by Chad Berghoefer and Dr. Randy Killorn

Chlorophyll Meter Promising As Tool For Nitrogen Management

But variances in weather and hybrids make it difficult to develop a standard critical level.

Summary: *Nitrogen management is an increasing concern for producers. Potential loss of N by leaching and volatilization decreases income and increases potential for ground-water contamination. Nitrogen fertilizer recommendations are based on the pre-sidedress soil nitrate test (PSNT). Representative soil samples must be taken and sent to a lab for analysis. The time lapse is critical if additional N must be applied. Fields that contain bands of N are difficult to sample because of variation created by the band. In search of an alternative, we commenced studies in 1991 at two sites in Iowa. Results to date suggest that measuring chlorophyll content in corn at the V6 stage may be the way to solve the variability problem created by banded N. Chlorophyll content in corn leaves at the V6 growth stage appears to relate to soil N and grain yield. However, other factors that affect chlorophyll content, such as weather and hybrid, are making it difficult to develop a standard critical level.*

A new method for assessing soil N in Iowa is the Pre-sidedress Soil N Test (PSNT). A conservative amount of N is applied preplant, followed by sidedressing in late spring. Problem is PSNT considers only soil NO_3-N. Ammonium-nitrogen is not measured. Because injected N does not nitrify as rapidly as broadcast N, the PSTN assessment could underestimate the amount of N in the soil by failing to measure ammonium nitrogen. Injection also makes it difficult to obtain a representative soil sample. There is no field uniformity with injected N, resulting in either extremely high or low concentrations when soil sampling.

A possible alternative to the PSNT method of assessing soil N, already being researched, is use of a portable chlorophyll meter. Studies include its use to spot N deficiencies in crops and, when calibrated, to estimate the amount of N fertilizer required for optimum yields, when readings are below critical value. Thus, it may be possible to walk through a field taking random chlorophyll readings and predict if

additional fertilizer is required. If so, the quantity could be determined within minutes of walking out of the field. Other research has reported that leaf N concentration in corn is related to the amount of chlorophyll in the corn leaf. Similarly, a good correlation between chlorophyll meter readings and the chlorophyll concentration in corn leaves has been found.

Focus of this discussion will be on whether or not chlorophyll content of corn leaves can be used as a measure of the N fertilizer needs of a crop growing in fields in which N fertilizer was injected before planting. Experiments were conducted at two sites in Iowa from 1991 to 1993. Data discussed here are from 1993 only. Three types of application were used: broadcast, spring inject, and sidedress inject.

Ames site

Chlorophyll content of V6 corn leaves increased with N rates. SPAD (Minolta meter) readings of V6 corn leaves increased with N rates. SPAD readings were not affected by method of fertilizer application. SPAD readings ranged from about 43 to 48. Maximum readings were reached at about 125 lbs/A of N.

Ammonium-nitrogen concentrations taken at sidedress were not affected by N rate or method of application. Most of the N fertilizer had nitrified, giving low levels of ammonium-nitrogen at the time of sampling.

Nitrate-nitrogen increased with N rate. Spring broadcast applications resulted in higher concentrations of nitrate-nitrogen than injected applications. Nitrate-nitrogen content of the check treatment was below the critical level of 21 ppm, indicating the need for additional N to optimize yield.

Grain yields increased with increased N rates. Figure 1 displays an almost linear relationship. Yields were also affected by method of application. Heavy precipitation leached most of the spring-applied N below the top foot of soil. The order of yields, ranging from highest to lowest, was: sidedress injected, spring injected, and broadcast, which supports the assumption that nitrification rates are lower in injected than in broadcast treatments.

The relationship between SPAD readings on V6 corn leaves and grain

yield is shown in Figure 2. SPAD readings ranged from about 42 to 48, while yield ranged from about 80 to 120 bu/A. There was a strong correlation between yield and SPAD readings.

Crawfordsville site

SPAD readings at the Crawfordsville site increased with N rate, but were not affected by method of application. SPAD readings ranged from about *50* to *54*. Maximum readings were reached at about 125 lbs/A.

Ammonium-nitrogen concentration in the surface foot of soil increased with N rates in both broadcast and injected applications at sidedress. Ammonium-nitrogen concentrations were higher in injected than in broadcast treatments. Nitrogen fertilizer was not applied until late in the season. This reduced the amount of N leached. There were higher concentrations of ammonium-nitrogen in injected applications than broadcast.

Nitrate-nitrogen concentrations ranged from about 9 to 27 ppm and increased with N rates. Method of application had no effect on nitrate-nitrogen concentration. Nitrate-nitrogen content of the check treatment was below the critical level of 21 ppm, indicating the need for additional N to optimize yield.

Grain yields (reported at 15.5 percent moisture) were generally low and ranged from 70 to 110 bu/A (Figure 3) and increased with N rates. Method of application had no effect on yield. Heavy rains and cool temperatures in the spring and summer reduced yields. Maximum yield was reached with about 130 lbs/A of N.

The relationship between SPAD readings on V6 corn leaves and corn yields is shown in Figure 4. SPAD readings ranged from *50* to *54*. The readings are grouped in two areas, suggesting a difference between deficient N and adequate N. The SPAD readings correlated well with yield.

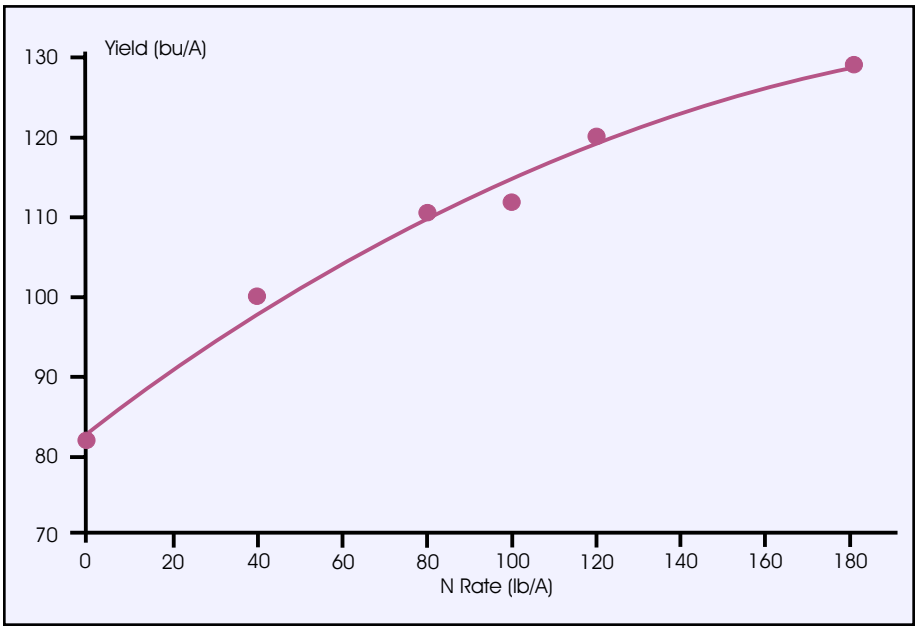

Figure 1. Effect of N fertilizer rate on corn grain yields at Ames, 1993.

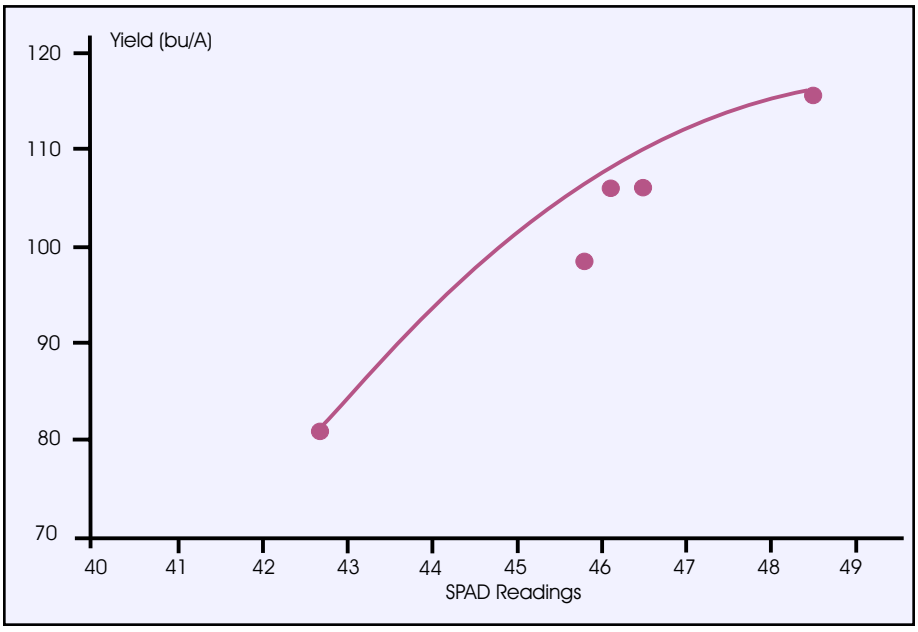

Figure 2. Relationship between SPAD reading on V6 carn and corn grain yiled at Ames, 1993

More work needed

Results in 1991/1992 were similar, indicating a good correlation between chlorophyll content, as measured in

SPAD values at V6 growth stage and corn yield. However, yield and SPAD readings were not as strongly correlated in 1993 because of unusually high amounts of precipitation.

SPAD meter readings were not affected by banded N, but showed differences in N availability. However, the narrow range of SPAD meter readings made it difficult to determine a critical value. This narrow range may make it difficult to predict N sidedress amounts.

SPAD meter readings were different for each site. This was probably caused by hybrid differences and site specific factors.

Our conclusion is using a chlorophyll meter to predict N status of corn is promising. However, because of hybrid/site effects, some sort of relative scale must be developed. This technology will be adopted only if users are willing to develop adequately fertilized areas in fields and base sidedress N recommendations on SPAD reading differences between the fertilized and unfertilized areas.

Experimental design

Soil. **Soil on** site located three miles

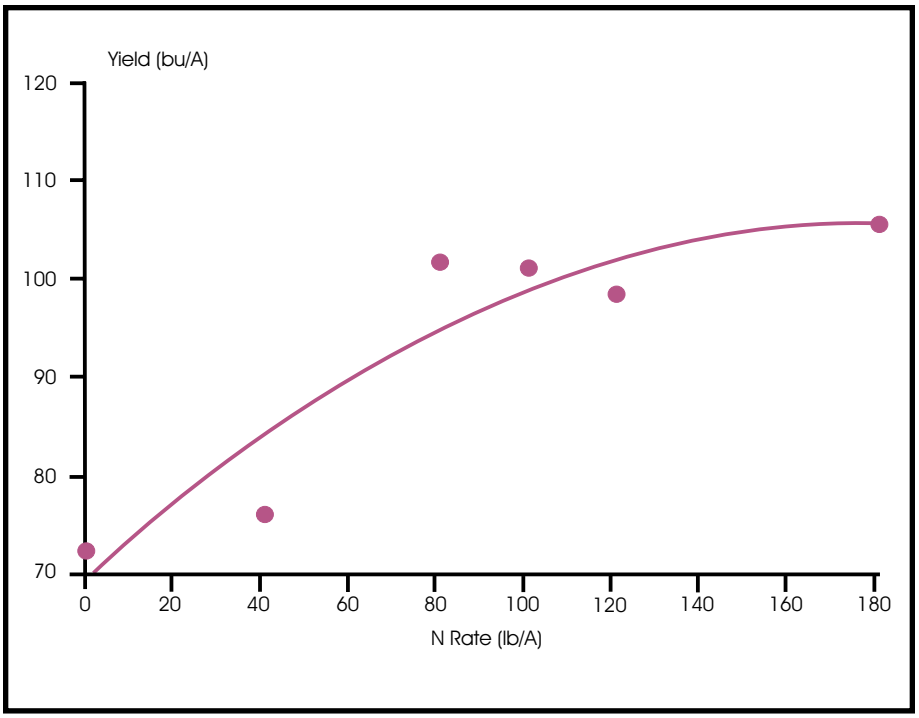

Figure 3. Effect of N fertilizer rate on corn grain yields at Crawfordsville, 1993.

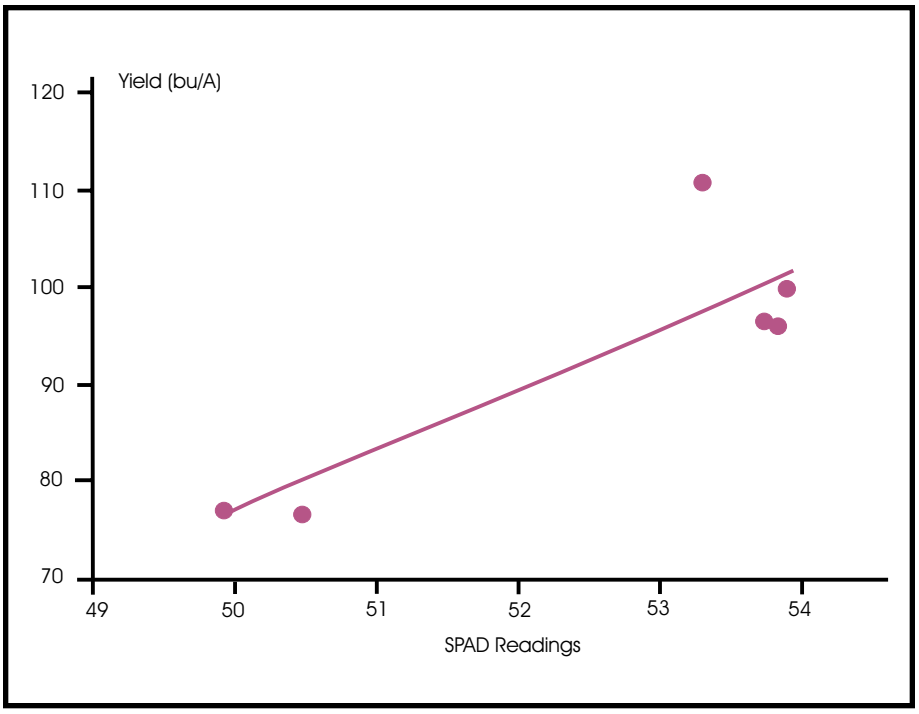

Figure 4. Relationship between SPAD reading on V6 carn and corn yield at Crawfordsville, 1993.

west of Ames is a Nicollet loam (Fine-Loamy, mixed, mesic Aquic Hapludoll). At the Southeastern Iowa Outlying Research Farm near Crawfordsville, soil is Mahaska (Fine, montmorillonitic, mesic Aquic Argiudaoll).

Plots. A split plot design with four replications was used at both locations. Main plots were method of N application. Sub-plots were N rates.

Fertilizer. Fertilizer source was 28% UAN. Broadcast N was incorporated within 24 hours. Two passes were needed to inject N. Crop was sidedressed at the V6 growth stage (six leaf collars visible on the stalk).

Readings were taken with a Minolta SPAD-502 Chlorophyll Meter from ten randomly selected plants in the two middle rows of each plot. Readings were taken halfway between the tip and collar (where the leaf was bent), and midway between the leaf midrib and the leaf edge of the most recently mature leaf.

Timing. Fertilizer was applied on April 26, 1993 at Ames and on May 20, 1993 at Crawfordsville.

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