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Animal Waste Management To Protect Water Quality Land Application Of Animal Wastes

The availability and relatively low cost of petroleum-based fertilizers made handling, shipping, and spreading manure fertilizers uneconomical for the past 50 years. However, substituting livestock and poultry manure for commercial fertilizers is now becoming more economical because of increased fertilizer costs, shortages of fertilizer materials, and environmental constraints.

The environmental concerns of land-applied animal waste are the same as those with commercial fertilizers. Once animal waste is applied to land, it becomes a potential nonpoint source of water pollution just like fertilizers and pesticides. Controlling nonpoint source pollution from animal waste requires careful planning by farm managers.

When using animal wastes as a substitute for commercial fertilizer, several preliminary steps should be taken before actual application. These steps are soil testing, nutrient analysis, and site selection. Then rate, timing, and method of application must be considered to increase nutrient uptake and decrease potential water pollution.

Soil Testing

An annual soil test can determine the available nutrient levels in your soil. This provides a baseline to let you determine how much additional nutrients are needed to achieve the desired crop yields.

Annual soil testing on cropland can help you determine if nitrogen is being used effectively, if salinity problems exist, if certain elements are at toxic levels, and if an increase of one element has reduced the availability of another.

When taking a soil sample, make sure the sample is representative of the entire field.

Nutrient Analysis

Whenever manure spreading takes place, some estimate of nutrient value is important to plan spreading rates to meet fertility needs. Manure nutrient analysis should be made just prior to land application so

that nitrogen and phosphorus contents can be matched with crop requirements. This step is very important since the nutrient content of animal manures varies with the animal species and diet, the type and amount of bedding or litter, and the storage and handling of the manure.

Nutrient analysis methods for various manures are covered in another article in the water quality series.

Site Selection

Matching nitrogen and phosphorus rates with crop requirements will not always prevent surface water and groundwater pollution. To determine whether animal waste can be safely applied, consider the following site and soil characteristics: water infiltration rate, water holding capacity, soil texture, and slope. Distances to streams, ditches, and other water sources must also be considered if animal wastes are surface applied and not immediately incorporated.

Rate Of Application

The application rate for animal wastes should be based on crop nutrient requirements, the nutrient pool of the soil, and the nutrient value of the manure. When animal waste is used as a fertilizer, the rate of application is usually based on matching crop nitrogen needs and available nitrogen in the waste. Any additional nitrogen requirements should then be met using supplemental commercial fertilizer. Where local surface water quality is threatened by phosphorus, the application rate should be limited by the crop uptake rate of phosphorus.

More information on calculating rates of application based on nitrogen needs can be found in another article in the water quality series.

Nitrogen and phosphorus requirements of selected crops are given in Table 1.

Excessive application of animal waste may result in nitrate-nitrogen leaching into groundwater sources, phosphorus accumulation in the upper soil profile

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Table 1. Nutrient Requirements Of Selected Crops.

Crop	Expected Yield	Nitrogen (lb./A)	Phosphorus (lb./A)
Corn	75 to 99 bu/A	75 to 100	60
	100 to 149 bu/A	110 to 165	80
	150 to 200 bu/A	180 to 240	80
Cotton	1.0 bales/A	40	40
	1.5 bales/A	60	60
	2.0 bales/A	80	80
	2.5 bales/A	100	80
Grain Sorghum	1500 to 2000 lb./A	30 to 40	20
	2000 to 4000 lb./A	40 to 80	40
	4000 to 6000 lb./A	80 to 120	60
	6000 to 8000 lb./A	120 to 160	80
Wheat	20 to 30 bu./A	40 to 60	20
	30 to 40 bu./A	60 to 80	40
	40 to 60 bu./A	80 to 120	40
	60 to 80 bu./A	120 to 160	60
	80 to 100 bu./A	160 to 200	60
Coastal Bermuda	Grazing only	100 to 160	50
	1 cutting plus grazing only	160 to 220	50
	3 cuttings	300 to 350	100
	4 to 6 cuttings	400 to 600	130
Alfalfa ^a	Non-irrigated, annually	0	60
	Irrigated, 6 tons/A	0	100
	Irrigated, 8 to 12 tons/A	0	140
Wheat	Light grazing	160	60
	Moderate grazing	200	75
	Heavy grazing	240	80
Sorghum/Sudan	1 cutting or light grazing	80	40
	2 cuttings or moderate grazing	160	60
	3 cuttings or heavy grazing	200	80

^aAlfalfa is a legume which can get its nitrogen from the atmosphere. If fertilized, it can utilize up to 180 pounds of N per acre in producing a yield of 4 tons.

Source: U.S. EPA, 1993.

where it may be lost by erosion, and excessive accumulation of salts.

The sandy loam soils of Alabama and Georgia are especially susceptible to short-term nitrogen accumulation and leaching. To prevent leaching and groundwater contamination, crop nitrogen requirements should be matched with the nitrogen value in the manure. Since phosphorus not used by crops can accumulate in the upper surface layers of the soil profile and be lost in surface erosion and because recent

studies indicate that soluble phosphorus increases where excessive P levels have been applied, crop phosphorus requirements should also be closely matched to the phosphorus content of the manure after phosphorus builds up to very high levels.

Salinity is not a common problem in Alabama. An average rainfall more than 50 inches per year and natural leaching on most agricultural soils keeps salts from building up to toxic levels. If excessive applications of manure are made, however, soil salinity can

become a problem. Salts can affect seed germination, cause inefficient use of plant elements, reduce yields, and be leached to groundwater. Corn, which has a low tolerance to salinity, can be significantly affected by excessive manure applications.

Timing Of Application

Timing of animal waste application must be considered to reduce potential water pollution and to increase plant nutrient uptake. Timing of application should be just prior to or during periods of maximum crop nutrient uptake such as either spring or summer when crops can utilize most of the nutrients.

Spring application can be made on almost any crop. Bermuda grass hayfields are ideal for spring applications of lagoon waste because they can use the water and large amounts of nitrogen. Make sure that the excess forage produced is harvested or heavily grazed.

Fall application can lead to losses of up to 50 percent of the total nitrogen through decomposition and leaching.

Winter applications have also shown large nutrient losses: up to 86 percent of the nitrogen and 94 percent of the phosphorus applied during the winter season can be lost in a single rainfall or snowmelt runoff event in colder climates. If fall and winter applications cannot be avoided, manure rates should be applied to a vegetative cover crop, thus reducing runoff losses.

Split application of animal wastes is a best management practice when applied to grasses or when injected as a side-dressing for row crops. Split applications are ineffective, however, if applied to bare ground where a crop is not available to immediately utilize the nutrients.

Climate, animal species, and crop type can also affect the timing of application.

Climate. In areas that are warm throughout much of the year, like the Southern Coastal Plain, organic-nitrogen and ammonium-nitrogen can be rapidly converted to nitrate-nitrogen. Thus, manurial nitrogen applied in the fall or winter seasons can be leached away before the following growing season.

Local weather conditions should also be checked before land application. It is best to spread manures in the morning when the air is warming and rising, when the humidity is low, and when the wind is blowing away from residential areas. Although rain removes odors from the air, waste should not be spread within 24 hours of predicted rain unless it can be incorporated into the soil at the time of application. Checking these and other weather conditions will help to dissipate the odors quickly.

Animal Species. The species of animal manure used should be considered in order to be assured that plant nutrients are available when they are most needed. More than 50 percent of the available nitrogen in swine and poultry waste may be mineralized in 3 to 6 weeks depending on climatic conditions; beef manure may take up to 18 weeks.

Crop Type. The crop's sensitivity to ammonia should also be taken into account when determining application time. Animal wastes with high ammonia concentrations have been shown to inhibit seed germination and decrease yields when applied too close to the planting date.

Methods Of Application

Methods of applying animal wastes are broadcasting; broadcasting followed by incorporation; knifing or injection; and irrigation.

The application method is dependent on the manure moisture content. Most animal manures are in a solid, liquid, or slurry form. Solid manure will have a solids content of about 15 to 25 percent; liquid manure will have 0 to 4 percent solids; slurry manure will have a solids content in between.

Liquid manure can usually be spray applied with an irrigation system. Liquid manure slurry knifed midway between the rows and applied 4 to 6 inches beside the rows has resulted in somewhat better yields than if the manure was surface applied or plowed under. Since knifing incorporates the liquid manure, it also reduces pollution from runoff.

Slurry manure can be spray irrigated but is often broadcast or soil injected by a liquid manure spreader. Waste slurries should be applied to the soil surface so that plants and soil bacteria can use and breakdown the nutrients with a minimum of soil and water pollution.

Solid manure can be handled either by drying or by adding bedding (straw, wood chips). Bedding, in addition to its adsorption properties, helps reduce volatilization losses of nitrogen.

Broadcasting without immediate injection can lead to losses by ammonia volatilization and by surface runoff. Limiting winter manure spreading to cropland with less than 4 percent slopes or on land treated to meet allowable soil loss limits can reduce surface runoff. Spreading animal manure on land further than 200 feet from a stream, tile intake, sinkhole, shoreline, or well can also reduce potential transport of nutrients to surface water and groundwater. Planting a grassed buffer strip between the land and any creek, waterway, and surface impoundment can protect the water from excess surface runoff and erosion.

Incorporation of manure into the soil before it dries produces the best crop yields and lowest nutrient losses. Immediate incorporation of solid manure minimizes losses to the air and allows soil microorganisms to decompose the waste sooner, thus allowing nutrients to become available sooner. When manure slurry is incorporated, losses to air and runoff, as well as odors, are minimized. All forms of animal waste should be incorporated when applied to land with slopes greater than 10 percent or on land subject to flooding.

BMPs For Land Application Of Animal Wastes

- Land to receive solid manures or wastewater irrigation should have a slope less than 6 percent. Waste and wastewater may be applied to steeper slopes if it is incorporated immediately or if vegetation and other practices to reduce erosion and surface runoff are adequate.

- Waste should not be spread when the ground is frozen or saturated or during rainfall.

- Waste should be incorporated into the soil within 48 hours of application. If the waste is not to be incorporated, a 200 foot buffer zone of grass or other thick vegetation should be maintained between the disposal areas and the downhill property line or water courses.

- Representative soil samples should be taken at least annually from the water and/or wastewater application site. Samples should be taken from three different depths below the ground surface: 0 to 6 inches, 6 to 12 inches, and 12 to 30 inches. The samples should be analyzed for nitrate-nitrogen, ammonia nitrogen, cation exchange capacity, extractable phosphorus, sodium, magnesium, calcium, sulfur, and electrical conductivity.

- When wastewater is applied through irrigation, a 100-foot or more buffer zone should be left downwind to prevent spray from leaving the property.

- The cover crop should be harvested at least once a year.

Land Application Practices In Alabama

In a survey conducted by Auburn University's Department of Agricultural Economics and Rural Sociology, farmers in Blount and Cullman counties were questioned about their land application practices. Wastes produced came from dairy, broiler, layer, beef, and hog operations.

In Alabama, manure is most often applied to pasture or hayland in solid form with a spreader. It is applied in multiple periods of the year to at least partly hilly land. More than 77 percent of the operators

rated the adequacy of their land application system as good or better.

Dairy operators were most likely to spread manure on crop acres and to spread on more acres than farmers in other enterprise categories. Dairy farms dispersed waste in liquid form more often than other types of operations. Two of the 14 dairy farms reported using irrigation as a method for applying waste to land. Almost 25 percent of the dairy operators reported spreading waste on land they described as mostly hilly.

Poultry operators were most likely to spread waste on pasture land and to apply manure to more acres. All the layer operations in the study applied animal waste at least once a year. About 62 percent of the broiler operators applied animal waste to land two or more times a year. Broiler operators were the only ones to recycle chicken manure as a component of a cattle ration. About 25 percent of the dairy and poultry operators gave animal waste to others without charge.

Beef operations applied manure least frequently of all the enterprise categories. Around 16 percent of beef and hog operations rarely or never spread manure. Almost a quarter of hog farmers indicated they applied animal waste to land that was mostly flat.

The results suggest that farmers clearly recognize the value of animal waste as a feed and a fertilizer, while at the same time they tend to discount the extent to which animal waste is a source of pollution to groundwater, rivers, and streams. Few respondents acknowledged the necessity of making changes in the way animal waste is handled on their farms.

The terrain of the study counties is such that application of animal waste to hilly land could readily lead to runoff and pollution problems. Animal waste spread on hilly land is vulnerable to erosion and subsequent pollution of rivers and streams. Given the hilly terrain characterizing the two north Alabama counties and the low levels of problem recognition, animal waste pollution may represent a significant performance gap for some farm operators.

Deciding If Land Application Is Appropriate For Your Operation

Many factors play a role in determining if land application is appropriate for your operation. Consider the following questions:

- How will you remove and apply animal wastes? Do you have access to pumping equipment and an irrigation system?

- What effect will land application have on your neighbors?

- Where will you be able to land apply animal wastes? Do you have nearby cropland, hayfields, or pasture land that can use the extra nutrients?
- How will you use the extra forage (hay or grazing) that will be produced?
- When can you apply the effluent so that the crop/forage will use both the water and nutrients.
- What do the soil tests indicate? What are your crop/forage needs?

By answering the above questions you will be better able to determine if land application of animal wastes is appropriate for your operation.

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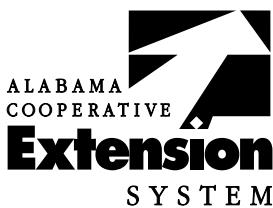
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