SOIL COMPONENTS

Soil serves as a storehouse for mineral nutrients (food), a habitat for microorganisms, and a reservoir of water for tree growth. It also provides anchorage for the tree. The characteristics of the soils that are found in a landscape make it useful for plant growth or prevent a healthy plant from ever growing in a specific location.

Plants can sometimes adapt to the conditions that are found in a particular soil type, but in most cases the soil type dictates which type of tree or shrub can grow in an area.

The soil is composed of three distinct parts or phases: gas (the soil air), liquid (the soil water), and the solid (soil minerals and organic matter). Each parts are closely related to each other.

Soil Air - The pore space in soils amounts to 30-50% of the volume occupied by the soil The amount of air is governed primarily by the extent that this pore space is filled by moisture. Ordinarily, air comprises about 20% of the volume of a well tilled soil.

The primary components of soil air spaces are oxygen and nitrogen. Oxygen is essential for the roots to breathe and supports the activity of numerous beneficial microorganisms. Nitrogen is used as a raw material for bacterial to manufacture protein, which later decompose to nourish the tree. Oxygen must be supplied to the soil in order for the tree roots to respire (breathe); the lack of air space and oxygen can lead to a poor condition for vegetation to grow.

Soil Water - Trees depend on the water contained in the spore space of the soil in which they are growing in order to survive. The roots absorb the water and pass it on to the leaves where it functions as a nutrient and in the absorption of carbon-dioxide from the air. Water also serves as as a solvent of the necessary nutrients for plant growth. Water is also a major component of every cell found in the tree.

Water is found in the soil in a variety of ways ranging from free water, that flows through the ground to hygroscopic water that is attached to soil particles. Some of the water is easy for the plant to absorb, while some is very difficult.

All plants need water in order to survive, and the soil is where the plants get the moisture for survival.

Soil Minerals - The solid body of the soil consists of varying proportions of course grains (sand), medium grains (silt), and fine particles (clay), all of which are mineral particles originating from the disintegration of rocks. The relative proportions of each component determine the soil type. In addition the soil contains varying amounts of humus material from the decomposition of plant remains.

Chemically, the soil depends upon working quantities of clay in the soil in order for the exchange of water to occur between the plant's roots and the soil.

A soil texture triangle shows the percentage of sand, silt, and clay in the soil. Ideally, the type of soil used in a planting should be the type most preferred by the plant. For example, some vegetation can only grow in sandy soil, while others can only survive in wetter, clay soils.

Soil Organic Matter - The second solid component of soil is organic matter. It is usually concentrated in the upper soil layers. It is essential for the maintenance of soil microorganisms and makes the soil porous and friable which means it can hold moisture, yet allows air to pass through it. When it decays, organic matter provide useful mineral nutrients and nitrogen for the plant to use.

SOIL ACIDITY AND REACTION

Soil Reaction (pH) - Chemically, soil is very active in the exchange of ions and cations. All you need to understand is that the chemical activity affects how much acid or alkalinity is contained in the soil. The amount of acid or alkalinity is measured by soil pH. Plants grow according to the amount of each that is contained in the soil (pH value). Acidic plants need a lower pH value, while other plants require a more neutral or alkaline soil type (higher pH).

You can adjust the soil pH by adding limestone or sulfur to the soil A soil test will provide you with the pH value, and the amount of each material to add to the soil.

Background

A good fertilization program will help maintain the vigor and health of woody plant material at the landscape site. Even mature specimen plants benefit from regular applications of fertilizer. Trees and shrubs are healthier and vigorously are less susceptible to attack by insects and disease. Too often the landscape maintenance contractor ignores the mineral-nutrient requirements of the trees and shrubs that they maintain. Although the tree might survive, it might not develop into the specimen that is wanted unless a sound fertilization program is developed.

However, fertilizers are not a substitute for sunlight and water, but make up just one of the environmental factors that must all be in balance if the landscape plant is to develop its full potential. A good fertilization program will ensure that deficiencies of essential mineral elements are not limiting plant growth.

Composition & Action of Fertilizers

There are many fertilizer materials on the market and selecting the right one to give maximum benefits for the money invested can be a problem. The analysis of any true fertilizer material must be given on the package label. A complete fertilizer contains three major elements essential for plant growth -- Nitrogen, Phosphorus, and Potassium.

A careful inspection of the analysis on the label should always be made. Many organic fertilizers have very low nutrient levels and their costs becomes exceedingly high in comparison with their total nutrient value. Two factors besides price should be considered when buying fertilizers: the availability to the plant of the nutrients in the fertilizer is important and the effect of the fertilizer on soil pH. Readily available fertilizers are those that can provide a source of nutrients to the plant immediately because the fertilizers salts used are water soluble. This may or may not always be desirable. For some needs, it may be desirable to use a more slowly available form to provide fertilizer to the plant for a longer time, and a water soluble fertilizer might not be wanted. In other fertilization programs, if an acid soil reaction is desired for a particular plant species, an acid-reacting fertilizer should be used. However, for most needs, the materials that will be useful will be neutral in ration, and their overall influence on soil pH will be minor.

Benefits of Fertilizer Application

The effects of undernourishement may be expressed as a failure of a plant to grow as rapidly as expected or as a gradual decrease in the vigor of the tree. This loss of vigor can weaken the tree so that it is less able to withstand biological and environmental pressures that can result in tree decline. In some cases, the deficiency of a specific nutrient will cause a reduction in the beauty and quality of trees and may cause symptoms that can be confused with infectious diseases.

Although fertilizer application does not constitute the whole of soil improvement, it is an important part of any tree/shrub maintenance program.

The objectives of tree fertilization are fourfold:

1. To increase the size of small trees as rapidly as possible;
2. To maintain the healthy appearance and vigor of mature trees;
3. To rescue declining trees;
4. To cure specific nutrient deficiencies.

Species response is variable, however, nearly all trees respond to nitrogen applications by making significant growth increases. Mature trees benefit from nutrient addition. Not only doe leaf size and color improve, but the speed of would closing increases as well. Trees responding to attack by wound invading decay organisms are sometimes able to limit the invasion. These responses require energy, and healthy trees are able to respond more efficiently than those which are undernourished.

Determining Fertilizer Needs

Fertilizers are sometimes used to excess, casing unnecessary expense, occasionally damage to sensitive plants, and potential water pollution. Before determining whether to fertilize , one should determine what is to be accomplished by fertilization. In the landscape, a young sapling, a mature healthy tree, or a declining tree would each have different needs.

Look for Subnormal Growth - The most direct way to determine if fertilization is needed is to observe the growth rate and leaf color of the trees. Young shade trees with twig growth of 9-12 inches per year and mature trees with growth of 6-8 inches per year will probably not be helped by additional nutrients.

Use a Soil Test - Soil tests are helpful in determining if fertilization is necessary.

Analysis Leaf Tissues - Nutritional problems may also be diagnosed through analysis of tree foliage. Usually, recently matured leaves are taken from various parts of the tree with a suspected problem and from similar healthy trees nearby. These samples are then analyzed by a laboratory for mineral content.

Some Rules of Thumb

- Nitrogen is the key element and should be applied at least every two years. Applications of phosphorus and potassium every 3-5 years is probably adequate for satisfactory growth.

- There are two basic techniques for applying fertilizer -- deep root feeding and surface application. Both have advantages, and conditions dictate which method to use.

- The addition of nitrogen should be at the rate of two pounds per 1,000 square feet. This rate should be used at each application if spring and fall applications are made.

- Another recommendation often made is to feed trees 1/2 pound of total nitrogen for each inch of trunk diameter.

FERTILIZING TREES AND SHRUBS

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Trees and shrubs in their wild or natural habitats rarely display symptoms of nutrient deficiency. This is due not only to the natural cycling of nutrients that occurs in nature but also because particular plants only grow where they are adapted or have a competitive advantage.

For the most part nursery and landscape plantings represent an artificial habitat. Soils may be vastly different from those of the plant's native habitat, and nutrient recycling systems may be altered or diminished as a result of planting schemes (planting in turf areas) or maintenance practices (collection of fallen leaves).

For these reasons periodic applications of fertilizer to the soil beneath shadeand ornamental trees and shrubs are needed to replenish essential mineral elements and to promote healthy growth. Proper maintenance of soil fertility and attention to plant nutritional requirements is at the heart of an effective IPM or Plant Health Care program.

Soil pH: A fertility program for woody plants begins with analysis of soil pH or level of acidity. The pH is measured on a scale of 0 to 14. Soils with pH below 7 are acid while those above 7 are alkaline. Adjusting pH levels is important not only because specific plants grow best within a certain range of pH, but because soil pH influences the availability of elements essential to plant growth.

At extremes in pH, many nutrients occur in forms unavailable for uptake by plant roots. Figure 1 shows the relationship between pH and availability of elements essential to plant growth.

Soil tests should be routinely done prior to any planting in nursery soils or at landscape sites. Typically limestone is required to adjust pH upward while sulfur is used to lower pH. It is best if these materials are incorporated into soils prior to planting since surface applications are slow to affect pH levels.

Most liming and sulfur recommendations are based on the assumption that the material be worked in to depths of eight inches. Deeper incorporation of either limestone or sulfur will require adjustments in rates to accommodate larger volumes of soil.

What to Use?

Basic plant nutrition involves the uptake of sixteen mineral elements essential to plant growth. Other than carbon, hydrogen, and oxygen obtained from air and water, the elements, nitrogen (N), Phosphorous (P), and potassium (K) are required in greatest abundance. However, research in woody plant nutrition has shown that nitrogen is the element that yields the greatest growth response in trees and shrubs. For this reason, high nitrogen fertilizers with N-P-K ratios of 4-1-1, 3-1-1, or 3-1-2 are generally recommended for feeding established woody plants. These include fertilizers with analyses such as 8-2-2, 15-5-5, 24-8-16 and similar formulations. Analysis refers to nitrogen, %phosphorous (as P_2O_5) and %potassium (as K_2O) in the fertilizer. Phosphorous, potassium and other essential elements other than nitrogen are slow to be depleted from soils. Provided these nutrients are at recommended levels, a fertilizer program for established woody plants can merely involve applications of nitrogen sources alone. Under normal conditions, complete fertilizers as mentioned above may be used every four to five years to ensure a supply of the other essential nutrients.

Because root growth and nutrient absorption can occur anytime soil temperatures are above 40 F application of slow-release forms of nitrogen provide the most efficient use of this nutrient. Isobutylidene diurea (IBDU), ureaformaldehye, sulfur-coated fertilizers (e.g. Sulfur Coated Urea) and resin-coated fertilizer (e.g. Osmocote) are commonly used sources of slow-release nitrogen.

Nitrogen in slow-release form may also be obtained from “natural” or “organic” fertilizers. Because of a lack of industry standards in the definition of “organic” and “natural” a great deal of variability exists among these products in terms of their composition and analysis. For those adhering strictly to “organic” methods, the label of a given product should be examined for organic certification either by the state agriculture department or organizations such as NOFA (National Organic Farmers Association).

Before applying “organic” or “natural” fertilizers the user must be aware of the nutrients analysis, i.e. the amount (by percent) of N, P, and K and the rate of release of the nutrients. Often mineral elements in natural materials, whether organic or inorganic, are released very slowly. This can benefit plants if nutrient release is steady and continuous over a long period of time. However, these materials may be of little immediate value in correcting nutrient deficiencies. Generally, slow-release materials must be applied in large amounts so that a balance exists between the rate of release and the amount of nutrients available at a given time for absorption by plant roots. Unfortunately, objective information on rates of release of mineral elements from natural materials is lacking, in part because of rate of release is a function of highly variable environmental factors.

Rates of Application

DBH Method – This method is used when determining application rates for trees and involves measuring diameter of the tree trunk at breast height (DBH), i.e., 4.5 feet above ground level. As a general recommendation, for trees with trunk diameters (DBH) less than six inches, apply ¼ pound of actual N for each diameter inch. Apply ½ pound of actual N per inch diameter for trees with DBH greater than 6 inches.

Actual N is calculated by examining the analysis rating on the fertilizer package label. For example, a 10-5-5 analysis fertilizer consists of 10% nitrogen, 5% phosphoric acid, and 5& potash. Therefore, 10 pounds of this fertilizer contains one pound of actual nitrogen i.e. 10% of 10 pounds. For a tree with an 8 inch DBH, a total of 4 pounds actual nitrogen or 40 pounds of the 10-5-5 should be applied. This calculation can be made using the following formula:

(inches DBH) x (rate) = lbs. Actual N
(lbs. Actual N x 100% N in fertilizer) = lbs. Fertilizer

example:

8 in (DBH) x .5 lbs. N/in. DBH (rate) = 4 lbs. actual N
4 lbs. N (actual N) x 100% / 10 (%N in 10-5-5) = 40 lbs. Of 10-5-5

The area to which this amount of fertilizer is applied should include that beneath the canopy of the tree, starting at a distance about 3 feet from the trunk and extending beyond the canopy by another 1/3 of the canopy radius. In areas where pavement or other impervious surfaces cover portions of the root system, amounts of fertilizer applied should be reduced accordingly. The rates as recommended above may have to be adjusted up or down depending upon the type of fertilizer used, soil texture, tree vigor, and environmental vulnerabilities as discussed below.

Area Method – The second method, especially suitable for shrubs, involves measuring the surface area beneath the branch spread of the plant. The surface area equals the radius multiplied times itself and that product multiplied by 3.14. For example a tree with a total branch spread of 36 feet would have a radius (distance from the trunk to the edge of the branch spread or drip line) of 18 feet. The area is then calculated as 18 x 18 x 3.14 = 1017 square feet.

For annual maintenance, it is recommeded that fertilizer be applied at a rate of 3 lbs. Actual N per 1000 sq. feet of surface area. Therefore the area within the dripline of this tree would receive 3 lbs. Of N annually. Since the roots of trees and shrubs often extend beyond the drip line, it is advisable to add a few additional feet to the radius when calculating the surface area. A useful formula for calculating amount of a given fertilizer to be applied using the surface area method is:

(recommended lbs. N/1000 sq. ft. x 100%) / %N in bag = lbs. Fertilizer

example:

(3 lbs. N/1000 sq. ft. x 100%)/10% = 30 lbs. Fertilizer/1000 sq.ft.

For trees on shallow, sandy, or poor soil sites reduce the amount of fertilizer so as not to burn the plant's roots. Using fertilizers with slow release forms of nitrogen will also help reduce the possibilities of root injury in such situations. Rates of nitrogen application should also be adjusted accordingly on sites where these exists a high potential for ground water contamination from nitrate leaching. On such sites, nitrogen application rates of 1 lb. N/ 1000 sq. ft. would be advisable. Again, use of slow release forms of nitrogen can reduce potential for leaching.

Rates of nitrogen application should also be adjusted according to levels of soil organic matter. High rates of nitrogen on soils low in organic matter will accelerate depletion of the organic matter and in the long run reduce the fertility and structural integrity of the soil. It is advisable that determination of soil organic matter levels of 4% or greater are desirable. In coastal areas where organic matter content of sandy soils is often in the range of 1 to 2%, use fertilizers containing at least 50% of the nitrogen in a water insoluble or slow-release form.

Applications of nutrients other than nitrogen should be based upon determination of need. Qualitative assessment of specific nutrient deficiencies may be made from examination of foliar symptoms. However, more precise determination of nutrient needs can only be accomplished by testing soil or foliage nutrient levels. University Soils Testing Laboratories perform both tests for a fee.

Methods of Application

There are several methods of applying fertilizers to trees and shrubs. The method selected depends upon soil characteristics, site factors, cost, and type of nutrients to be applied. Below is a brief summary of the common methods of application.

Liquid Soil Injection – This is the method most often used by professional arborists because it is quick, easy, and also leads to rapid uptake of nutrients. It involves high pressure injection of liquid fertilizer into soil. Injection points should be 2 – 3 feet apart depending upon pressure and about 8 – 12 inches deep.

Drill Hole – This technique involves drilling holes into soil and distributing granular fertilizer evenly among the holes. Holes are drilled to depths of 8 – 12 inches and are spaced 2 – 3 feet apart in concentric circles around the tree, beginiing at a point about 1/3 the distance from the trunk to the drip line and extending 1 – 3 feet beyond the drip line. While rarely used on a commercial scale, this method is effective in opening heavy compacted soils, allowing fertilizer, water, and air to reach the root zone. The holes may be left open or filled with compost, peat, or other organic material. The drill hole method should be used where there exists a potential for injury to fine turf from high fertilizer rates or fertilizers with a high salt index.

Surface Application – Granular forms of fertilizer may be spread by hand or mechanical spreader over the surface of soil around trees and shrubs. It is quick, easy, and inexpensive. Recent studies have shown this method application to be as effective in supplying nutrients to plant roots as other techniques. It is particularly good for applying fertilizers to mulched areas and shrub borders.

Fertilizer Spikes/Stakes – With this method, solid rods of a premeasured amount of fertilizer are placed in holes in soil around woody plants. Wide spacing of holes and slow lateral distribution of nutrients limit the effectiveness of this technique.

Foliar Fertilization – This technique involves the spraying of liquid fertilizers onto the foliage of plants. It is used primarily as a “quick fix” for minor element deficiencies. Foliar feeding is not effective in supplying essential nutrients in quantities necessary for satisfactory growth. Spraying leaves with micronutrient solutions is most effective when done just before or during the growth period.

Tree Trunk Injections – Injections of nutrients directly into a tree is used almost exclusively to correct minor element deficiencies, e.g. iron, manganese, and zinc.

Frequency of Application

With the exception of newly planted trees and shrubs, frequency of application depends on general vigor and growth of the plant. Woody plants growing in soils with continual replenishment of nutrients from decomposition of organic matter may not need regular fertilizing. However, plants in a nursery production cycle and landscape plants with abnormal leaf size and color, little or no annual growth, or with significant amounts of dead wood within the plant should be fertilized annually.

Timing of Application

Fertilizers are best applied late August through September. Absorption of nutrients by roots is very efficient in late summer and will continue until soil temperatures approach freezing. Nitrogen absorbed in fall will be stored and converted to forms used to support the spring flush of growth. The second best time to fertilize woody plants is early spring just prior to initiation of new growth.

Background

Lawn grasses live an in unnatural environment. The grass plants are crowded together and compete with each other, along with neighboring trees and shrubs, for water and nutrients. They are mowed regularly, which is highly irregular in nature, and their clippings, a source of nutrients, are often removed.

Because of this competition and the unnatural demands placed on lawns, they must be fertilized. Just as a balanced diet works best for people and animas, the same is true of lawns -- they need fertilizer for sustenance. When properly fertilized, a lawn maintains good color, density, and vigor, and does not easily succumb to insects, weeds, or diseases. When underfertilzed, the lawn is not only less attractive, but also is considerably more susceptible to environmental stress and damage.

Nutrients

Sixteen different mineral elements are essential to the growth of all lawns. Some are common, such as oxygen from air and hydrogen from water. Others, such as zinc or boron, are needed in only the minute amounts found in most soils.

Nitrogen: This is by far the most important element that a lawn needs. It promotes rapid shoot growth and gives lawns a healthy color. Nitrogen is the mineral most often in short supply. Growing lawns need a plentiful and continual supply of water, but water also flushes nitrogen from the soil. Without sufficient nitrogen, growth stops and the lawn becomes pale and yellowish. On the other hand, if there is too much nitrogen, thatch and disease develop.

Phosphorus: This nutrient is less important, but is still essential for the healthy growth of lawn grasses. It stimulates the early formation and strong growth of the roots, which is why new lawns need it at such a high percentage. It is not readily flushed from the soil by watering and is needed by established lawns in small quantities, so most balanced fertilizer contain only a low percentage. Phosphorus is supplied by phosphoric acid.

Potassium: Next to nitrogen, potassium is second in importance. And like nitrogen, it is flushed out by water, but at a slower rate. It strengthens lawn grasses, enabling them to withstand traffic and resist disease. Potassium is needed in about the same quantity as nitrogen, but since the soil supplies a considerable, not as much is added to fertilizers. The major source of potassium in fertilizers is potash.

Calcium, Sulfur, and Magnesium: It takes relatively large amounts of these nutrients to meet the needs of most lawns. Calcium is either present in adequate quantities in the soil or is added through periodic applications of lime. Dolomite (or dolomitic limestone) supplies magnesium as well as calcium. Most soil sulfur reaches a lawn through the air, water, or organic matter.

Micronutrients: These are elements needed in small amounts. If your lawn does not become greener with an application of nitrogen, the problem may be a shortage of iron. This is particularly true in areas where soil pH is high. Yellowing can also be caused from a sulfur deficiency, overwatering, manganese deficiency in sandy soils, or a pH less than 5.0. A soil test may help find the cause of persistent, soil related problems such as these

Types of Fertilizer

There are an abundance of lawn fertilizers available for use by landscape contractors. You will find labels proclaiming “fast acting”, “slow release” and so on. There is a difference in the types of fertilizers available. The following outlines the differences in fertilizer types.

Organic Fertilizers: Organic refers to a fertilizer derived from plant or animal waste. The variety of organic fertilizers is endless. There are manures of all types, municipal sewage sludge, blood meal, and seed meals. They all share advantages and disadvantages. In some areas they may be inexpensive and easy to obtain, while in other areas, the opposite is true. Most have distinctly beneficial soil-building properties.

Since the action of organics is slow, overfertilizing is usually not a problem. This is the major difference between organic fertilizers and soluble synthetic fertilizers: their nutrients are released slowly. Organic fertilizers a bulkier, heavier and more difficult to handle than other types of fertilizer. They have a low percentage of nitrogen, so it is necessary to apply a much greater quantity at one time. They also may have an unpleasant odor. The release of nutrients from organic fertilizers depends on the amount of water and therefore unpredictable. Soil temperature also plays an important role, since soil microbes are required to activate the fertilizer, and these are not active in the soil in early spring or late fall, when the cool-season grasses are actively growing.

Soluble Synthetic Fertilizers: These are the most common fertilizers used on lawns today. The big advantage of this type of fertilizer is predictability. Because their characteristics are known precisely, you can learn the exact effect they have on a lawn. This is an important feature for may lawns Soluble synthetic fertilizers become available to the lawn before the soil has thoroughly warmed in the summer, are less expensive than organic fertilizers and are easier to handle. Less fertilizer needs to be applied since the percentage of nitrogen is usually high.

However, more work is usually required of those who use them. More applications are necessary because the effects are short term. Further, because of the high percentage of nitrogen, there is the possibility of fertilizer burn.

Slow Release Fertilizers: To some extent these fertilizers these fertilizers combine the characteristics of the organics and the soluble synthetics. Usually they have a high percentage of nitrogen, so spreading large quantities is not necessary. The possibility of fertilizer burn is reduced, sine the nitrogen does not become available to the plant all at once.

Several types are available. Some are categorized on the fertilizer bag as WIN, meaning water-insoluble nitrogen, while others are actually a combination of soluble nitrogen and water insoluble fertilizer.

Slow release fertilizers are favored by many lawn growers because they make heavier applications of nitrogen possible, hence making fewer application necessary. However, they do not provide a quick green-up.

FERTILIZING TREES

What does that mean?

- **Fertilizing trees refers to the practice of adding supplemental nutrients (chemical elements) required for normal growth and development.**
- You can't "feed" a tree, since trees are *autotrophs*: they use nutrients to feed themselves by making sugar in the leaves through photosynthesis.

Do I *need* to fertilize my trees?

- **Often, you may not.** A reasonably fertile soil will have enough nutrients to support healthy growth on most established trees.
- **Trees adjust their growth and development** rates to the level of nutrients, and will usually make out all right as long as the roots can continue to grow.
- **In nature,** trees get nutrients from air, recycled organic matter, beneficial microbes, and soil minerals.
- **In urban settings**, the recycling of organic matter is often reduced, beneficial microbes may be minimal, and some minerals can be unavailable because of the soil pH.
- **Clayey soils** (common on urban sites) present special problems in the availability of micronutrients like iron and manganese for some trees.
- **Lack of water, organic matter, and soil air often limit growth of urban trees** much more than nutrient levels.

What conclusions are supported by research?

- **Young deciduous trees** benefit from some additional nitrogen (e.g., 10-6-4).
- **Conifers rarely need fertilization at all,** since most are genetically adapted to low-nutrient soils.
- **A layer of organic matter** maintained under the tree crown will increase fertility, microbial activity, soil air, and water retention--all factors that increase tree growth.

- **Serious pest and structural problems can result on trees that are overfertilized, especially when a predominantly water-soluble fertilizer is used.**
- **Surface application** is the easiest and cheapest method of fertilizing ornamental trees.
- **Trees surrounded by turf** benefit from the application of additional nitrogen every few years, because grass competes well against trees. Soil-injected fertilization can put the nutrients just below the grass roots so that the trees benefit the most.
- **If contracting out fertilization,** make sure that you specify "work to be carried out according to ANSI A300 standards." These standards specify
  a determination of deficiency

  a specific objective
  manner most beneficial the plant
  preference for at least 50% water-insoluble nitrogen and a salt index below 50

When should I fertilize the trees?

- **Fertilizers with at least 50% water-insoluble nitrogen** should be applied in **early fall or early spring**.
- **Predominantly water-soluble fertilizers** should be applied in **late May or early June** in the Northeast**.**