# NITROGEN RECOMMENDATIONS FOR WHEAT USING THE CHLOROPHYLL METER

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## ABSTRACT

The use of a hand held chlorophyll meter showed good promise in helping to make N recommendations for wheat on a field basis. Using 5 site-years on well drained soils over a 2-year period, a correlation index ($R^2$) of 0.88 was found relating the March (Feekes 5) N needed for optimum yield with a differential chlorophyll reading. Research on this method will be continued and expanded to field trials. Soils in less than a well drained class may require a separate calibration or the method may not be suited to such soils.

## INTRODUCTION

Nitrogen recommendations for wheat are based on a solid science background, but there is still some art involved in specific field recommendations due to a number of fluctuating variables (variety, management, and weather). There is now a new tool - a chlorophyll meter - on the market that might improve the accuracy of nitrogen recommendations for individual fields in specific seasons.

The chlorophyll meter can accurately measure chlorophyll in plant leaves. Plant chlorophyll and nitrogen content are closely correlated. Measuring chlorophyll is done in the field with a hand meter so measurements and recommendations might be made quickly.

The Kentucky Small Grain Growers Association entered into cooperative agreement with the authors to see if this meter might be used to improve nitrogen recommendations on wheat.

## METHODS

Experiments were conducted at Russellville, Princeton, Lexington, and Owensboro on a Pembroke sil, Tilsit sil (tiled), Maury sil, and Belknap sil, respectively, in 1993 and 1994. At each location, nitrogen (N) was added in early to mid-February (Feekes 3 Growth Stage) at different rates (0, 40, 80, and 160 lbs/A). To each of the above treatments, different rates of N were applied in March (Feekes 5) to determine the N rate needed for optimum yields.

Chlorophyll readings were made at several stages of growth, but for the purposes of this report only the readings made at Feekes 5, just prior to the March N application, are reported. The readings were made at midleaf on the first fully expanded leaf from the top of the plant.

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At maturity, the plots were harvested for grain and yields were adjusted to 13.5% moisture. The N rate applied in March (Feekes 5) which resulted in the maximum yield was determined for each N treatment made in February. This was done by plotting yield against N rates applied in March. The optimum March N rates were then compared to the chlorophyll readings made at Feekes 5, using regression analysis.

## RESULTS AND DISCUSSION

An excellent relationship was found between the amount of nitrogen added in February (Feekes 3) and chlorophyll readings at Feekes 4, 5 and 6 growth stages. However, chlorophyll readings were found to vary with growth stage, variety, leaf position, and location on the leaf. The chlorophyll readings decreased with increasing growth stage, lower leaf positions, and lighter colored varieties. The changes in readings due to these and other reasons have been found in other research and are not surprising. However, this makes it difficult to use chlorophyll readings from one set of conditions and make them meaningful under another set of conditions.

### Chlorophyll Readings to Predict N Needs

When the chlorophyll readings taken at Feekes 5 were used to predict the amount of N needed for maximum yield, the results were mixed. At each trial location, the results were extremely accurate (Figure 1). This indicates that under very specific conditions the chlorophyll meter can be used as a tool to aid in N recommendations. When all locations over the 2 year period are included (Figure 2), the accuracy was greatly reduced ($R^2$ of 0.61). This is acceptable and comparable to other methods that are presently available, but is not an improvement.

### Differential Readings to Predict N Needs

The amount of chlorophyll in the wheat leaf will stabilize at a maximum level. As N is added above this point, there is very little change in the chlorophyll readings. This characteristic has been used to establish a more stable reference than raw chlorophyll readings which change with conditions. Using this technique a "differential reading" was calculated by subtracting each treatment's chlorophyll reading from the maximum chlorophyll reading found at each location. The maximum readings were taken from treatments receiving 140 to 160 lb/A N in February (Feekes 3).

Using the "differential reading" taken at Feekes 5 to predict the amount of N needed for maximum yield increased the reliability as one began to combine locations (different conditions). For each individual location in a given year, the correlation index ($R^2$) was the same for the use of actual chlorophyll as compared to the differential readings. As locations and years were combined the $R^2$ using actual readings drops (Figure 2, $R^2$ = 0.66) while those using the differential readings remain fairly stable (Figure 3, $R^2$ = 0.88). It may be that using the differential readings removes some of the conditions which cause the chlorophyll readings to vary (variety, growth stage, etc.).

If the system were to become useful for aiding in N recommendations, then it would be necessary to treat a small part of each field with a high rate of nitrogen (about 150 lbs/A) early in February. The small treated area might represent more than one field if field conditions were similar.

Regression Equation

With the data which we presently have, the formula which gives the best prediction of nitrogen needed in March is:

$y = 6 + 7.8 X$

y = amount of nitrogen (lb/ac) needed at Feekes 5 (March)

x = max reading (minus) field chlorophyll reading

max reading = chlorophyll reading taken from area with 150 lb/A N added in mid-February.

Soil Type

There are many things that effect chlorophyll formation in the plant and not all of them can be corrected for by an in-field high nitrogen area. One of these is soil type. All of the trials (5 site-years) were completed on soils that are well drained and highly adapted to winter wheat production. One location from which readings were obtained was not well drained. The soil type at this location is a deep, somewhat poorly drained soil. Although wheat is grown on this soil type, the yield potential is not equal to that of a well drained soil and wheat growing on this soil often shows a yellowing from excessive moisture in late winter and early spring. The readings on this site were inconsistent with the well drained sites and are not reported in this manuscript. It may be that this technique would have to be calibrated for different soil drainage classes or confined to certain drainage classes.

Future Plans

This work will continue on well drained and to some extent on lesser drained soils as designed in this experiment. The technique will probably be taken to the field in the spring of 1995 for comparisons with current recommendations under the diverse conditions found in our wheat production region.

FIGURE 1. RELATIONSHIP BETWEEN CHLORPHYLL READINGS AND N NEEDED AT FEEKES 5 FOR MAXIMUM YIELD AT RUSSELLVILLE SITE IN 1994 ($R^2$ = 0.98)

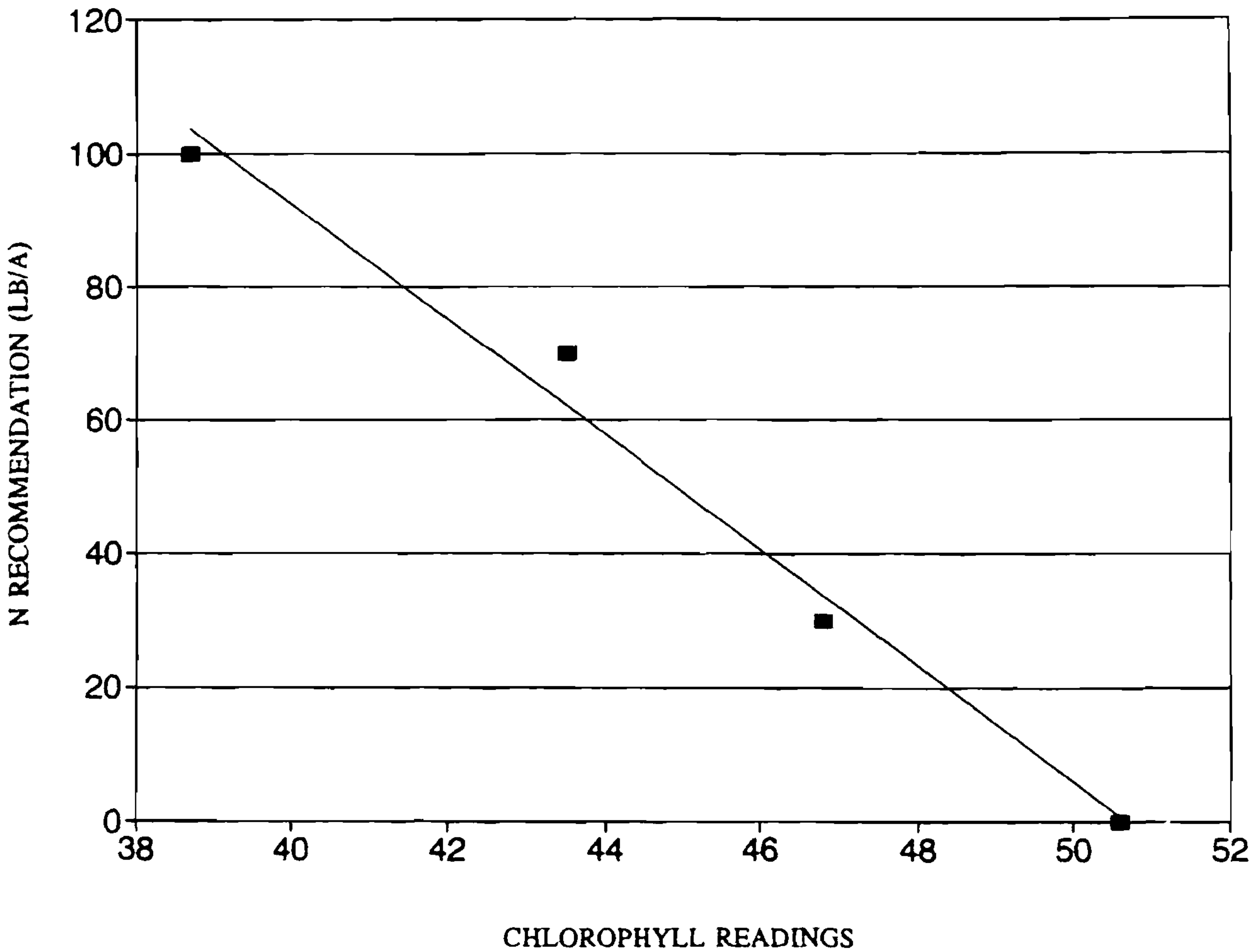


FIGURE 2. RELATIONSHIP BETWEEN CHLOROPHYLL READINGS AND N NEEDED AT FEEKES 5 FOR MAXIMUM YIELD FOR ALL WELL DRAINED SITES OVER BOTH YEARS ($R^2$ = 0.61)

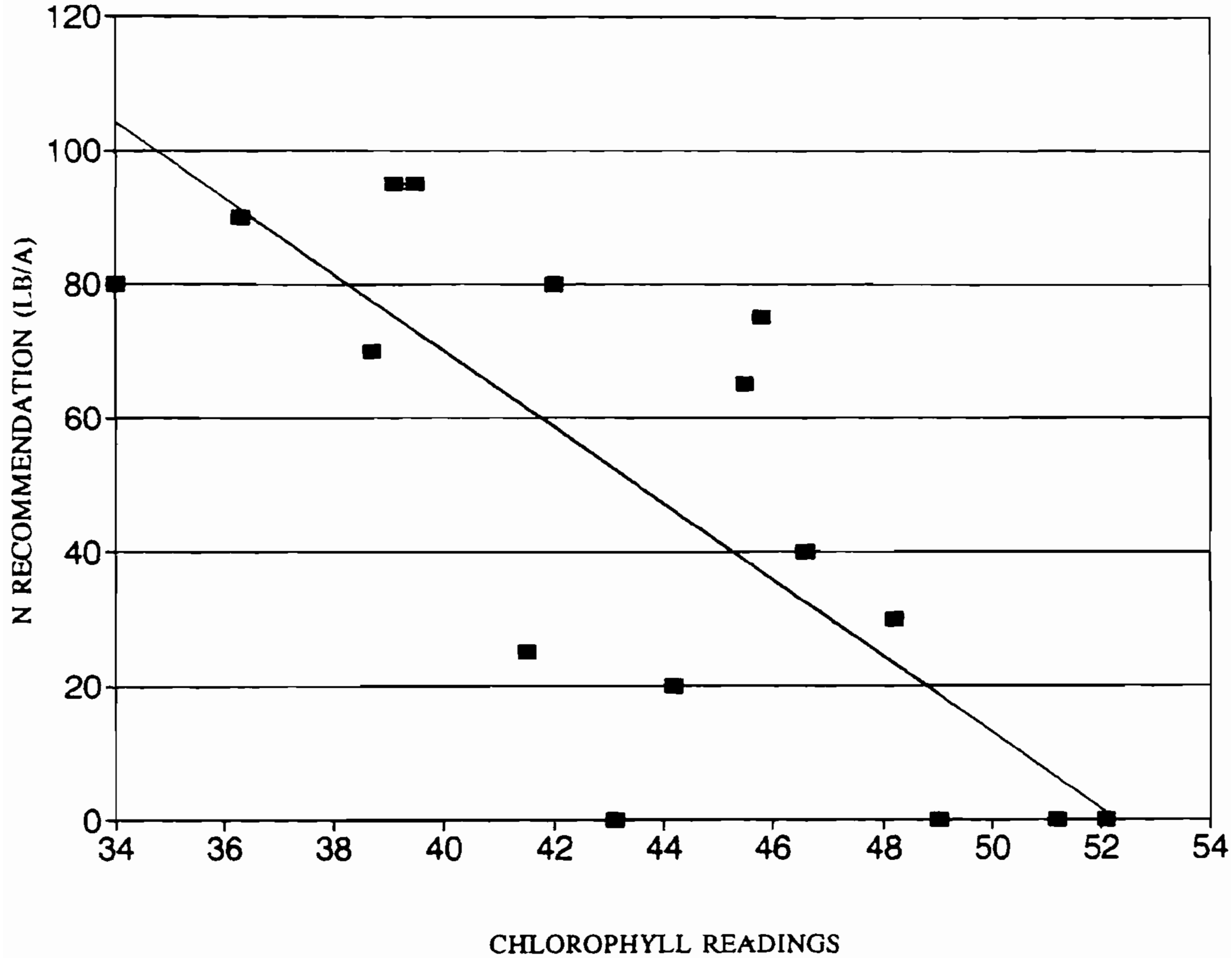
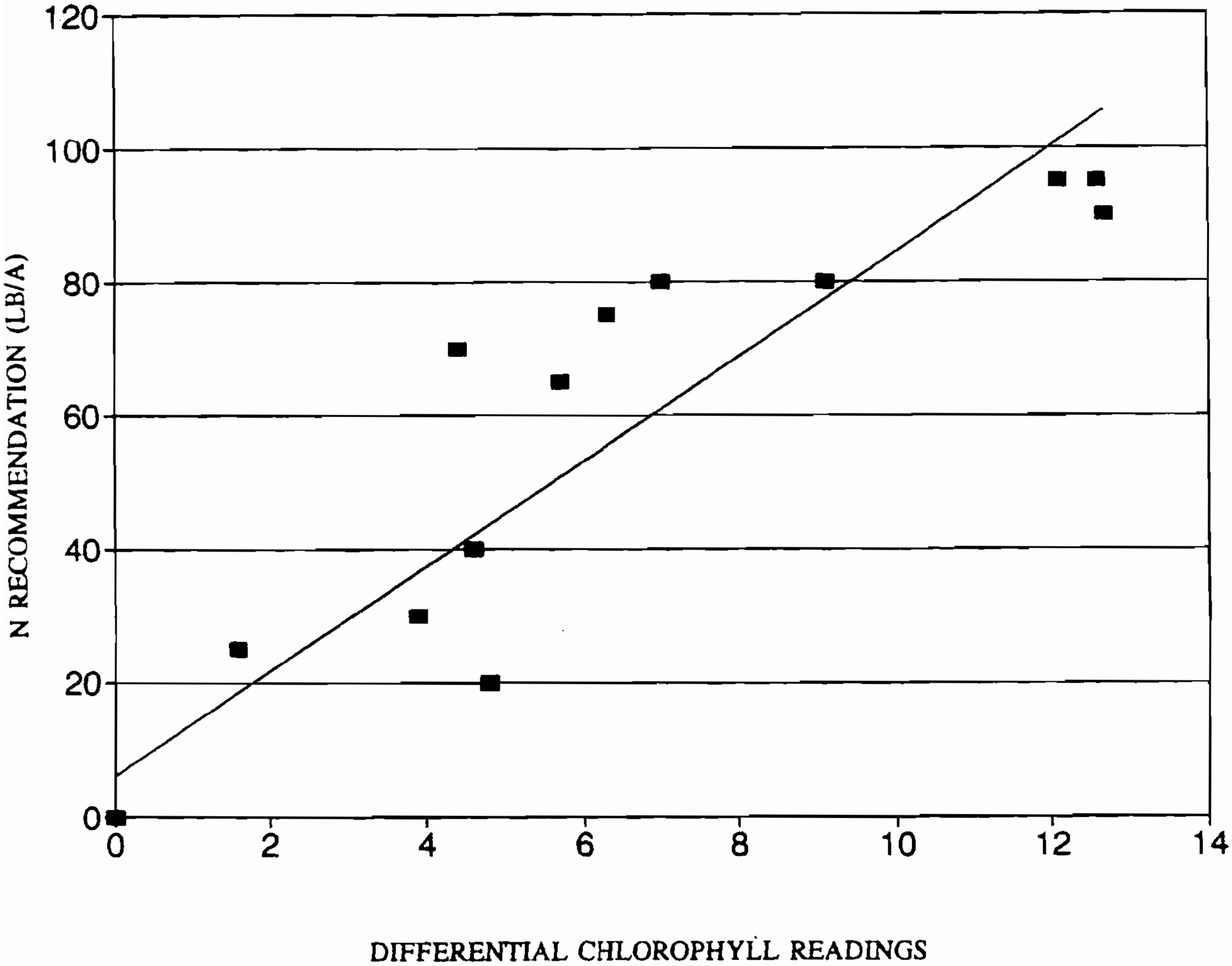


FIGURE 3. RELATIONSHIP BETWEEN DIFFERENTIAL CHLOROPHYLL READINGS AND N NEEDED AT FEEKES 5 FOR MAXIMUM YIELD FOR ALL WELL DRAINED SITES OVER BOTH YEARS ($R^2$ = 0.88)



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