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Corn and soybean grain prices have been declining and there is considerable uncertainty about future fertilizer prices. Therefore, many producers are considering reducing phosphorus (P) and potassium (K) application rates due to reduced economic benefits from fertilization. However, reducing P and K rates across all conditions is not a good management decision.

Use soil testing wisely

Soil testing is a diagnostic tool on which P and K fertilization should be based. Compared to the costs of production, soil testing has become less expensive and its appropriate use results in economic benefits. Field research results have been used to develop Iowa soil sampling and soil-test interpretations for P and K in ISU Extension publications PM 1688 [A General Guide for Crop Nutrient and Limestone Recommendations in Iowa](#), which was updated in 2023.

On average yield increases from P or K fertilization are large and highly probable in low-testing soils, but the increase in yield and the probability of yield response decrease as soil-test values increase. There is a very small probability of small yield increases for the soil-test categories high (5%) and very high (1% or less).

The profits from P or K fertilization also are very large and likely in low-testing soils. Figure 1 shows the relationships between profits from P fertilization and soil-test P and from K fertilization and the moist soil-test K. The large benefits observed in low-testing soils decrease sharply as soil-test levels increase to the optimum level, which is the level recommended to be maintained by application based on crop removal. Moreover, in high-testing soils there are losses to investment in fertilizer because the none to small yield increases do not offset the fertilizer cost. Similar results were observed for K fertilization. Reducing P or K fertilization rates in low-testing soils is not a good business decision, unless the

Learning Objectives

- Learn why you should not cut or reduce P or K rates across all conditions when grain and fertilizer prices are unfavorable.
- Use soil test reports to make profitable fertilizer decisions.
- Use good soil sampling methods and variable-rate technology to apply P and K.
- Realize that there is high temporal removal and soil-test P and K variation.

farmer's economic condition does not allow for the purchase of other essential inputs. Moreover, use of the recommended application rates gradually buildup soil-test values to levels that should be maintained for long-term productivity and benefits.

Producers (mainly those with uncertain land tenure) could temporarily reduce recommended removal-based P and K rates to maintain soil tests in the Optimum soil-test category (or apply starter) without affecting yield much because yield increases are small and infrequent. This will increase profits in the short-term, but higher rates will be needed in the future. Some believe that similar yield levels can be achieved by using reduced banded P or K fertilizer rates compared with broadcast fertilization. Research has shown that this is not the case in Iowa low-testing soils. The most rational way of assuring high returns from fertilization with unfavorable prices is to withhold P or K application to high-testing soils until soil levels decrease to the optimum range.

Consider P and K removal with harvest

Removal with harvested products is used to decide P and K fertilization rates for soils testing in the Optimum soil-test Interpretation category. The rates should be based on average nutrient removal in harvested crop parts or forage consumed

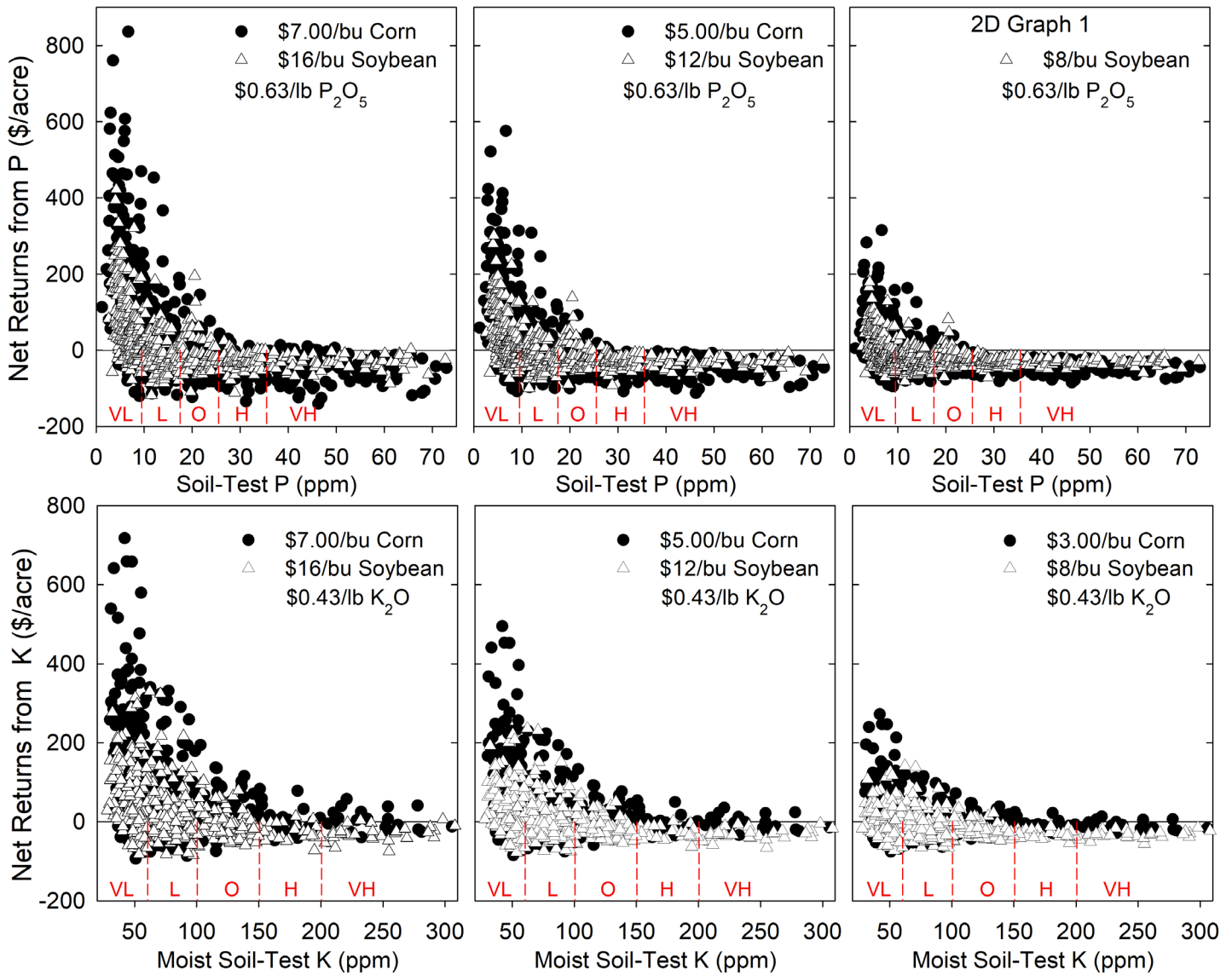


Figure 1. Benefits from P fertilization for different soil-test P levels in lowa soils assuming shown grain and P prices. Interpretation categories very low, low, optimum, high, and very high are from publication PM 1688.

and not recycled by grazing animals. Publication PM 1688 indicates concentrations to be used that reflect approximately the upper seventy-fifth percentile of available data and are adjusted to an appropriate standard moisture basis for the crop portion harvested. Default yield levels are provided for cases when the laboratory or crop consultant do not receive yield level information. These default values should be adjusted to prevailing actual yield levels in a field or portions of fields (not a yield goal). Current soil-test results and last crop removal should not be considered together with histories of soil-test values and removal because the relationship between soil-test values and removal are good only over 4 years or more. This is because of potential soil testing errors and large temporal variability of both.

The graphs in Figure 2 show that the relationships between P or K removal and soil-test values were close over many years but not from year to year. The mismatch in short-term results from variation in recycling with crop residues and large temporal variation in the equilibrium of different soil P and K pools, and these processes are known to be greatly influenced by rainfall and soil moisture patterns. Since P or K removal is not closely related to soil-tests values in the short term, producers should consider “prevailing” yield levels in a field and long-term soil-test trends when making decisions about STP or STK maintenance. Producers should not overreact to higher or lower than normal yield or soil-test value in a specific year because this may not reflect well what’s going on. Large changes in application based on information from only one year may not be the best thing to do for long-term profitability and overreacting to very high or very low values will introduce more variability and confusion.

Results in Figure 2 justify more frequent soil sampling than the usual 4-year interval. Sampling every two years for the corn-soybean rotation is reasonable, since the relative cost of soil sampling and testing have decreased over time compared to many crop production costs. Also, frequent sampling will provide more useful soil-test trends. When it's time to make a fertilization decision, comparing the current yield and soil-tests values with trends over time will result in a better estimate of the amount of fertilizer to be applied.

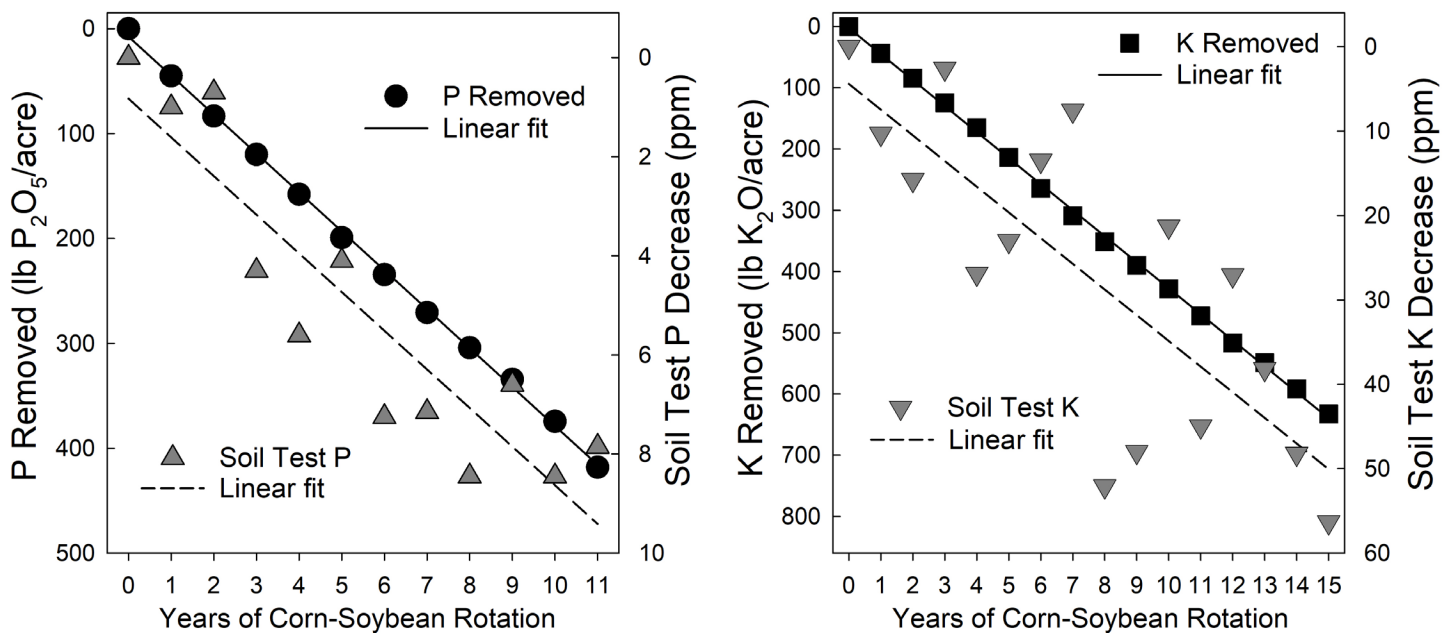


Figure 2. Examples of phosphorus and potassium removed with grain harvest and soil-tests trends over time for corn-soybean rotations in high-testing soils of long-term trials for not fertilized plots.

Resources

Take a Good Sample to Help Make Good Fertilization Decisions (CROP 3108): <https://shop.iastate.edu/extension/farm-environment/crops-and-soils/farm-business-management/crop3108.html>

Phosphorus and Potassium Tissue Testing in Corn and Soybean (CROP 3153): <https://shop.iastate.edu/extension/farm-environment/crops-and-soils/soil-fertility-and-management/crop3153.html>

Fertilizing Pasture (PM 869): <https://shop.iastate.edu/extension/farm-environment/crops-and-soils/forages-hay-and-grazing/pm869.html>

Using Manure Nutrients for Crop Production (PMR 1003): <https://shop.iastate.edu/extension/farm-environment/crops-and-soils/agronomic-crops/pmr1003.html>

Soil Fertility Extension website: <https://www.agronext.iastate.edu/soilfertility/homepage.html>