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Experiment Station

Professional Fertilizer Applicator Certification and Training (ProFACT)

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This manual provides the training required of professionals seeking to take the certification exam to become a certified fertilizer applicator in the state of New Jersey. This educational material also satisfies the training standards expected of those professionals seeking to become a trained fertilizer applicator.

Manual for Certified Fertilizer Applicators

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Introduction to the New Jersey Fertilizer Law

Good water quality is important for human, animal, and plant health. Maintaining healthy turf through the proper use of fertilizer is one practice that helps to protect water quality.

However, excess fertilizer containing phosphorus and nitrogen can degrade the quality of freshwater and coastal waterbodies. Excess phosphorus is the primary concern in freshwaters, while nitrogen is the main concern for coastal waters and drinking water supplies.

New Jersey has passed a law regulating the application, sale, and use of fertilizer for turf. This state law pre-empts local municipal ordinances on fertilizer use. Professional fertilizer applicators (as well as homeowners) are required to comply with state rules on fertilizer use. Nitrogen and phosphorus are the specific fertilizer nutrients being regulated; other fertilizer nutrients and liming materials are not affected.

The law was passed to protect all New Jersey surface and ground waters by minimizing nitrogen and phosphorus pollution that may be derived from misapplications of fertilizer to turf (residential and commercial lawns, sports fields, recreational lawns, etc.). Please note that fertilizer is just one of many sources of nitrogen and phosphorus that can impact water quality.

Training Module 1
Nutrient Pollution Hazards to Waterbodies

Why Does Land Development Cause Nutrient Pollution of Water?

Converting forests to farms, suburbs and cities increases the amount of certain pollutants entering waterbodies. The most common of these pollutants are eroded soil, phosphorus, and nitrogen. Affected waterbodies include streams, rivers, ponds, lakes, and coastal waters. There are many factors that contribute to this including:

1. Land clearing disturbs the soil that supports forests, woodlands, and other plants. This disturbance releases nutrients (nitrogen and phosphorus) that are stored in plants and soil. These released nutrients can leach into groundwater or run offsite into nearby surface waterbodies with stormwater. Additionally, exposed soil (bare ground) erodes from rain and wind, which moves the nutrients contained in soil into waterbodies.
2. There is greater nutrient input into urban and farm ecosystems. There are many sources of nutrient input into urban and farm lands. Sources include: fertilizer applied the lawns, gardens and farm fields; the food we eat and wastes generated; animal feed and wastes generated; fuel for vehicles, equipment and power plants; and nitrogen added to the soil by leguminous plants like clover, black locust, and soybeans.
3. On developed lands, the drainage infrastructure often increases the movement of water runoff, soil, and nutrients into waterbodies. Therefore, more stormwater runoff comes from land that has been converted to urban and suburban uses than from the original forested land. Land converted to roads and highways, residential dwellings, commercial buildings, and dense urban

areas typically have compacted soil and land contours that are designed to rapidly shed water and channel it away.

4. Plants (including turf) growing in shallow compacted soil will require more fertilizer and irrigation to survive.

The consequence of all this is greater runoff transporting more soil and nutrients into nearby waterbodies.

Nutrients Required by Turf

Plants require 16 essential elements for growth. Oxygen, carbon, and hydrogen are non-mineral nutrients that plants get from the air and water. The other essential nutrients are largely taken up by plants from the soil and many are applied as a component of fertilizers.

These include:

– Nitrogen (N)	– Iron (Fe)
– Phosphorus (P)	– Copper (Cu)
– Potassium (K)	– Boron (B)
– Calcium (Ca)	– Chlorine (Cl)
– Magnesium (Mg)	– Manganese (Mn)
– Sulfur (S)	– Zinc (Zn)
	– Molybdenum (Mo)

Nitrogen, phosphorus, and potassium are typically the nutrients applied in the largest amounts in fertilizers to turfgrass, other landscape plants, and crops. <u>Both nitrogen and phosphorus from improper or excessive fertilization can harm waterbodies</u>, including freshwater lakes and rivers, coastal waters, and groundwater.

What Happens to Nutrients After the Application to Turf?

Turf cover of soil actually protects water quality by reducing runoff and soil erosion. Less runoff means there is less risk for nutrients and sediment to move off landscapes and pollute water. The source of sediment is soil that is eroded from a field or landscape, usually due to a lack of vegetative cover or other cover protecting the soil.

The goal of applying fertilizer is to have nutrients taken up by plants (and other soil organisms) for growth or storage in the soil for later use. When properly applied, fertilizer nutrients help to maintain and, in some cases, improve the effectiveness of turf at reducing nutrient runoff and soil erosion.

Depending on how nutrients are applied to turfgrass the outcome may be:

Good: Taken up by plants and other soil organisms
Good: Stored in the soil on clay particles and organic matter

Bad: Runoff into water or with soil erosion
Bad: Leach into ground water when water carries nutrients below plant roots
Bad: Volatilize – nitrogen can convert to a gas and be lost to the air

How do Nutrients Move from the Land into Water?

Bare soil is easily washed away with stormwater runoff into waterbodies. Soil contains many nutrients including nitrogen and phosphorus. Soil erosion from suburban and urban landscapes is a more common and more important source of water quality problems than most people realize. It is important to not leave bare soil exposed to intense rain or to flowing water from stormwater runoff. Protect soil with a perennial vegetative cover such as turf. Other protective covers for soil include temporary vegetative cover, mulch, river stone, sea shells, and erosion control blankets.

The risk for nitrogen and phosphorus movement is greater whenever soil is wet or frozen or fertilizer is mistakenly applied to hard (impervious) surfaces. As a result, nutrient losses from turf are more likely to occur during winter precipitation when soil conditions are very wet and nutrient uptake into plants is slow. During these conditions excess water will often follow one of two paths. 1) Water may run downhill across landscapes and impervious surfaces into the storm drain system or directly into surface waterbodies. This is called 'runoff'. 2) Water may percolate into the soil past the root zone of plants moving downward to ground water. Ground water can then move into streams, rivers, lakes and coastal water as well as drinking water supplies. Nitrogen and phosphorus are more likely to move with excess water whenever a fertilizer application occurs at the same time that stormwater creates runoff or percolation.

Phosphorus from fertilizer can move away from where it was applied with stormwater in several processes:

1. attached to eroding soil particles,
2. dissolved in water runoff, and
3. leached through the large channels of the soil into drainage pipes.

<u>Of these processes, soil erosion is the process that creates the largest amount of phosphate pollution in waterbodies</u>.

Phosphorus losses from landscapes increase when the volume of water runoff is large. And water runoff from a landscape increases when the soil is very wet (saturated) or frozen.

Nitrogen, especially nitrates, can be carried along with water as it moves down through the soil. This process is called ‘leaching’ of the nitrogen. Leaching losses of nitrogen from turf are predominately caused by winter precipitation when soil conditions are very wet and nitrogen uptake into plants is slow. <u>Landscapes with shallow ground water and soil sandy have a greater risk for leaching.</u>

While some quantity of nitrogen and phosphorus occurs naturally in all waterbodies, human activities can increase the amounts to levels that are harmful for people and ecosystems.

What are the Risks of Excess Nitrogen and Phosphorus in Water?

Too much phosphorus in a lake or river (freshwater) can cause <u>excessive growth of algae and aquatic weeds</u>. This excess of plants <u>interferes with using the waterbody for recreation</u> such as swimming and boating. Furthermore, an excess of plant growth in a lake can deplete the oxygen in the lake, causing harm or death to fish and other animals in the lake. A term used to describe surface waters with excess algae and weeds is "eutrophication." Eutrophication is really a state of increased biological production; that is, the excessive growth of algae, plants, and weeds due to the increased amount of available nutrients in the water. This can happen naturally over a long period of time, but it may happen "unnaturally" (more rapidly) if a waterbody receives excess nutrients.

Nitrogen, on the other hand, can be problematic in coastal waters and in ground water. Nitrogen can move away from where it was applied, moving with either stormwater runoff from rain or with water flowing through the soil. If the nitrogen eventually reaches a coastal bay, estuary, or gulf, it acts similarly to how phosphorus acts in a lake: stimulating the growth of plants and leading to a low-oxygen condition that can kill fish and otherwise harm the coastal ecosystem.

High concentrations of nitrogen in ground water are a concern because people rely on ground water as a source of drinking water, and high amounts of nitrate-nitrogen in drinking water can be harmful to human health. Nitrate-nitrogen in drinking water can cause "blue baby syndrome", where the nitrates interfere with the blood's ability to carry oxygen. Because of this, pregnant women, infants, and people with certain medical conditions should not drink water with high amounts of nitrate. Similarly, high nitrates in drinking water can be harmful to young animals and livestock.

When and Where Does the Law Restrict Fertilizer Application?

To avoid runoff and leaching of fertilizer nutrients intended for plant health, don't apply fertilizer to surfaces where they can't be absorbed, when soil conditions are very wet or frozen, and when nutrient uptake into plants is slow. This is the basis for prohibiting fertilizer application as directed in the law:

- Applications are prohibited before and during heavy rain and whenever soil is saturated or frozen.
- Applications to impervious surfaces are prohibited and any fertilizer accidentally applied to impervious surfaces must be swept up and removed. Impervious surfaces include driveways, sidewalks, streets, porous pavement, paver blocks, gravel, crushed stone, decks, patios, elevated structures, and other similar structures, surfaces, or improvements.
- Nitrogen and phosphorus fertilizer cannot be applied within 25 feet along waterbodies. The 25-feet distance constitutes a buffer area around the waterbody. This buffer distance can be reduced to 10 feet if the application is directed; see Training Module 3 for more detail. One "rescue treatment" per year is allowed to turf between 10 and 25 feet of a waterbody.
- Applications are prohibited after December 1st and before March 1st for professionals. Applications by homeowners are prohibited after November 15th and before March 1st.

Training Module 2
Best Management Practices for Nutrient Management of Turf

Best management practices (BMPs) for nutrient management in turf refer to all effective and practical methods that assure efficient utilization of nutrients. BMPs are based upon the specific needs of a site. Turf managers should continually improve their understanding and use of all BMPs.

Soil Properties and Relationship with Nutrient Loss and Erosion

There is a strong connection between soil and water quality. Soil is often considered a "water purifier" as water passes through it resulting in relatively clean groundwater. But soil can contribute to water pollution when it is not stabilized in the landscape. For example, when there is sparse vegetative cover. Soil erosion pollutes water with "suspended solids" as well as the fertilizer nutrients and other potential contaminants contained in soil. Therefore, it is important to prevent soil erosion.

Improving soil in urban landscapes through better soil structure and organic matter greatly reduces the amount of fertilizer and irrigation needed. Better infiltration capacity of soil reduces the amount of stormwater runoff and, as a result, nutrient pollution of waterbodies.

Practices that improve soil structure, reduce compaction, improve organic matter content, and prevent soil erosion are perhaps the cheapest and most effective strategies for improving water quality and conserving water supplies.

A complete vegetative cover of soil (for example, turf) maintains and improves infiltration of rain, stabilizes the soil and retains nutrients and other contaminants, which, in turn, reduces runoff and pollution of water.

Visit http://profact.rutgers.edu/Pages/training_module.aspx?CID=22 for more information.

Turfgrass Species Selection

Select and use turfgrass species and varieties that are adapted to the site conditions such as shade, poorly drained soil, sandy soil, and intense use.

Tall fescue and fine fescues should be considered for turfgrass seed blends or mixtures when establishing new turfs or renovating older turfs. Tall fescues and fine fescues have a lower need for fertilization (nitrogen) compared to Kentucky bluegrass and perennial ryegrass. Many turf areas in New Jersey are well suited for these species. Information on the best adapted turfgrass varieties and tolerance to important pests and drought conditions can be found at Rutgers New Jersey Agricultural Experiment Station (www.njaes.rutgers.edu/pubs/subcategory.asp?cat=5&sub=35) and the National Turfgrass Evaluation Program (www.ntep.org).

Planting and Establishment Practices to Prevent Nutrient Loss and Erosion

Nitrogen and phosphorus loss and soil erosion are substantial risks on sites that do not have vegetative cover protecting and stabilizing the soil against the erosive forces of rain and moving water. Thus, there is great risk on landscape construction and re-construction sites before vegetative cover is established.

Examples of best management practices for establishment of turf include:

- Till phosphate fertilizer into the soil before planting or wait until after seedling emergence to apply phosphate fertilizer and then apply only a small amount (≤ ½ pound of available phosphate per 1,000 square feet of turf).
- If a soil test indicates a large need for phosphate, apply ≤ ½ pound of available phosphate per 1,000 square feet of turf every two to four weeks until the recommended quantity is achieved.
- Apply nitrogen "lightly and frequently". For example, ½ pound rate of nitrogen per 1,000 square feet every two to four weeks as the new turf covers the ground and becomes rooted.
- Stabilize soil with weed-free straw, spray tack, hydromulch, mulch pellets, fiber blankets, sod, etc.
- Establish vegetative "buffer strips" of sod or fiber blankets across and at the bottom of slopes of new seedings to slow water movement that may occur over the site and to filter sediment and nutrients from flowing water.
- Irrigate new seedings or sodded areas lightly and frequently to prevent runoff and soil erosion.

Visit http://profact.rutgers.edu/Pages/training_module.aspx?CID=3 for more information.

Management Practices to Prevent Unwarranted or Over-Application of Nutrients

- Test soil to determine the amount of phosphate to apply with a fertilizer. Applying the proper amount of phosphate, if needed, is important because excessive and improper application of phosphorus fertilizers increases risks to water quality. There is no difference between an inorganic and organic phosphorus fertilizer sources regarding phosphorus runoff losses.
- Water soluble nitrogen fertilizers, especially nitrate, have a greater leaching potential than slow release nitrogen. Avoid applying high (greater than 0.7 pound per 1,000 square feet) rates of water soluble nitrogen to reduce leaching risk.
- Use fertilizer with slow release nitrogen when applying more than 0.7 pound of nitrogen per 1,000 square feet to minimize leaching risk. Slow release nitrogen also reduces the risk of "burning" plants at higher nitrogen fertilization rates.
- Do not apply nitrogen or phosphate fertilizer during late fall or winter. Soil will frequently be very wet (saturated) or frozen, conditions conducive to runoff and leaching.
- Fertilizer should not be applied while turf is dormant. Dormant vegetation is not able to uptake nutrients. Nutrients applied at that time could be easily lost in runoff or leaching during intense rain.
- Monitor weather forecasts for impending intense rain storms that would generate runoff or leaching and avoid scheduling fertilizer applications immediately before those events.

- Avoid spreading fertilizer onto non-target areas such as buffers and impervious surfaces. If misapplied, immediately sweep up or blow fertilizer into turf.
- All fertilizer spills should be cleaned up immediately.
- Perform field calibration checks of application equipment to ensure accurate application amounts and placement. See training module 4 for more details.
- Establish buffers in sensitive areas (waterways, wells, impervious surfaces, pond/stream edges) where fertilizer will not be applied. Buffers function as a water quality treatment structure, that is, reduce the amount of runoff or filter sediment and/or nutrients. Care must be taken to avoid loss of vegetative cover in buffers; otherwise exposed soil will be subject to erosion resulting in severe nutrient and sediment loading of nearby waterbodies.
- Maximize the effectiveness of nutrients by improving the soil conditions with amendments, aeration, topdressing, and vertical mowing when necessary.
- Unfortunately, recommendations for rates and timing of nitrogen fertilization cannot be determined from soil testing. Other factors are used to develop recommendations for nitrogen fertilization including:
  1. Function of Turf
  2. Age and Vigor (health) of Turf
  3. Owner/User Expectations (color, density, weeds, etc.)
  4. Time of Year
  5. Current Soil Fertility Level
  6. Mowing
  7. Irrigation Availability

  See table on page 8 and accompanying footnotes for more details. For large acreage sites with more than one type of turf, it is important to develop a separate nitrogen fertilization plan for each type of turf based on these factors.

Guidelines to Develop a Nitrogen (N) Fertilization Schedule for Established Turfs

The age, function, vigor (health), and maintenance practices of a turf are major factors influencing the need for nitrogen and must be determined for each site/turf. Older turfs typically require less nitrogen fertilizer. Assessment of function, vigor, and management intensity should include mowing, traffic (intensity of use), stress levels, soil compaction, pest pressure, irrigation, and other factors. Proper use of the data in the table below requires an understanding of and adherence to the accompanying footnotes below the table. Turf managers and applicators have observed that applications of ½ rates often provide acceptable results.

		Timing of Applications				
Type of Turf	Annual[1]	mid-March to April[2]	May to mid-June[3]	late June to early August	mid-August to mid-September[4]	late September to mid-November[5]
General Turf (mowed ≥ 1-inch)	pounds of N per 1,000 square feet					
Irrigated, clippings removed	1 to 4¼	0 to [1]	½ to {1}	not required	½ to (1½)	0 to (1¼)
Irrigated, clippings not removed	1 to 3	0 to [1]	0 to ½	not required	½ to (1½)	0 to (1)
No irrigation, clippings not removed	0 to 2	0 to [1]	not required	not required	0 to (1½)	not required
Zoysiagrass	0 to 2	0	0 to {1}	0 to {1}	0	0
Utility Turf no irrigation, infrequent mowing	0 to 2	0 to ½			0 to (1½)	
Sports Turf	1 to 4¼	½ to [1]	0 to {1½}	0 to {1}	½ to (2)	0 to (1½)
Golf Course Turf						
Putting Green	1 to 4¼	¼ to [1]	¼ to {1¼}	¼ to {1¼}	¼ to (1)	0 to (1)
Teeing Ground	2 to 4¼	¼ to [1]	½ to {1½}	¼ to {¾}	½ to (1½)	½ to (1)
Fairway	1 to 3	0 to [1]	½ to {1½}	0 to {¾}	½ to (1½)	0 to (1¼)
Rough	0 to 2	0 to [1]			0 to (1½)	
Naturalized Areas	0	Not recommended except for extremely poor soils. If fertilized, use low analysis natural organic material.				

[1] State law restricts the annual amount of N applied to 4.25 pounds per 1,000 square feet. Use ½ rates for older (mature) healthy turfs that have been properly managed for many years and receive low to modest amounts of traffic (use/play), especially older turfs with 6% or more soil organic matter content. Use rates at the higher end of recommended range for turf that receives intense use (traffic) or is recovering from other forms of damage such as goalmouths, teeing grounds, localized soil quality problem areas, etc. Improvement of soil before establishing turf will dramatically reduce the need for N fertilization.

(Table footnotes continued on next page)

(Table footnotes continued)

- State law limits the amount of water-soluble-nitrogen that can be applied to turf in a single application to 0.7 pounds per 1,000 square feet.
- To avoid nitrogen leaching on very sandy soils, do not fertilize turf at more than ½ to ¾ pound of nitrogen per 1,000 square feet in a single application unless a fertilizer containing sufficient slowly available nitrogen is used to limit the water soluble portion to no more than 0.7 pound per 1,000 square feet. Applications nearer to the ½ pound rate may be better for sites where leaching concerns are great.
- Fertilizer should not be applied near waterbodies or impervious surfaces where rain can wash fertilizer nutrients into waterbodies. Excess nutrients entering streams, ponds, lakes, and estuaries will lower water quality.

[2] March–April nitrogen application(s) may not be needed if you fertilize late in the season (September to mid-November) the previous year. When spring green-up and growth is satisfactory, delay fertilization until May or June, or possibly do not apply spring fertilization. To avoid excessive growth during mid to late spring, use a slowly available source of nitrogen (natural organics, sulfur-coated urea, polymer-coated urea, methylene urea fertilizers, etc.). New Jersey law prohibits N application before March 1st and restricts a single application to no more than 1 pound of nitrogen per 1,000 square feet and nitrogen fertilizer must contain sufficient slowly available nitrogen to limit the portion of water soluble nitrogen to 0.7 pound per 1,000 square feet; application rates shown in [ ].

[3] To avoid excessive growth during late spring and approaching the stressful summer months, use a slowly available source of nitrogen (natural organics, sulfur-coated urea, polymer-coated urea, methylene urea fertilizers, etc.), especially for amounts greater than ½ pound of nitrogen applied per 1,000 square feet of turf or split quantities greater than ½ pound of nitrogen into two or more applications; application rates shown in { }.

[4] When applying more than 1 pound of N per 1,000 square feet during this time period, it is best to split the quantity into two or more applications. New Jersey law restricts a single application to no more than 1 pound of nitrogen per 1,000 square feet and nitrogen fertilizer must contain sufficient slowly available nitrogen to limit the portion of water soluble nitrogen to 0.7 pound per 1,000 square feet; application rates shown in ( ).

[5] Apply only when grass is still green. Do not apply if grass is dormant (brown). If aesthetics (green color) is the primary objective for late season fertilization, consider applying micronutrients [iron (Fe) and/or manganese (Mn)] to reduce the amount of nitrogen applied at this time by as much as 25%. Use greater nitrogen rates where denser turf cover is desired or turf requires recovery from extensive play (wear). When applying more than ¾ pound of N per 1000 square feet during this period, it is best to split the quantity into two or more applications. If splitting the quantity into two or more applications is not feasible, New Jersey law restricts a single application to no more than 1 pound of nitrogen per 1,000 square feet and nitrogen fertilizer must contain sufficient slowly available nitrogen to limit the portion of water soluble nitrogen to 0.7 pound per 1,000 square feet; application rates shown in ( ). Note that, according the New Jersey law, the latest date that fertilizer can be applied is December 1st for professional applicators (November 15th for home owners).

- Late fall applications should not contain phosphorus; late fall applications of phosphorus increase the risk of phosphorus runoff. Fertilization to correct deficiency in the soil is best done before late fall.

Irrigation Management to Prevent Nutrient Transport with Runoff and Leaching

Over irrigation may be the most important cultural practice that results in excessive N leaching and more P runoff during the growing season.

- Irrigation should be managed to keep the soil dry to moist (not wet) so that water will infiltrate and be stored in the soil rather runoff or leach through the root zone.
- Irrigate lightly after fertilizer is applied to dissolve it into soil and promote nutrient uptake by turf. Irrigation intensity should be low enough to allow infiltration and avoid ponding or runoff.
- Irrigate turf as needed based on weather (evapotranspiration) and soil water availability and not on a calendar schedule. Irrigation controller technology should be optimized to ensure efficient application of irrigation water. Rainfall sensors on shutoff valves should be used with irrigation systems to avoid excessive application of water that would result in runoff or leaching. If you don't have ready access to data from a weather station, the Northeast Climate Center (http://www.nrcc.cornell.edu/grass/) summarizes weather data for NJ and other states, which can be used to estimate the need for irrigation. Estimates will be improved if you have data from a local rain gage to refine the estimated need for irrigation.
- Use hand-held irrigation methods whenever feasible to manage small, localized dryness in turf rather than automatic irrigation systems to avoid over-application of water.
- When feasible, direct surface water runoff to catch basins or ponds that recycle water back to irrigation holding ponds, rain gardens, or bioretention basins.
- More detailed descriptions of irrigation management are available in Rutgers Cooperative Extension publications FS555 (Best Management Practices for Watering Lawns) and E278 (Best Management Practices for Irrigating Golf Course Turf). Both publications are available at www.njaes.rutgers.edu/pubs/.

Mowing Practices Related to Nutrient Management

- Leave grass clippings on the turf and other organic materials in place whenever feasible.
- Do not discharge grass clippings onto impervious surfaces where clippings may be washed into a stormwater drainage system or directly into surface waterbodies. Remove tree leaves, grass clippings, other plant debris, and uncontained soil and composts from impervious surfaces where leachate would be discharged to surface waterbodies.
- When feasible, use turf clippings for compost, mulching, or as a soil organic matter supplement. This recycles the nutrients in the clippings and eliminates the need to dispose of clippings as a nutrient resource when feasible.
- Do not mow turf during periods of severe plant stress or pest pressure.
- Mowing frequency should increase during rapid, vigorous plant growth and decrease during dry stressful periods. Cutting height should dictate when mowing is performed so that no more than ⅓ of the grass blade is removed. For example, a lawn maintained at two inches (height of cut) should be mowed when the leaf growth reaches no more than three inches tall.
- Mow at the highest acceptable height. Higher mowing reduces the need for irrigation and risk of over irrigation.

Mixing and Loading Practices

Take care to avoid spills while mixing and loading fertilizer. Spills should be cleaned up immediately. Regular spills of small quantities in the same place or on paved surfaces with the potential to wash-away put water quality at risk.

- Park fertilizer equipment on level ground. Avoid slopes that lead to open water or stormwater drainage features.
- Avoid mixing and loading fertilizers near a well, surface waterbody, drainage feature, or paved surface that drains into a stormwater drainage system. Stay 100 feet or more downslope from any well.
- Place a tarp under fertilizer spreaders and hoppers when mixing and loading granular fertilizers to contain spills.
- Have brooms, shovels, and buckets available for immediate cleanup.
- Sweep small spills off trailers and hoppers onto the tarp and collect for distribution to intended target (turf).
- Mix and load liquid fertilizers on an impervious pad with containment slope/curb and a sump that allows collection and transfer to storage. Avoid mixing and loading on impervious surfaces (driveways, streets, parking lots) that drain into a stormwater sewer system or surface waterbody. Mixing and loading above a clay surface is better than sand or gravel; sand and gravel allow the fertilizer to quickly soak through the soil. Sandy soils are more vulnerable to leaching of nutrients than clayey soils.
- Use a water source for mixing liquid fertilizers that is separate from a well to fill the sprayer tank; for example, a separate water tank. Anti-back-siphon devices on wells are required by New Jersey law. Do not put the hose into the spray tank; leave an air gap of 6 inches between the hose and top of the tank.
- Always supervise filling of the sprayer.
- Consider a closed handling system which transfers the fertilizer directly from the storage container to the spray tank through a hose.
- Use rinsate for mixing subsequent loads or apply the rinsate to the turf.
- Limit the number of fertilizer transfer/loading sites within a facility whenever feasible.

Spill Cleanup

All personnel handling and applying fertilizer should have a copy of standard operating procedures (SOP), which describes the procedures for fertilizer spill response. The fertilizer spill SOP should identify personnel responsible for clean-up and the chain-of-command for documenting remedial actions. Prepare an emergency response plan for the site(s). You should assess where runoff will go, how to handle your particular fertilizers, and whom to call for help.

In the event that a fertilizer spill does occur, the following steps should be taken:

- Contain spills on tarps placed under loading trailers and application equipment receiving the fertilizer.

- Have buckets and shovels available for immediate clean-up of dry granular fertilizers.
- Have absorbent materials available for immediate clean-up of liquid fertilizers.
- Sweep small spills off trucks, trailers, and hoppers onto the tarp and distribute this material within the intended target field.
- Dry impregnated fertilizer is considered a pesticide; if spilled, it should be swept up and applied to the turf as it was intended. Dry impregnated fertilizer is fertilizer that contains a pesticide, and so is considered a pesticide, and should be also treated as a pesticide.
- For liquid spills, recover as much of the spill and reuse as intended, if feasible. Use absorbent materials for use in recovering small spills. There are numerous gel and clay-based granules as well as absorbent pads and towels available on the market.
- Report spills of any amount into streams or lakes. Report spills of more than 50 gallons on the soil or a mixing/loading pad. Smaller quantity spills should be reported if these could cause damage because of the nature of the material or spill location.
  - To report, call the 24-four Emergency Hotline of the New Jersey Department of Environmental Protection (DEP) at 1-877-WARNDEP / 1-877-927-6337
  - Remove the spilled material and contaminated soil and dispose according to DEP recommendations.

Fertilizer Storage and Container Disposal Practices

Fertilizer stored in a dry, secure location poses little danger to ground or surface waters. Fertilizers should be stored under cover to prevent exposure to rain or snow. A fenced or locked storage area away from all activities is preferred.

Containers	Fertilizer containers should be clearly labeled and have no holes, tears, or weak seams. Lids should be tightly secured. Re-bag or immediately use the fertilizer in damaged bags or containers.
Granular Fertilizer	Dry fertilizer containers should be kept dry and out of the way of activities which might break open a container or allow rain to enter the container. Dry fertilizer should be covered and stored on impervious surfaces or clay soil where spills are easily collected. Store dry fertilizers away from liquids to prevent accidental wetting.
Liquid Fertilizer	Liquid fertilizer should be stored within concrete or other impermeable secondary containment that will prevent spills from contaminating soil or waterbodies. Locks on valves of liquid fertilizer containers are an added level of security and help prevent discharges by accident or vandalism. Storage tanks should be constructed of materials that are resistant to corrosion, puncture, or cracking. Materials used for valves, fittings, and repairs should be compatible with metals used in storage tanks. For more information on building or modifying a storage facility refer to: ftp://ftp-fc.sc.egov.usda.gov/NJ/partnerships/farmasyst/fertilizer.pdf and http://www.p2pays.org/ref/50/49471.pdf

Container Disposal Practices

Proper offsite disposal practices are essential to avoid contamination of water supplies. Bulk deliveries of liquid and dry fertilizers can reduce the need to dispose of containers. Fertilizer bags should be bundled and small plastic liquid containers should be rinsed before disposal in an approved landfill.

Whenever possible, re-use the rinsate from spray tanks. Nutrient concentration in the rinsate is often low enough that it can be used for subsequent loads without affecting nutrients concentrations. Rinsates can also be disposed by spraying the dilute solution onto the intended target (turf).

Record Keeping and Nutrient Management Plan (NMP)

Reductions in fertilizer waste make financial and environmental sense. Keeping accurate records of what you buy and use allows you to determine what you have in stock and make better purchasing decisions. Keep records of past field application rates and the effectiveness of those applications. Buying only the amount of fertilizer that you need eliminates long-term storage and the associated risks.

Nutrient Management Plan (NMP)

A turfgrass nutrient management plan (NMP) is recommended for all persons who own, lease, or otherwise control large-acreage or multiple properties upon which nutrients are applied. A nutrient management plan will help managers organize, review and refine their practices related to nutrient use. Components of a NMP include identification of the property, manager and date of plan; field maps and aerial photographs; turf and nutrient recommendations; best management practices; implementation and records; and reporting.

The amount of fertilizers applied and the quantity of land to which fertilizer was applied and the NMP identification information should be summarized and recorded by March 1st of every calendar year. The entire NMP should be updated by December 15 of every third year or whenever the acreage of turf managed increases by 25% or more.

See http://profact.rutgers.edu/Pages/training_module.aspx?CID=14 for a more detailed description of a nutrient management plan.

Training Module 3
How to Read a Fertilizer Label

Information on the fertilizer label enables applicators to match the nutritional needs of a turf with the correct fertilizer grade ensuring a cost-effective and accurate application while avoiding "burn" of plants (from fertilizers with a high salt index) and water pollution. Nutritional needs of a turf are determined by soil test recommendations, annual N recommendations, and site conditions (pages 6–9).

Specialty Fertilizer Label

The term "specialty fertilizer" means a fertilizer distributed for non-farm use.

The following information (a–g), in the format presented, is the minimum required for all specialty fertilizer labels.

If nutrients other than N, P, and K are claimed, those will also be listed in the Guaranteed Analysis. Zero guarantees are not allowed except in the chemical form break-down where these may be used if needed for clarity.

a. Net Weight

b. Brand Name

c. Grade

d. Guaranteed Analysis

Total Nitrogen (N).................................____%

____ % Ammoniacal Nitrogen

____ % Nitrate Nitrogen

____ % Urea Nitrogen

____ % Water Insoluble Nitrogen

____ % (Other recognized and determinable forms of N)

Available Phosphate (P_2O_5) .... ____%

Soluble Potash (K_2O) .... ____%

Breakdown forms of N add to the Total Nitrogen (N) guaranteed.

e. Derived from:

f. Name and address of the licensee.

g. Directions for use to the end user.

Sources of nutrients, when shown on the label, shall be listed below the Guaranteed Analysis statement.

Directions for use are unique to specialty fertilizer, must be listed on the product label and include:

1. Recommended application rate or rates, which may be expressed as the amount (lbs.) of fertilizer recommended to be applied per unit area (1,000 sq. ft.) or the area the entire contents of the container will cover;
2. Application timing and minimum intervals to apply the product when plants can utilize nutrients;
3. Statement "Apply Only as Directed" or a statement of similar designation.

Explanation of Fertilizer Grade

Fertilizer grade describes the analysis of the fertilizer or the guaranteed concentration (expressed as a percentage of the total fertilizer weight) of the three macronutrients in the product:

- total nitrogen (N)
- available phosphate (P_2O_5)
- soluble potash (K_2O)[†]

The format used to display this information is the "N - P_2O_5 - K_2O" label. The first number is the percentage of nitrogen, the second number is the percentage of available phosphate, and the third number is the percentage of soluble potash.[1]

Examples of fertilizer grades with zero available phosphate include:

22-0-4   22-0-10   16-0-5

Pounds of Nutrients in a Container

Use these percentages to determine how many pounds of each nutrient are in a container. For example, how many pounds of nitrogen are in a 50-lbs. bag of 22-0-10 fertilizer? To calculate, multiply the total weight of the bag (50-lbs.) by the percentage of nitrogen in the fertilizer grade (22%) divided by 100 (converts percentage to a fraction).

50 x 22 ÷ 100 = 11 lbs. of nitrogen

Repeat the same calculation to determine the amount of available phosphate and soluble potash in a container.

50 x 0 ÷ 100 = 0 lbs. of available phosphate

50 x 10 ÷ 100 = 5 lbs. of soluble potash

Basic Steps in Selecting the Proper Fertilizer Grade

The specific fertilizer needs of a turf will depend on turf and soil conditions, previous fertilizer and organic matter additions, type and age of turf being grown, management practices, and time of growing season. The basic decision-making steps for selecting a fertilizer grade include:

1. Determine the annual N rate (pounds per 1,000 square feet or pounds per acre) for the site based on type and age of turf, expectations for the turf, etc. (see pages 7–9);
2. Determine the annual need for other nutrients such phosphate and potash (pounds per 1,000 square feet or pounds per acre) based on soil testing recommendations;

    Soil testing is used to determine which nutrients (except for nitrogen) should be added to a soil. A comprehensive soil test is recommended every two to three years for landscapes; more frequently if serious deficiencies exist. See [Rutgers Soil Testing Laboratory] or your

[1] There is not actually "P_2O_5" or "K_2O" in the bag. The amount of P and K in the bag is expressed as phosphate and potash equivalent for historical reasons.

Cooperative Extension County Office for instructions on how to collect soil samples and where to send for analysis. Soil test laboratories will interpret the results in a report and many will also provide recommendations on the amount of nutrients to apply with fertilizer. Make sure that a soil laboratory is making recommendations that are consistent with nutrient recommendations from the New Jersey Agricultural Experiment Station and the NJ Fertilizer Law.

3. Calculate the ratio of nutrients needed in a fertilizer using the annual amounts of N, phosphate and potash.

   For example, 4 pounds of N per 1,000 square feet is recommended for an established turf that is irrigated and clippings are not removed. A soil test report indicates that the soil phosphorus and potassium levels are medium and, therefore, recommends ½ pound of P_2O_5 and 1 pound of K_2O per 1,000 square feet.

   Arrange the recommended amounts of nutrients in the order of N: P_2O_5: K_2O to determine the ratio of nutrients.

   4: ½: 1

4. Use the ratio of nutrients to identify a fertilizer grade(s) that will apply the correct proportions of recommended nutrients. More than one fertilizer product may be needed to achieve annual nutrient needs.

   Multiplying (or dividing) each number in the ratio by 2, 3, 4, etc. calculates the various fertilizer grades that would be appropriate to use for the site. For this example, multiplying the values in the ratio (4 : ½ : 1) by 2, 4, 6 and 8 results in the fertilizer grades listed below, which would be appropriate matches for the soil conditions.

   8 - 1 - 2   16 - 2 - 4   24 - 3 - 6   32 - 4 - 8

Forms of Nitrogen: Water Soluble and Slowly Released

The nitrogen in fertilizer can be composed of several different sources. These sources are categorizes in two basic forms:

- Water soluble nitrogen
- Slowly released nitrogen

Water Soluble Nitrogen

- Water soluble nitrogen is readily available for uptake by plants and other soil organisms. It produces a rapid color and growth response in turf. These effects are usually apparent for 4 to 6 weeks.
- Water soluble nitrogen has greater potential for foliar burn and loss through leaching and runoff.
- Sources of water soluble nitrogen in turf fertilizers include urea, ammonium sulfate, potassium nitrate, ammonium nitrate, and ammonium phosphate.

Water Soluble Nitrogen and the Fertilizer Label

Water soluble nitrogen is reported on the label of the fertilizer container as % Ammoniacal Nitrogen, % Nitrate Nitrogen, % Urea Nitrogen, and % Other Water Soluble Nitrogen. These forms are listed as a break-down of the total nitrogen (N) analysis on the fertilizer label.

Below is an example of water soluble forms of nitrogen that can be listed on the label.

Total Nitrogen (N)................................%
...........% Ammoniacal Nitrogen
...........% Nitrate Nitrogen
...........% Urea Nitrogen
...........% Other Water Soluble Nitrogen

The % Other Water Soluble Nitrogen may contain forms of water soluble nitrogen with slowly available properties. See discussion of slow release nitrogen for more detail on labeling of Other Water Soluble Nitrogen that contains slow release nitrogen.

Slowly Released Nitrogen

- Slow release nitrogen fertilizer delays and extends the availability of the nitrogen for plant uptake.
- Slow release nitrogen is available over a longer period of time and the turf response lasts longer.
- Slow release nitrogen also has a lower risk for foliar burn and loss through leaching and runoff.
- Sources of slow release nitrogen include natural organics, ureaform materials, coated soluble materials, and methylene ureas.

Slowly Released Nitrogen and the Fertilizer Label

Slow release nitrogen is reported on the label of the fertilizer container in the breakdown of the Total Nitrogen (N). Commonly used terms to describe slow release nitrogen include:

% Water Insoluble Nitrogen

% Slowly Available Water Soluble Nitrogen

% Other Water Soluble Nitrogen

% Slowly available nitrogen from polymer coated sulfur coated urea

% Slowly available nitrogen from methylene ureas

Below are examples of how slowly released forms are listed on the label.

SLOW FERTILIZER 20-0-0
Guaranteed Analysis

Total Nitrogen (N)	**20%**
8.0% Urea Nitrogen	
2.0% Other Water Soluble Nitrogen	
2.9% Slowly Available Water Soluble Nitrogen*	
7.1% Water Insoluble Nitrogen	
***2.9% slowly available nitrogen from methylene ureas.**	

In the example above, a portion of the slow release N is listed as footnote. The total amount of slow release N equals 10% (10 = 2.9 + 7.1). Also note that all of the breakdown forms of N add to 20% (20 = 8.0 + 2.0 + 2.9 + 7.1).

SLOW FERTILIZER 20-0-0
Guaranteed Analysis

Total Nitrogen (N)	**20%**
8.0% Urea Nitrogen	
4.9% Other Water Soluble Nitrogen*	
7.1% Water Insoluble Nitrogen	
***2.9% slowly available nitrogen from methylene ureas.**	

In the example above, a footnote is used to indicate that a portion (2.9%) of the Other Water Soluble Nitrogen is slow release. The total amount of slow release N equals 10% (10 = 2.9 + 7.1). Also note that all of the breakdown forms of N add to 20% (20 = 8.0 + 2.0 + 2.9 + 7.1).

Fertkote 10-15-20
Guaranteed Analysis

Total Nitrogen (N)	**10%**
2.5% Ammoniacal Nitrogen	
2.5% Nitrate Nitrogen	
5.0% Urea Nitrogen*	
Available Phosphate	**15%**
Soluble Potash (K_2O)	**20%**
Sulfur	**14%**
***5.0% Slowly available nitrogen from polymer coated sulfur coated urea.**	

In the example above, a footnote is used to indicate that the fertilizer contains one coated material (urea) and 5% is slow release nitrogen. Also note that all of the breakdown forms of N add to 10% (10 = 2.5 + 2.5 + 5.0).

Fertkote 10-15-20
Guaranteed Analysis

Total Nitrogen (N)*	**10%**
2.5% Ammoniacal Nitrogen	
2.5% Nitrate Nitrogen	
5.0% Urea Nitrogen	
Available Phosphate	**15%**
Soluble Potash (K_2O)	**20%**
Sulfur	**14%**
***10% slowly available nitrogen from polymer coated sulfur coated nitrogen.**	

In the example above, the footnote designates that all materials of one nutrient are coated and the total amount of slow release N equals 10%. Also note that all of the breakdown forms of N add to 10% (10 = 2.5 + 2.5 + 5.0).

Breakdown Components of Total Nitrogen

The sum of each percentage (%) for breakdown components equals the percentage (%) of Total Nitrogen. The Certified Fertilizer Applicator is expected to understand how to use this information to calculate the percentages of slow release versus water soluble nitrogen.

Sample Calculation of the Percentages of Slowly Released and Water Soluble Nitrogen in a Fertilizer

FERTILIZER 26-0-5
Guaranteed Analysis

Total Nitrogen (N)	**26%**
11.6% Ammoniacal Nitrogen	
1.4% Urea Nitrogen	
5.0% Other Water Soluble Nitrogen*	
8.0% Water Insoluble Nitrogen*	
Soluble Potash (K_2O)	**5%**
***13% Slowly Available Nitrogen from Methylene Ureas**	

In this example, Water Insoluble Nitrogen is 8% of the total weight of the fertilizer. Additionally, the component of Other Water Soluble Nitrogen is footnoted (*) as Slowly Available Nitrogen from Methylene Ureas. The footnote indicates the 13% of the total weight of the fertilizer is Slowly Available Nitrogen from Methylene Ureas. By subtraction (13 - 8 = 5), this means that all of the Other Water Soluble Nitrogen is slowly released as indicated by footnote (*).

To calculate the percentage (%) of the Total N that is slowly released nitrogen, divide the sum of the percentages of slowly released nitrogen (13%) forms by the percentage of Total N (26%) and multiply by 100:

$$13 \div 26 \times 100 = 50$$

Therefore, 50% of the Total N is slowly released nitrogen.

Note that the specific source of slow release nitrogen (sulfur coated, methylene urea, feather meal, etc.), if claimed, is listed on the label as a footnote.

Calculating the Fertilizer Application Rate

The fertilizer grade is used to determine the application rate of the fertilizer product. The fertilizer application rate is calculated by dividing the recommended nutrient rate by the proportion (grade percentage ÷ 100) of the nutrient in the fertilizer product.

For example, a 20-0-0 fertilizer will be used to apply 0.7 pound of N per 1,000 square feet to 5,000 square feet of turf.

First, calculate the application rate of the fertilizer per 1,000 square feet:

$$\frac{\text{0.7 pound of nitrogen}}{\text{1,000 square feet}} \div \frac{\text{20\% nitrogen}}{\text{100\% of fertilizer}} = \frac{\text{3.5 pounds of fertilizer}}{\text{1,000 square feet}}$$

Then, calculate the amount of fertilizer needed for the entire area of turf:

$$\frac{\text{3.5 pounds of fertilizer}}{\text{1,000 square feet}} \times \text{5,000 square feet} = \text{17.5 pounds of fertilizer}$$

Training Module 4
Equipment Use and Calibration

Certified Fertilizer Applicators are expected to provide Trained Fertilizer Applicators with thorough instructions regarding equipment setup and use. Calibration to assure the equipment setup is accurate is the responsibility of the Certified Fertilizer Applicator.

Equipment for Granular Fertilizer

There are two basic equipment types for applying granular fertilizer: drop spreaders and broadcast spreaders.

Drop spreaders provide the most precise and accurate application of fertilizer. Narrow models are especially useful within small confined areas; for example, small courtyards and parkways between sidewalks and street curbs. Side-by-side passes of a drop spreader, however, present a challenge regarding overlaps and skips, particularly for large turf areas requiring numerous passes where the applicator can suffer from operator fatigue.

Broadcast spreaders can apply fertilizer faster than drop spreaders because the material is broadcast over a wider area. Rotary and pendulum spreader are widely used types of broadcast spreaders.

> Rotary spreaders are also known as broadcast, cyclone, or centrifugal spreaders. Fertilizer drops from a hopper through adjustable openings and falls onto the rotating impeller, which throws the fertilizer away from the spreader in an arcing pattern. Applications with rotary spreaders are not as accurate and uniform as drop spreaders, but the distribution can be satisfactory if the proper overlap is used. The quantity of fertilizer applied at the outside edges of the application swath from a rotary spreader will be less than the center of the swath. Thus, side-by-side swaths of a rotary spreader should be overlapped to equalize the quantity of fertilizer between each swath. The amount of overlap for each spreader should be based on recommendations of the manufacturer. Some rotary spreaders can be operated with a deflector shield, which will direct the applied material to one side of the rotary spreader. This setup on a rotary spreader is useful for trim applications (fertilizing along edges where fertilizer should not be applied; for example, the edge of a waterbody or planting bed).

> Pendulum spreaders have a spout that moves from side to side and can distribute fertilizes over relatively large distances when the spout moves rapidly. As with other spreaders, the application rate is controlled by openings at the bottom of the hopper and the speed that the spreader travels. Some overlap between successive application swaths is needed for uniform distribution of the fertilizer; see the manufacturer recommendations.

Calibration of Spreaders

The goal for equipment calibration is to ensure the accurate delivery of fertilizer. The calibration matches the amount of fertilizer applied per area with the target application rate. Calibration ensures cost effective applications, avoids unhealthy turf, and prevents risk to water quality.

The amount of fertilizer applied will depend on mechanical differences [opening(s) size(s), adjustments, wear] between spreaders as well as the weather (humidity may affect flow of fertilizer through spreader). Additionally, each spreader should be calibrated and used based on its specific characteristics for:

- ✓ Swath width – distance (width) over which a spreader applies fertilizer
- ✓ Overlap distance – distance that each successive pass (swath) overlaps the previous pass (swath)
- ✓ Walking or vehicle speed – speed that an applicator or machine travels during application
- ✓ Settings for "trim" passes along non-fertilized areas (impervious surfaces and buffers)

Fertilizer manufacturers may provide instructions on the fertilizer container regarding the approximate settings for specific brands of spreaders. <u>However, these instructions are approximate and should be confirmed with calibration.</u> Calibration is done to ensure these settings are correct. If the field calibration check indicates the settings are not accurate, the spreader:

- needs maintenance and re-calibration or
- should be replaced.

See the manufacturer's manual for procedures on adjusting and repairing the spreader. The training material at https://profact.rutgers.edu/Pages/training_module.aspx?CID=18 provides more detail on re-calibrating a spreader. If re-calibration does not improve performance and repairs are not feasible, the spreader should be replaced.

Field calibration or re-calibration should be done <u>once every 25 to 50 hours of equipment use</u>. The Certified Fertilizer Applicator is responsible for performing (or providing instructions to the Trained Fertilizer Applicator on how to perform) a field calibration check for spreading equipment.

<u>Field Calibration of Spreaders</u>
Field calibration of spreaders to check the control setting(s) and operation of equipment is a relatively easy method. Simply record the amount of fertilizer applied to a known area of turf. The amount of fertilizer can be recorded as number of bags or as pounds of fertilizer.

Information required to perform field calibration of a spreader includes:

1. target rate of fertilization in pounds of nitrogen (or other nutrient) per 1,000 square feet;
2. percentage of nitrogen (or other nutrient) in the fertilizer;
3. area (1,000 square feet) of turf treated with fertilizer,
4. expected total amount of fertilizer to be applied to the area (#3), and
5. actual total amount of fertilizer applied to the area (#3).

If the actual total amount (#5) differs from the expected total amount (#4) by more than 10%, the spreader and its operation should be checked for problems and re-calibrated.

For example, the target rate of nitrogen fertilization is <u>0.5 pound per 1,000 square</u> feet using a <u>20-0-0</u> fertilizer to be applied to <u>20,000 square feet</u> of turf.

Calculate the expected total amount of fertilizer to be applied to the area of turf when the spreader is properly set and operated:

$$\frac{\text{0.5 lb. of nitrogen}}{\text{1,000 sq. ft.}} \div \frac{\text{20\% of nitrogen}}{\text{100\% of fertilizer}} \times \text{20,000 sq. ft.} = \text{50 lb. of fertilizer}$$

Therefore, one 50-lb bag of the 20-0-0 fertilizer should be applied to the turf area in this example. If the actual amount applied is different from the target amount by 5 or more pounds (50 lbs. x 10% ÷ 100 = 5 pounds), the spreader opening(s) or operation (speed, overlap) need adjustment and re-calibration.

Calibration and Use of Sprayers

Calibrating for accurate spraying of liquid fertilizer uses the same concepts as those used for calibration of dry granular fertilization. The major difference between sprayer and spreader calibration is determining that the flow rate of the liquid is correct. This determination is a two-step process.

1. Determine the correct nozzle type and size meeting spray parameters for the fertilizer application, and
2. Measure to confirm the actual nozzle output.

Nozzle Type and Size

Use manufacturer specifications to determine the correct nozzle type and size that meets the spray parameters for the fertilizer application, which includes the acceptable range for sprayer output (foliar vs. root zone placement). Spray output for fertilizer applications range from 20 to 220 gallons per acre (0.5 to 5 gallons per 1,000 square feet) depending on the desired rate and placement of the applied fertilizer. Read the label of the liquid fertilizer product being applied to determine the most appropriate spray output.

Flat-fan nozzles are used on broadcast spray booms where a medium droplet size is needed; this type of nozzle is often used for foliar placement of fertilizer. Flood type and full cone nozzles produce large drift-resistant spray droplets, and wide nozzle spacing can be used. Flood type and cone nozzles are often used for root zone placement of fertilizer. Handheld "shower-head" nozzles are commonly used for liquid applications on residential and commercial turfs. These nozzles produce a large droplet size with low drift potential to prevent off-target application.

Confirm the proper liquid flow rate through nozzle(s) after selecting and installing the nozzle(s).

- Flow water into a measuring container for one minute.
- The amount of water collected should be the same as the manufacturer specifications.
- If there is slightly more or less water in the measuring container, adjust the pressure regulator down or up and repeat the one-minute calibration measurement.
- Repeat until the pressure delivers the correct amount of water in one minute.

Nozzles constructed of wear-resistant materials such as tungsten, carbide, ceramic and hardened stainless steel help maintain a constant flow rate over a longer period of use. Plastic and brass nozzles will be less durable and flow rates are likely to increase after short period of use. The flow rates of less durable nozzles can increase by 10 to 15% due to wear of nozzle orifices over a period of 50+ hours of spraying. Replace nozzles that have an output that is 10 percent more or less than the manufacturer's specifications. Less durable nozzles will need to be replaced more frequently.

For more details on calibrating boom sprayers, see ProFACT training material at http://profact.rutgers.edu/Pages/training_module.aspx?CID=20.

For more details on calibrating handheld spray guns, see ProFACT training material at http://profact.rutgers.edu/Pages/training_module.aspx?CID=25.

Field Calibration of Sprayers

Field calibrations are useful checks of sprayer performance and help to avoid potential applications errors. Sight gauges on the side of a spray tank or calibrated dipsticks can be used to measure the number of gallons used during a spray over a known distance (acreage). The steps to perform a field calibration include:

1. Measure the gallons in the tank after mixing the spray solution.
2. Spray over a known distance in the field (treat at least 3,000 square feet).
3. Measure the number of gallons remaining in the tank using the sight gauge or calibrated dipstick.
4. Determine the application rate (GPA) using the following formula:

   GPA = (Gallons Used ÷ Area Sprayed) x 43,560

   where:

   GPA = the sprayer output in **gallons per acre**,
   Gallons Used = the numbers of **gallons** in step 1 minus the number of **gallons** in step 3,
   Area Sprayed = the distance traveled **in feet** multiplied by the swath of the spray **in feet**.

Determining the Swath for a Spray Application

Swath of the spray boom (feet) = number of nozzles x spacing of the nozzles (inches) ÷ 12

Spray swaths for a handheld spray gun typically range from 8 to 10 feet, depending on the applicator. Mark the edges of the spray swath of a handheld spray gun as the operator holds the spray-gun at a 45° angle to the body and swings the spray-gun back and forth across his/her body. The applicator's arm should swing fast enough to hit an area within the swath three times with the spray as the applicator walks over the application area (typically 3 mph). Measure the swath.

Note that trim applications along sidewalks, streets, and buffers are performed using a half-swath with a handheld spray-gun.

- Applicator walks along a position that is 1.5 feet from the non-target edge.
- To avoid "burn", applicator starts with the spray-gun held pointing away from the non-target edge. The spray is triggered as the applicator's arm swings toward the non-target edge.
- Applicator uses a half-swing of the arm to create a half-swath and throws the spray back into the turf area (away from the non-target area).
- Walking speed is increased to 26 feet in 5 seconds (3.5 mph).
- First pass after the trim pass, move over a half-swath distance and use the full application swath. The full application swath should overlap to your foot tracks from the previous pass.

Example Field Calibration Calculations

A spray tank contains 100 gallons of fertilizer solution. The sprayer has 12 nozzles spaced 20 inches apart, which produces a 20-foot swath (12 nozzles x 20 inches ÷ 12 inches per foot). You operate the sprayer for 250 feet, which produces a sprayed area of 5,000 square feet (20 feet swath x 250 feet travelled). You check the spray tank and determine there are 90 gallons remaining in the spray tank, which means 10 gallons were sprayed (100 gallons to start – 90 gallons remaining). Thus,

GPA = (10 gallons used ÷ 5,000 square feet) x 43,560
GPA = 87.1 gallons per acre

Fertilizer Mixing Rate Calculation

Accurate spray applications require the correct amount of liquid fertilizer be added to the spray tank. Use the following equation to determine the mixing rate of liquid fertilizer with water in the spray tank (in pounds, ounces, or fluid ounces per gallon):

Fertilizer Mixing Rate = **FAR** ÷ **GPA**

where:

FAR = fertilizer application rate in pounds, ounces, or fluid ounces per acre, and
GPA = the sprayer output in gallons per acre.

> Note: Fertilizer application rates given in pounds, ounces, or fluid ounces per 1,000 square feet need to be converted to pounds, ounces, or fluid ounces per acre before performing the calculation above.
>
> Multiply the quantity per 1,000-square-feet by 44 to convert to “per acre”.

Example Calculation

The fertilizer application rate (FAR) is 5 fluid ounces per 1,000 square feet or 220 fluid ounces per acre (5 x 44 = 220). The calibrated sprayer output is 20 gallons per acre. Thus,

220 fl. oz. per acre ÷ 20 gallons per acre = 11 fl. oz. of liquid fertilizer per gallon of solution

Responsibility of Certified Fertilizer Applicator

Certified Fertilizer Applicators are responsible for training Trained Fertilizer Applicators on spray equipment setup and use. The Certified Fertilizer Applicator is responsible for performing (or providing instructions to the Trained Fertilizer Applicator on how to perform) field calibrations of spray equipment.

Useful Equivalents and Formulas

- 1 acre = 43,560 square feet
- 1 gallon = 128 fluid ounces
- 1 pint = 16 fluid ounces
- 1 pound = 16 ounces of weight (16 fluid ounces of water at 39 degrees Fahrenheit weighs 1 pound)
- Gallons per acre = (5,940 x gallons/minute/nozzle) ÷ (MPH x nozzle spacing)
- Gallons per minute per nozzle = (gallons/acre x MPH x nozzle spacing) ÷ 5,940
- Ounces per minute per nozzle = (gallons/acre x MPH x nozzle spacing x 32) ÷ 1,485
- Miles per hour = distance travelled (ft) ÷ (88 x minutes) = distance travelled (ft) ÷ (1.467 x seconds)

Training Module 5
Laws, Rules, and Regulations for Fertilizer Application to Turf

The New Jersey Act P.L.2010, c. 112 was conceived to protect all New Jersey surface and ground waters from impairment by minimizing nitrogen and phosphorus loading that may be derived from lawn fertilizer. The Act addresses the application, sale, and use of fertilizer for turf and distinguishes between retail fertilizer and professional applications. The Act does not apply to farms including sod farms. Golf courses are exempt from the rules of this Act except that the application of fertilizers must be made by a certified fertilizer applicator or a trained applicator supervised by a certified fertilizer applicator.

What applications of nitrogen and phosphorus fertilizer are prohibited by the law?

- Applications before and during heavy rain and whenever soil is saturated or frozen.
- Applications to impervious surfaces. Impervious surface include driveways, sidewalks, streets, porous pavement, paver blocks, gravel, crushed stone, decks, patios, elevated structures, and other similar structures, surface, or improvements. Misapplications must be swept up and removed or blown back into turf.
- Applications after December 1st and before March 1st for professionals. Applications by homeowners are prohibited after November 15th and before March 1st.

What kind and amount of fertilizer does the law restrict?

- Nitrogen and phosphate fertilizer cannot be applied within 25 feet along waterbodies.
  - When using a "directed" application technique within a 25-foot buffer along a waterbody, buffer size can be reduced to 10 feet. A direct application refers to drop spreaders, spray applications, and rotary spreaders with a deflector shield.
  - One "rescue treatment" per year is allowed to turf growing between 10 and 25 feet of a waterbody. Rescue treatment refers to applications intended to prevent the loss of vegetative cover within the buffer.
  - Other environmental standards established by State or federal law, rule, or regulation may apply in non-fertilized turf buffers and must be followed.
- Turf fertilizers must not contain available phosphate unless:
  - Available phosphate is prescribed by a soil test that is no more than 3 years old;
  - New turf is being established;
  - Turf is being repaired; or
  - The fertilizer is, or includes, a natural organic fertilizer that contains available phosphate. Application of these fertilizers must not exceed 0.25 lb. per 1,000 square feet of available phosphate per application.
- The maximum "per application" rate of nitrogen is 1.0 lb. per 1,000 square feet and cannot apply more than 0.7 lb. per 1,000 square feet of water soluble nitrogen. The maximum "per application" rate for home owners is 0.9 lb. per 1,000 square feet.
- The annual rate of nitrogen cannot exceed 4.25 lbs. per 1,000 square feet. The annual rate of nitrogen for application by home owners cannot exceed 3.6 lbs. per 1,000 square feet.

Who Can Apply Fertilizer?

- A professional fertilizer application refers to any individual who applies fertilizer for hire, including any employee of a government entity who applies fertilizer within the scope of employment.
- Professionals fertilizer applications by must be done by certified fertilizer applicators or trained applicators.
- Trained fertilizer applicators must be supervised by a certified fertilizer applicator.
- Home owners may also apply fertilizer. The content and use of retail specialty fertilizers for turf are restricted as required by the law.

The intent of the law is to ensure that professional fertilizer applicators are aware of the potential risks of fertilizer to water quality and that fertilizers are applied as the law directs.

What are the penalties for violations?

Any professional fertilizer applicator who violates the law is subject to a civil penalty of $500 for the first offense and up to $1,000 for the second and each subsequent offense, to be collected in a civil action by a summary proceeding under the "Penalty Enforcement Law of 1999," P.L.1999, c.274 (C.2A:58-10 et seq.).

If the violation is of a continuing nature, each day during which it continues shall constitute an additional, separate and distinct offense.

Any person, other than a professional fertilizer applicator or person who sells fertilizer at retail, who violates this law may be subject to a penalty, as established by municipal ordinance.

Who enforces the law?

This law may be enforced by any municipality, county, local soil conservation district or local health agency. A local soil conservation district may institute a civil action for injunctive relief in Superior Court to enforce this law and to prohibit and prevent a violation of this law, and the court may proceed in the action in a summary manner.

Are existing ordinances and resolutions preempted by the law?

The provisions of the law preempt any ordinance or resolution of a municipality, county or local health agency concerning the application of fertilizer to turf, except that municipalities are allowed to establish penalties for persons other than a professional fertilizer applicator or person who sells retail fertilizer.

Professional Fertilizer Applicator Certification and Training (ProFACT)

Any person who applies fertilizer for hire, including any employee of a government entity who applies fertilizer within the scope of employment must obtain:

1. Training and certification or
2. Training if applying fertilizer under the direct supervision of a certified fertilizer applicator.

The training of professional fertilizer applicators includes education in at least the following subject areas:

1. The environmental risks to water quality related to fertilizer use on turf;
2. The best management practices for nutrient management in turf developed by the Rutgers New Jersey Agricultural Experiment Station (NJAES);
3. The correct interpretation of fertilizer labeling information;
4. The proper use and calibration of fertilizer application equipment; and
5. All applicable State and federal laws, rules and regulation.

Online training programs for Certified and Trained Fertilizer Applicators are available on online at ProFACT.rutgers.edu

Organizations qualified by Rutgers NJAES may train certified fertilizer applicators and individuals who will apply fertilizer only under the direct supervision of a certified fertilizer applicator.

Rutgers NJAES may also recognize the training program of any person employing professional fertilizer applicators if the training meets the established requirements.

<u>Certified Fertilizer Applicators</u>
Rutgers NJAES conducts examinations to certify that an individual possesses sufficient knowledge of the State and federal laws, rules and regulations, standards and requirements applicable to the use and application of fertilizer.

Before taking the exam, individuals must demonstrated that they have obtained the education and training established by the certification program developed by Rutgers NJAES, in consultation with the NJ Department of Environmental Protection (DEP).

<u>Trained Fertilizer Applicators</u>
Professionals who will apply fertilizer only under the direct supervision of a certified professional fertilizer applicator must obtain training. Direct supervision means that the Certified Fertilizer Applicator provides written instructions to the Trained Fertilizer Applicator and maintains immediate contact through a mobile phone or radio (voice communication). Written instructions should include directions for the application as well as spill response protocol.

The minimum standards for the training program are established by the Rutgers NJAES, in consultation with the NJ DEP.

<u>Public List of Certified and Trained Fertilizer Applicators</u>
Rutgers NJAES publishes and maintains a list of all certified and trained fertilizer applicators on its internet website (ProFACT.rutgers.edu) as required by law. Certified and trained fertilizer applicators will carry a certificate containing a QR code that can be scanned in the field with a smartphone to gain access to the applicator's status on the website.

Annual Certificate Renewal for Professional Fertilizer Applicators

1. Certified Fertilizer Applicators shall renew their certificates annually with the NJAES and pay the renewal fee of $25.
2. Trained Fertilizer Applicators must receive annual training and pay a registration fee of $25. Training materials and requirements are available through the ProFACT website. Note that due to the large turnover, Trained Fertilizer Applicators are removed from the public list after December 1st. The list is re-populated by March 1st of the next year through the annual training and registration fee process.
3. A Certified Fertilizer Applicator who has not renewed their certificate with the NJAES for two consecutive license years shall lose certification status and shall be required to again become certified in accordance with the training and examination program of ProFACT.

Recertification of Certified Fertilizer Applicators

Certified Fertilizer Applicators must maintain certification by meeting the requirements of recertification. Certification is good for 5 years presuming the annual certificate renewal fee is maintained (see above). The recertification date will be a December 1st date and is calculated by adding 5 years to the next December 1st date after the date you passed the certification exam (example: pass exam February 15, 2013; next December 1st date is December 1, 2013; recertification date is December 1, 2018). Professionals taking the exam just prior to December 1st (October or November) of a given year will be given the option of applying the certification to the year of the exam or the next year.

Recertification can be accomplished in two ways:

1. Retake the Certified Fertilizer Applicator certification exam during the 5th year.
2. Accumulate credits for recertification over the 5 year period by attending ProFACT approved courses and seminars, or participating in online ProFACT training. A Certified Fertilizer Applicator must accumulate 8 credits (one credit equals 30 minutes of instruction time or one online training module) in subject matter over the 5 years. Examples of subject matter are topics such as regulations of fertilizer and its use, the environmental risks of fertilizer misuse, the proper use and calibration of fertilizer equipment, the correct interpretation of fertilizer labeling information, and the best management practices for nutrient management in turf.

Courses will also be offered through County Cooperative Extension Offices, professional associations and private companies which are approved to offer such courses by the ProFACT program. Online courses for recertification credit are currently being developed and will be offered via the internet.

Professionals will receive an update of recertification status at least once a year along with notification of the annual certificate renewal. Professionals can log in (user ID and password) at profact.rutgers.edu and click on the status tab to view their recertification status / credits.

Please call the ProFACT program at 848-932-6373 or visit the program online at profact.rutgers.edu with any questions on the certification program for professional fertilizer applicators.