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How do uncertain prices influence phosphorus and potassium fertilization this fall?

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Abstract
Crop prices and phosphorus (P) and potassium (K) fertilizer prices have changed significantly in the last two years, and there is considerable uncertainty about future prices. Profitable crop production requires appropriate soil P and K levels, so careful fertilization planning is required. Iowa State University (ISU) soil-test interpretations and fertilization guidelines in extension publication PM 1688, A General Guide for Crop Nutrient and Limestone Recommendations in Iowa (available to order or to download from www.extension.iastate.edu/pubs), were last updated in November 2002. Some important changes were to recommend higher soil-test K (STK) levels for all crops and to update default yield levels for calculating P and K fertilizer rates needed to maintain desirable soil-test levels.

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How do uncertain prices influence phosphorus and potassium fertilization this fall?

by Antonio P. Mallarino and John E. Sawyer, Department of Agronomy

Crop prices and phosphorus (P) and potassium (K) fertilizer prices have changed significantly in the last two years, and there is considerable uncertainty about future prices. Profitable crop production requires appropriate soil P and K levels, so careful fertilization planning is required. Iowa State University (ISU) soil-test interpretations and fertilization guidelines in extension publication PM 1688, A General Guide for Crop Nutrient and Limestone Recommendations in Iowa (available to order or to download from www.extension.iastate.edu/pubs), were last updated in November 2002. Some important changes were to recommend higher soil-test K (STK) levels for all crops and to update default yield levels for calculating P and K fertilizer rates needed to maintain desirable soil-test levels. Experiments conducted since 2002 confirmed that the older STK interpretations often recommended too little or no K fertilizer for fields with a high probability of yield response and that soil-test P interpretations are appropriate. Potassium deficiency symptoms sometimes are observed in fields having apparently adequate STK; however, symptoms may be due to high within-field STK variability or deficiency induced by other factors that were discussed in a previous *Integrated Crop Management* article (Potassium deficiency symptoms in corn and soybean: What can we do about them?).

Producers are concerned about increasing fertilizer prices, but some forget that grain prices also have increased significantly. Study of economic return from yield responses with current grain to P and K fertilizer price ratios confirm that fertilization rates recommended in PM 1688 for soils testing "Very Low" or "Low" (deficient soil-test levels) are appropriate. The rates recommended for these soil-test categories are based on yield response data, attempt to optimize long-term profitability by avoiding yield losses where yield responses are large and very likely, and provide a high probability of large profits at current price ratios. At the same time, application of the suggested rates will increase soil-test levels from deficient to optimum levels over time. The recommendations suggest maintenance fertilization rates based on crop removal for the "Optimum" interpretation class, and as publication PM 1688 indicates, the provided default rates should be adjusted for actual yield levels. Research continues to show a large effect of yield level on P and K removal and the fertilization rate needed to maintain soil tests. This is very important because of increasing corn and soybean yields in most areas of the state.

Conversations with producers and consultants strongly suggest that many are not adjusting their maintenance fertilization rates to the higher yields. This is especially

troublesome for soybean when P and K fertilizers are applied only before corn in the corn-soybean rotation. Long-term Iowa research shows no difference between annual or biannual P and K fertilization for corn, soybean, or other crops but only as long as the right amount is applied. Table 1 gives the current interpretations and fertilizer recommendations for corn and soybean for one example group of soils. The rates for the "Optimum" soil-test class shows how the maintenance rate increases significantly from yield levels common five or six years ago to levels common today. In fact, nobody should be surprised if at very high yields the rate for the "Optimum" class is similar to the rate for the "Low" category, as the example shows for P with corn and K with soybean. This is a logical result of basing fertilization for low-testing soils on response-based economic results and for soil-test maintenance onnutrient removal. Some producers are asking if the grain P and K concentration of new corn hybrids and soybean varieties differ from older ones and from the values in PM 1688 used for calculating maintenance rates. Ongoing research indicates little or no consistent change in grain P and K concentrations because the suggested values are within the measured range.

Producers and consultants must understand that we always have to deal with probabilities concerning crop response to fertilization, and that fertilizer management (as well as for other inputs) can be adjusted to specific production conditions. Field research indicates a very high probability of yield response to K in low-testing soils, on average less than 25 percent probability in soils testing "Optimum" and less than 5 percent in soil testing "High." Due to the low probability of response (and small yield increase if it occurs) in soils testing "Optimum," for example, producers can adjust maintenance rates for their economic situation, land tenure, and management philosophy. Some apply maintenance rates for the "Optimum" soil-test class as Iowa State University publication PM 1688 suggests, and others fertilize only low-testing soils or to maintain high-testing values. Reasons for these differences vary greatly, but, for example, it is reasonable to adjust fertilization rates to specific economic conditions and land tenure. Due to a low proven probability of crop response in soils testing "Optimum," a reduced fertilizer rate (even as low as a starter rate) might be appropriate for a tenant with uncertain land tenure or a producer having a cash flow issue. On the other hand, producers with certain land tenure for two or more years into the future can minimize yield and economic losses by applying recommended maintenance rates. Research continues to show, however, that all producers can save money by withholding P and K fertilization in high-testing soils, except for small starter rates for corn in some conditions.

Iowa research has demonstrated that use of variable-rate P and K fertilization is a good option to improve P and K management in fields that have significant variation in soil-test and yield levels. Therefore, this technology can be used to target applications to the most deficient field areas to get the highest possible return when price ratios are unfavorable and also to improve maintenance fertilization by considering yield variability. Yield maps from the past two to four years (not just the last one) should be used together with soil-test values to help define P and K application rates. Research suggests that either grid sampling or zone sampling methods are superior to the classic sampling by soil type. The Iowa State University publication PM 287 provides information about soil sampling methods (Take a Good Soil Sample to Help Make Good Decisions).

As always, careful management of P and K is needed for economic reasons. For P, additional benefits accrue for water quality protection. Rising fertilizer prices do not

necessarily mean drastic change in fertilization practices, especially with concurrently rising crop prices, but does add incentive to reevaluate what is being done and look for opportunities to do things better. Additional information about P and K management is available online at the Soil Fertility website and Antonio Mallarino's website.

Table 1. Phosphorus (P) and potassium (K) fertilization rates for corn and soybean in publication PM 1688, except that maintenance rates for the "Optimum" category are shown for the default and higher yield levels.*

Nutrient	Soil-Test Category	Soil-Test Range	Corn Yield Level		Soybean Yield Level	
			150 bu	200 bu	50 bu	60 bu
		ppm	------- lb P2O5 or K2O/acre -------			
P	Very low	0-8	100	100	80	80
	Low	9-15	75	75	60	60
	Optimum	16-20	55	75	40	48
	High	21-30	0	0	0	0
K	Very low	0-90	130	130	120	120
	Low	91-130	90	90	90	90
	Optimum	131-170	45	60	75	90
	High	171-200	0	0	0	0

*Interpretations for soil series with low subsoil P and K levels and fine-textured soil. See publication PM 1688 for information for other crops or soils and for P and K concentrations in harvested plant parts used to define maintenance rates for the "Optimum" soil-test category.

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