SOYBEAN WHOLE PLANT, AND TRIFOLIATE PHOSPHORUS CONCENTRATION RELATIONSHIPS TO YIELD AND PHOSPHORUS REMOVAL RATES

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Abstract

Plant tissue analysis is becoming a more popular tool to diagnosis nutrient deficiencies. Whole plant samples may be taken early (< 1 foot tall) and potentially allow for in season nutrient corrections. Leaf samples taken just before grain fill may be used to diagnose problem spots in a field. Benton Jones Jr. et al. (1991) reports that the phosphorus (P) sufficiency range for upper most developed trifoliates is between 0.26 and 0.50 percent P. There is no published data on whole plant P sufficiency ranges from V4 to V6. Nutrient grain analysis is valuable in evaluating fertilizer replacement rates. The current P removal rate used in Kansas is 0.8 pound P_2O_5 per bushel for soybeans. Objectives of this study are to 1) examine the relationship between whole plant and trifoliate P concentrations to relative yield and 2) effects of P fertilizer applications on soybean P removal rates.

This study was conducted across eastern Kansas from 2012 to 2014, with seven experiments conducted each year. Each site was set up as a randomized complete block with four replications. Individual plot size was 15 feet (6-30 inch rows) x a minimum of 40 feet. Fertilizer was broadcast applied as Monoammonium phosphate (MAP 11-52-0), immediately after planting. Fertilizer rates were 0, 20, 40, 60, 80, and 100 pounds P_2O_5 per acre. Soil samples were taken to a depth of 6 inches and analyzed for Mehlich-3 P by block in 2012. To capture soil P variability, samples were taken by individual plot in 2013 and 2014. From rows two and five, twenty whole plants were collected when plants were 8 to 10" tall (V4 to V6). Thirty upper fully developed trifoliates were collected at early pod fill (R4). Yield was determined at maturity by harvesting rows three and four with a small plot combine. Soybean moisture was measured and yield adjust to thirteen percent. Relative yield and P levels were calculated by block. Plant tissue and beans were dried at 60 C for at least 48 hours and analyzed for P using a sulfuric peroxide digest.

Poor relationships were observed between whole plant P percent and soil P in 2012 (R^2 = 0.0025) and 2013 (R^2 = 0.20). A weak relationship to relative yield was also observed in 2012 (R^2 = 0.13) and 2013 (R^2 = 0.0045). Lack of a relationship may be due to plants still drawing from stored seed P at V4 to V6. Trifoliate P percent ranged from 0.14 to 0.38 percent, in 2012, with no relationship (R^2 = 0.0057) to relative yield. 2012 was a dry year and other factors besides P were likely yield limiting. In 2013, Trifoliate P was above 0.26 percent for all sites except Atchison Co., where the only yield response to fertilizer was observed. This observation supports the current trifoliate sufficiency P level being 0.26 percent. Grain removal increased with fertilizer applications at one site in 2012 and four sites in 2013. This suggests that luxury uptake occurs at higher fertilizer rates. Grain removal rates were lower than the currently considered removal rate as they ranged across sites from 0.55 to 0.81 and 0.50 to 0.72 pounds P_2O_5 per bu in 2012 and 2013, respectively.

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