Agronomy "Crib" Notes

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Phosphorus Management Strategies

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Phosphorus (P) is a critical nutrient for crop production, and is applied as fertilizers, manures and/or biosolids; but, P can be lost to surface and ground water by erosion, runoff and leaching. If too much P enters lakes and reservoirs, it can cause algal blooms, accelerate eutrophication, and increase the cost of treating drinking water.

Although P comes from sources other than agriculture, agriculture's charge should be to manage P judiciously as a crop nutrient and to minimize losses to surface and ground water resources.

Overall Management Strategies

Any cropping system that optimizes fertilizer rate, timing, form, and placement, and minimizes soil erosion and runoff will effectively manage soil and P losses from fields.

Soil Testing

Fertilizer recommendations are based on the nutrient needs of the planned crop and the quantity of those nutrients available in the soil as measured by a soil test. While most soils have an ability to supply some P to the plant, this is most likely to happen under optimum pH and soil biology. **At a minimum, all phosphorus applications should be based on the results of a soil test and Purdue University recommendations (**Crop Fertilizer Recommendation Calculator)**.**

- Sample and analyze soils every four years or less. **It is imperative to have and use an up-to-date soil analysis.**
- A composite soil sample should consist of a minimum of 12-15 individual soil cores regardless of the soil sampling method (grid, soil type, management zone) used.
- A composite soil sample should not represent more than 20 acres. Smaller sample sizes (grids or management zones) are even better.
- Collect a 0-8 inch soil sample for nutrient recommendations for all agronomic cropping systems.
    - For no-till systems, collect an additional 0-4 inch soil sample for pH and lime recommendations only. A 0-4 inch soil sample will also assess the degree of soil nutrient stratification. However, the 0-4 inch soil sample should not be used for nutrient recommendations.

Applications and Economics

Phosphorus is mined, processed and shipped via barge, rail car and trucks to local fertilizer dealerships. P is not an endless nutrient--relatively speaking. P used to be a less expensive nutrient input but in recent years the price has increased and the supply has not always been consistent. Therefore, minimizing P losses will maximize the economics on the farm and minimize water quality issues.

A soil test should be the basis to justify all phosphorus applications – making applications based on the idea that "this is how we've always done it" needs to change. It is important for farmers and retailers to understand and ***follow the soil test recommendations from Purdue University***.

- ***Never** apply phosphorus to frozen or snow-covered ground, saturated soil, or before a predicted rain event that may cause runoff*. These conditions are the highest risk conditions for losing P.

- Soil test P levels greater than 50 ppm (100 lbs./acre) increase soluble P losses in tile water and surface runoff. Research shows that adding P to fields with soil test P levels greater than 50 ppm will almost never result in greater crop yield.
- Agronomically, research shows little likelihood of crop yield response if soil test P is greater than 30 ppm (60 lbs./acre) for corn and soybeans. Applying maintenance rates of P_2O_5 (the amount removed in the harvested portion – approximately 0.37 lbs./bu. for corn grain; 0.80 lbs./bu. for soybeans) will ensure continued yields.
- Use variable rate application methods to apply P only where needed (soil management zones or grid) as indicated by soil test results. This method often reduces the amount applied and spent for fertilizer.
- When applying maintenance rates (or less) of P, it's best to apply the P in a 2 x 2 band placement at planting.
- For P deficient soils (<15 ppm or 30 lbs./acre), recommended rates of fertilizer should be applied annually. Also, apply 25 to 50 percent of the recommended fertilizer in a band or strip below the surface.
- Do not surface apply P on soils with high runoff potential, especially during late fall, winter or early spring. *Phosphorus lost in erosion and runoff is not available for the next crop*.
- Optimize soil pH: Liming soils with a pH less than 6.0 will increase the availability of soil P to plants.

Water Quality

There are several loss mechanisms that impact losses of phosphorus:

- Minimize/prevent **all** forms of erosion (sheet and rill, wind, ephemeral, and classic gullies, irrigation induced) to decrease P delivered to surface waters. Any soil lost to tile inlets, ditches, streams, rivers, ponds, or lakes can negatively impact water quality.
- Reduce runoff by increasing infiltration. Runoff can best be decreased by adopting a system that includes long-term continuous no-till, cover crops, and the treatment and prevention of compaction and surface crusting.
- Integrating cover crops alone will likely reduce runoff and erosion, however, using only cover crops that winter kill, such as daikon radish, may increase dissolved phosphorus (DP) on the soil's surface as the leaf and shoot tissues degrade. Late winter rains, when the soil can be frozen, can deliver DP to the nearest tile rise or water course, so it is better for water quality to add a cover crop to the mix that is winter hardy, like cereal rye.
- Utilize flotation equipment and/or controlled traffic cropping systems to decrease the total amount of the field trafficked. This will reduce soil compaction, increase water infiltration and reduce surface runoff.
- Establish filter strips and/or setbacks to avoid applications near environmentally sensitive areas (e.g., watercourses, surface tile inlets, tile blow outs, flood plains, steep slopes, or poorly drained soils). These practices will reduce P movement to environmentally sensitive areas.
- Crop residues, particularly soon after senescence or harvest, can be high in DP. Minimize the loss of crop residues from fields. Establishing a cover crop, leaving higher stubble heights and avoiding excessive chopping and sizing of crop residues can all reduce residue losses from the field via both wind and water.

In summary, regular soil testing, scouting for crop nutrient deficiencies, tissue sampling (as needed), reducing soil compaction and crusting, and improving soil health are all tools that should be part of a nutrient management plan for all cropping systems.

Reminders & Additional Resources

Agronomy Technical Note – Phosphorus Management Best Accepted Technology (Dec. 2011).
Agronomy Technical Note #5 – Residue Management and Waste Utilization (May 2009).
Tri-State Fertilizer Recommendations for Corn, Soybeans, Wheat and Alfalfa (E-267), 1996.
Indiana Field Office Technical Guide (FOTG) Standard (590) Nutrient Management (Oct. 2013).
Indiana Nutrient Management / Soil Health (website)

Prior issues of this publication are located at http://www.in.nrcs.usda.gov/technical/agronomy/agronomy.html