Applying knowledge to improve water quality

Pacific Northwest

Regional Water Program

A Partnership of USDA NIFA
& Land Grant Colleges and Universities

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Agricultural Nutrient Management:

Protecting Surface Waters from Phosphorus

Phosphorus (P) is essential to all forms of terrestrial life. It is widely distributed over the surface of the Earth in biologically available forms, cycling within plants, animals, soil, and water. In commercial agriculture, P fertilizer can be a major addition to this cycle. Because water quality is so important to residents of the Pacific Northwest, agricultural best management practices (BMPs) to protect water bodies from P pollution are becoming more important. Phosphorus is a common water pollutant in the region's lakes and rivers. Phosphorus originates from many sources including agriculture.

The green scum on the surface of this water body is caused by phosphorus runoff from agricultural land.

After nitrogen, P is the most common fertilizer nutrient applied to cropland in Alaska, Idaho, Oregon, and Washington. Scientists at the land grant institutions in our region provide P application guidelines for most crops. These guidelines are contained in over 100 different fertilizer guides produced for specific crops and include suggested rates of P fertilizer to apply along with proper application methods. Management practices are designed to maximize crop yields and also to protect surface waters. Agricultural scientists at these institutions (University of Alaska, University of Idaho, Oregon State University, Washington State University) also provide responsible guidelines for the handling of animal waste so that the nutrients can be effectively used in agricultural ecosystems and that surface waters are protected. We call these guidelines that both protect the environment and encourage high crop and animal yields best management practices.

Additions of P to ponds, lakes, and reservoirs by humans cause a rapid increase in the growth of aquatic organisms that live near the surface of water bodies called phytoplankton (also known as algae). Under natural conditions, phytoplankton numbers are low because the lack of P in most water bodies prevents their rapid growth. However, when humans introduce large quantities of P to water bodies the algae grow rapidly and can often form a green scum on the surface of the water body. Scientifically, nutrient enrichment that causes a rapid increase in phytoplankton numbers is called eutrophication. If eutrophication is severe, the levels of oxygen in the water body may become depleted resulting in poor fisheries and even fish kills. Fish kills due to the lack of oxygen in surface water bodies (lakes, ponds, and reservoirs) are quite common in agricultural areas of the region.

Water quality problems associated with P are generally confined to surface waters. P in soil is tightly held to soil particles, is immobile, and does not leach. Consequently, contamination of groundwater is rarely a problem. Many human activities contribute phosphorus to surface waters. Agricultural 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. Activities associated with modern agriculture often significantly increase soil erosion, water runoff, and transport of sediment into surface waters.

Surface water pollution from P is controllable – by reducing soil erosion and keeping soil and animal waste out of creeks, streams, rivers, and lakes. Specific BMPs for P fertilizer management that are recommended by Pacific Northwest land grant institutions that should be employed to protect surface water quality in many areas of the Pacific Northwest include:

Washington State University
Oregon State University OSU
University of Idaho
A Legacy of Leading
Northwest Indian College
UAF University of Alaska Fairbanks
United States Environmental Protection Agency
National Institute of Food and Agriculture
USDA

Pacific Northwest Regional Water Quality Coordination Project Partners

Land Grant Universities

Alaska
Cooperative Extension Service
Contact Fred Sorensen:
907-786-6311
http://www.uaf.edu/ces/water/
University Publications:
http://www.alaska.edu/uaf/ces/publications/

Idaho
University of Idaho
Cooperative Extension System
Contact Bob Mahler: 208-885-7025
http://www.uidaho.edu/wq/wqhome.html
University Publications:
http://info.ag.uidaho.edu/Catalog/catalog.htm

Oregon
Oregon State University
Extension Service
Contact Mike Gamroth: 541-737-3316
http://extension.oregonstate.edu/
University Publications:
http://extension.oregonstate.edu/catalog/

Washington
Washington State University
WSU Extension
Contact Bob Simmons:
360-427-9670 ext. 690
http://wawater.wsu.edu/
University Publications:
http://pubs.wsu.edu/

Northwest Indian College
Contact Charlotte Clausing:
360-392-4319
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Water Resource Research Institutes

Water and Environmental Research Center (Alaska)
http://www.uaf.edu/water/

Idaho Water Resources Research Institute
http://www.boise.uidaho.edu/

Institute for Water and Watersheds (Oregon)
http://water.oregonstate.edu/

State of Washington Water Research Center
http://www.swwrc.wsu.edu/

Environmental Protection Agency

EPA, Region 10
The Pacific Northwest
http://www.epa.gov/r10earth/

Office of Research and Development, Corvallis Laboratory
http://www.epa.gov/wed/

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The Project

Land Grant Universities, Water Research Institutes, and EPA Region 10 have formed a partnership to provide research and education to communities about protecting or restoring the quality of water resources. This partnership is being supported in part by the USDA's National Institute of Food and Agriculture (NIFA).

Our Goal and Approach

The goal of this Project is to provide leadership for water resources research, education, and outreach to help people, industry, and governments to prevent and solve current and emerging water quality and quantity problems. The approach to achieving this goal is for the Partners to develop a coordinated water quality effort based on, and strengthening, indivudual state programs.

Our Strengths

The Project promotes regional collaboration by acknowledging existing programs and successful efforts; assisting program gaps; identifying potential issues for cross-agency and private sector collaboration; and developing a clearinghouse of expertise and programs. In addition, the Project establishes or enhances partnerships with federal, state, and local environmental and water resource management agencies, such as by placing a University Liaison within the offices of EPA Region 10.

- Soil erosion control
- Using P fertilizer recommendations on agricultural land that are based on research and soil sampling
- Correct fertilizer placement (away from the soil surface)
- Efficient manure management
- Barnyard and/or feedlot runoff control
- Conservation tillage and residue management
- Instillation of buffer strips between cropland and water bodies

These dead fish are the result of eutrophication that depleted oxygen levels in this lake.

Runoff and soil erosion from agricultural lands are major causes of P pollution of surface waters. In addition to reduced cropland productivity through the removal of fertile topsoil, the consequences of soil erosion include accelerated eutrophication and sedimentation of surface waters, destruction of fish and wildlife habitat, and decreased recreational and aesthetic values of surface waters. Sediment is a prime carrier of P.

Since fertilizer P is tied up by soil particles – the real key to phosphorus management is to keep the soil in the field. So any practice that reduces soil erosion protects surface bodies of water from P. Examples of best management practices that reduce soil erosion on agricultural lands include: permanent vegetative cover, conservation cropping rotation, conservation tillage and residue management, contour farming, strip cropping, planting cover crops, installing buffer (filter) strips, and mulching.

National Water Quality Program Areas

The four land grant universities in the Pacific Northwest have aligned our water resource Extension and research efforts with eight themes of the USDA's National Institute of Food and Agriculture.

1. Animal Waste Management
2. Drinking Water and Human Health
3. Environmental Restoration
4. Nutrient and Pesticide Management
5. Pollution Assessment and Prevention
6. Watershed Management
7. Water Conservation and Management
8. Water Policy and Economics

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