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Care with Plant Nutrient Analysis

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Abstract
This season, many climatic and soil factors are causing problems with corn and soybean growth. Sometimes plants also exhibit nutrient deficiency symptoms. A natural questions is whether the plants are actually nutrient deficient. If they are expressing deficiency symptoms, then yes they are. However, the reason may not be due to insufficient available nutrients in the soil, but rather poor uptake due to climatic or soil factors affecting growth. This was recently discussed in an ICM News article for potassium (K) in corn and soybean. If the symptoms are clearly present, then there really is no need for plant sampling and analysis as the plant is indicating the deficiency.

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Care with Plant Nutrient Analysis

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This season, many climatic and soil factors are causing problems with corn and soybean growth. Sometimes plants also exhibit nutrient deficiency symptoms. A natural questions is whether the plants are actually nutrient deficient. If they are expressing deficiency symptoms, then yes they are. However, the reason may not be due to insufficient available nutrients in the soil, but rather poor uptake due to climatic or soil factors affecting growth. This was recently discussed in an ICM News article for potassium (K) in corn and soybean. If the symptoms are clearly present, then there really is no need for plant sampling and analysis as the plant is indicating the deficiency.

Taking care with plant analysis

Issues with plant analysis, especially whole plants but also leaves, arise from various factors. The tissue nutrient concentrations often differ across hybrids and varieties and as plants develop during the season. So interpretation of test results often needs to be specific to hybrids or varieties and to the plant part sampled and the growth stage. Also, the nutrient concentration increases or decreases as a result of growth and amount of dry matter in response to climatic and soil conditions. There can be a dilution, where rapid growth, even with adequate nutrient supply, causes the concentration to be low. Or it can be the opposite, where reduced growth increases concentration when in fact the nutrient could be deficient in the soil. Partly due to these issues, as well as other factors, correlation of nutrient concentrations to fertilizer response for small whole corn and soybean plants or leaves at midseason has been poor.

Because of these issues the usefulness of plant analysis is limited, and it is commonly suggested to sample specific plant parts at specific times that provide the best possible correlation to yield response and critical levels. For corn this is the ear leaf or leaf opposite and below the ear leaf at tassel to silk emergence; for soybean the upper fully developed trifoliate leaves, petioles discarded, prior to pod set; and for alfalfa the top 6 inches of stems at the early bud growth stage. Sampling at these plant stages are too late in the corn and soybean growth cycle for remediation in the current year, but can be quite helpful for alfalfa where nutrients can be applied after any cut during the growing season.

Recent research in Iowa with plant analysis

Iowa research with whole plant analysis (V5 to V6 growth stage) for P and K has not been successful in corn and soybean, and similar very poor results occurred with analysis of leaves collected at silking in corn or at pod initiation (R2 to R3) in soybean (Figures 1 and 2). In corn with sulfur (S), the S concentration in ear leaf samples has not provided a useful correlation with fertilizer response (Figure 3). As can be seen in these graphs, similar nutrient concentrations can range across widely varying yield response levels, hence the reason for poor relationship to a critical level. Probably the best plant analysis relationship that has been found is in alfalfa for S, where samples of the top six inches of the plant at early bud stage provided a good relationship to fertilizer response, and indication of a critical level at 0.23 percent S (Figure 4). That concentration is quite similar to past research reports from other states.

For nitrogen (N) in corn, Iowa research on plant deficiency and critical levels during the late 1980s and 1990s with small plants showed very poor correlations with yield response to N. Therefore, research during the last few years has focused on use of sensing tools rather than plant analysis, such as the SPAD chlorophyll meter (Figure 5) or active canopy sensors. With those sensing tools, differentiating slight to moderate N deficiency has been difficult.

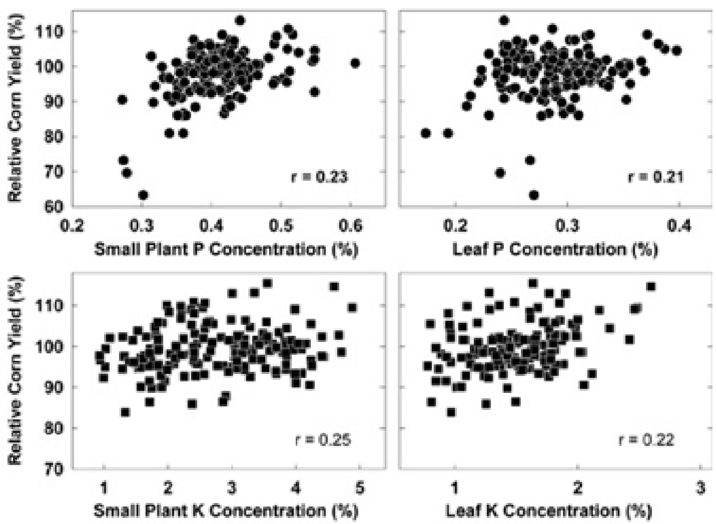

Figure 1. Relationships between relative corn yield response to P and K fertilization and the nutrient concentration of small plants or leaves (at V5-V6 or silking) across several Iowa field trials. Relative yield represents the yield without fertilization expressed as the percentage of the maximum yield achieved with fertilization.

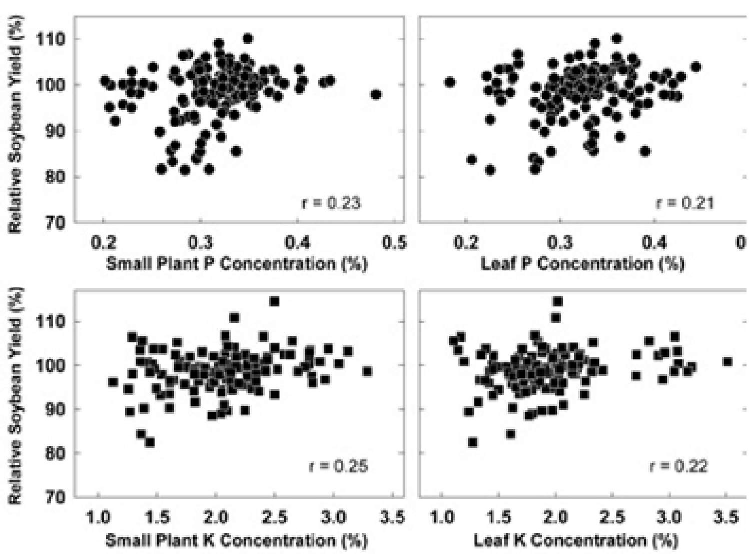

Figure 2. Relationships between relative soybean yield response to P and K fertilization and the nutrient concentration of small plants or leaves (at

V5-V6 or R2-R3 stages) across several Iowa field trials.

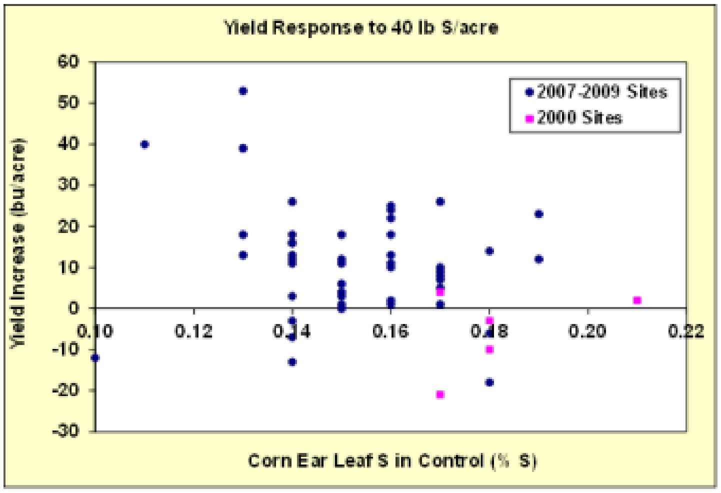

Figure 3. Relationship between corn yield increase to S fertilizer application and corn ear leaf S concentration (R1 growth stage).

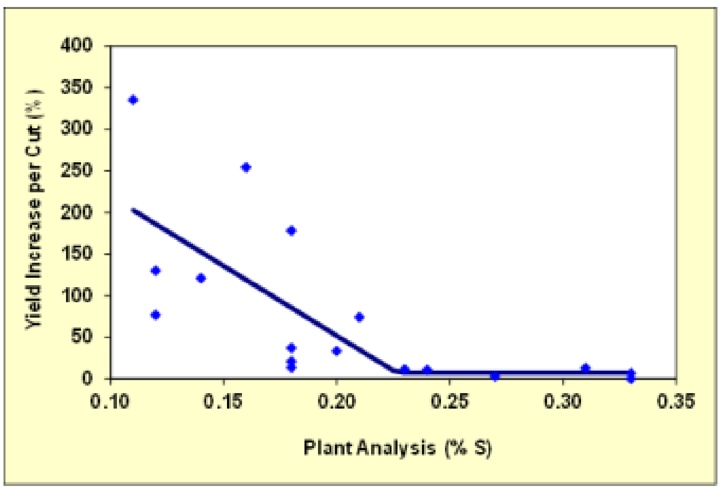

Figure 4. Relationship between alfalfa yield increase per cut to S fertilization and S concentration of the 6 inch plant top at early bud stage.

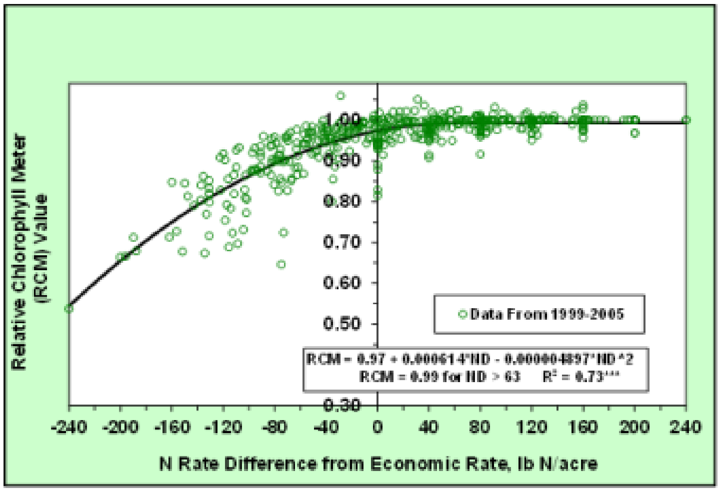

Figure 5. Relative SPAD chlorophyll meter (RCM) value versus N rate difference from economic optimum N rate, R1 corn growth stage (from ISU Extension and Outreach publication PM 2026).

Summary

Available research results indicate that plant sampling and analysis for corn and soybean is of limited value. Its use can aid in determination of nutrient deficiencies in diagnostic situations, where good and poor growth areas in a field can be sampled for comparison; and when is used in conjunction with soil testing to help confirm potential deficiency issues. Unlike soil testing, calibrations and interpretations of plant analysis results for N, P, K, and S for corn and soybean have not been produced in Iowa for reasons given above. For micronutrients, with the only exception of zinc for corn, neither soil tests nor plant analysis have been successfully correlated to fertilizer response or calibrated to nutrient application requirement because of a major reason: if no deficiencies exist and there are no responses to fertilizer application, then critical levels cannot be determined.

Ongoing research continues to investigate plant analysis for P, K, and S. New research began this year to study the relationship between plant analysis for micronutrients at different corn and soybean stages to yield response to foliar and soil applied fertilizer at many research farms and farmers' fields. If yield responses are found in a sufficient number of fields, then this research may be helpful for determining critical plant analysis concentrations. Stay tuned.

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