Fertilization 101: What to Use and When

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While most trees growing in their natural habitats, such as forests or woodlands, can reach their full potential with no human intervention, trees in a landscape often need some help – soil rich in nutrients and organic matter, proper aeration and a sufficient water supply – to be healthy and productive.

Trees are highly diverse plant populations that are grown to satisfy our various needs such as landscaping, shade, fruit, bloom or foliage production, timber, etc. Trees are known for longevity and resilience. Trees growing in their natural habitats such as forests or woodlands can reach their full potential with no human intervention. Some tree species can tolerate extreme growing conditions – high or low temperatures, dry or water-logged soil conditions, acidic or alkaline soil. Other trees need proper care to be healthy and productive – good soil rich in nutrients, organic matter, aeration, water supply, and pest management.

Nutrients

A tree synthesizes starch during photosynthesis (synthesis of food material using light energy), taking carbon dioxide from the atmosphere and water from the soil. Photosynthesis is a biochemical activity in which a host of enzymes play crucial roles. Enzymes are essentially proteins; for an enzyme to be active it usually needs a cofactor such as manganese, magnesium, iron, copper, boron, zinc, etc. In addition to photosynthesis, for a tree to be alive and productive it has to perform a number of other activities – respiration, synthesis of other complex molecules (proteins, amino acids, fatty acids, nucleic acids), cell division, growth, reproduction, etc. To carry on all essential activities, a tree needs essential nutrient elements.

Structural and functional components of cells that make up a tree have one or more essential elements. The essential inorganic nutrients are: carbon (C), hydrogen (H), oxygen (O), nitrogen (N), phosphorus (P), sulfur (S), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), manganese (Mn), molybdenum (Mo), boron (B), zinc (Zn), copper (Cu), and chlorine (Cl). A tree owes approximately 90 percent of its dry weight to carbon and oxygen. Hydrogen, nitrogen, potassium, calcium, magnesium, phosphorus, and sulfur that make up nearly 8 percent of the dry weight of a plant are macronutrients. The rest of the elements, Cl, Fe, Mn, Mo, B, Zn and Cu, which contribute less than 0.1 percent of the dry weight of a plant, are the micronutrients or trace elements. Except for hydrogen (from precipitation), carbon and oxygen that a tree can obtain from the atmosphere as well as from soil, all the other nutrients are available in a healthy soil for root absorption.

Nutrient deficiencies

An absence of any of the essential elements or an inability by the tree to uptake any of the nutrient elements for use would adversely affect a tree's health. This inability could be due to very low or high temperatures, poor aeration resulting in oxygen deficiency, too little or too much moisture in the soil, a lack of microbial activity to convert soil nutrients to absorbable forms, very low or high pH, etc. Under these unfavorable conditions a tree would develop nutrient deficiency symptoms. Symptoms such as yellowing of leaves (chlorosis), abnormal coloration, browning due to tissue death (necrosis), reduced leaf, bloom, or fruit size or productivity, spindly growth, dieback, etc., indicate a deficiency of one or more essential nutrients. When such abnormal symptoms show up, take remedial action to supply the deficient nutrient or nutrients; an application of an appropriate fertilizer containing the right amount of deficient nutrient or nutrients may be called for. Since symptoms due to pest or disease attacks at times show symptoms similar to nutrient deficiencies, do soil and tissue analyses (foliar analysis) prior to fertilizing.

Soil test and tissue analysis

Collect soil samples from different locations, place them in a sealable bag, seal and send it to a soil test laboratory. The laboratory will give a complete analysis of the

soil that should include the amounts of various nutrients, microbial content, organic contents, soil types and soil pH, and also remedial measures for correcting the soil for healthy tree growth. One needs a tissue analysis to know that the tree is in a position to use the soil nutrients. A tissue analysis provides the exact metabolic status of nutrients in plant tissues. For this purpose, collect samples of healthy and unhealthy leaves for analysis. Based on the results of soil and tissue analysis, use appropriate fertilizers to meet the nutrient needs of a tree.

Sometimes all a tree needs is water. Fertilize according to the needs of a tree. Indiscriminate, excessive use of fertilizer (especially a chemical fertilizer) will do more harm than good.

Soil pH

Just because it's in there doesn't mean the tree can use it.

Soil pH is an important factor in the availability of nutrients for root uptake. Very low pH (highly acidic, less than 4) or very high pH (highly alkaline – more than 10) will make certain nutrients unavailable to roots even when present in a soil. The addition of sulfur to an alkaline soil will lower its pH; the addition of lime to an acidic soil would increase the pH. Carefully monitor pH when trying to change it.

Most trees grow well under a pH of around 6.8. However, some plants, such as American holly, rhododendron, azalea, pin oak, and some pines, prefer acidic soil – a low pH of around 5.

Fertilizers

A fertilizer contains one or more essential nutrients. Use a fertilizer of your choice – biofertilizers, natural (organic) or chemical fertilizers. Biofertilizers contain live microorganisms such as mycorrhizae, bacteria or algae (See "Biofertilizers Bring Soil Back to Life," TCI March 2006). Cotton seed meal, dried blood, fish emulsion, animal manure, sewage sludge, rock phosphate, granite dust, kelp (seaweed), wood ashes, coffee grounds, compost, etc. are natural fertilizers. Chemical fertilizers are synthetic fertilizers that contain definite amounts of inorganic compounds such as nitrates, phosphates, potash, ammonium sulfate, chelated iron, Epsom salt, etc.

A chemical fertilizer on the label indicates the ratio of three major nutrients, nitrogen (N), phosphorus (P) and potassium (K). NPK 20-20-20 means that 100 pounds of the fertilizer contains 20 pounds of each of those nutrients – nitrogen (N), phosphorus (P) and potassium (K). In addition, most fertilizers contain trace elements and other nutrients. Some chemical fertilizers contain only one compound – Epsom salt contains magnesium sulfate only. Chelated (iron-EDTA) iron is often used when there is chlorosis due to iron deficiency. Chemical fertilizers release nutrients quickly.

Chemical fertilizers are available as powder, granules and sticks or in liquid form. Nutrients in liquid fertilizers are readily available for root use. Slow-releasing sticks release nutrients for an extended period.

Organic fertilizers contain fewer amounts of various nutrients and release nutrients slowly and steadily over an extended period of time. Therefore, one has to apply more organic fertilizers than inorganic fertilizers. Blood (dried), sewage sludge (activated) and cottonseed meal are good sources of nitrogen. Bone meal is an excellent source of phosphorus. Kelp, greensand and ash are good sources of potassium. Compost usually is a complete fertilizer; the level of nutrients in compost show seasonal fluctuations and vary depending on the stage of composting.

Nutrients from organic fertilizers are available to root absorption by microbial activity. Leaching of nutrients from chemical fertilizers is more rapid than from organic fertilizers.

Time of application

Remember that the need for various nutrients depends on seasonal variations, the phase of a tree's growth (vegetative, reproductive or dormant), tree type (deciduous or evergreen), established or a new transplant. In spring, when a tree is growing vigorously producing new shoots, it will need more nitrogen than in a dormant season. During reproductive phase (flower and fruit production) a tree needs more phosphorus than nitrogen. During dormant season, a tree needs potassium and phosphorus for strong roots, winter hardiness, and disease resistance and not much nitrogen. Fertilize according to the needs of a tree. Indiscriminate, excessive use of fertil-

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Roots can absorb soil nutrients as long as soil temperature does not go below 40 degrees. Root growth in woody ornamentals is active in fall and late winter/early spring. Hot summer temperatures slow root growth. During the dormant phase, root growth still occurs. Fall to spring is a good time to fertilize trees. Apply a balanced fertilizer (NPK 10-10-10) early in spring. Do not hesitate to apply fertilizers in fall. However, use fertilizers containing more phosphorus and potassium and very little nitrogen during autumn (especially late fall) or dormant phase. Fall fertilization is more effective in promoting plant growth than spring fertilization. Remember it takes a few weeks to see the effect of fertilizers after application. Apply slow-release fertilizers early in the season to avoid new growth in late fall.

Do not fertilize young transplants immediately after transplantation. Give time for root establishment. When planted in fall, apply fertilizer in early spring; for spring transplants wait for six to eight weeks after transplanting. To overcome transplantation stress, you may apply compost tea or highly diluted liquid fertilizer.

Evergreens and most avenue trees do not need fertilizer once they get established.

Apply fertilizer early in the morning or in the evening and water thoroughly. Do not fertilize when raining, as water-soluble nutrients would leach out easily.

Amount of fertilizer

Calculate the amount of fertilizer for a tree according to the size of its root zone, which extends beyond the drip line. The distance between the outermost branches of a tree to the base of the trunk is the crown radius. The root zone extends beyond this, to approximately one-and-one-half times the crown radius. So, when the crown radius is 10 feet, the radius of the root zone is 15 feet.

Use the following formula to calculate the area of fertilization:

root zone = pi x r2
The root zone area in this case is:
3.14 x 15 (feet) x 15 (feet) = 706.5 square feet

In addition, calculate the amount of actual nitrogen present in the fertilizer prior to fertilization. For example, the percentage of actual nitrogen in NPK 10-10-10 is 0.1 (10 pounds of nitrogen per 100 pounds of fertilizer). Let's say that you did not want

to exceed two pounds of actual nitrogen per 1,000 square feet. When using the fertilizer 10-10-10 one has to apply 20 pounds per 1,000 square feet. Use the following formula to calculate the amount of this fertilizer needed for the root zone area of 706.5 square feet:

706.5 x 20/1000 = 15.3 pounds

For trees with narrower canopies or unusual shapes, measure the dbh (diameter at breast height) of the trunk. If it is 10 inches, multiply it by 1 or 1.5 feet to get the radius of the root zone: 10 x 1= 10 feet or 10 x 1.5 = 15 feet.

Remember that less is better than more in fertilization. By applying more fertilizer, especially chemical fertilizers, you could burn tree roots.

Methods of application

Top dressing is easy and effective as feeder roots are close to the soil surface, but it is not recommended for grassy areas. Spread fertilizer evenly all around the trunk but not close to the trunk. Nitrogen is easily mobile in a soil; hence, use top-dressing. Phosphorus is not that mobile and its level may also vary. Potassium deficiency rarely occurs. In any case, fertilize based on the results of soil and tissue analysis.

Drilling holes and distributing fertilizers equally in holes around the tree can be rather cumbersome and unnecessary. In addition, drilling may hurt tree roots. Slow-release fertilizer spikes are expensive and not really as effective as granules or powder. Most tree care companies use soil injection with liquid formulations. Trace elements can be delivered through microinjections. Foliar applications of compost tea or liquid fertilizers are often used for correcting nutrient deficiencies. Spray foliage with highly diluted chemical fertilizers to avoid foliage burning; it is better to spray leaves early in the morning.

The key rule in fertilization is to fertilize when the tree needs the fertilizers. Follow manufacturer's instructions on the label when using chemical fertilizers. Natural fertilizers do not hurt trees or beneficial soil microflora or fauna. Organic fertilizers improve soil structure by preventing compacting. Biofertilizers and organic fertilizers are eco-friendly. Depending on your philosophy of maintaining trees, use a fertilizer of your choice when your tree needs fertilization.

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