SOLUTIONS

10 Questions about the Phosphorus (P) Index in Iowa

Where did the Phosphorus (P) Index come from? In April 1999, the USDA Natural Resources Conservation Service (NRCS) issued national policy and general guidelines on nutrient management. Each state was then required to revise NRCS state policy guidelines by April 2001. This included developing a phosphorus risk assessment tool for assessing the potential for P delivery from fields to surface waters. A core team of scientists and technical personnel from various institutions and agencies used available Iowa research and applicable research from other states to develop this index, now known as the Iowa P Index. NRCS field staff use this field assessment tool when providing technical assistance to producers. The Iowa Department of Natural Resources has also adopted this index for assessment of P risk with manure application.

How is Phosphorus (P) harmful to the environment? Phosphorus is a nutrient needed for crop production and animal growth. When P is in water, it does not create a direct human/livestock health or consumption concern. But, P is a water concern when it comes to increasing aquatic vegetation and algae blooms; which can have an impact on fishing, boating, and swimming. Low P levels in surface water systems usually limit the growth of aquatic plants in surface waters. When this nutrient is not limited eutrophication can occur. With excessive algae growth, and decomposition of these organisms, oxygen levels in surface waters are reduced – causing imbalances in these ecosystems and reducing the aesthetic value of lakes or streams.

Why does livestock production increase the risk? Many Iowa soils have soil P test levels above those needed to optimize crop production. This can increase the chances of P leaving the field and being deposited in surface waters. There are several potential reasons for these increased levels of soil test P. The first is that many livestock rations exceed dietary requirements for animals, so livestock manure has a higher than neces-

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sary P content. Managing dietary inputs of P for animal feed rations can reduce manure P levels by 5-50 percent, depending where the starting point was. It is not uncommon to observe a 25 percent reduction in swine manure P when unnecessary inorganic supplements are removed and diets are formulated based on available P. In dairy diets, reductions of this magnitude may occur if feedstuffs are selected with care taken to minimize overfeeding of P. A second potential reason livestock production increases risk to the environment is that manure is sometimes over-applied to fields and nutrient application exceeds the requirements for crop production. Because manure is not a homogeneous product like commercial fertilizer products, it can sometimes be difficult to determine the amount of nutrients in the manure and then distribute those nutrients equally within a field. Finally, distribution of manure is an issue. As long as manure from livestock is not applied directly back onto the fields where the crop containing the original P came from, we will continue to have a P-imbalance in the nutrient cycle. In addition to livestock manure P, all other forms of phosphorus applied to the soil in excess of crop removal will also increase the risk.

P Management – do all states work the same? No. Each of the 50 states has developed P management guidelines since 1999, but there can be quite a difference on how each state chose to develop these guidelines. Most states have developed a P Index, although some have developed soil test P thresholds that indicate when additional P can be applied to a field – or not – based solely on what the soil test is. Iowa and most states have not chosen that route. The argument can be made that just because a soil has high P soil test levels does not make it a risk for surface water contamination from P; if much of that P stays in the field and out of surface water, then the risk is reduced. The Iowa P Index considers soil-test P and also the mechanisms that may carry P off the fields, such as erosion, surface runoff, and tile drainage.

Who needs to use the P Index, and when? Iowa livestock producers who receive cost share funds for livestock facilities through the EQIP program need to use the P Index as part of their required nutrient management plan or Comprehensive Nutrient Management Plan. All producers with a new or expanding confinement feeding operation with greater than 500 animal units need to use the P Index when developing a manure management plan for the DNR. Producers who submitted a manure management plan to DNR prior to October 25, 2004, will need to update their plans to include the P Index in 2006 or 2008, depending on when their plan was originally submitted. It is anticipated that Concentrated Animal Feeding Operations (CAFOs), defined by the EPA as a facility with over 1,000 animal units, will also need to implement the P Index as part of their nutrient management plans in the near future.

How is the P Index calculated? There are three mechanisms by which phosphorus is generally believed to move from a field into surface water systems. In the Iowa P Index the potential impact of each of the three mechanisms is assessed for fields, assigned a value, and summarized into one final index number. Here are the three components, and the factors that determine the risk of each of the loss routes:

1. Movement with soil particles or erosion. The P attached with soil particles typically accounts for the greatest quantity of P that gets transported to surface waters. However, not all of the phosphorus attached to these particles is immediately available for aquatic plant use, but may be released over time, causing long-term water quality risk. This risk is evaluated by assessing how much soil leaves the field, and what concentration of phosphorus these soil particles contain. Information needed for calculating risk in this component include erosion rate, any structures present that trap sediment (such as terraces, filter strips, etc); distance to surface water, type of tillage used, landform region where you live, and soil test P levels.

2. Surface P runoff. Phosphorus can leave dissolved with the water that runs off fields after rainfall. The higher the soil test – the higher the risk. Phosphorus applied to the surface (either fertilizer or manure)

also creates greater risk. Incorporating manure reduces risk for this category. Location in Iowa makes a difference, too, because fewer excess rainfall events occur in NW Iowa than in SE Iowa. Factors used to calculate risks in this component of the P Index include precipitation, the runoff curve number from the county you are in, soil test levels, and how P is applied to the soil.

3. Subsurface drainage. Excess water drained from soil can also be a source of P in surface water. Tile lines and coarse textured (sandy) soils with subsurface recharge to surface water systems help speed the movement of excess water out of the soil, and increase P risks. Inputs for assessment of risk in this component include if the field is tiled and if the soil is one that has subsurface recharge to surface water systems. Although not much P moves in this way, the P that does move is soluble and very available to aquatic plants.

If my soil test is high, does that mean I cannot apply manure to this field? A very important point – the soil test level for phosphorus is NOT the P Index for the field – it is just one factor in the index. It is possible that the soil test P level might be high, but because of conservation practices utilized the risk of P movement to surface waters might be low. Of course, the opposite could occur also.

How will the P Index level for my farm affect how I apply manure? The answer to this question may differ if the P Index is used for nutrient management planning if you are voluntarily choosing to participate in USDA programs through NRCS or for manure management plans required by the Iowa DNR. It is important to know the risk categories are the same, but how you are allowed to apply manure or commercial fertilizer differs based on the outcome of the P Index. Make sure to check with the appropriate agency to determine requirements with the P Index risk rating associated with your specific fields.

NRCS P Index Risk Categories:

Very Low, 0-1: A field in which movement of P off site will be Very Low. If soil conservation and P management practices are maintained at current levels, impacts on surface waters from P losses from the field will be small.

Low, >1-2: A field in which movement of P off site will be Low. Although the P delivery to surface water bodies is greater than from a field with a very low rating, current soil conservation and P management practices keep water quality impairment low.

Medium, >2-5: A field in which movement of P off site will be Medium. Impacts on surface water resources will be higher than for the field with a low rating, and the P delivery potential may produce some water quality impairment. Careful consideration should be given to further soil conservation and P management practices that do not increase P delivery to surface water.

High, >5-15: A field in which movement of P off site will be High. Water quality impairment will be large. Remedial action is required to reduce P movement to surface water bodies. New soil and water conservation and/or P management practices are necessary to reduce offsite P movement and water quality degradation.

Very High, >15: A field in which movement of P offsite will be Very High. Impacts on surface water resources are extreme. Remedial action is required to reduce P delivery to surface water. All necessary soil and water conservation practices plus a P management plan, which may require discontinuing P applications, must be put in place to reduce water quality impairment.

DNR P Index Risk Categories:

Very Low, 0-1: Manure shall not be applied in excess of a nitrogen-based rate.

Low, >1-2: Manure shall not be applied in excess of a nitrogen-based rate.

Medium, >2-5: Manure may be applied at a nitrogen-based rate if current or planned soil conservation and phosphorus management practices predict the rating of the field to be not greater than 5 for the next determination of the phosphorus index. Manure shall not be applied in excess of two times the phosphorus removed with crop harvest over the period of the crop rotation.

High, >5-15: Manure shall not be applied on a field with a rating greater than 5 and less than or equal to 15 until practices are adopted which reduce the phosphorus index to at least the Medium risk category. However, prior to December 31, 2008, fields with a phosphorus index greater than 5 and less than or equal to 10 may receive manure at a phosphorus-based rate if practices will be adopted to reduce the phosphorus index to the medium risk category

Very High, >15: Manure shall not be applied on a field with a rating greater than 15.

How can I reduce the P Index level for my field? Increase the conservation practices in the field – such as increase terraces, reduce tillage, install conservation buffers, etc – and apply fertilizer P and manure properly. Also, if a field has an area with characteristics that may result in high risk of P loss (for example, high erosion rates) and the remainder of the field has lower risk, then a possibility is to divide the field into two zones for P Index calculation – and don't apply manure to the high risk areas. Ultimately, the goal of this process is to identify high-risk areas and reduce the risk of P loss. You can do that on most pieces of property in Iowa.

Where can I find more information about the Phosphorus Index? NRCS has two documents at their web site: www.ia.nrcs.usda.gov , including NRCS Technical Note #25 "Iowa Phosphorus Index," and a support document titled "Background and Basic Concepts of the Phosphorus Index." A P Index calculator is also available there. More information on manure management topics, including the P Index, is available at the Iowa Manure Management Action Group (IMMAG) web page, found at: http://extension.agron.iastate.edu/immag/, and the ISU Agronomy Extension Soil Fertility web page found at: http://extension.agron.iastate.edu/soilfertility/.

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