

- Some solutions may salt out at lower temperatures.
- Applying sufficient quantities without causing severe leaf burn may be difficult.
- Frequent applications at low rates may be necessary to promote a more lasting turf response and prevent leaf burn.

*Foliar feeding* utilizes low fertilizer rates (e.g., 1/8 lb N or Fe per 1,000 sq. ft.) at low spray volumes (e.g., 1/2 gal per 1,000 sq. ft.). Low nutrient and spray volumes are used to minimize costs and to supplement the normal fertilization program with nutrients absorbed directly by turfgrass leaves. The fertilizer is washed off the leaves at higher spray volumes (e.g., 3 to 5 gal per 1,000 sq. ft.), resulting in increased root absorption. In this process, called *liquid fertilization*, fertilizers and pesticides often are applied together. Although the initial cost of spray equipment for liquid application is higher, application of liquid fertilizer usually is less expensive than that of granulars.

Fertilization through an irrigation system is termed *fertigation*. Ideally, this process combines the two operations to use resources and labor more efficiently. Frequent light applications (e.g., *spoon feedings*) of fertilizer are metered into irrigation lines and distributed with irrigation water through sprinkler heads. Nitrogen and sulfur are the primary elements applied with this method; potassium and highly soluble forms of iron and zinc also have been used. Fertigation helps maintain a more even turf color and growth and minimizes the occurrence of color surges that typically follow heavy granular applications. It also reduces labor costs associated with the frequent applications required for granular forms. Fertigation also is beneficial on sandy soils subject to nutrient leaching, since heavy fertilizer applications are avoided.

Lack of uniform application may occur with some irrigation systems. The use of properly designed irrigation systems and skilled operators will minimize this problem. Salt buildup on soil surface and shallow turf rooting are other concerns associated with light, frequent fertigation applications. The use of nitrate solution containing free ammonia or anhydrous ammonia fertilizer materials with water high in calcium, magnesium, and bicarbonates also may result in precipitant formation. This can scald plants and plug irrigation equipment. Sulfuric acid often is added in such instances to prevent the formation of these precipitates.

## II. Fluid Fertilizers

The three main categories of fluid fertilizers are as follows:

1. *Clear liquid*. These are true solutions limited to low analyses, since they will salt out at low temperatures in high fertilizer grades.
2. *Suspension fertilizer*. These are mixtures of liquids and finely divided solids that do not settle rapidly and can be redispersed readily by agitation to yield a uniform mixture. Certain types of clays usually are added as suspending agents.
3. *Slurry fertilizers*. These are mixtures of liquids and finely divided solids that settle rapidly without agitation and form a firm layer in the bottom of the tank. This layer is difficult to resuspend.

A main difference between liquid and dry fertilizers is related to phosphorus solubility. Water solubility of phosphorus sources in dry fertilizer may vary from 30% in some highly ammoniated superphosphates to almost 100% in diammonium or monoammonium phosphate. Therefore, granular phosphorus fertilizers should be used to supplement fertigation fertilizers. Practically all potassium and inorganic nitrogen sources in both fluid and dry fertilizer have a water solubility of 100%.