University of Idaho
Cooperative Extension System

BMPs for Phosphorus Management

College of Agriculture

Idaho's Water

Water is a finite resource essential to life. Water sustains Idaho's fish and wildlife, agriculture, industry, mining, forestry, hydropower generation, recreation, and growing population. Idaho is renowned for its rivers and lakes which support water recreation and provide some of the most spectacular natural scenery in the world. Water is precious, and its management determines the quality of Idaho's environment.

Water is the lifeblood of Idaho. Over 22 billion gallons of water are used each day in Idaho. More than 97 percent of this water is used on 4.1 million acres of irrigated farmland. Eighty percent of this water comes from surface sources (rivers and reservoirs); the other 20 percent is from groundwater. Currently, the quality of water used in Idaho is very good.

Commercial fertilizers and pesticides are two of the major technological breakthroughs of the 20th century. They have given us a means to make soils more productive and to combat pests that threaten our crops. When misused, however, many agrichemicals pose a hazard to the environment. Improper management of pesticides and fertilizers can result in contamination of both the surface and groundwaters in Idaho.

Because water is so vital to Idahoans, best management practices (BMPs) for agricultural management have and are becoming more important. Phosphorus (P) is a common water pollutant in Idaho's lakes and rivers. Phosphorus originates from many sources including agriculture.

Phosphorus and Water Quality

Phosphorus is essential to all forms of terrestrial life. Phosphorus is widely distributed over the surface of the earth in biologically available forms cycling within plants, animals, soil, and water.

Water quality problems associated with P are generally confined to surface waters only. Phosphorus is immobile

in soils and does not leach. Consequently, contamination of groundwater is rarely a problem. The rest of this brochure discusses P as a surface water quality concern.

Many human activities contribute P to surface waters. Activities associated with modern agriculture often significantly increase soil erosion and water runoff from land and transport sediment into surface waters. Land enriched with P by fertilization or manure can contribute substantial amounts of P to surface waters as the result of runoff and/or erosional processes.

Phosphorus in fertilizers and manures will not leach through soils to pollute groundwater because it is held tightly to soil particles. However, the soil particles that are transported off the field by erosion P will pollute surface waters. Surface water pollution with P is controllable -- by reducing soil erosion and keeping soil out of creeks, streams, rivers, and lakes.

Specific types of BMPs for P fertilizer and manure management that should be employed to protect surface water quality in many areas of Idaho include:

1. *Soil Erosion Control*
2. *Fertilizer Recommendations Based on Research and Soil Sampling*
3. *Correct P Fertilizer Placement*
4. *Variable Fertilizer Management*
5. *Efficient Manure Management*
6. *Barnyard and/or Feedlot Runoff Control*
7. *Conservation Tillage and Residue Management*
8. *Buffer (Filter) Strips*

Specific Phosphorus BMPs Include:

Soil Erosion Control

Runoff and soil erosion from agricultural lands are major causes of P pollution of surface waters. Consequences of soil erosion include removal of fertile topsoil, accelerated eutrophication and sedimentation of surface waters, destruction of fish and wildlife habitat, and decreased recreational and aesthetic value of surface waters. Sediment is a prime carrier of P.

Numerous BMP management practices for the control of runoff and soil erosion are available. These practices have been shown to be effective in reducing contaminant transport to surface waters. Practices for runoff and soil erosion control include both management options and the building of physical structures. Management practices designed to control runoff and soil erosion are:

- Permanent vegetative cover
- Conservation cropping sequence (rotation)
- Conservation tillage and residue management
- Contour farming
- Strip cropping
- Cover crops
- Buffer (filter) strips
- Mulching

Structures designed to control runoff and soil erosion include:

- Diversions
- Grade stabilization structures
- Grassed waterways
- Ponds
- Sediment basins
- Terraces

Fertilizer Recommendations Based on Research and Soil Sampling

Phosphorus application rates for Idaho crops should be based on scientific information. Reliable fertilizer recommendations are developed by calibrating and correlating laboratory soil test values with plot research on crop response to fertilizer application rates.

The University of Idaho has developed over 30 fertilizer guides for Idaho crops. The data base used to develop these fertilizer guides is extensive and has been collected for over 30 years. Fertilizer guides are based on years of field research and take into account the amount of residual P in the surface foot of the soil profile.

Soil sampling is a very important BMP that considers the amount of plant available P already in the soil profile. Soil sampling should be done three to four weeks before planting a crop. The soil samples should be representative of the field. Normal sampling depth is to 12 inches for phosphorus.

You should take soil samples at least once during each crop rotation cycle. Maintain a record of soil test results on each field to evaluate long-term trends of nutrient levels.

Correct P Fertilizer Placement

Placement of fertilizers is an integral part of efficient crop management. Correct placement of fertilizers often improves the efficiency by which nutrients are taken up by plants and consequently encourages maximum yields of intensively managed agronomic crops. It is also apparent that correct fertilizer placement is more critical for maximum crop yields under reduced tillage operations than with conventional tillage management.

Phosphorus should never be placed on the soil surface. Band applications below or with the seed and/or broadcast incorporated placements are BMPs because potential erosional losses of P are minimized.

Variable Fertilizer Management

Variable fertility management within a single field is a strategy that has the potential to improve nutrient use efficiency, improve economic crop return, and reduce environmental pollution. A variable fertilizer management strategy can be easily tailored for any field. The only knowledge a grower needs to implement this type of best management practice is to know how yield varies across a field. To use a variable management strategy follow these steps: (1) divide your field into different management units based on yield potential, (2) take separate soil samples for each management unit in your field, (3) apply nitrogen based on yield potential using fertilizer guides for each management unit, and (4) apply phosphorus, potassium, and sulfur based on soil sampling and analysis from each management unit.

Efficient Manure Management

Runoff from manured fields carries both soluble and sediment-associated contaminants to surface waters. The high soluble P content of manure can have immediate adverse effects on surface water quality. Manure management strategies should consider application methods, application rates, application timing, a site evaluation, and manure storage.

As with commercial P fertilizers, threats to surface water from manure will be minimized if applications are incorporated or injected beneath the soil surface. Manure should be tested for P content and a soil test will help determine the amount to apply to meet crop demand. The period of major concern for application of manure from a surface water quality standpoint is the winter and early spring months when manure incorporation is difficult and runoff most likely.

Site considerations include land slope and proximity to surface water sources. During periods when suitable sites for land application of manure are not available, the use of manure storage facilities is recommended. Manure management BMPs are not only environmentally sound but are also very often cost effective.

Barnyard and/or Feedlot Runoff Control

Runoff from barnyards and/or feedlots has been shown to contribute significant amounts of nutrients including P to nearby surface water bodies. Water quality impacts are greater with decreased distance between a barnyard and a water body. BMPs to protect water quality can be grouped into clean water diversions and runoff treatment practices. Runoff treatment practices include: yard shaping, settling basins, outlet boxes, and the use of filter strips.

Conservation Tillage and Residue Management

Conservation tillage and residue management is any tillage system that leaves plant residue on the soil surface. Conservation tillage systems are BMPs because both runoff and erosion are reduced when adequate residues are maintained on the soil surface.

Buffer (Filter) Strips

Buffer strips of vegetation around water bodies are BMPs that reduce sediment and nutrient content of runoff waters. The velocity of runoff is reduced when passing through a buffer strip as is its capacity for transporting sediments and nutrients. Sediment is deposited and runoff infiltrates or passes through the buffer strip with a substantially reduced contaminant load.

Summary of Best Management Practices for Phosphorus

- Utilize soil erosion control practices to minimize runoff and soil loss.
- Test soil and apply P at recommended rates for crop production in Idaho.
- Credit P contributions from manure and other organic wastes.
- Either band below the soil surface or broadcast incorporate fertilizer P applications.
- Limit manure applications on untilled lands.
- Avoid manure applications to sloping, frozen, saturated, or eroding soils.
- Control runoff from barnyards and/or feedlots.
- Install buffer (filter) strips adjacent to surface waters receiving runoff from croplands.

University of Idaho

The University of Idaho Cooperative Extension System has over 140 faculty strategically located throughout the state, including 84 agricultural agents and home economists stationed in 42 of 44 counties. In addition, faculty (specialists) are located on campus in Moscow and at research and extension centers in Aberdeen, Caldwell, Idaho Falls, Kimberly, Parma, Sandpoint, Tetonia, and Twin Falls.

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