WEED FREE

For scenic roadsides, deeply-rooted plants are needed to successfully battle weeds for water and nutrients. That means developing a sound fertilizer program.

by C. Robert Staib, Nor-Am Chemical Co.

Only slow-release nitrogen should be used in the planting hole. This is also the best time to incorporate phosphorus in the planting medium.

"America the Beautiful" is an appropriately descriptive phrase, in part because of the country's highway system. Miles and miles of weed-free scenic roadsides are taken for granted by the traveling public. Only the landscape manager realizes the complexities of establishing and maintaining "that to which we have become so accustomed."

Developing a sound fertilizer program can help the landscape architect and horticulturist or agronomist to achieve their goals. Besides the beauty and functionality of roadside plantings, more vigorous growth helps keep a weed-free environment less dependent on expensive herbicide applications.

Healthy root systems

The long-term success of the roadside landscape is dependent on many factors, including availability of water, good drainage, and ability of plants to withstand effects of salt, auto exhaust emissions, and herbicides.

Roadside developers and agronomists know full well that maintenance resources are limited, and many times their plantings will have to fare for themselves. This is only possible when plant roots are firmly established, and thriving as deep as possible in the soil profile. The growth of plant vegetation is accompanied by a corresponding demand for carbohydrate reserves from the root system.

Healthy, deep roots, therefore, are vital to foster vigorous growth and plant density for long periods in diverse soils and weather conditions.

Key macro-nutrients

Most commercial fertilizers used in the landscape consist of synthetic organic nitrogen (urea, slow-release or coated products) plus reacted or mined phosphate and potassium sources (potassium chloride, also known as muriate, or potassium sulfate).

Nitrogen, phosphorus, and potassium, the major nutrients, are required by plants in the greatest quantity.

Of these, nitrogen is the most important, and is required in the highest amounts. Next in importance is potassium, required to sustain cellular structure and strength of the cell wall. Phosphorus, vital in the process of energy transfer within all living tissue, is nevertheless used in much smaller amounts.

Research shows that potassium levels of 50 percent of applied nitrogen (or even higher) are highly beneficial to turf. Except in extreme situations, residual soil phosphorus is generally sufficient to meet the needs of grasses and groundcovers once they become established.

Secondary nutrients

Calcium, magnesium, and sulfur are important in carrying out or supporting metabolic processes. These nutrients are also important in the development of soil characteristics favorable for plant growth.

Studies have shown that low rates of water-insoluble nitrogen applied in the sodbed prior to laying sod encourages rapid root growth. A firm early knit of sod is important on erosion-prone cut and fill slopes along roadsides.

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Tree planting positions are marked out with piles of slow-release ureaform. Auguring through the pile thoroughly mixes the fertilizer with the backfill soil as the hole is dug.

Calcium and magnesium are important components of organic matter which provide stability to soil aggregates.

These elements in the carbonate form help achieve a more neutral pH in acid soils, while sulfur is used to lower the pH of alkaline soils. A nearly neutral pH allows maximum availability and utilization of plant nutrients.

Minor plant nutrients include iron, manganese, zinc, copper, boron, and molybdenum. Except in very unusual situations, iron is the minor element most likely to be deficient.

High pH and high phosphorus levels in the soil can create iron deficiency. In both cases, iron is precipitated to insoluble, unavailable salts. Correcting soil pH and applying iron in fertilizer or as foliar sprays will correct the situation.

Nitrogen availability

The process by which fertilizer nitrogen becomes available in soil is called *mineralization*.

The rate at which urea mineralizes to ammonium ions (which then nitrify to nitrate nitrogen) is quite rapid, occuring over two to seven days at temperatures above 50 degrees F.

Nitrate (NO_3^-) nitrogen is the form most rapidly absorbed into the plant system. Highly water-soluble nitrate ions are subject to leaching, and in coarse soils excessive moisture can result in significant nitrogen loss.

Another avenue of N loss is via ammonia volatilization. In addition to ammonium ions (NH_4^+) which are absorbed on clay and organic matter particles, some urea may hydrolize to ammonia (NH_3) which is subject to volatilization.

Improving plant vigor and density with a sound fertilizer program establishes an environment least favorable for weeds and scrub brush.

This is more pronounced in high pH soils, and can account for 25 percent or higher nitrogen loss. Nitrogen fertilizer made from ammonium salts, (e.g. ammonium sulfate, di-ammonium phosphate, ammonium nitrate, etc.), though water-soluble, are less subject to volatilization than urea.

Fertilizer programs

Few soils in a new right-of-way or rest area contain adequate major plant nutrients to forego applying commercial fertilizer. The establishment phase of roadside landscaping is the most critical in terms of assuring vigorous growth and long-term survival.

Spring is a good time to apply nitrogen, phosphorus, and potassium, and may be the only time that many miles of roadside vegetation will ever receive these important nutrients.

This is all the more reason to consider a nitrogen program that encourages strong rooting and extended availability over many months of growing season, though fall fertilization on cool-season grasses is also recommended if possible.

Commercial farm-grade nitrogen fertilizers are inexpensive and easily obtainable. However, they are water-soluble, release nitrogen rapidly, and generally have high salt indexes which can off-set their beneficial effect on new seedlings and small plants.

Besides the possibility of nitrogen loss, the faster release of N from these sources encourages too rapid growth of vegetative tissue. The consequences can be a shallow, less developed root system, poorly equipped to sustain grasses, trees, and shrubs through years of varied, often stressful growing conditions.

As previously mentioned, it is particularly important to get phosphorus down at the time of planting since it has its greatest influence on seedling establishment and root formation.

Since neither phosphorus or potassium move rapidly through the soil, regular farm-grade sources of these nutrients are both efficient and economical.

Low or no-N, high P-K fertilizers such as 6-24-24 or 0-20-20 are ideal sources of phosphorus and potassium, and are easily obtainable through farm fertilizer distribution channels.

Potassium's role in plants, both constructive and protective, is important in maintaining rigidity and integrity of cell walls, and helps to protect plants from disease and environmental stress.

Phosphorus is a key element in cell metabolism and energy transfer. Once plants become established under adequate levels of N, P, and K, the natural recycling of these nutrients from soil to plant to soil helps to satisfy long-term requirements. Also, deep roots can tap these elements where they exist at residual levels in the lower soil profiles.

The major nutrient

Nitrogen is so important in plant growth that it demands primary consideration when choosing a fertilizer. Several slow-release N sources are popularly used in landscape design.

If multiple applications of fast-release N sources are impractical, slow-release N fertilizers become a logical alternative.

How much N, P and K?

Because of the author's experiences, recommendations are based on using ureaform nitrogen in a single application at planting time, or once a year or less often under maintenance conditions.

Other slow-release N sources are suitable for long-term effects, and should be considered over fast-release fertilizers for these infrequent applications. For the purpose of clarification, "luxury turf" is defined as that composed of improved varieties of turfgrass cultivars mowed and maintained for aesthetic appearance near buildings and along urban parkways.

Seedbeds, luxury turf

400 lbs. ureaform, 38-0-0, (152 lbs. N) + 400 lbs. 6-24-24 (or other high P-K fertilizer) per acre, applied separately* or blended.

Seedbeds, low-maintenance grasses and groundcovers

200-lbs. ureaform, 38-0-0, (76 lbs. N) + 200 lbs. 6-24-24 (or other high P-K fertilizer) per acre, applied separately* or blended.

(* In seedbeds, phosphorus and potassium will be more efficiently utilized over a longer period if incorporated in the top three-to-four inches of the soil prior to seeding. The nitrogen fertilizer should be surface-applied for best results. Mulching or slight incorporation will help prevent rainfall from moving particles away from the site of application.)

Under sod

115 lbs. ureaform, 38-0-0, (44 lbs. N) + 200 lbs. 6-24-24 (or other high P-K fertilizer) per acre. Equivalent to 1 lb. N per 1000 sq. ft. Slightly incorporate into the soil surface prior to laying the sod.

Established luxury turf

400 lbs. ureaform, 38-0-0, (152 lbs. N) + 200 lbs. potassium sulfate, 0-0-50, (or 150 lbs. potassium chloride, 0-0-60) per acre. Apply in spring or early fall.

Established low-maintenance grasses and groundcovers

200 lbs. ureaform (76 lbs. N) + 100 lbs. potassium sulfate, 0-0-50, (or 75 lbs. potassium chloride, 0-0-60) per acre. Apply separately or blended, spring or early fall.

Tree establishment (bare root or ball and burlap)

1/2 lb. ureaform, 38-0-0 + 1/2 lb. single super-phosphate, 0-20-0, per 1/2-inch trunk diameter.

Mix fertilizer with backfill to be replaced in the planting hole. *Application technique tip*.....Mark out the planting hole locations wih pre-measured amounts of fertilizer. Power-auger directly through the pile, automatically blending the fertilizer with the back-fill as the hole is dug.

A soil test may indicate that levels of phosphorus and/or potassium are adequate to sustain growth. If so, apply ureaform only. If potassium is required, it is best to apply it on the surface in order to dilute the salt concentration in the vicinity of the newly planted roots.

Seedling trees and shrubs

2 ozs. ureaform, 38-0-0, + 2 ozs. of a high P-K fertilizer, surface broadcast around each planting. In an area of many closely spaced plantings, surface broadcast 400 lbs. ureaform, 38-0-0, + 400 lbs. of 6-24-24 (or other high P-K fertilizer) per acre. Apply separately or blended.

Established trees and shrubs

Surface apply 1/2 lb. ureaform, 38-0-0, per inch of trunk diameter uniformly beneath the canopy.

Trees and shrubs almost always will exhibit a response to nitrogen fertilization. Trees showing an unusually pale leaf color may be suffering from iron chlorosis. This is mostly a problem in alkaline soils. It can be corrected with iron chelate.

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The three most popular of these are SCU (sulfur-coated urea), IBDU (isobutylidene diurea), and ureaform. The mode of release from each of these varies considerably.

SCU, 32 percent or 37 percent, releases nitrogen by diffusion through cracks, pinholes, and fissures in the coating. Typically, a third or more of the N is released in one week following application, with the remainder available over the next several weeks.

However, any stress—mechanical or weathering—affecting the coating will increase the rate of diffusion. It is faster in warm soils, and particularly so following rapidly alternating wet and dry periods.

IBDU (31 percent N) releases nitrogen via hydrolysis to urea in the presence of moisture. Large particles of IBDU hydrolize more slowly than fine-grade product, and affect a more sustained release during wet weather. Little nitrogen is released from IBDU when moisture is lacking.

Ureaform (38 percent N) is a reaction product of urea with formaldehyde, forming carbon: nitrogen linked polymers of varying chain length and solubility.

The shortest-chain polymers are sparingly soluble in water, while intermediate and long-chain polymers are water insoluble. These polymers, or compounds, are known as methylene ureas.

Nitrogen is released by soil bacteria feeding on the polymers. The short-chain C:N linkages are more readily digestable.

Under growing-season conditions, about 1/3 of the N is released in four-to-six weeks, 1/3 at two-to-12 months, and 1/3 over one-to-two years. A slight residual amount will carry over to be available the third year following application.

Research at the University of Illinois has shown that ureaform is less subject to N loss from leaching or volatility than other turf-type slow-release fertilizers.

Other research at Iowa State University and the University of Nebraska has shown uniform turfgrass establishment and rapid root formation from sod and seed when ureaform was applied directly in the sod or seed bed.

Significant root development was exhibited during a three-week period immediately following an application of 1 lb. N per 1000 sq. ft. (equiv.) from ureaform on sandy soil under ryegrass sod disks.

This greenhouse test compared the effects of several N sources, including urea and IBDU. Phosphorous and potassium levels were uniform (2 lbs. P_2O_5 and K_2O each, per 1000 sq. ft.).

The spring season is the best time to apply nitrogen, phosphorus, and potassium, and may be the only time that many miles of roadside vegetation will ever receive these important nutrients.

Soil pH

The fertilizer program must take into account the pH of the soil. In acid soils, lime (calcium carbonate, $CaCO_3$) will raise the pH toward neutral (7.0) while elemental sulfur or gypsum (calcium sulfate) is effective in amending alkaline or sodium soils. Too acid or alkaline soils interfere with nutrient availability.

If such conditions are suspected, a soil testing lab can advise on corrective methods in either case.

Fertilizer as a weed manager

Improving plant vigor and density with a sound fertilizer program establishes an environment least favorable for weeds and scrub brush. Deeply rooted desirable plants compete successfully for water and nutrients, while a dense canopy restricts light availability to weed seeds lying in wait at the soil surface. The money saved on chemical weed control is but a small part of the total benefits to be realized when fertilizer is a primary tool in roadside vegetation management. **WT&T**