RESEARCH SHOWS A ROLE FOR PHOSPHORUS AND POTASSIUM TISSUE TESTING IN CORN

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Background

Soil testing is a useful and commonly used diagnostic tool for making phosphorus (P) and potassium (K) fertilization decisions. Tissue testing has been suggested for decades as another tool for these and other nutrients. Tissue testing has not been widely implemented for P or K in Iowa or the North Central region, however, because of inconclusive results from limited field calibration research that has associated yield response. Iowa State University (ISU) has no P or K tissue test interpretations for any crop. Therefore, research was conducted to evaluate the value of tissue testing for P and K in corn.

Summary of Procedures

Several P or K fertilizer application rates were applied in 73 response trials in 2013 and 2014, and these data were combined with data from 20 K trials and 6 P trials that had been conducted previously since 2003. Therefore, the study included 99 site-years, 32 for P and at 67 for K distributed across Iowa and encompassed 17 soil series. The sites were managed with no-till or chisel-plow/disk tillage. The tissue tests evaluated were the P and K concentrations in aboveground corn plants at the V5-V6 growth stage and in ear-leaf blades opposite and below the main ear at the R1 stage (silking). Relative grain yield response was calculated for each site-year by expressing the yield for each treatment as a percentage of the statistically maximum observed yield.

Critical nutrient concentrations in soil or plant tissue distinguish between conditions of nutrient deficiency with likely crop response to fertilization from conditions with adequate levels and unlikely response. A critical concentration range was determined for each nutrient and tissue sampled by using two response models (linear-plateau and quadratic-plateau) that are commonly used for this purpose.

Corn Yield Responses to Fertilization

Initial soil-test P and K across the sites ranged from very low to very high according to ISU interpretations PM 1688 (A General Guide for Crop Nutrient and Limestone Recommendations in Iowa). Average grain yield across treatments and trials ranged from 78 to 238 bu/acre. There were statistically significant yield increases in 27 of the 32 P site-years (up to 77 bu/acre) and in 37 of the 67 K site-years (up to 111 bu/acre). No corn yield response to P and K fertilization was expected in several sites because soil-test P or K was in the high or very high interpretation categories.

Tissue tests for Phosphorus

Figure 1 shows that the yield response to P decreased (so the relative yield increased) with increasing tissue P concentrations. The critical concentration ranges were 0.48 to 0.55% P for young plants and 0.25 to 0.31% P for leaves. The models R^2 values indicate the proportion of

variation explained, and were very similar for both models but were higher for the sampled corn leaves than for the young plants. Also, the capacity of the tissue test values to predict the magnitude of response below the critical concentration range was poorer for young plants than for leaves at silking. Therefore, a P tissue test for leaves at silking was better than for young plants.

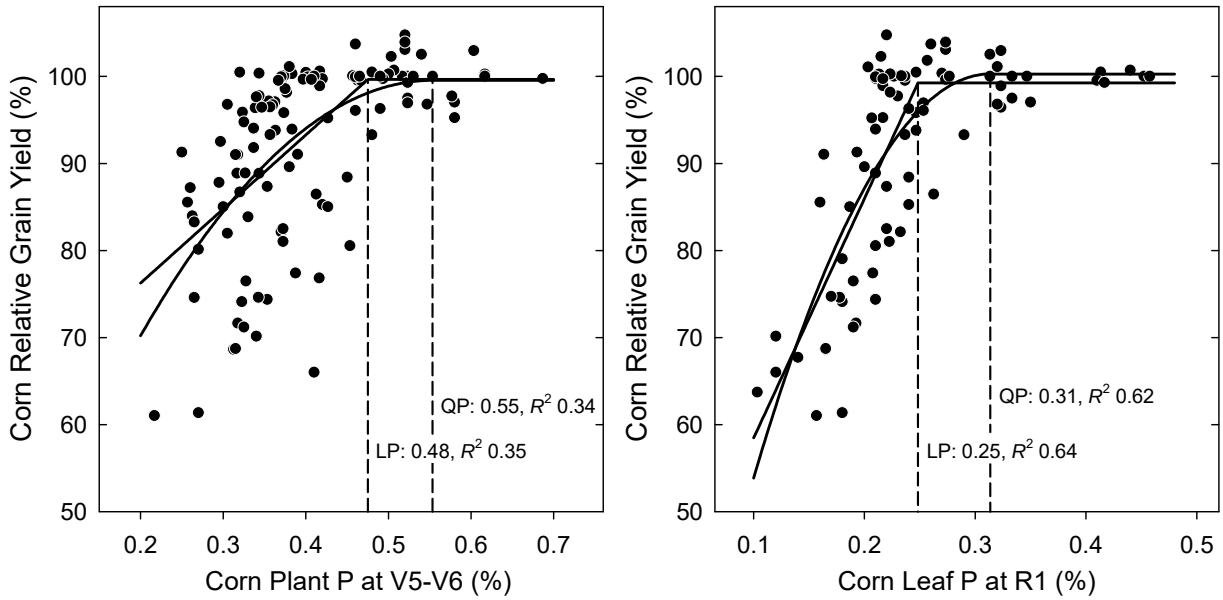

Fig. 1. Relationship between yield response and the P concentration in whole plants at the V5-V6 stage and leaves (leaf opposite and below ear) at the R1 stage. Critical concentrations and models R^2 values are shown.

Tissue Tests for Potassium

Figure 2 shows that the yield response to K also increased with increasing tissue K concentrations. The critical concentration ranges were 1.88 to 2.53% K for young plants and 1.06 to 1.42% K for leaves. The R^2 values of the relationships were approximately similar for response models and tissue tests. Therefore, K tests based on young plants or leaves showed similar performance.

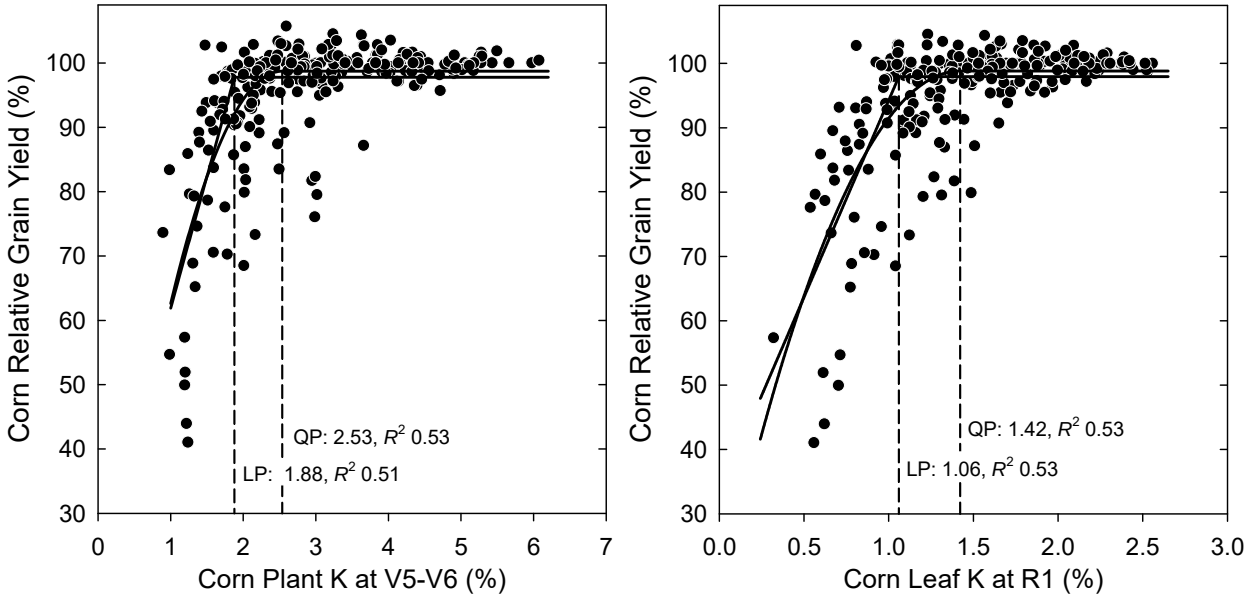

Fig. 2. Relationship between yield response and the K concentration in whole plants at the V5-V6 stage and leaves (leaf opposite and below ear) at the R1 stage. Critical concentrations and models R^2 values are shown.

Conclusions

The study demonstrated that tissue tests can be used as in-season tools to assess the P and K sufficiency in corn. The estimated critical concentration ranges for P and K are lower or in the lower portion of sufficiency levels suggested in various literature sources, which were developed mostly from older research or for other regions.

Although these results will be used to develop the first tissue-test guidelines for P and K in Iowa, the value of tissue testing is not better than soil testing as a diagnostic tool, and is of doubtful value to correct deficiencies for the sampled crop. Therefore, tissue testing should be used to complement and not substitute widespread use of soil testing for making fertilization decisions.

Acknowledgements

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