EASTERN U.S.

Phosphorus and Potassium Removal in Corn

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State mandates for nutrient management planning have prompted a need to re-evaluate established crop nutrient removal values for corn. Where application rates of manure are restricted to the level of crop nutrient removal, land requirements for livestock operations vary with crop nutrient content. This study measured the variability of P and K removal by corn grain produced in the eastern U.S.

> An accurate accounting of crop removal of phosphorus (P) and potassium (K) is an important component of a nutrient management plan. Recent measurements of removal indicate that P and K contents of harvested grain corn vary considerably across sites and growing conditions, with some tendency to increase with soil fertility level and yield.

We grew corn in five states (Delaware, Massachusetts, Maryland, New Jersey, and Pennsylvania) in 1998 and 1999 for a total of 23 site-years. Sites were selected to represent the wide range of soils and P fertility levels on farm fields within the region. They included both on-farm and research station land. Local extension recommendations guided cultural practices. Starter fertilizer at all sites supplied 30 lb P_2O_5/A in the form of mono-ammonium phosphate. We measured yields from a harvested area of two 20-foot rows in each of four replicate plots. Harris Laboratories in Lincoln, Nebraska, analyzed all grain samples for P and K concentration. All nutrient content values are expressed on a 15.5 percent moisture content basis.

Minimum and maximum nutrient contents for P and K across all sites varied by more than two-fold for P and by almost two-fold for K (**Table 1**). Since sites differed in soil and weather conditions as well as hybrids, it is not possible to isolate the effect of hybrid completely. However, one hybrid grown at six of the sites showed almost as much variation in P and K contents as the 10 hybrids across all 23 sites. The mean values we obtained for corn grain P and K removal agree fairly well with those found in published nutrient removal tables (**Table 2**).

Some of the variability in grain P content appeared to be associated with soil test P (**Figure 1**). The Mehlich 3 P (M3P) soil test ranged from 36 to 418 parts per million (ppm) across the 23 sites, with a mean of 138 ppm. Since the agronomic optimum range is about 30 to 50 ppm, most of these soils were high in P. Soil test P correlated positively with grain P content ($r = 0.52$; $p < 0.02$). However, for any given soil test level, there was still considerable variability in grain P content. Since K fertilizer application varied from site to site, we could not properly evaluate whether a

TABLE 1. Variation in nutrient content of corn grain in 1998

	All hybrids (23 sites)		Pioneer 3394 (6 sites)	
	P_2O_5	K_2O	P_2O_5	K_2O
	.... lb/bu			
Mean	0.43	0.27	0.37	0.24
Minimum	0.24	0.18	0.24	0.18
Maximum	0.58	0.35	0.44	0.28
CV, %[1]	20	14	19	15

[1] CV = coefficient of variation, standard deviation expressed as percentage of the mean.

TABLE 2. Published reference values for

Source	P_2O_5	K_2O
	········ lb/bu ········	
Potash & Phosphate Institute	0.44	0.29
North Carolina State University	0.35	0.27
Penn State University	0.40	0.30
USDA-NRCS	0.34	0.20

similar relationship existed between soil test K and grain K.

Both grain P and K contents were also positively associated with yield (**Figures 2** and **3**). Since yields reflect the favorability of the growing environment, it is possible that sites with more favorable conditions for corn growth also had better conditions for the diffusion of P and K from the soil to the roots. The correlation coefficients between grain P and K content and yield (r = 0.38 and 0.36, respectively), though statistically significant at the 10 percent level of probability, were not strong.

Much of the variability in grain P content was not explained even by a combination of the associations with soil test P and yield. Grain P content could be expressed as a function of both yield and M3P as follows:

$P = 0.31 + 0.00040(Y) + 0.00034(M3P); R^2 = 0.33,$

where P = grain P_2O_5 (lb/bu), Y = grain yield (bu/A), and M3P = Mehlich 3 P in soil (ppm). Within this two-variable equation, statistical significance for the Y coefficient was only at the 20 percent level of probability while that for M3P was at the 3 percent level. Our observations do not support interpretation of this equation as proof of a cause-and-effect relationship.

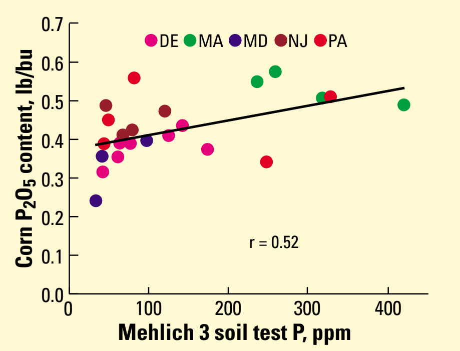

Figure 1. Association between grain P (P_2O_5) content of corn and soil test P level at 23 sites in five states.

Rather, the equation describes the mean grain P_2O_5 content as a function of weak trends with soil test P and yield observed within the five states. The R-square value of 0.33 indicates that it explained only one-third of the variability observed. In other words, this equation does not estimate nutrient removal much better than the mean value of 0.43 lb/bu. Neither the mean value nor the regression should be extrapolated to soil test and yield levels beyond the range encountered in our sites, nor should they be used in other regions without verification by local data.

Some of the remaining variability in grain P and K contents may have been related to the soils at each of the sites (**Table 3**). Specific effects of soil characteristics could not be separated from the differences in weather

(continued on page 6)

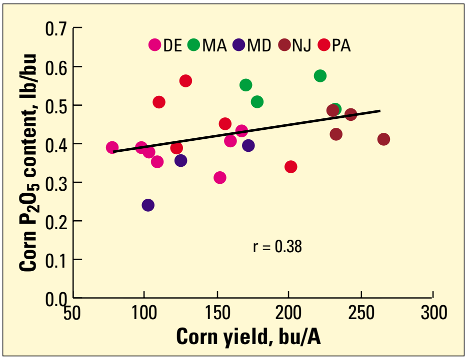

Figure 2. Association between yield and grain P (P_2O_5) content of corn.

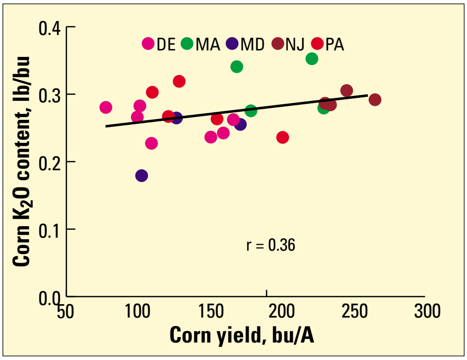

Figure 3. Association between yield and grain K (K_2O) content of corn.

Information Agriculture Conference Set for August 7-9, 2001

The popular Information Agriculture Conference series continues with InfoAg 2001 scheduled for August 7, 8 and 9. Organized by PPI and FAR, InfoAg 2001 will take place at the Adam's Mark Hotel – Airport, Indianapolis, Indiana.

Dr. Harold F. Reetz, Jr., PPI Midwest Director, will serve as conference planning coordinator. Program tracks will be offered in four major components: Economics/Farm Management; Data Analysis/Tools; Site-Specific Nutrient Management; and Communications/Environment. As with previous Information Agriculture Conferences, an exhibit area will feature some of the latest in site-specific systems, data management, and communications technology. There will also be a return of the special Cyber-Dealer sessions targeting the business aspects of incorporating site-specific management systems services into retail supply and consulting businesses.

Individual registration fee for InfoAg 2001 is $350.00 until July 15 and $450 thereafter.

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Phosphorus and Potassium Removal...

(continued from page 5)

conditions excountered at each site. The overall differences between the two years were very small.

Variability in nutrient content implies that some farmers may need to obtain an analysis of their harvested crop in order to accurately assess nutrient removal. Nutrient management planners may consider taking into account increased crop removal of P at higher soil test levels and at higher yield levels. Livestock producers should also consider the implications of variability in P and K content of grain upon ration balancing for the mineral nutrition of their animals. BC

TABLE 3. Soils included in the five-state

State	Soil
DE	Evesboro loamy sand
DE	Kenansville sandy loam
DE	Matapeake silt loam
DE	Rumford loamy sand
DE	Sassafrass sandy loam
MA	Hadley very fine sandy loam
MA	Merimac sandy loam
MD	Mattapex silt loam
NJ	Aura gravelly sandy loam
NJ	Freehold sandy loam
NJ	Quakertown silt loam
PA	Allenwood silty clay loam
PA	Braceville gravelly loam
PA	Hublersburg silty clay loam
PA	Linden sandy loam

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