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PURDUE EXTENSION

PPP-14

Category 14 Agricultural Fertilizer Applicator

Front cover photo Dow AgroScicences

Category 14

Agricultural Fertilizer Applicator

Cheri Janssen, Program Specialist
Cindy Myers, Publication Designer
Purdue Pesticide Programs
Purdue University Cooperative Extension Service

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Drew Martin, Purdue Pesticide Programs

Matthew Pearson, Office of Indiana State Chemist

Fred Whitford, Purdue Pesticide Programs

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Planning Applications

Lynn Betts, USDA NRCS

Learning Objectives:

A. Describe who must be legally licensed to apply manure or commercial fertilizer. State the number of individuals a certified applicator may supervise.

B. Define the following: runoff, leaching, volatilization, and denitrification.

C. List the three mineral components of soil, and know which soil type is most susceptible to leaching.

D. List the three major nutritional requirements of row crops (i.e., nitrogen, phosphorus, potassium).

E. Identify the two forms of nitrogen taken up by plants. Identify the form of applied nitrogen most subject to: denitrification, volatilization, and leaching.

F. Recognize common fertilizer materials (e.g. urea, potash, manure).

G. Given a fertilizer label identify the nutritional components of the product; state the percentage of each nutrient contained in the product.

H. List the elements of a manure test report and identify the per unit difference between dry and as-is (wet) analysis.

I. Describe the purpose of nitrification inhibiters.

J. Identify environmental conditions that can lead to water contamination; list the management practices that minimize the potential for contamination.

K. Identify application sites considered sensitive due to the presence of people (e.g. schools, outdoor recreation areas).

L. Select appropriate application equipment based on field conditions, fertilizer type, and application method.

M. Explain the emergency procedures for a fertilizer spill. List the agencies to contact when anhydrous ammonia is spilled.

N. Identify appropriate personal protective equipment for handling various fertilizer materials.

Introduction

Every grower knows that soil nutrients are essential to quality crop production. But nutrients in the soil are not unlimited. Crops take up nutrients from the soil as they grow and produce, and those nutrients must be replenished; that is, the soil must be fertilized to support agricultural production.

The Indiana General Assembly passed legislation requiring fertilizer applicators to become certified. Commercial applicators of agricultural fertilizers, as well as individual applicators of manure from confined feeding operations (CFOs), are subject to this legislation. They are required to demonstrate minimum competency by becoming certified through the Office of Indiana State Chemist (OISC). This manual assists those seeking certification to prepare for the Category 14 certification examination.

Agricultural Fertilizer Applicator Certification

Certification refers to the procedure (testing) by which an individual demonstrates minimal competency in the subject matter. Fertilizer certification is required if

- A person who applies or transports agricultural fertilizer for hire, or

- A person who applies or transports manure from an Indiana confined feeding operation (CFO). This also includes manure, transported or applied, from an out-of-state operation if defined as a CFO by Indiana standards.

Commercial Applicator Certification and Continuing Education

A person may take the Category 14 exam at the monthly exam sessions at Purdue University, West Lafayette campus. The exam can also be taken by computer at remote testing sites in Indiana and neighboring states. Commercial certification is valid for five years. If the applicator already holds credentials from OISC, there is no additional fee and the Category 14 will be added to their card.

Fertilizer material is defined to mean both commercial agricultural fertilizer and manure from a confined feeding operation.

A business license is needed to apply fertilizer material for hire. A business must employ at least one Category 14 certified applicator and submit the license application. If the business currently holds a pesticide business license, no fee is charged, otherwise it is an annual $45 fee.

To keep their certification valid, a commercial applicator obtains three CCH's (continuing certification hours) over the five-year period—or—retakes the Category 14 exam. A list of programs with approved Category 14 CCH's can be found on the OISC website listed in the Appendix.

Private Applicator Certification and Continuing Education

A private fertilizer applicator applies manure from a CFO to their own property. Certification requirements include manure from out-of-state CFO-sized facilities. People who annually apply less than 10 cubic yards or less than 4,000 gallons of manure from a CFO are not required to become certified. Nor do farmers who apply commercial fertilizers, including anhydrous ammonia, to their own land. Application of agricultural lime is excluded from the certification requirements.

Private applicators may take the Category 14 exam at monthly exam sessions at Purdue University, West Lafayette; at regional exam sites for private applicators; or by computer at remote testing sites. If the private applicator holds a current pesticide permit, Category 14 will be added as a rider to their private applicator card. The Category 14 certification has the same expiration as their pesticide permit. No fee will be charged. If the private applicator certifies only as a Category 14, a $20 fee will be assessed for their five-year credential.

> ***CFO Definition and Numbers***
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> *A confined feeding operation (CFO) is any animal feeding operation engaged in the confined feeding of at least 300 cattle, or 600 swine or sheep, or 30,000 fowl, such as chickens, turkeys or other poultry. Animals are fed and maintained for at least 45 days during any year. The Indiana Department of Environmental Management (IDEM) regulates these confined feeding operations.*

Private applicators attend three private applicator recertification programs (PARP) or take the Category 14 exam to recertify at the end of the five-year certification period. County extension educators host the programs and topics can be related to pesticides, soil nutrients, or manure. A $10 fee will be collected at each program if a private applicator wishes to receive recertification credit. Approved recertification programs are posted on the PARP website and listed on the phone line listed in the Appendix.

Supervision

A certified agricultural fertilizer applicator may supervise up to 10 trained employees. The certified applicator is responsible for fertilizer applications made by all noncertified applicators under his supervision; he must ensure that all noncertified employees receive training and that records of the training are kept on file. A training syllabus is in the Appendix of this manual. The supervisor, that is, the certified applicator, must provide the employee with the means and instructions to establish direct voice contact during the distribution or application of fertilizer materials. The supervisor is to contact the Indiana Department of Environmental Management, (IDEM) immediately, to report any spill that could threaten the waters of the state.

Licensed Distributor

Any person (individual, partnership, business, corporation) that only distributes, but does not apply fertilizer materials, must obtain a fertilizer distributor license. A distributor license does not require passing the Category 14 exam. The distributor submits an application for a license and $45 annual fee to the OISC. The distributor license must be renewed annually.

Fertilizer Material Plan

Selecting fertilizer materials and then matching fertilizer application rates to crop needs is essential for optimal crop production. However different crops in different fields require varying amounts of fertilizer materials due to variation in soil types, soil fertility levels, and nutrient needs.

Soil Characteristics

Soil texture is defined by the proportion of sand, silt, and clay. Soil texture affects how well nutrients and water are retained in the soil. An ideal soil contains equivalent portions of sand, silt, clay, and organic matter. Indiana soils vary in texture, making some more productive than others and affecting the potential for nutrient loss.

Soils with more clay, are sticky when wet and hard and clumpy when dry, are better suited for holding nutrients and water until needed by the crop. Sandy soils have larger soil particles and water (and some nutrients) quickly drains through these soils. This condition is called leaching. When nutrients leach below the root zone, they are not available to plants and can enter groundwater.

Organic matter, generally concentrated in the topsoil, improves a soil's capacity for holding water and nutrients. Areas with a shallow layer of topsoil and a water table near the soil surface are prone to groundwater contamination.

The amount of water flow (runoff) across the soil surface is influenced by soil texture, slope of the field, and residue cover. As water flows over soil, it can pick up and carry soil particles, nutrients, and pesticides to surface water. The chance of runoff is greater on steep slopes and unprotected soil surfaces. Fertilizer material applications made to areas saturated from precipitation events increase the chance of runoff as well.

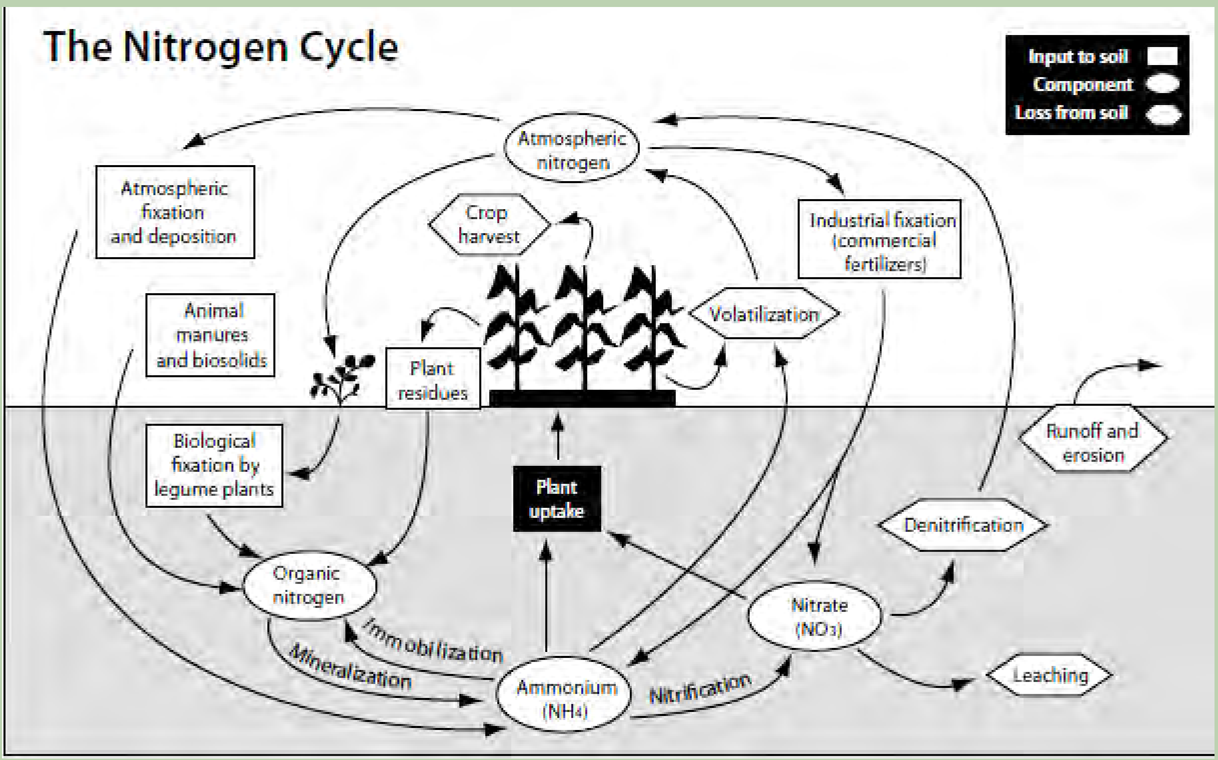
Nutrients

The three crop nutrients applied most frequently to crops are nitrogen (N), phosphorus (P), and potassium (K). These three are also known as macronutrients because they are most likely to be limiting.

Nitrogen (N) Nitrogen speeds plant growth, increases seed production, and improves the quality of leaf and forage crops. Nitrogen is mobile in the soil and must be applied every year to non-legume crops. Plants can take up and utilize nitrogen in the form of ammonium (NH_4) or nitrate (NO_3). Commercial fertilizers contain the ammonia (NH_3), ammonium (NH_4) or nitrate (NO_3) form of nitrogen. Urea is also applied as a commercial fertilizer. Manure contains organic nitrogen which must be converted before plants can utilize it. Manure also contains a substantial amount of NH_4 in the liquid portion of the manure.

Leaching occurs when nitrate-N moves deep into the soil with water. If nitrate-N leaches below the root zone, it becomes a concern for groundwater. Denitrification occurs when nitrate-N is converted into a gas and escapes into the atmosphere. This reaction occurs when soil is water-saturated. Denitrification losses are common on poorly drained soils that remain saturated for days. Ammonium-N can convert to ammonia gas and escape back into the atmosphere in a process called ammonia volatilization. Volatilization is most likely to occur with surface-applied urea fertilizer and manure.

The International Plant Nutrition Institute



Phosphorus (P) Phosphorus plays an essential part of photosynthesis by capturing and converting energy from the sun. Phosphorus loss from the soil generally is not a problem of well-managed applications. Phosphorus is tightly bound to clay particles and can be lost when soil particles erode into surface waters. Phosphorus can be leached through the soil profile, but this happens only on very sandy soils with high application rates of phosphorus. Phosphorus leaching is seldom a problem in the Midwest.

Eutrophication is the slow, natural nutrient enrichment of surface waters that is responsible for the “aging” of ponds, lakes, and reservoirs. Excessive amounts of nutrients, especially nitrogen and phosphorus, speed up the eutrophication process. Rapid eutrophication is associated with increased algal growth. As more and more algae grow in the nutrient-rich waters, then die and decompose, dissolved oxygen is depleted in slow-moving water. This may result in fish kills, offensive odors, and reduced attractiveness of the water for recreational and other public uses. However, this condition occurs only when excessive nutrients are present.

Potassium (K) Potassium is absorbed by plant roots in larger amounts than any other nutrient except nitrogen. Potassium is essential in nearly all processes needed to sustain plant growth and reproduction. Most of the potassium fertilizers are highly soluble in water and are held in the soil by clay and other organic matter. Potassium is not converted to a mobile form by its interaction with water and, therefore, remains close to the initial point of application. Although leaching of potassium is not generally a problem, it can leach in sandy soils.

Fertilizer Material Selection

All fertilizer labels have three numbers that describe the percentages of nitrogen, phosphorus, and potassium. The first number is the percent of nitrogen (N), the second number is the percent of phosphate (P_2O_5) and the third number is the percent of potash (K_2O). A 100 lb bag of 10-10-10 contains 10 lb of each nutrient.

Fertilizer grades are made by mixing two or more nutrients sources together to form a blend consisting of different colored particles. By blending the different components the different grades are produced for different crops to meet that specific crop’s nutrient needs. Fertilizers can also contain just one of the primary nutrients. See the following table for examples.

Fertilizer	Label	Percentage
Ammonium nitrate	33.5-0-0	33.5 % nitrogen
Urea nitrogen	46-0-0	46% nitrogen
Triple superphosphate	0-46-0	46% phosphorus
Potassium chloride	0-0-60	60% potash

Nitrogen Fertilizers

Anhydrous ammonia (82-0-0)

Widely used for direct application, anhydrous ammonia contains the highest nitrogen concentration of all fertilizer sources. It is the slowest of all nitrogen fertilizer forms to convert to nitrate-N. Therefore it has the least chance of nitrogen being lost by leaching or denitrification. Anhydrous ammonia must be injected into the soil to prevent surface volatilization loss. It is frequently applied in the fall to acres that will be planted to corn in the spring. Addition of a nitrification inhibitor, which further slows the conversion of ammonium-N to nitrate-N, may be beneficial where there is a greater potential of leaching or denitrification (e.g., in sandy or poorly drained soils receiving substantial rainfall).

DowAgro Sciences

Many safety features must be followed when handling, transporting, and applying anhydrous ammonia.

Urea (46-0-0)

A relatively high nitrogen concentration and lower production cost make urea one of the most common nitrogen fertilizers used worldwide. Urea readily converts to nitrate-N in the soil profile. Once urea moves beneath the soil surface, the loss of ammonia is mostly eliminated. However denitrification in wet soils after conversion to nitrate-N should be considered. Once converted to nitrate-N it is subject to denitrification and leaching losses. Urea is also highly leachable when in the urea form which lasts only for a short time. Leaching is a potential problem in sandy, course-textured soils.

The Fertilizer Institute

Urea is an excellent nutrient source to meet the nitrogen demand of plants. Because it readily dissolves in water, surface-applied urea moves with rainfall or irrigation into the soil.

Nitrogen solutions

Formulations containing a mixture of the nitrogen from urea and ammonium nitrate are common. Urea ammonium nitrate (UAN), is popular because of its ease in handling, complete solubility, and mixing compatibility with other chemicals. UAN as a nitrogen fertilizer behaves similar to each of the individual components. UAN solutions can contain 28 to 32 percent nitrogen. The nitrate component makes it immediately subject to leaching and denitrification.

Ammonium nitrate

Ammonium nitrate contains 50 percent ammonium-N and 50 percent nitrate-N. The ammonium-N quickly converts to nitrate-N making it a leaching risk, but its low risk of volatilization make it a good choice for surface applications. Availability of ammonium nitrate is becoming more limited due to concerns by Homeland Security regarding its explosive properties.

Organic sources of nitrogen

For many cropping conditions, organic sources of nitrogen can be beneficial. When manure is used as a nitrogen source, it is important to know its nutrient content, expected volatile loss of ammonia, and rate and extent of nutrient release. When manure contains more bedding material, it will release nitrogen more slowly. These slower nitrogen-releasing manures generally provide more nitrogen the second year following the application; this should be considered when applying them.

Phosphate

Monoammonium phosphate (11-52-0)

Diammonium phosphate (18-46-0)

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Monoammonium phosphate (MAP) is a widely used source of phosphorus and nitrogen. It is made of two constituents common in the fertilizer industry and has the highest phosphorus content of any common solid fertilizer.

In most soils, the type of soluble phosphorus fertilizer does not influence plant uptake. The most commonly used dry phosphorus fertilizers are monoammonium phosphate (MAP) and diammonium phosphate (DAP).

Both MAP and DAP are widely used

forms of phosphorus and nitrogen. Both are water soluble and dissolve rapidly in soil with adequate moisture. Upon dissolution, the fertilizer separates again to release nitrogen and phosphorus.

Manure can be an excellent source of phosphorus for plants. When manure is used primarily as a source of nitrogen the amount of phosphorus applied is often three to five times more than many plants require, which can result in excessive phosphorus accumulation following multi-year applications. An alternative is to apply manure to provide adequate phosphorus and then supplement that with additional nitrogen fertilizer to meet crop nutrient requirements.

Potash

Potash refers to potassium compounds and potassium-bearing materials. The most common being potassium chloride (60 to 62 percent K_2O), also referred to as muriate of potash.
Potassium chloride is one of the major sources of potassium fertilizer. Potash varies in color from pink or red to white depending on the mining and recovery process used.

Potassium present in manure and plant residues remains soluble and readily available for plant uptake, similar to commercial potassium fertilizer.

The Fertilizer Institute

Because it is often the least expensive and most abundant potassium mineral in deposits, potassium chloride is the most widely used source of potassium.

Manure Analysis

Manure analyses can vary between seasons, or changes in management practices. Compare results to previous reports and if significantly different, resample the manure.

Each type of manure—cattle, hog, poultry—has its own nutrient content. In order to know the percent of nitrogen, phosphorus, potassium, an analysis by a commercial lab is needed. Lab analyses are presented in a number of ways. The easiest to use is a wet, "as-is" basis in pounds of plant-available nutrient, total nitrogen (available-N and unavailable-N), ammonium (NH_4), total phosphorous (P), and total potassium (K) per ton if solid, or per 1,000 gallons if liquid. Generally the small amount of nitrate-N in raw manure is not enough to include it in crop nutrient decisions. Results reported on a dry basis should be converted back to a wet basis. The equation below can be used to convert dry basis results to wet basis.

Some labs give nutrient results as a concentration in parts per million (ppm) or milligrams per liter (mg/l). If phosphorus and potassium are given as elemental phosphorus and potassium, convert them to the fertilizer basis of P_2O_5 or K_2O.

Nutrient content _____ (wet basis) = Nutrient content _____ (dry basis) x [1- (moisture content (%) ÷ 100)]

Nitrification Inhibitors

Ammonium formed in soil or added as fertilizer is converted to nitrate in the nitrification process carried out by specific bacteria. Nitrification results in the production of nitrate, a form of plant-available nitrogen which is readily lost from soils. Stabilized nitrogen is nitrogen maintained for a longer period of time. This makes nitrogen less likely to be lost by leaching and denitrification and ensures that more nitrogen will be available to plants. **(Refer to nitrogen cycle image page 14).**

Nitrification inhibitors are chemicals that slow down or delay the nitrification process, decreasing the possible loss of nitrate before the fertilizer nitrogen is taken up by plants. Nitrification inhibitors also can be effectively used with liquid animal manures injected into the soil. Examples of products available to inhibit nitrification are N-Serve® and dicyandiamide (DCD).

Another method used in slowing down the release of fertilizer is controlled-release products. Use of controlled-release fertilizers (CRFs) can provide significant benefits in yield and reduce environmental impacts. Some controlled-release products have a polymer shell surrounding the soluble fertilizer (most often urea). The release of nitrogen from CRF materials is controlled by biological activity in the soil or by slowly dissolving in water. This allows a release of fertilizer over a longer period of time.

Application Decisions

Crop nutrient decisions include such factors as timing of fertilizer applications, application methods, best management practices (BMPs), application records, and expected crop yields. Many of these same factors influence how the fertilizer materials interact with the environment.

Time and Place Decisions

Losses of nitrogen and phosphorus in runoff are related to rate, timing, and method of application. Soil characteristics, such as slope and texture; crop management practices; residue or crop cover; and weather during and after application also need to be considered when making application decisions.

Soil incorporation of fertilizer materials decreases runoff potential and conserves nitrogen and phosphorus for the crop. Incorporating manure by injection or field cultivation diminishes odors. Most odor complaints with livestock production are caused by application of manure on the surface. Incorporation of manure into soil avoids many odor complaints. In addition to incorporation, the use of residue cover and cover crops help control nutrient runoff.

Ohio State University

Soil samples can be sent to a laboratory for nutrient analysis to determine the fertility level of a field.

Many Indiana communities rely on surface water as their source of drinking water. Therefore, it is important to know the locations of water supplies in and around where the fertilizer application will occur. Some nutrient applications may include a setback from surface water, including drainage ditches and tile outlets. Wells and sink holes are a direct link from the surface to groundwater and are at risk of contamination from applications of fertilizer materials. Maintaining a setback distance when making fertilizer or manure applications protects groundwater supplies. (see page 62 for a table of setback distances determined by IDEM).

Nutrients should be applied at times that will maximize crop use and minimize loss. Timing is most important for nutrients applied to soils with a high leaching potential.

Lynn Belts, USDA NRCS

Grass filterstrips between crop ground and surface waters not only provide a setback but also protect surface water from eroded soil, nutrients, and pesticides.

Applying fertilizer materials to sandy soils before a crop can use it will likely result in nitrogen loss.

Current weather conditions also must be considered when planning applications. Fertilizer materials should not be applied to saturated soils, after heavy precipitation, or when the soil surface is frozen. Applications made in these conditions increase the potential for environmental contamination and reduce the availability of the nutrients to be used by the crop. Liquid or solid manure must not be applied to frozen or snow-covered ground without residue protection, or cover crop, with slopes in excess of two percent (2%).

Consider neighboring residences when making setback and timing decisions. Developing and maintaining good neighbor relations are important for everyone in agriculture industry. Neighbors most frequently find the odor of fertilizer applications objectionable. A strong odor for a short time (hours) is usually considered less objectionable than a lighter odor for a long time (days). Odors from fertilizer applications can be minimized by injection or immediate incorporation. Avoid making applications on weekends, holidays, or family celebrations. Be aware of public gathering sites such as sports fields, parks, and schools. Schedule fertilizer applications when these areas are not occupied.

Besides odors, dust, and noise can create complaints. It is best to reschedule if an application is to take place during an outdoor event. If asked, reschedule an application for another time or day to accommodate their needs.

Equipment Decisions

Whether applying liquid or dry fertilizer, the goal is to make certain that the correct blend is used and the necessary rate applied in the location where the crop can best utilize the nutrients.

Stahly

Following recommended minimum application rates improves application accuracy; rates vary with the material applied. For example the minimum application rate of a solution of UAN is 10 gallons/acre.

Broadcast

Granular and liquid fertilizers can be broadcast across the soil surface. Granular fertilizer is typically applied with a spinner spreader. Following a minimum application rate of at least 100 lb/acre improves accuracy by ensuring an adequate quantity for the equipment to function optimally. Broadcast surface applications can be followed by tillage to incorporate the fertilizer. Incorporation minimizes runoff and volatilization, but it disturbs the residue cover in conservation tillage systems.

Banding

Banding places the fertilizer, dry or liquid, in a concentrated band where the crop roots can best utilize the nutrients. Banding limits exposure of fertilizer to the soil profile where it can be made unavailable to the crop. On highly erodible ground timing the fertilizer application close to crop utilization is critical. Banding is the preferred method when making spring applications to erodible ground.

Manure Applications

Injection Manure injection systems are designed to place the manure below the surface and cover it with soil. This method of applying manure has many benefits:

- Nitrogen less likely to volatilize
- Nutrients less likely to runoff
- Odor complaints reduced

When injecting manure, application rates should be lower than broadcast rates since very little nitrogen is lost in the air. There also are potential adverse effects of manure injection. In particular, injection can disturb the soil surface, which can significantly affect cover crop residue in conservation tillage systems.

Broadcast Manure applications can be made to surface by these methods:

- Liquid tank spreaders
- Dry spreaders
- Irrigation systems

Each of these systems has two management concerns: applying the manure at the proper rate and achieving uniform distribution. In general, application patterns for broadcast systems tend to be less uniform than for injection systems. For liquid tank and dry spreaders, application patterns typically are high in the center (behind the spreader) and taper down toward the edges. This is especially true for dry box spreaders. To achieve a uniform application and avoid streaked crops, the pattern edges must be overlapped. Good management and equipment calibration is required in all cases to achieve uniform application at the right rate when broadcasting manure.

Emergency Procedure Review

Emergency action plans should be developed to meet current fertilizer material management regulations. A plan should be available and understood by all employees at the farm or retail facility because accidents, leaks, and breaks can happen at any time.

The plan should include:

1. Stop the release of fertilizer material

2. Assess the extent of the spill and note damage

3. Contact the appropriate agencies

4. Clean up the spill

There is no particular order in which the actions are to be accomplished; that will depend on how the situation unfolds. The fertilizer material spilled, the amount released, the area potentially impacted by the spill, all influence the type of response.

The main points of the emergency action plan, and the relevant phone numbers, should be posted by all telephones at the site; and programmed into employees' cell phones. A copy also should be available in remote locations and vehicles. Employees should be able to respond to such emergencies and notify the appropriate person at the farm or retail facility. These individuals are usually assigned the responsibility of contacting IDEM and other agencies.

Dry spills should be swept up promptly and the fertilizer reused as it was intended. With liquid, immediately stop the leak. Then, recover as much of a liquid spill as possible and reuse it as is. Some contaminated soil may be required to be removed and field applied if possible.

Be prepared. Missing, unavailable, and nonfunctional equipment is of no help in an emergency. A spill—can happen to anyone—even to those individuals who exercise safety procedures to minimize the possibility.

Assess the extent of the spill and note any obvious damage. Be prepared to answer the following questions if asked by IDEM.

- What material was released?
- When did the spill occur?
- Did the fertilizer material reach any surface waters?

Contact appropriate agencies

If a spill threatens the waters of Indiana, (IDEM) Indiana Department of Environmental Management must be contacted at:

- In Indiana: (317) 233-7745
- 24 hours-a-day, 7 days-a-week

- Approximately how much was released and for how long?
- Did any damage occur, such as employee injury, fish kills, or property damage?
- Did the spill leave the field being treated?
- Does the spill have the potential to reach surface waters?
- Could future rainfall cause the spill to reach surface water?
- Has any of the spill been cleaned up?

Anhydrous Ammonia Release

Anhydrous ammonia can be used as safely as any other pressurized gas or liquid as long as precautions are closely followed. Most accidents happen when ammonia is moved from the storage tank to a nurse tank. A major cause of accidents is the accidental opening of hose-end valves and quick-couplers. Accidents can occur on the road while transporting. Also, defective hoses allow ammonia to escape without warning. If a leak or release occurs, the area should be evacuated immediately.

Anhydrous ammonia safety tips include:

- Examining all equipment — hitches, hoses, and tanks — before hauling.

- Wearing personal protective equipment. Unvented goggles prevent vapors from entering the eyes; rubber gloves, pants, and long sleeves protect the skin from spills.

- Carrying a cell phone when handling anhydrous ammonia. Program emergency numbers into the phone.

Anhydrous Spill Reporting

1. Anhydrous spills greater than 100 pounds MUST be reported National Response Center EPA 800-424-8802.

2. Anhydrous spills that do not stay within property boundaries, even if the release is less than 100 pounds MUST be reported to IDEM 888-233-7745.

3. Contact the Local Emergency Planning Committee (LEPC). Obtain the local number and list it in the emergency plan and save to employees' cell phones.

4. Stay current on all necessary anhydrous ammonia spill/ leak reports. Some circumstances may require a Hazardous Material Report be filed with Indiana Department of Transportation.

Storing Fertilizer Materials

The Fertilizer Institute

Learning Objectives:

A. Identify storage hazards (e.g. cracks in secondary containment, leaks in tanks or valves).

B. Describe sampling procedures and equipment for different types of fertilizer materials.

C. Identify how to find laboratories where samples can be analyzed.

D. Define stockpiling and staging.

E. Describe runoff problems that might occur from stockpiling and/or staging manure.

F. Identify legal requirements for stockpiling and staging manure.

G. Describe social concerns that might be associated with stockpiling and staging manure.

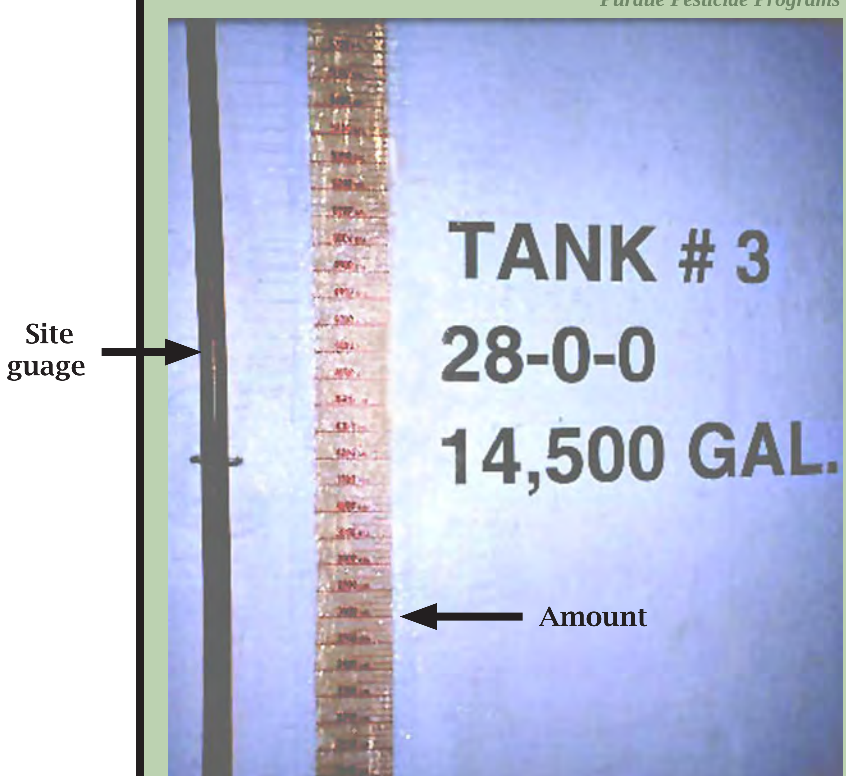
Maintaining and Monitoring Fertilizer Materials Storage

Properly designed facilities promote safe storage and handling. They also protect the environment from possible contamination. An ideal storage facility provides:

- Secure fertilizer storage.
- Containment of spills resulting from normal mixing/loading operations.
- Secondary containment of large, accidental spills or leaks (separate secondary containment for pesticides and fertilizers).
- Facilities for collecting and recycling excess solutions and rinse water.

Bulk Commercial Fertilizer Storage

Purdue Pesticide Programs



A tank labeled with the fertilizer analysis. Also note the external site gauge for monitoring the level of liquid fertilizer.

Bulk fertilizer storage as defined by the OISC is a tank with a rated capacity of more than 2,500 gallons of liquid fertilizer; more than 7,500 total gallons of liquid fertilizer; or dry fertilizer in undivided quantities (piles, not bags) exceeding 12 tons. Any facility storing commercial fertilizers in these quantities must register with the OISC as a bulk storage facility.

Tanks (for primary containment) must be labeled with the fertilizer analysis (e.g., 28-0-0). The external sight gauge on fertilizer tanks must be locked except when checking the liquid levels. Liquid fertilizer storage tanks should be constructed of materials resistant to corrosion, puncture, or cracking. The use of incompatible materials in construction or repair of storage tanks can result in weakened containers, thus increasing the risk of leaks. Tanks should be filled only to the capacity for which they are designed, taking into account the density and expansion of the products being stored. Materials used for valves, fittings, and repairs should be compatible with metals used in storage tanks.

Farmers and agribusiness personnel commonly use plastic tanks for efficient storage and transportation of liquids. These polyethylene tanks, called poly tanks, are popular because they offer design flexibility and are compatible with many liquid products used by commercial applicators, businesses, and farmers. They can be designed so that the amount of liquid in the tank is clearly visible.

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While poly tanks have many benefits, there is a potentially serious drawback: at some point, they will fail. Tanks are not designed to last forever, so it is important to inspect them regularly.

The useful life of a poly tank depends on a number of factors, including the quality of its construction, the product it contains, and whether its specific use is storage or transport. If a poly tank is left outdoors over a period of time, ultraviolet (UV) radiation from the sun degrades the polyethylene, changing it from tough and pliable to hard and brittle, making the tank more prone to breakage. Continued use of such a damaged tank can be a serious economic and environmental mistake.

The diked area (secondary containment) must have the capacity to hold the volume of the largest tank and displacement of any other tanks in the dike. An additional 6 inches of sidewall is needed if the secondary containment is not roofed. Drains and hoses must not be placed through the walls. The floor of the dike must be sloped to allow for the collection of rainfall and spilled material. Pesticide and fertilizer tanks must be held in separate diked areas; however the containment areas for pesticides and fertilizers may share a common wall.

Every component of the facility must be maintained. Examine the dike wall closely for cracks. Inspections should be conducted regularly: before receiving chemicals and at the end of the season, at a minimum.

Before accumulated rainwater is released from the secondary containment, it must be tested to verify that it is not contaminated. Keep the area clean, monitor the level of fertilizer in each tank, and prevent leaks to keep accumulated rainwater free of contamination.

Regulation of dry bulk fertilizer begins at 12 tons. The building storing the dry fertilizer must be roofed, walled, and have a nonporous surface. Stored fertilizer must not come in contact with rainwater. In addition, loading and unloading of dry fertilizer must be done on an impervious surface.

In the field, dry fertilizer can be stored for up to three days. Between 3 to 30 days, the fertilizer must be covered. It is important to select a site that is not near water. After 30 days, dry fertilizer must be stored in a building.

Manure Storage

Liquid manure on Indiana farms is typically stored in one of the following types of structures:

- deep pits under the building floor housing the animals,
- outside below ground earthen or concrete pits,
- outside aboveground tanks,
- treatment lagoons, or
- holding ponds.

Manure is stored until it can be applied to cropland. Manure storage structures must be designed and managed to contain manure and wastewater without discharge. If discharge does occurs, contamination of water sources with excess nutrients results in algae blooms, reduced oxygen levels, and fish kills. Contamination with bacteria and nitrogen also poses a human health risk. While all livestock operations permitted as CAFO's in Indiana must follow the conditions listed in the their current permit, all liquid manure storage structures constructed since 2002 must have at least 180 days or more of storage capacity. This available storage must be able to contain the following:

- manure from the animals;
- any bedding used, if applicable;
- net average rainfall during this time that falls on an uncovered manure storage and on any area that drains into the manure storage;
- expected runoff from a 25-year, 24-hour rainfall event that falls on any area that drains to the storage;
- process wastewater (including excess drinking water, clean-up water, milking parlor wastewater); and
- 2 feet of freeboard if the storage is uncovered.

It should be noted that an uncovered storage structure does not need to include the expected rainfall from a 25-

year, 24-hour rainfall event that falls on the storage surface since the required 2-ft of freeboard should be large enough to contain this in Indiana.

Typically, pits and aboveground tanks are used to store slurry liquids from swine and dairy operations. Underground, steel storage tanks for manure are prohibited in Indiana. Plastic and fiberglass tanks and aboveground tanks must be strong enough to withstand design loads; be water tight; installed well above the seasonal high-water table or anchored to prevent flotation. Aboveground tanks must have shut-off valves for all inlet and outlet pipes, to prevent spills.

Treatment lagoons are earthen structures that store diluted manure for an extended period of time; biological treatment reduces organic matter and nitrogen. Treatment lagoons are sometimes used for dairy, swine, and beef cattle operations. Below ground, outdoor earthen storage areas typically are used to store undiluted manure. Cattle manure typically forms a crust on top, which traps odors within the waste. However no crust forms on swine and poultry manure contained in earthen storage, so it is considered a more significant source of odor.

Agitation of stored manure while removing it for analysis or application can create odors and dangerous gas emissions. Hydrogen sulfide, especially when emitted from manure in enclosed areas, can be lethal. Always keep agitation nozzles below the liquid surface in a deep pit or lagoon, and never agitate manure when the wind is blowing toward neighboring residences.

Fertilizer Material Analysis

Just as storage structures need to be inspected regularly to ensure structure integrity, stored fertilizer materials need to be analyzed by a reputable commercial laboratory to ascertain nutrient content.

Purdue Extension Service compiled a list of commerical laboratories that is available from county offices or the website listed in the Appendix.

Proper sampling is the key to obtaining a reliable and consistent analysis. Samples of dry fertilizer should be taken from different sections and compiled into one sample to be analyzed. Samples should be submitted according to instructions from the laboratory being used; they generally include the facility/farm name and address, date and location of collection, and an identification number and/or code.

Liquid manure should be thoroughly mixed before random samples are taken. Each of several liquid manure samples should be placed in a clean, plastic container and sealed immediately. Most labs require at least one pint of material for analysis.

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A composite sample of fertilizer should be taken for the most comprehensive analysis N, P, K.

Solid manure samples should be representative of the manure's average moisture content. Stockpiled manure should be sampled at a depth of 18 inches and at six or more locations, then combined to make a single sample. Approximately one quart of the mixed sample should be placed in a durable plastic bag, sealed, and packed with dry ice, for immediate shipment to the lab. Poultry cake litter samples should be taken at the depth of cake removal. If samples are going to be stored for more than two days before being submitted for analysis, they should be refrigerated.

Manure Stockpiling and Staging

Stockpiling is a common method of storing solid manure until it can be applied to cropland. This method generally is used by smaller livestock operations, because their size makes a manure storage structure cost-prohibitive.

Stockpiling can be an environmentally safe method of manure storage if the site is well chosen. When rain or melted snow comes in contact with the manure, water can pick up particles and transport them off site. The pollutants can be solids, dissolved nutrients, and pathogens.

Sites where manure is stockpiled must be located and constructed so that contaminated runoff cannot move into ditches and creeks. Permeability of the soil is an important consideration in determining the suitability of a site. Sandy soil is highly permeable, allowing water to leach quickly to groundwater, whereas, dense clay soil types slows the flow of water — and anything dissolved in it — through the soil profile.

The thickness of the soil layers above the water table also factor into site selection; i.e., thicker, unsaturated soil profiles lessen the risk of groundwater contamination.

Sinkholes provide a direct conduit to groundwater; therefore, manure should not be stockpiled within 300 feet of a sinkhole.

Manure staging is the temporary placement of manure (in a pile) at a site where it will be land applied within days. The staging of solid manure is most commonly related to poultry waste. The following guidelines apply to manure generated from a CFO or from a CAFO within the state of Indiana — and to manure brought into Indiana from another state for staging.

Farms too small to qualify as CFOs still must manage manure so it does not cause a discharge to surface water. It is recommended that they follow manure staging requirements to protect local water supplies.

Manure can be staged for 72 hours. If it cannot be applied within 72 hours, it must be effectively covered or bermed to prevent runoff. Note these requirements for staging manure:

- Manure must be staged in an area with less than six percent (6%) slope
- The area must be more than 300 feet from surface water, drainage inlets, and water wells
- Manure must be land applied to the site within 90 days of staging
- Manure cannot be staged in a waterway or in standing water.

Minnesota Pollution Control Agency

Using insecticide to help control flies and beetles may be beneficial at staged manure sites located near public areas.

Maintaining Application Equipment

Jodie Miller, The Ohio State University

Learning Objectives:

A. Explain the proper way to dispose of rinse water and debris following equipment cleaning.

B. List the proper site characteristics to clean equipment.

C. Define the terms pathogen and biosecurity.

Equipment Maintenance

Taking the time to maintain application equipment can result in economic savings by having the job done well the first time. Maintaining equipment can reduce injuries to people and protect the environment from excess applications.

Applicator safety depends on maintaning the equipment in good working condition. Regular checks of tire wear, brakes, and lights can detect problems before a potentially unsafe situation occurs. Inspection of hoses, fittings, couplings, etc. prior to application may mean the difference between a trouble-free day or a day of unnecessary delays, risks, and expenses.

Environmental contamination is another possibility when vehicles are not inspected regularly for proper maintenance. Any source of leaks from the equipment may result in soil or water contamination.

Liquid fertilizer application equipment is subject to high application volumes. Check the pump regularly for wear. Suspension solutions can increase wear and tear on nozzles. Hoses and pipes need to be clean and free of clogs, kinks, and leaks.

Uniform coverage of granular fertilizer depends on the spinners and the gate opening. These points should be examined at each application site.

Cleaning Application Equipment

Cleaning of application equipment is part of regular maintenance. Each farm and facility will have its own protocol on cleaning of equipment. But methods that protect the environment should be followed during the cleaning of equipment. The best method of disposing of leftover fertilizer material and rinse water is to apply it on the application site. An option is to mount a washer system on the equipment and wash it at the application site when the job has been completed.

When cleaning equipment at the application site, consider the following when selecting a location in the field. Cleaning should be done away from surface water and tile inlets, neither should it be done on ground that slopes toward surface water. Choose a location that is not at risk to erosion or prone to leaching.

At the facility clean equipment on the mixing and loading pad. The pad should be equipped with a pump so the rinse water can be collected and land applied.

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By mounting a washer system on the vehicle it can be washed at the application site. In-field cleaning eliminates the risk of carrying residues back to the facility.

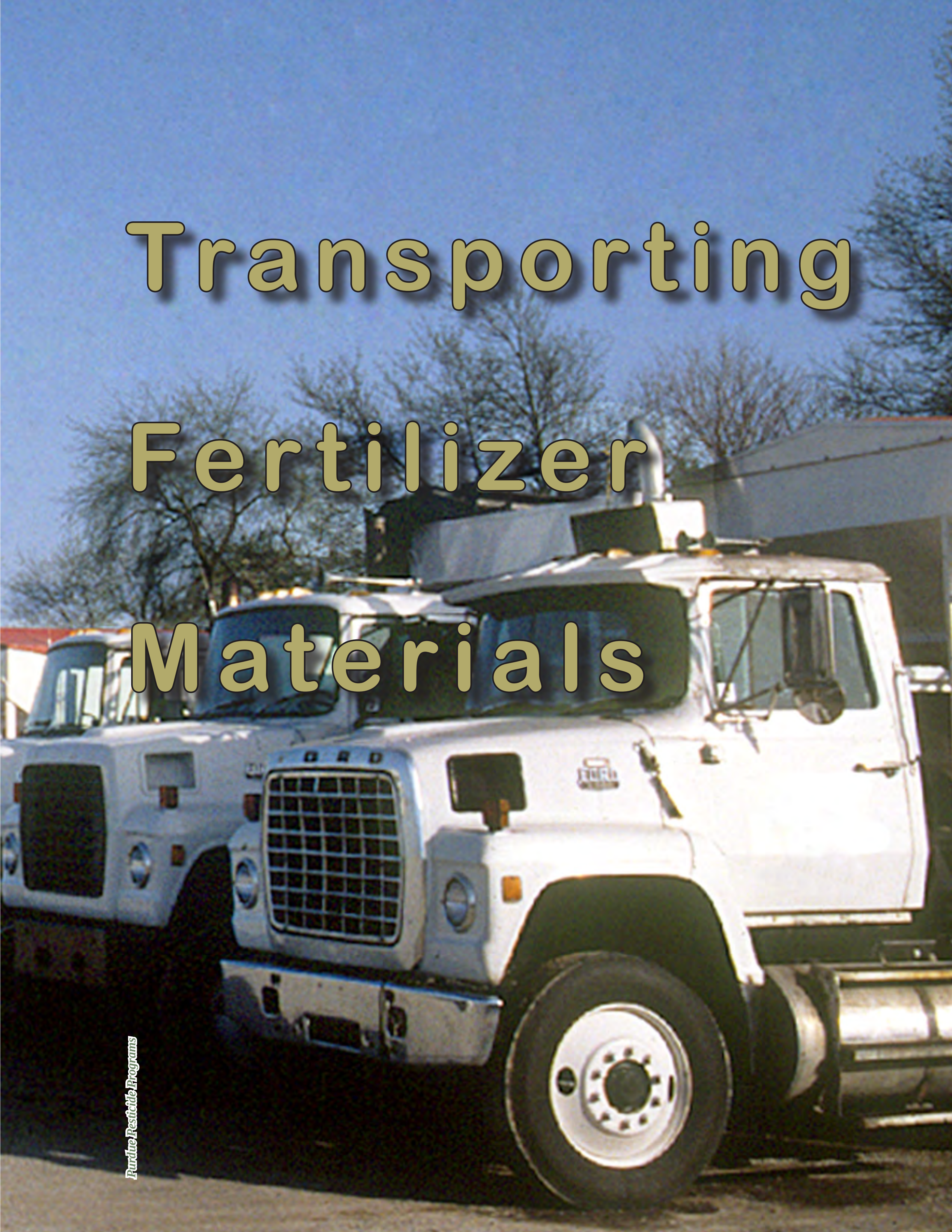
Biosecurity Concerns

Drivers that pick up and deliver manure from an animal feeding operation must follow the biosecurity standards established by that farm. Biosecurity practices are put in place to prevent the spread of infectious disease to and from the farm. Prior to entering the farm, the manure hauling vehicle will be pressure-washed and disinfected. The disinfection assures the removal of pathogens, or disease-causing agents. The cleaning and disinfection includes the undercarriage and tires.

In many cases the driver stays in the truck while the manure is loaded. In other situations the driver may be requested to shower and change clothes before entering.

When all loads from the farm have been picked up and delivered, the cleaning and disinfection process is repeated before the truck leaves. The rinse water is collected and added to manure applications.

Transporting Fertilizer Materials



Learning Objectives:

A. Describe why congested areas and roads should be avoided.

B. Interpret a map index and identify landmarks on a map.

C. Describe optimal transportation times.

D. Identify sources of information regarding local ordinances such as frost laws and over-weight road permits.

Transportation Safety

Safe driving is as important as technical training in all aspects of farming and the fertilizer application business. Consider safe driving training for new employees and refresher courses for everyone.

Courteous and cautious driving should be practiced at all times. Before braking begins, turn signals should be activated well before the turn. Signaling tells drivers behind that the rig will be turning soon and gives them time to prepare. Agriculture equipment is most commonly involved in left-turn collisions and rear-end collisions.

Driving at slow speeds at dawn and dusk can be risky. Placing a slow-moving vehicle sign on the back and using flashers and brights warns other drivers to slow down.

Be aware that application rigs require more gradual braking than other vehicles simply to keep chemicals and equipment from shifting. Gradual acceleration prevents the load from shifting.

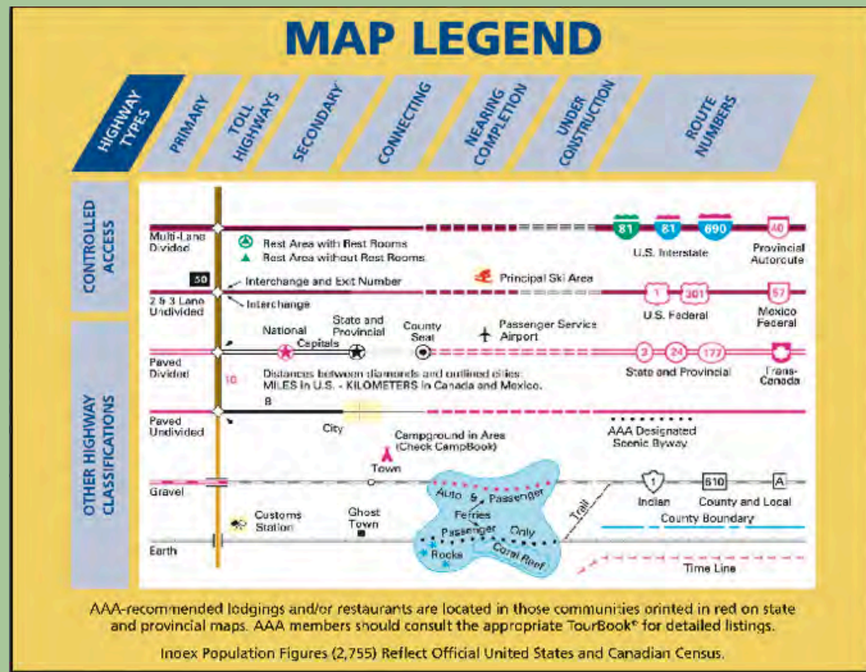
Drivers need to adjust driving speed to weather and road conditions. Low visibility due to fog, rain, and even dust requires a slower driving speed and headlights. Driving too fast on rough, uneven pavement jolts the fertilizer load and application equipment.

Determining the Transportation Route

Drivers should locate the application site before leaving the facility or farm. Computer software can provide maps that show efficient routes and estimates of the time to reach the destination. County plat books are also useful in locating fields as well as directions that include clearly visible landmarks. Determining a route before getting in a vehicle eliminates the need of reading a map or calling for directions while driving.

Area traffic patterns, such as rush hours or school bus routes, go into route planning. Selecting less congested routes or driving at a time when there is less traffic reduces the risk of an accident. Lastly, vehicles and implements of agriculture with slow-moving vehicle signs attached cannot be driven on interstate highways.

AAA Hoosier Motor Club



Common symbols found on map key for Indiana.

Road Restrictions

Road restrictions can include construction detours, road weight limits, high water, and hazardous materials routes. County highway departments can provide up-to-date road restrictions.

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Frost laws need to be adhered to, especially in northern Indiana counties. Frost laws protect county roads from damage caused by heavy vehicles traveling during a time when the roads and the road bases are defrosting. County commissioners are a good source to learn of local roads that fall under a frost law.

It is important to follow posted driving signs. Many rural bridges are not in the best of conditions. Exceeding bridge load limits can cause damage. Cost of bridge repairs are charged to the person causing damage. Check with Motor Carrier Service (MCS) Division of Department of Revenue to see if overweight permit is needed.

Transportation Signage

Many of the vehicles used in fertilizer applications will need a slow-moving vehicle emblem. Vehicles that normally do not exceed 25 miles per hour need to have the sign displayed so it is easily seen by vehicles following behind. The red and orange triangles can be purchased from auto supplies or agriculture supply retailers.

Anhydrous ammonia tanks require the hazard material emblem. It signals emergency responders and other motorists that hazardous materials are being transported.

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The anhydrous ammonia tank displays both the hazardous material (green) and slow-moving vehicle (orange) signs.

Applying Fertilizer Materials

Learning Objectives:

A. Given field size, analysis, and nutrient recommendation, calculate the amount of dry or liquid fertilizer materials needed.

B. Calculate liquid or dry application rate when given applicator capacity, distance traveled, and swath width.

C. Calculate the amount of N, P, and K applied per acre given the nutrient content and application rate.

D. Identify methods to calibrate application equipment (e.g. pan testing commercial fertilizer equipment, manure spreader visual check).

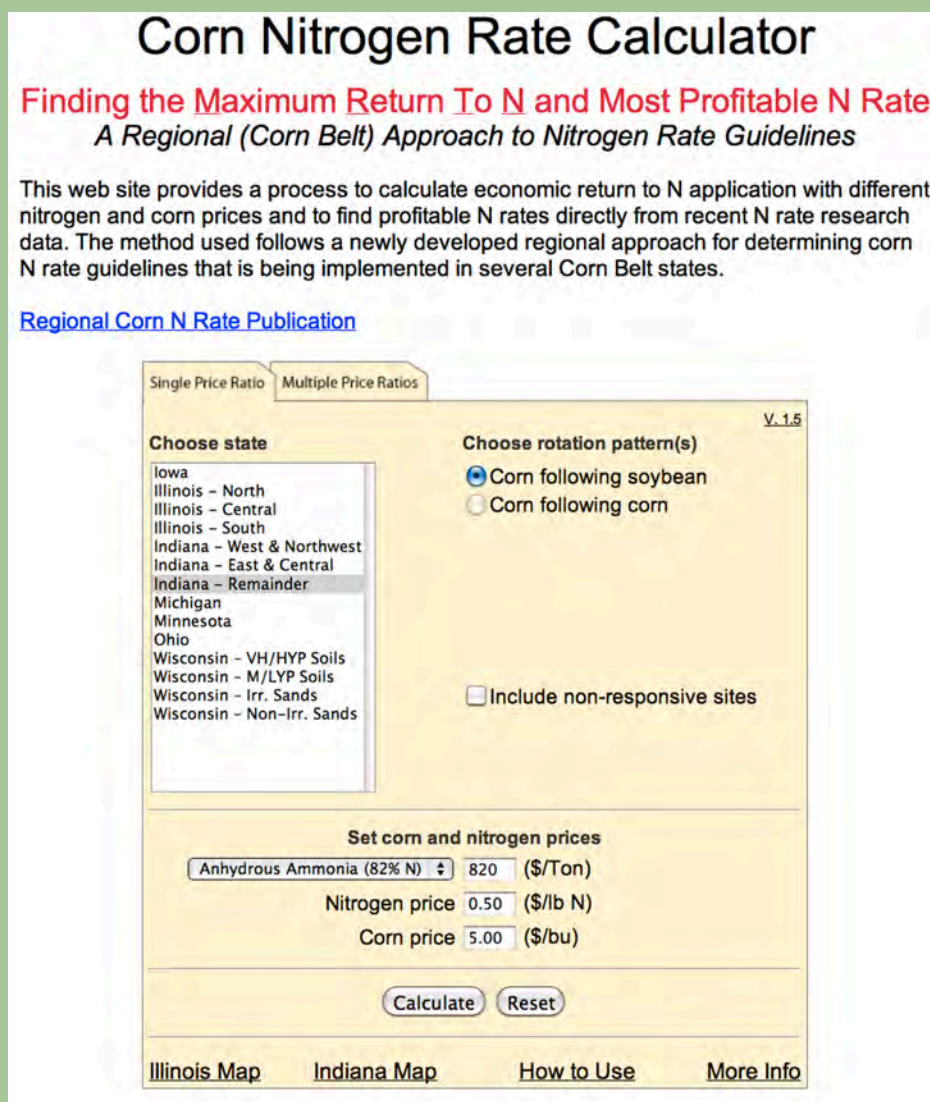
E. List common problems applicators should monitor during operation (e.g. hoses, fittings/couplings).

F. Identify where leaks are most likely to occur on equipment (e.g. hoses, valves, couplings/fittings, tarps).

G. Describe the public benefits of a well-managed fertilizer application program.

Calculating Application Rates

In order to apply the correct rate of fertilizer the nutrient requirements of the crop needs to first be determined. Every crop removes a certain amount of nutrients from the soil depending on the crop and planting population. A soil test measures how much nitrogen, phosphorus, and potassium is available in a field. Resources such as the Tri-State Fertilizer Recommendations and the Corn Nitrogen Calculator are recommended tools to determine nutrient needs of a crop.



url: extension.agron.iastate.edu/soilfertility/nrate.aspx

Understanding the Label

As described in the first section, the fertilizer label posted on each bag and tank of fertilizer represents the percentage of nitrogen-phosphate-potash. A bag of 10-10-10 fertilizer contains 10 percent nitrogen, 10 percent phosphate, and 10 percent potash.

To calculate the pounds of nutrients in a 50-lb bag of 10-10-10 fertilizer:

Multiply 50 by 0.10. Do the same for calculating the amounts of phosphate and potash.

5 lbs nitrogen, 5 lbs phosphate, and 5 lbs potash.

A 50-lb bag of 10-10-10 contains a total of 15 lbs of nutrients. The remaining weight is carrier, usually sand or granular limestone to allow an even distribution of the nutrients.

American Society of Agronomy

This 50 lb bag contains 2 lb of phosphate. [0.04 x 50]

Information Needed To Calculate Application Rate

- The N-P-K content of the fertilizer material
- The required rate for the crop based on soil analysis
- The application area
- The density of liquid if applied

Need To Know Facts

Area = Length X Width (L x W)

1 acre = 43,560 sq.ft.

1 ton = 2,000 lb.

Example: Liquid Nitrogen Fertilizer for Corn

A 500-acre corn field requires 160 lb of nitrogen per acre to be applied. The fertilizer material applied is liquid nitrogen in the form of 30% UAN. A gallon of the UAN weighs 10.86 lb. Determine the gallons and tons needed to treat the area.

Step 1. First determine how much nitrogen is in one gallon of UAN.

lb of nitrogen in one gallon of 30% UAN = 10.86 lb/gal x 0.30 lb nitrogen/lb of fertilizer
= 3.26 lb nitrogen/gal

Step 2. Determine how many gallons of 30% UAN will be needed per acre.

160 lb nitrogen/acre ÷ 3.26 lb nitrogen/gal = 49.1 gallons of 30% UAN/acre

OR

$$\frac{1 \text{ gal}}{3.26 \text{ lb nitrogen/gal}} = \frac{X \text{ gallons}}{160 \text{ lb/acre}}$$

= 49.1 gallons of 30% UAN/acre

Step 3. Determine number of gallons for 500 acres.

49.1 gallons 30% UAN /acre x 500 acres = 24,550 gallons of UAN

Step 4. Calculate the tons needed.

24,550 gallons x 10.86 lb/gal	= 266,613 lb
266,613 lb ÷ 2000 lb/ton	= 133.3 tons

Example: Liquid Manure Application

On a 60-acre field, 100 loads of liquid manure at 30 lb nitrogen/1,000 gallons is to be applied. The manure tank holds 3,000 gallons. Determine the nutrient application rate per acre.

Step 1. First determine how many gallons liquid manure was applied to 60 acres.

100 loads x 3,000 gal/load	= 300,000 gallons

Step 2. Next figure how many gallons were applied per acre.

300,000 gallons ÷ 60 acres	= 5,000 gallons/acre

Step 3. Determine the amount of nitrogen applied per acre.

5,000 gal/acre x 30 lb nitrogen ÷ 1000 gal	= 150 lb nitrogen/acre

OR

$$\frac{30 \text{ lb nitrogen}}{1000 \text{ gal}} = \frac{X}{5000 \text{ gal/acre}} \quad = 150 \text{ lb nitrogen/acre}$$

Using the information from the above example: 60-acre field, 150 lb nitrogen/acre; calculate how many loads will be applied.

Step 1. Calculate how much nitrogen is needed.

60 acres x 150 lb nitrogen/acre	= 9,000 lb nitrogen needed

Step 2. Next determine how much nitrogen per tank. The 3,000 gal tank holds 3 1,000 gal load.

30 lb nitrogen per 1,000 gal load x 3	= 90 lb for each 3,000 gal load

Step 3. Then how many loads.

9,000 lb nitrogen needed ÷ 90 lb/load = 100 loads

Additional calculation examples are listed at the end of this section, page 65.

Calibrating Application Equipment

Properly calibrated and maintained equipment ensures a more uniform distribution of fertilizer materials. This, combined with other conservation practices reduces crop production costs and nutrient movement to nearby surface waters.

Calibrating Liquid Fertilizer Applicators

Sprayers that have not been maintained or calibrated may have problems delivering an adequate flow of liquid nitrogen. Pumps that generate a flow of less than 40 gallons per minute and distribution hoses to boom sections that measure one-half inch or less in inside diameter are probably inadequate on larger sprayers. Centrifugal or roller pumps may not be capable of delivering the high-capacity flows that are necessary, without being overhauled or replaced.

Calibrating Granualar Fertilizer Applicators

Because of varying physical properties of dry fertilizer materials, it is important to consider material distribution across the swath as well as application rate. Granular material is typically applied with a spinner spreader or custom-applied with a pneumatic spreader. Regardless of the method, a well-graded product of uniform size should be used to achieve uniform application. Material of nonuniform size tends to separate during loading of the spreader and later in application. Filling the spreader box with a level fill or pouring many small cones helps to avoid this rolling.

Spreader equipment should have a pattern check conducted of all materials to be applied (especially materials not used previously). This check is accomplished by catching fertilizer material in several pans laid out perpendicular to the spreader's travel direction. Dividers in the catch pans help limit material bouncing out of the pan. The check should be done in low-wind conditions with the spreader driven in the same travel direction as the wind. Multiple passes (always in the same direction) may be required to obtain enough granules to check by weight or volume.

American Society of Agronomy

Spinner blades can become uneven resulting in a non-uniform application.

Application rate in an individual pan may be calculated as follows: Application rate (lb/acre) = (392,000 x **Wt)**/(**L** x **W**)

Wt = weight of material (in ounces) in pan for a single pass; **L** = length of pan (in inches); **W** = width of pan (in inches).

Calibrating Liquid Manure Applicators

To apply manure at proper rates, liquid tank spreaders must be calibrated accurately. To calibrate a spreader the following information is needed

- Tank volume, gallons
- Gear, rpm (revolutions per minute) and PTO speed
- Time, minutes, to unload spreader
- Time, seconds to travel 100 ft, or speed (mph) of tractor
- Spread width, ft.
- Spread length, ft.

1. Determine the spreader's speed by recording the time to travel 100 ft. The following equation calculates the travel speed.

Travel speed(mph) = 68.18 ÷ time to travel 100 feet

2. Measure the application area, length and width, in feet.

3. Determine the application area in acres by multiplying length by width, divided by 43,560 ft^2 per acre.

Application area (acres) = Area [Length (ft) x Width (ft)] ÷ 43,560 ft^2 per acre

4. To calculate the application rate in gallons per acre, divide the spreader capacity in gallons by acres covered.

Application rate for spreader (gal/acre) = spreader volume (gal) ÷ application area (acre)

Example Calibrating Liquid Manure:

A 3,500-gallon capacity tanker applies to an area 35 ft x 350 ft. What is the application rate in gallons per acre?

1. Coverage area (acres) = 350 ft x 35 ft ÷ 43,560 ft^2/acre

   Coverage area = 0.28 acres

2. Application rate for spreader (gal/acre) =

   3,500 gal ÷ 0.28 acres

   Application rate = 12,500 gal/acre

Calibrating Capacity of Box-Type Manure Spreader

The capacity of a box spreader is difficult to estimate accurately because the density of solid manure is quite variable. Density is the weight of the manure per volume of manure (e.g., lb./$ft.^3$). Manure density varies depending on the amount of bedding used. Therefore, spreader capacity estimates that only uses the volume of manure that a spreader holds do not take into consideration that some manure weighs more than other manure. A significant error can occur when calculating manure application rates.

The preferred method provides a reasonable estimate of spreader capacity and accounts for the variability in manure density.

1. Weigh five different spreader loads, using drive-on scales or portable truck scales. Calculate the average weight.

2. Weigh the spreader when it is empty, and subtract this value from the average loaded weight. The resulting value is the manure holding capacity.

Average Loaded Weight — Empty Spreader Weight =
Capacity of Spreader (unit)

If access to scales is not available spreader volume can be calculated by measuring three dimensions of the spreader. Realize that this method is much less accurate than weighing. Fill the spreader and measure the distance from the bottom of the box to the top of the manure load. This measurement is the manure height. Take five measurements and use the average value in the formula.

Length (ft.) x Width (ft.) x Manure Height (ft.) x 0.025 = Spreader Capacity (units)

Application Uniformity

For liquid manure, a line of trays of known weight can be placed equally at 2- to 4-foot intervals across the spreader path. The pans are partially filled with absorbent material, such as cat litter, before weighing to prevent splashing of liquid manure. One spreader pass is made directly over the center pan. The contents of each pan is weighed. The useful spreader width is found by locating the point on either side of the path where the containers received half of the amount in the center container. The distance between these containers is the operative spreader width. For the most uniform applications, this should be the spacing between spreader passes across the field. For solid manure a set of tarps of known size works to capture manure. The procedure is similar to using pans to capture dry fertilizer.

Monitoring Applications

Observation continues throughout the application and at each site. Spread patterns should be checked and the necessary adjustments made when changing fertilizer material or the application rate. Even with proper adjustment, it is difficult to maintain a completely uniform and accurate application rate of granular fertilizer if wind speeds exceed 15 mph.

Proper delivery of fertilizer material to the spinner or boom is necessary for uniform application of granular fertilizer, especially on hillsides and in other adverse field conditions. Accurate spacing of swaths is essential and requires careful driving. A constant ground speed is important for a uniform application with many spreaders.

Liquid fertilizer applicators need to be monitored at each application site for leaking hoses. Rough field terrain and uneven road conditions can jar loose hose connections.

Knives and hoses on anhydrous ammonia equipment need to be updated for uniform nitrogen application. It’s recommended knives all be of the same make, and free of obstructions.

Fertilizer Application Management

The goal of any fertilizer program is to facilitate optimum crop yield to justify its cost and the expense of application.

Proper timing, type, rates, equipment calibration, and placement are essential components of responsible fertilizer application program.

The table below lists the setback distances for manure applications determined by IDEM. The distances can be used as a guideline for commercial fertilizer applications as well. Certain practices that optimize the availability of nutrients in the soil also protect water quality.

A management system which includes crop records increases returns by improving nutrient efficiency. Suggested records for each field include soil analysis; the crop planted and yield; fertilizer material applied and rate; tillage practices; planting and harvest dates; and weather synopsis.

Setback Distances (in feet)

Known Feature	Liquid Injection	Single Pass Incorporation (liquid or solid)	Liquid Incorporation (within 24 hrs.)	Surface Application To Pasture	Surface Application (solid or compost)	Liquid Surface <or = to 6% slope or residue cover	Liquid Surface > 6% Slope
Public water supply wells & public water supply surface intake structure	500	500	500	500	500	500	500
Surface water	25	25	50	50	50	100	200
Sinkholes	25	25	50	50	50	100	200
Wells	50	50	50	50	50	100	200
Drainage inlets	5	5	50	50	50	100	200
Property lines & public roads	0	0	10	10	10	50	50

Taken from the Indiana Confined Feeding Regulation Program, Guidance Manual, presented by Indiana Department of Environmental Management, Land Application of Manure Rule 10. Land Application of Manure

Sample Problems:

1. How many pounds of nitrogen are provided when dry fertilizer at 30-40-0 are applied at 150 pounds per acre?

2. How many pounds of nitrogen formulated at 28% dry are need to provide 150 pounds of nitrogen per acre?

3. How many tons of granular fertilizer (28%) are need to treat 150 acre field at a rate of 80 pounds of nitrogen per acre?

4. How many pounds of nitrogen (28-0-0) is in on gallon of liquid product? (a gallon weighs 11 pounds)

5. How many acres will you have to treat in an area 2,000 feet long x 3,000 feet wide? (one acre is equal to 43,560 square feet)

6. A tank has a 1200-gallon tank is calibrated to apply 20 gallons per acre. How many acres will the full tank cover?

7. A spreader has a 5 ton-hopper which is calibrated to apply 2000 pounds per acre. How many acres can be treated with a full load? (one ton = 2,000 pounds).

8. You put out 175 gallons to a field that measures 80 feed long x 1500 feet wide. What is the amount of gallons being applied per acre?

Answers:

1) 150 pounds per acre x .30 = 45 pounds of nitrogen applied

2) 150 divided by .28 = 536 pounds per acre
You can double check work by multiplying 536 x .28 = 150 pounds.

3) 80 divided .28 = 285.7 pounds per acre (do the reverse to double check. 285.7 x .28 = 80 pounds)

285.7 pounds per acre x 150 acres to treat = 42857 total pounds

42857 total pounds divided by 2000 pounds per ton = 21.4 tons of fertilizer needed for 150 acres.

4) 11 pounds per gallon x .28 = 3.08 pounds of nitrogen in each gallon

5) 2,000 feet x 3,000 feet = 6,000,000 square feet
6,000,000 square feet divided by 43,560 square feet in an acre = 174. 4 acres

6) 1200 gallon tank divided by 20 gallons per acre = 60 acres (Reverse to double check. 60 acres x 20 gallons per acre = 1200 total gallons or the size you started with).

7) 5 tons x 2,000 pounds = 10,000 total pounds that the hopper will hold
10,000 pounds divided by 2,000 pounds per acre = 5 acres

8) 80 feet x 1500 feet = 120,000 square feet

120,000 square feet divided by 43,560 square feet = 2.75 acres being treated
175 gallons divided by 2.75 acres = 63.3 gallons per acre

Appendix

Training Requirements for Noncertified Employees Using Fertilizers Materials for Agricultural Crop Production

The Indiana rule *Certification for Distributors and Users of Fertilizer Materials* (355 IAC 7) allows trained noncertified employees to apply, handle or transport agricultural fertilizer materials under the supervision of a certified Category 14 applicator.

The Category 14 supervisor is responsible for:

- Ensuring that the employee gets the State Chemist approved training.
- Keeping a record of the training provided to employees.
- Providing employees with equipment and instructions to contact:
  - the supervisor; and
  - IDEM to report fertilizer spills and releases that could enter water.
- Making employee fertilizer material work assignments.
- Knowing the status of those work assignments.

The goal of any fertilizer use is to apply or distribute the material in an amount sufficient to meet the nutrient needs of the crop and in a manner and at a time that is protective of water resources.

The above referenced training can be accomplished by the trainer covering the following questions with the noncertified trainees. These questions should allow producers, growers or agricultural retailers to discuss specific policies, practices and procedures with their noncertified employees.

After training, you *[the noncertified employee]* should be able to answer the following questions:

1. Who is my Category 14 certified supervisor? (name & contact information…)
2. How will I contact my supervisor? (two-way radio, pager, cell phone, land-line...)
3. How will I confirm I am at the correct application site? (work order, address, map ...)
4. What items do I need to verify on the work order before leaving the farm or facility? (type, grade & amount of fertilizer material, specific field or location for application or staging...)
5. What personal protective equipment will I need to bring to the job site?
6. What safe transportation practices do I need to consider? (use tarps, load & un-load on impervious surfaces, drive defensively & courteously, obey speed limits, be aware of poor road conditions, know late evening/ early morning transportation hazards….)
7. What are commonly encountered sensitive areas in or around fertilizer delivery or application sites? (lakes, ponds, rivers, streams, drainage ditches, tile inlets/ outlets, wells, sinkholes, frozen/saturated soils, parks, residences, day cares, schools...)
8. What changes will I make to my delivery (staging) or application near sensitive areas? (observe setbacks, reschedule the job when weather permits or neighboring sites are vacant, contact my supervisor or customer regarding alternative delivery/staging location…)
9. How will I confirm the correct application rate? (too much or too little fertilizer left in tank/hopper after covering a known area…)
10. When should I contact my Category 14 certified supervisor? (customer or neighbor complaint, wrong application site, fertilizer spill, traffic accident, unexpected sensitive areas nearby, immediate change in weather, application rate seems off...)
11. What are some common problems with application equipment? (uneven application pattern, clogged or leaky tips, hose/tank leaks...)
12. What are my spill response procedures? (cleanup of a small spill vs. a large spill, supervisor to contact, different protocols for dry/liquid/anhydrous ammonia, IDEM emergency response or adverse incident number for water 1-888-233-7745...)
13. What are my procedures for cleaning application equipment at the end of the day? (over pads, in field, reuse rinse water...)

Remember, you are a professional. Performing like one instills public confidence!

March 21, 2011

Verification of Training for Noncertified Employees Using Fertilizer Materials

This is to verify that the training defined in 355 IAC 7-2-18 and required by 355 IAC 7-3-4 was delivered to the below listed employees on the date indicated. This is to further verify that the questions on pages 1 and 2 of this document were fully discussed with the employees signing this form.

I [we] guarantee that the persons signing below were present for the fertilizer training program in its entirety.

______________________	________	__________________	_______
Signature of Category 14 certified supervisor	Date	Signature of trainer if different from supervisor	Date

(NOTE: A certified supervisor can supervise no more than ten employees at any time.)

The following noncertified individuals were present at this training event on the indicated date:

Printed Name:	**Signature:**
___________________________	______________________________
___________________________	______________________________
___________________________	______________________________
___________________________	______________________________
___________________________	______________________________
___________________________	______________________________
___________________________	______________________________
___________________________	______________________________
___________________________	______________________________

Individuals who falsify or use fraud in creating this training record are subject to penalties including but not limited to fines, certification or license modification, suspension or revocation.

Recommended Online Resources

Confinement Site Manure Applicator Study Guide Notebook. Angela Rieck-Hinz, Iowar State University.
https://www.extension.iastate.edu/store/

Corn Nitrogen Rate Calculator, Iowa State University.
http://extension.agron.iastate.edu/soilfertility/nrate.aspx

Introduction to CFO Program, 327 Indiana Administrative Code Article 16
http://www.in.gov/idem/files/cfomanual.pdf

Livestock and Poultry Environmental Stewardship Curriculum Lessons. eXtension.

http://www.extension.org/pages/8964/livestock-and-poultry-environmental-stewardship-curriculum-lessons

Manure Management Planner
http://www.agry.purdue.edu/mmp/

Manure Testing Laboratories
http://www.ansc.purdue.edu/ManureLocator/TestingLabs.html

Office of Indiana State Chemist
http://www.isco.purdue.edu/pesticide/index_pest1.html

Private Applicator Recertification Program (PARP)
http://www.ppp.purdue.edu/parp/
PARP phone line: 800-319-3090

PAMS – Purdue Animal Manure Solutions
http://www.agriculture.purdue.edu/pams/

Purdue Pesticide Programs
http://www.ppp.purdue.edu

Soil Fertility Section, Purdue University Agronomy
http://www.agry.purdue.edu/ext/soilfertility

Soil Testing Labs
http://urbanext.illinois.edu/soiltest/

The Education Store
http://mdc.itap.purdue.edu

Tri-State Fertilizer Recommendations for Corn, Soybeans, Wheat, and Alfalfa. E-2567. M.L.Vitosh, Michigan State University; J.W. Johnson, The Ohio University; D.B. Mengel, Purdue University.
http://www.extension.purdue.edu/extmedia/AY/AY-9-32.pdf

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