Phosphorus Best Management Practices
Protecting Water Quality

Phosphorus Sources, Application Timing and Methods

Authors: Jessica Davis, Colorado State University, Fort Collins, Colorado; Bob Stevens, Washington State University, Pullman, Washington

Authors' email
(Jessica.Davis@Colostate.edu)
(stevensr@wsu.edu)

Editing and Design:
Forbes Walker
Wanda Russell
Gary Dagnan
Anne Dalton

University of Tennessee Extension

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Definition:

How, when and where phosphorus (P) sources are applied have a critical impact on the mobility of P in runoff. In addition, the P source may impact the amount of P available to move in runoff. These factors are inter-related and will be considered together in this factsheet.

Purposes:

Making good P application decisions will:

- reduce levels of P in runoff
- maximize crop use efficiency
- decrease fertilizer costs

How Does This Practice Work?

Different sources of P can affect the concentration of P in runoff. Recent research results have shown that composted manure, applied at the same P rate as raw manure, resulted in lower P runoff concentration. Water-soluble P content in manures and composts may be predictive of P runoff from those manures following land application.

In addition, if organic amendments are applied at agronomic nitrogen (N) rates, then producers should monitor soil for buildup of P. Because of the variability of N and P levels in organic sources, it is essential to analyze them for nutrient content. It is important to remember that P concentration is usually higher in compost than in raw manures, and the N:P ratio will tend to be lower, thus increasing the P risk if compost is applied to meet N needs. Nutrient analysis of organic P sources is essential to agronomic rate determination.

P applications should be made at times when significant runoff events are not expected. Weather forecasts should be closely monitored prior to application. Periods when significant precipitation events are likely to occur will vary across climatic zones. Conditions such as frozen ground, snow-covered land and soil saturation encourage rapid runoff; therefore, P should not be applied to land in these situations. In addition, whenever P is applied, it should be incorporated as soon as possible to reduce potential contact with runoff water. Producers should look for guidance from National Resource Conservation Service (NRCS) and Cooperative Extension staff for local recommendations.

Federal Concentrated Animal Feeding Operation (CAFO) regulations allow for multiple-year P applications on fields that do not have high potential for P runoff to surface water. This allowance was made because of the practical difficulties in applying manure at P-based rates with standard manure spreading equipment and the higher cost involved in spreading lower rates over greater acreage. A multi-year approach allows a single application to meet several years of a P requirement, as long as the manure application rate does not exceed the N-based agronomic rate.

Where P is applied also affects its potential impact on surface water quality. Although P was not its primary consideration, the Environmental Protection Agency (EPA) recently established setbacks of 100 feet from surface water and wellheads within which no manure, litter or wastewater should be applied. Local regulations may require greater setbacks. In addition, steep fields with low infiltration rates will have greater runoff, so these areas should

be avoided if possible. The local P Index should be used to determine the most suitable locations for P application.

How organic P sources are best applied will vary with type of manure, biosolids or wastewater. If the organic P source is solid, it should be incorporated as soon as possible to reduce N volatilization losses, thus improving the N:P ratio, and to reduce P contact with water on the soil surface. To minimize runoff from forage or pasture land, application should be scheduled to avoid peak runoff times. Compost may be a better source for this type of scenario and for conservation tillage areas, due to its smaller particle size and ability to move into the soil rather than stay on the surface.

Slurries should be injected below the soil surface to avoid contact with rainfall or runoff. This will also capture N and improve the N:P ratio. Wastewaters are often applied through irrigation systems. If sprinkler irrigation systems are used, it is critical to apply wastewater at rates below the soil's infiltration rate to avoid ponding and runoff. If furrow irrigation systems are used, tailwater must be collected or eliminated, so that no wastewater runs directly off a field.

Where This Practice Applies and Its Limitations:

Specific recommendations are subject to local soil, climate and management scenarios. However, the concepts described here apply to all of these scenarios.

Effectiveness:

Following these practices will reduce P runoff from the field boundaries by reducing soil test P buildup and minimizing the potential for P transport. Considering when, where and how applications are made will result in the greatest effectiveness in protecting surface water quality.

Cost of Establishing and Putting the Practice in Place:

Applying manure on a P-basis will increase application costs due to lower application rates, requiring more labor and greater transportation costs. Agronomic P applications may also require either the purchase of more land, arrangements with neighbors to use manure or even the marketing of manure off-site. However, minimizing N losses from manure, as mentioned previously, will reduce the amount and cost of supplemental fertilizer.

Some of the practices described above, such as incorporation timing, present no additional cost because they only affect timing. However, immediate incorporation may present labor difficulties due to other needs and demands at the same time. Injection of slurries, on the other hand, does require greater horsepower for application, as compared to surface application.

In addition, soil and manure sampling also costs money, both for labor and for lab analysis, but these practices are currently required by the EPA.

Operation and Maintenance:

The P application decisions that this factsheet addresses are not made at one time for the indefinite future. These decisions must be reconsidered every time that P is applied to land in the form of manure, biosolids, wastewater or fertilizer. Site-specific soil and climatic conditions will affect these decisions. Representative soil samples should be taken at least every three years. State regulations may require more frequent soil testing.

References:

USDA-NRCS Agronomy Manual http://policy.nrcs.usda.gov/scripts/lpsiis.dll/M/M_190NAM.htm

USDA-NRCS Core 4 Training Guide http://www.nrcs.usda.gov/technical/ECS/agronomy/core4.pdf

Other USDA-NRCS and Cooperative Extension technical references and standards are available at local county offices.

For Further Information:

Contact your local conservation district, USDA-NRCS or Cooperative Extension office.