large number of weather conditions. In 1981, we started the database project on 80 strips in farmers fields (40 in corn, 40 in soybeans). The database project officially ran for 10 years, although some farmers insisted upon continuing data collection for several more years afterward.

Measurements taken from each strip were not limited to management practices and yields. Agronomic evaluations, such as degree of weed control, severity of disease, degree of compaction, percent lodging, etc. were also included (Table 1). These additional measurements were an important part of the database. When consulting with many of my farmers, much of the information I needed to diagnose a problem or answer a question had not been recorded or measured by the farmers. I wanted to be sure and measure these variables in the test strips so that I could begin to quantify the impacts of various management practices used locally.

Analyzing the Database

Waiting ten years to complete the database project was an initially tough sell to the plant managers. They felt they needed something different immediately. However, those needed differences occurred in the first year of the project. The farmer meeting we held the first year to discuss project results was different from any other farmer meeting in the area. I had begun to fulfill the charge given "to be different."

Large numbers of observations were needed to discern trends in the data. At the end of the project, we had a total of 1600 observations. To create meaningful analyses, strips included in a query were those whose variables, other than the ones of interest, were similar or the same.

Table 1. Variables measured on test strips in farmers' fields.

Crop	Frost? Y/N	Weed control rating: 1(good), 2(medium), 3(poor)	Split N application? Y/N	Organic matter
Year	Crop rotation	Disease rating: 1(good), 2(medium), 3(poor)	Total P rate	Bray P1 soil test
Farmer	Primary fall tillage	Compaction: 1(slight), 2(moderate), 3(severe)	Total K rate	K soil test
Location	Secondary fall tillage	Percent barren stalks	Total B rate	Mg soil test
Planting date	Primary spring tillage	Percent lodging	Total S rate	Ca soil test
Seed company	Secondary spring tillage	Percent soft stalks	Total Zn rate	Soil pH
Hybrid/ variety	Cultivation? Y/N	Total applied N rate	Total Mn rate	Cation exchange capacity
Relative maturity	Primary herbicide	Pre-plant N rate	Total lime rate	K base saturation
Planted population	Primary herbicide rate	N timing	Manure applied? Y/N	Mg base saturation
Harvest population	Secondary herbicide	N form	Manure rate	Ca base saturation
Harvest date	Secondary herbicide rate	Side-dress N rate	Starter N:P ratio	H base saturation
Row width	Tertiary herbicide	N Serve? Y/N	Starter N rate	Soil test S
Test weight	Tertiary herbicide rate	N Serve rate	Starter P rate	Soil test Zn
Moisture	Insecticide	Side-dress fertilizer? Y/N	Starter K rate	Soil test Mn
Yield	Insecticide rate	Side-dress N form	Starter S rate	Soil test B

It was essential that the results of the database be compared to the current body of agronomic knowledge. Not all relationships uncovered made agronomic sense. Only those that were consistent with agronomic principles were presented to the farmers and used as a basis for changing management practices.

Local Nitrogen Management and Calibration

Database results provided a good starting point for further, more detailed investigations. For instance, the 15 years of consulting I had done prior to the initiation of the database project convinced me that soil types were having a significant impact on nitrogen response in our area. Before the database started, we had been sampling soil types separately and using them as management zones for potassium (K) and phosphorus (P) applications. However, nitrogen (N) was still managed on a whole field basis. As the ability to apply N variably across the field became simpler with new technology, I wanted to determine what rates would be best for the two predominant soil types in the area. A study was established to investigate response of corn to N on two predominant soil types: a Cyclone silt loam and a Fincastle silt loam. A split-plot experiment, replicated 4 times, was designed with soil type as the whole plot and N rate as the sub-plot. The N rates selected were based upon database results (Figure 1). These results indicated that crop response was possible up to high rates of N. Therefore, the rates selected for small plot work were 60, 90, 120, 150, 180, 210, 240, and 270 lb N/A. The study was conducted for 5 years on corn following soybeans.

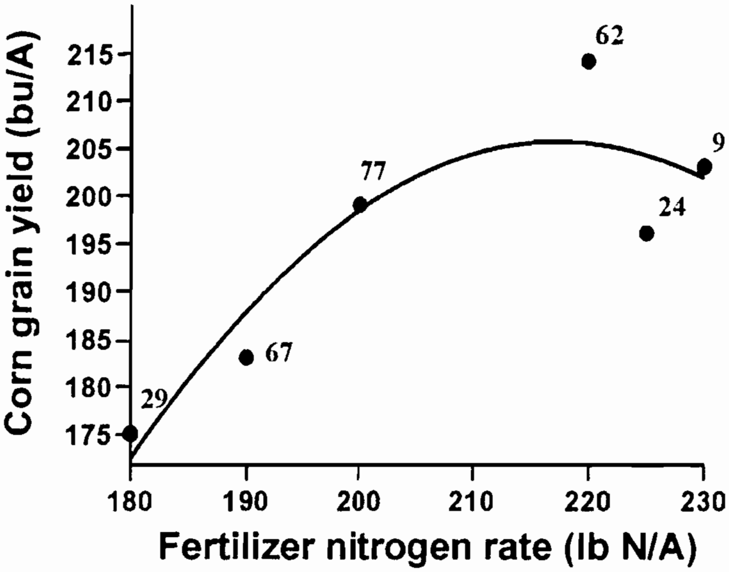

Figure 1. Relationship between fertilizer nitrogen rate and corn grain yield, determined from database queries. Numbers indicate the number of observations comprising the mean for each data point.

Small plot research revealed differences in the way the two soils responded to N applications. The overall production level on both soils were similar; however, the Fincastle soil was more responsive (Figures 2 and 3). Recommendations for N based upon this research were 180 lb N/A for the Cyclone soil and 210 lb N/A for the Fincastle soil. These recommendations were counter to the opinion held by many farmers in the area that the darker Cyclone soil should get more N because it was more productive. These results indicated that the lighter Fincastle soil was capable of high production too and should be fertilized with more N to reach this potential. In addition, these data resulted in less N than recommended by the university. Yield goals of 200 bu/A are appropriate in many areas of the fields in my area. At this production level, the current university recommendations are 215 lb N/A for corn following soybeans, taking a 30 lb N/A credit for the previous year's soybean crop. This is close to the 210 lb N/A recommendation for the Fincastle soil, but is 35 lb N/A greater than the local recommendation for the Cyclone soil. Local recommendations therefore represent a 2% and 16% reduction in N use on Fincastle and Cyclone soils, respectively. Reduced rates of N, based upon these local data, are used on approximately 25,000 acres in my area.

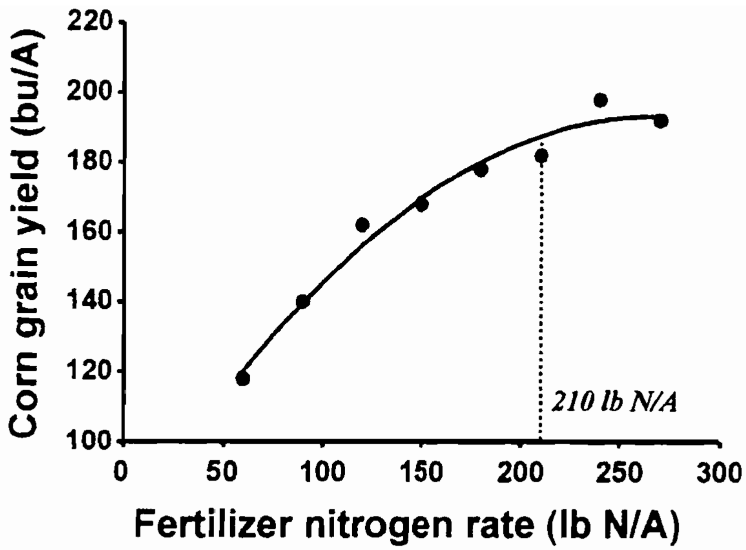

Figure 2. Corn grain yield response to fertilizer N for the Fincastle soil, determined from replicated small plot research. Each data point represents the mean of 20 observations (4 replications, 5 years). Dotted line indicates the economically optimum N rate.

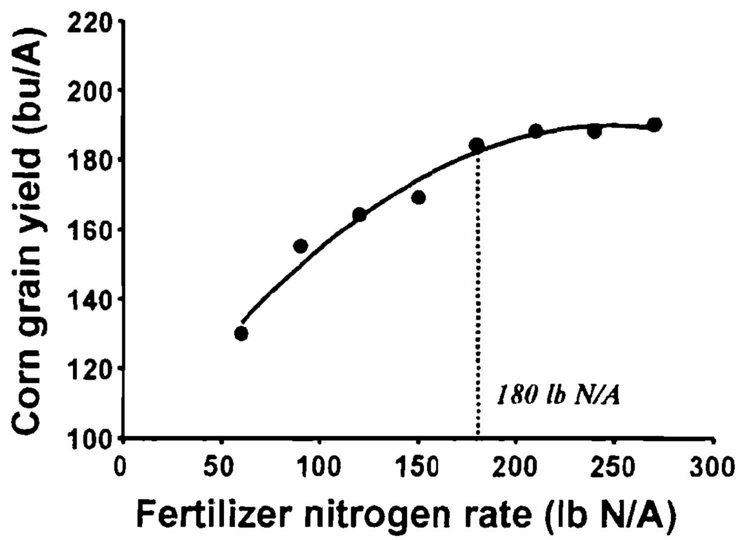

Figure 3. Corn grain yield response to fertilizer N for the Cyclone soil, determined from replicated small plot research. Each data point represents the mean of 20 observations (4 replications, 5 years). Dotted line indicates the economically optimum N rate.

The small plot research provided the data necessary to begin site-specific N management. These data provided a research base for local recommendations and determined rates to use with variable rate equipment. Without these data, we would still be managing N at the local level in a way that was inefficient.

Local Starter Fertilizer Management

In our efforts to differentiate ourselves from other dealerships, we wanted to investigate two key aspects of starter fertilizer management: 1) placement and 2) formulation. At the time of our interest in this topic, many retail outlets were offering 10-34-0 only. Rather than compete with them on price, we decided to see if any other starter formulations would be of agronomic benefit. We talked to our formulation chemist about new product possibilities with agronomic promise. Two new products were tested: 14-14-3 and 12-30-0-3. From discussions with some of our key customers, we realized that most farmers would not adjust the liquid rate of starter fertilizer. The rates they were using had the logistical advantage of emptying the fluid tank on the planter at about the same time that the seed boxes were beginning to run empty. Timing fertilizer and seed refills to match facilitated tendering. Therefore, we designed a study to test the hypothesis "do other starter formulations perform any better than 10-34-0 when applied at the same fluid rate/A?"

Figure 4 presents the findings of a 5-year replicated, small plot study examining 3 different starter formulations applied at a constant liquid delivery rate of 12 gal/A. The data showed that 12-30-0-3 and 14-14-3 were superior to 10-34-0. We later discovered, however, that 14-14-3 did not remain stable under all storage conditions. This left 12-30-0-3 as the product of choice, since it had both an agronomic advantage over 10-34-0 and stored well.

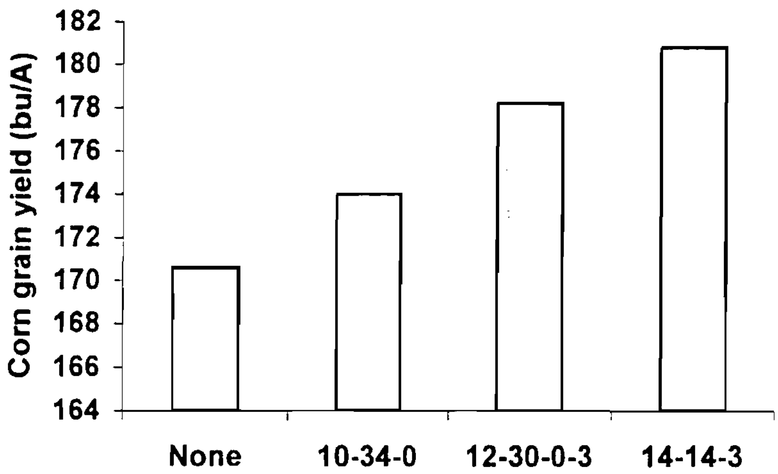

Figure 4. Corn grain yield response to various starter formulations applied at a constant 12 gal liquid/A. Bars represent 5-yr. average yields (1992-1996).

Another question we investigated was the placement of starter fertilizer. While researching new starter formulations, we examined the placement of the widely-used 10-34-0 starter. Farmers were interested in cutting rates and applying starter with the seed. We tested the hypotheses "does using a lower rate of 10-34-0 placed with the seed have an advantage over the higher, commonly used rate applied 2 in. below and 2 in. beside the seed (2x2)?" Figure 5 shows that a lower rate of 10-34-0 placed in furrow does not yield as much as a higher rate placed 2x2. In the same study, we also determined that placing a reduced rate of 10-34-0 with the seed delayed maturity, as indicated by the higher moisture content at harvest for this management practice (Figure 6).

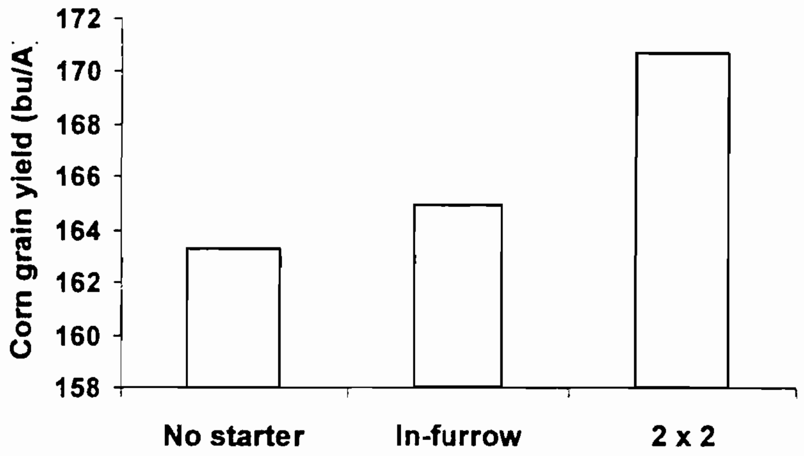

Figure 5. Corn grain yield response to 12 gal 10-34-0/A applied 2 in to the side and 2 in. below the seed (2x2) and 5 gal 10-34-0/A applied with the seed (in furrow). Bars represent 5-yr. average yields (1992-1996).

Impacts of Local Data and Research upon Best Management Practices

Knowledge leading to improvements in management practices is a valuable asset to a farmer's business, and farmers recognize this. Local data and changes in management practices were well accepted, because local farmers had been part of the process. Farmers appreciated knowing how certain management practices might influence yields as they planned various strategies. Farmers generally were willing to allow us to create their nutrient management program. However, in other areas of their management, such as their herbicide or tillage programs, they preferred to be given options and possible outcomes and then decide for themselves.

The database project and local research plots were also good for the dealerships. Their customer base increased as did farmer loyalty. Many farmers felt that if they took their business somewhere else, they would miss important developments. The increase in customer base was especially important, since some of our recommendations, such as those for N, resulted in reduced product sales per field. However, by providing scientifically-based information to those in our area, our increase in customers more than made up for the reduced N recommendations per field.

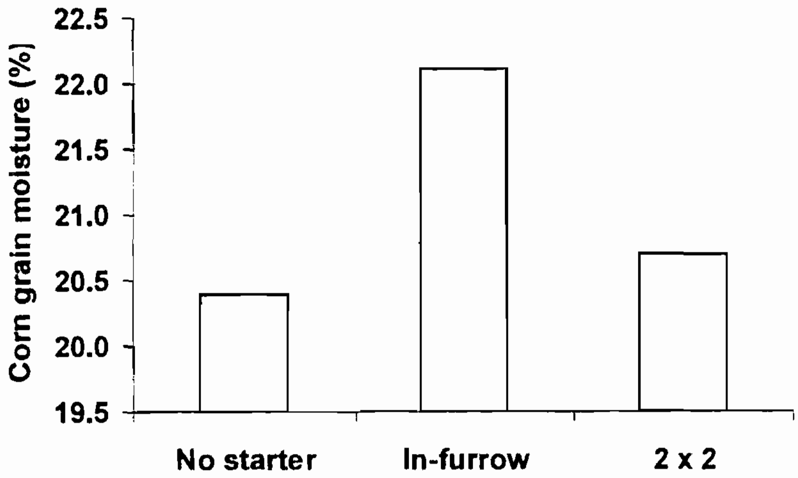

Figure 6. Corn grain moisture response to 12 gal 10-34-0/A applied 2 in to the side and 2 in. below the seed (2x2) and 5 gal 10-34-0/A applied with the seed (in furrow). Bars represent 5-yr. average moisture content (1992-1996).

Summary

Nutrient management is part of many management decisions a farmer needs to make. It is an evolutionary process, rather than a procedure. It takes years of collecting good data, conducting controlled experiments, and building rapport with farmer customers. Even though sound nutrient management planning involves a great deal of effort, time, and commitment, the results are rewarding: good relationships with farmers, excitement of trying new practices that could increase profitability, increased understanding of how to better production at the local level, attainment of expertise of local best management practices, and a profitable business for all involved. With so many benefits, one shouldn't wait any longer to begin the process. Too many good things are waiting to happen.

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