FIELD CORRELATION OF TISSUE TESTING FOR PHOSPHORUS AND POTASSIUM IN CORN AND SOYBEAN

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Introduction

Interest in tissue testing as a method of guiding fertilization and detecting nutrient deficiencies in corn and soybean in the upper Midwest is increasing. Tissue testing may be a helpful diagnostic tool for assessing in-season crop nutrients deficiencies. No current yield-response based interpretations for tissue test results are available in Iowa, although previous reports based on limited data collected during the 1990s and 2000s suggested that the value of tissue testing for phosphorus (P) and potassium (K) as a diagnostic tool is lesser than for soil testing (Mallarino, 2013). Most guidelines available in a few states of the north-central region are old or mainly based on research from other regions. This article reports preliminary results of a large ongoing study focusing on correlating P and K tissue tests for corn and soybean based on grain yield response. The study will be completed once crops of numerous trials conducted in 2014 are harvested and all are data analyzed.

Summary of Procedures

Plant-tissue samples were collected from 226 crop response trials conducted during the late 1990s, 2000s, and in 2013 across a variety of Iowa soil series, tillage management, fertility regimes, and climate conditions. Several soils included in the trials also are found in areas of states neighboring Iowa and initial soil test values ranged from very low to very high in P and K. Fertility treatments replicated three to four times included mostly broadcast or banded commercial fertilizers, although a few trials also included manure treatments. The trials were managed with no-tillage or chisel-plow/disk tillage. With tillage, the cornstalks were chisel-plowed in the fall and disked or field cultivated in the spring whereas soybean residues were disked or field cultivated in the spring.

The aboveground corn plant parts were collected at the V6 growth stage (six exposed leaf collars) and ear-leaf blades were collected at the R1 stage (silking). The aboveground soybean plant parts were collected at V6 stage (six unfolded trifoliate leaves) and top mature leaves including petioles were collected at the R2-R3 stage (full bloom to beginning pod). Each sample from each plot contained 10 plants or leaves. Samples were dried at 60°C to constant weight, ground to pass a 2-mm screen, and analyzed for total P and K concentrations by the nitric acid procedure with measurement by inductively-coupled plasma (Zarcinas et al. 1987). Linear-plateau and quadratic-plateau models were fit to relationships across site-years between the relative grain yield response to fertilization and the tissue P or K concentration.

Highlights of Results

Data in Figs. 1 through 4 show that there were statistically significant ($P \leq 0.05$) relationships for all crops and tissue sampling dates, but coefficients of determination ranges from very low to high. The reliability of tissue critical concentration ranges defined by values encompassed by critical concentrations identified by these two models varied greatly across nutrients and crops. For corn, critical concentration ranges for young plants and leaves were 0.37-0.41 and 0.22-0.27 % P and 2.59-3.33 and 0.95-1.15 % K, respectively, and the model R^2 values were 0.27 to 0.40. For soybean, no P critical concentrations could be determined because although relationships were statistically significant for both young plants and leaves the unexplained variation was very high ($R^2 < 0.05$). The K critical concentration ranges identified for soybean young plants and leaves were 1.91-2.41 and 1.48-1.89 % K, respectively, and the models R^2 values were 0.24 to 0.59. The identified critical concentration ranges were lower or within the lower range of previously reported sufficiency ranges for other states or regions.

Preliminary Conclusions

Plant tissue testing shows some potential to be used as a diagnostic tool for sufficiency of P and K in corn and soybean, but is not superior to the capability of soil testing demonstrated by extensive previous Iowa research. Supported conclusions including final suggested tissue critical concentration ranges are not possible until the evaluation of more than 30 field trials established in 2014 for each nutrient is completed.

References Cited

Mallarino, A.P. 2013. Interpretation of plant tissue test results for phosphorus and potassium in corn and soybean In Proceedings, NCERA-13 Committee (eds.) North Central Region Soil and Plant Analyst Workshop. Feb. 26-27, 2011. Iowa City, IA.

Zarcinas, B.A., B. Cartwright, and L.R. Spouncer. 1987. Nitric acid digestion and multi-element analysis of plant material by inductively coupled plasma spectrometry. Commun. Soil. Sci. Plant Anal. 18:131-146.

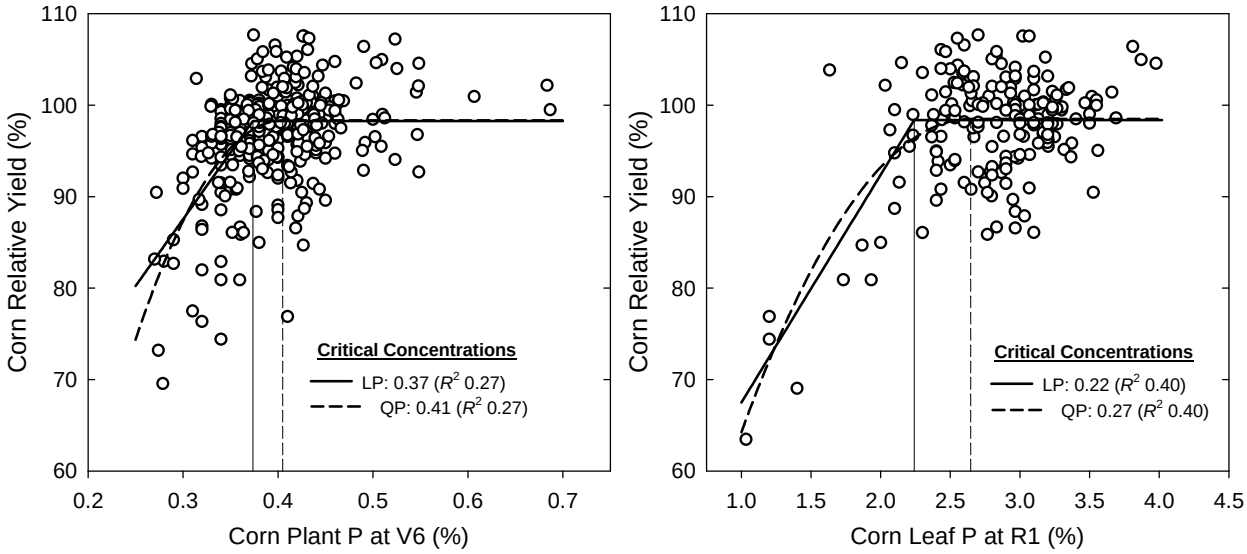

Figure 1. Relationships between the corn relative yield response to P fertilization and the P concentration of small plants or ear leaves across all trials and years. LP, linear plateau; QP, quadratic plateau.

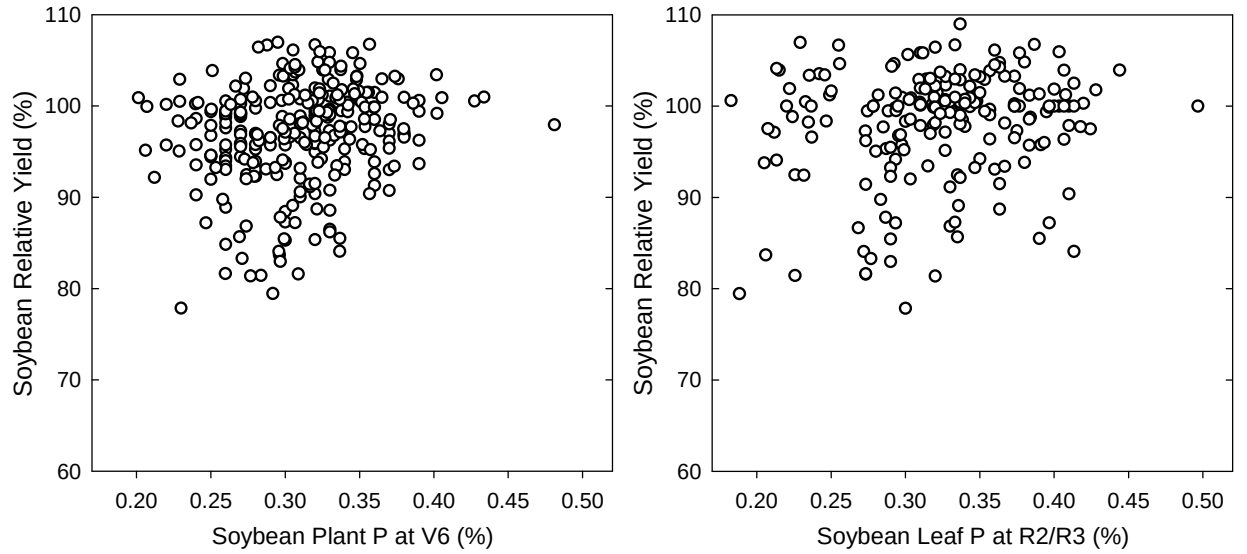

Figure 2. Relationships between the soybean relative yield response to P fertilization and the P concentration of small plants or mature leaves across all trials and years. No model fit had $R^2 > 0.05$ so results are not shown.

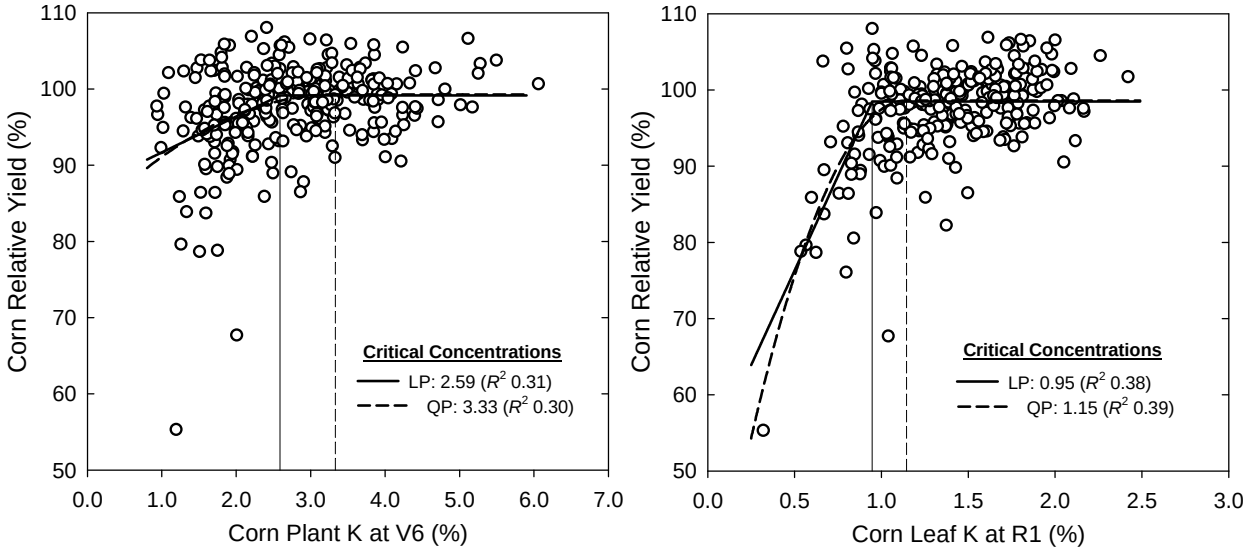

Figure 3. Relationships between the corn relative yield response to K fertilization and the K concentration of small plants or ear leaves across all trials and years. LP, linear plateau; QP, quadratic plateau.

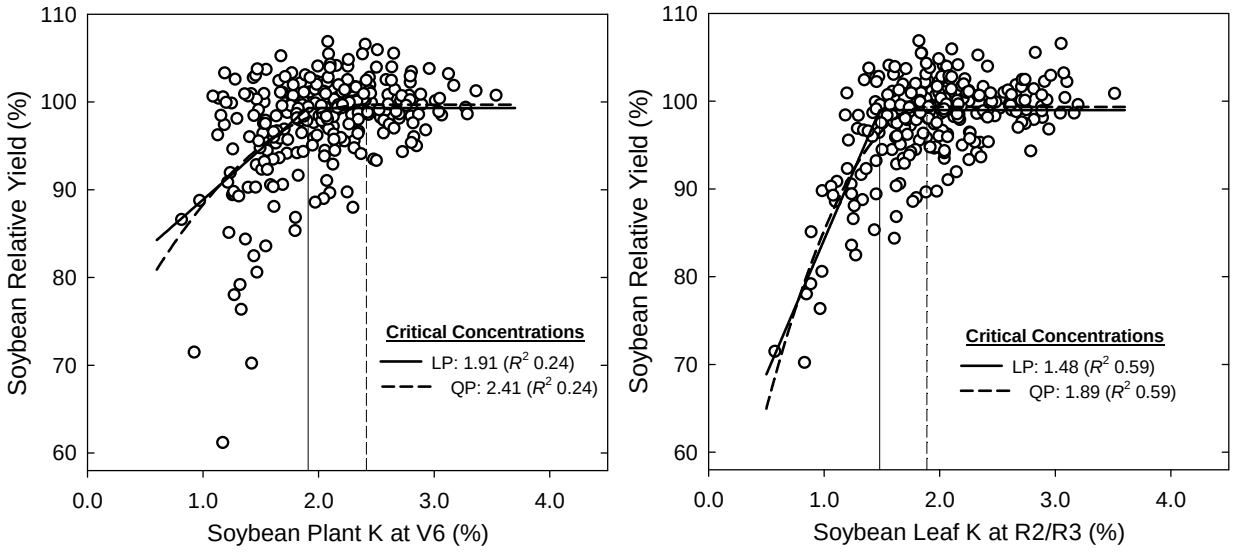

Figure 4. Relationships between the soybean relative yield response to K fertilization and the K concentration of small plants or mature leaves across all trials and years. LP, linear plateau; QP, quadratic plateau.

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