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Better Crops, Better Environment...through Science

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WHAT CAN VARIABLE RATE PHOSPHORUS APPLICATIONS DO FOR YOU?

Many agricultural fields possess a high degree of spatial variability in soil test phosphorus (STP) that can affect crop yield. Spatial variability of nutrients in the field results from changes in soil type, topography, previous cropping history, and many other factors. Common practices like composite soil sampling and uniform fertilizer application rates ignore spatial variability and can result in inefficient fertilizer use by under- and over-applying nutrients in some areas of the field. Variable rate (VR) P fertilizer applications can provide several benefits compared with uniform applications.

Variable rate P can increase crop yield in areas of the field that are low in STP. Yield maps combined with fertilizer application maps can show where efficiency gains may have occurred, but yield benefits following VR applications are often difficult to observe in practice because rate comparisons are not included in the field. Test strips in the field also won't always show the benefits of VR if they transect different zones across the field. A study conducted in Iowa reported that although yields from transects across areas of a field receiving uniform or VR P applications were not different, yield comparisons within soil test classification zones showed that VR increased yield over the uniform rate when soil test levels were very low. Some service providers are beginning to include high and low fertilizer rate check plots within management zones to allow growers to more easily evaluate yield response to VR applications.

Variable rate P can reduce the total P applied to the field—but not always. The average amount of P applied using VR methods depends on the scale of variability and distribution of STP values. In the six fields included in the Iowa study, four received lower average P rates using VR compared with a uniform rate; one received the same rate; and one received more fertilizer using VR. Averaged across the six fields, VR methods resulted in 12% less P being applied compared with the uniform rate method. Factors that can affect the average P rate applied using VR methods include: 1) adequacy of assessing STP variability (grid size selection); 2) whether P is applied for one or multiple crops; and 3) whether P rates beyond crop requirement are recommended to build up STP in soils testing below optimum.

Variable rate P can reduce spatial variability in crop yield. Less yield variability usually occurs in fertilized areas compared with unfertilized areas and in the Iowa study, 33% of the sites showed further reduction in corn yield variability following VR P applications compared with the uniform rate. Half of the study sites showed no difference, while 16% had increased variability in yield using VR. What is interesting about these results is that the reduction in variability often occurred in fields where no difference in grain yield between methods was observed. This reduction was considered to be due to increased P rates resulting in nominal (statistically non-significant) yield increases in areas of the field that test low or very low in STP and no P being applied to high-testing areas.

Variable rate P has the potential to reduce P loss from fields. Following three years of P applications, the Iowa study showed smaller increases in STP using VR in five of the six fields used in the study and no difference in the sixth compared with the uniform P rate. The VR applications also reduced within-field STP by eliminating P applications to high testing areas. The potential for VR P applications to increase yield in low STP areas, eliminate unneeded P applications in high STP areas, and reduce spatial variability in yield and STP make it a valuable management choice for reducing P loss from fields to water resources.

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