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James J. Hoorman
Hoorman Soil Health Services
Website: HoormanSoilHealth.com
Email: HoormanSoilHealthServices@gmail.com
Cell: 419-421-7255

Reducing Phosphorus Runoff

Tremendous farmer turnout occurred for the new Ohio H20 plan for $30 million being provided to 14 Northwest Ohio counties to improve Lake Erie water quality. Almost everyone agrees that phosphorus (P) in surface water is a major issue. The excess P in surface water is causing Harmful Algal Blooms (HAB) in Lake Erie. Since we are dealing with many algae (singular), the plural is algal not algae (common mistake). One pound of P in water may produce 500 pounds of HAB. The HAB in water need 1/10 the amount of P that our land-based plants need to thrive, so even a little P in surface water causes HAB to thrive.

In the 1970's/1980's, the problem was total phosphorus which includes dissolved (or soluble) reactive phosphorus (DRP) plus the particulate phosphorus (PP) or P attached to soil particles. Recently, researchers have concentrated mainly on DRP because it flows with the water and is easily HAB absorbed. DRP was rising the fastest while the PP appeared to be stable. Recent information from Dr. Libby Dayton shows that 20-30% of soil bound particulate P becomes DRP when it is detached in water. Controlling **Both** DRP and PP is important to solving our water quality problems, and here is where the message gets muddled.

Consider two scenarios. A conventional tilled field has 8 inches of water runoff and a DRP concentration of 10 parts per million (PPM) compared to a cover crop field with 5 inches of runoff and a 12 PPM DRP. Cover crops absorb 90% of the soil nitrogen (N), so cover crops are effective at keeping N out of surface water. It may appear that cover crops are 20% less efficient because the DRP concentration is 20% higher than conventional tillage; however, simply relying on DRP concentration gives you a wrong answer.

The formula for determining P loads is fairly simple. The water P concentration times the volume of water runoff plus the sediment P concentration times the weight of sediment. While the P concentration in cover crops is 20% higher, the volume of water runoff in this example is 60% lower. Simple math shows that cover crops are more effective. The average sediment load (erosion rate) for Ohio is 2.6 tons lost per acre on conventional tilled fields versus less than .5

tons for a dense grass cover crop. Assuming the P concentrations are the same, the cover crops has 20% (1.2X) higher P concentration but less than 1/5 (.5/2.6) the amount of erosion and sediment losses. The cover crops reduce P loads in both the surface water and sediment losses. We all want our tax dollars to be used on the most effective practices! Unfortunately, that message is not always be being conveyed correctly.

Numbers vary by field, but about 30% of the P comes from surface water runoff off the top of a field and 70% runoff (includes DRP and sediment PP) comes from tile or subsurface losses. Around 80% of our P losses occur with the 1-2 most intense rainfall events that occur each year. It's not the light rains, it's the big intense rains that cause the most damage. Many farmers think soil erosion does not occur on flat soils. Put on a raincoat/boots and watch the water run into our ditches and streams during and after a rainfall. The water is brown and muddy for a reason and watch what comes out the tile. Farmers should concentrate on reducing soil erosion to get a 50-60% improvement in water quality, because most soluble nutrient losses (N and P) are associated with both soil and water losses. Four USDA-NRCS soil health practices improve water quality: 1) Minimize soil disturbance, 2) Maximize surface residue, 3) Maximize live roots year-round, and 4) Maximize Biodiversity.

If the P concentration is 20% higher in cover crop fields, do we need to put on as much P fertilizer? No. Healthy soils have 1,000 to 2,000X more microbes in the soil which make phosphorus (P) plant available. Each microbe is a soluble bag of fertilizer, recycling P and feeding the plant. Healthy soils with live roots and high soil organic matter (SOM) need less P fertilizer than exposed degraded soils with low SOM because increasing SOM stores soluble soil nutrients. Healthy soils produce healthy food for healthy people and give us clean water to drink.