AREA Forum

DO ARBORISTS THINK OF THE ENVIRONMENTAL IMPACTS OF FERTILIZERS WHEN THEY FERTILIZE URBAN TREES?

Commercial and municipal arborists deal frequently with fertilization. Are they thinking only of benefits to trees, or are they also thinking of the environmental impacts of fertilizers? If you would like to participate in the discussion of this subject, please send your thoughts to ach@correo.azc.uam.mx or to the *Journal* Editor (see inside front cover).

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The potential environmental impacts of tree fertilization in the cities of Spain are not really a problem because fertilization is not a common practice. When fertilization is done by cities in Spain, it is normally by contract with private companies. A few private gardens do their own fertilization, but both private garden and municipal park managers never ask about potential environmental impacts for these products.

Arborists use some fertilizer in tree care but rarely consider their environmental impacts and never ask about risks to their own health. They feel it is more important to use fertilization to solve a tree problem rather than to be concerned if a product is, or is not, dangerous to the environment.

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In the forest, the growing condition is ideal for many woody plants because of undisturbed soil; stable temperature, pH, and moisture; recycling of organic matter; enhanced microbial activity; and lack of compaction and competition from turfgrass. In our field experience, we have observed that plants often do not survive when the proper factors are not adequately available for growth and development in an urban environment. The horticultural attributes of plants can be improved through proper inspection and incorporation of Plant Health Care practices, including prescription fertilization.

It is important to know the extent to which nitrogen fertilizer may contribute to water quality degradation, particularly nitrate contamination of groundwater. Nitrate nitrogen (NO_3–N) in groundwater is of concern because nitrate can be harmful to humans and livestock if consumed in drinking water. A maximum acceptable level of 10 ppm NO_3–N (45 ppm nitrate) has been established by the U.S. Environmental Protection Agency. Critical NO_3–N levels as low as 0.3 ppm have been proposed for controlling eutrophication of surface waters (Alexander 1972). Fertilizer is only one potential source of nitrogen. The earth's atmosphere is approximately 78% nitrogen and, according to a study by the U.S. Geological Survey in 2000, vehicles and power plants contribute to about 35% of nitrogen found in coastal streams.

Previous research has conclusively shown the value of slow-release fertilizers in reducing nitrogen leaching under various soil conditions. In Michigan, slow-release fertilizers have reduced subsoil nitrate concentrations compared to water-soluble fertilizers (Rieke and Ellis 1974). In Texas, nitrate leaching from highly modified, coarse-textured golf-green–type soils was reduced to low levels when slow-release N sources were used. Nitrate N losses in descending order were NH_4N0_3 > 12-12-12 > Milorganite > Isobutylidene diurea (IBDU) > Ureaformaldehyde (UF) (Brown et al. 1982). Similar results were demonstrated in Florida as shown by Sartain (1992).

Slow-release nitrogen fertilizers are not new. The oldest, Milorganite, has been marketed for more than 50 years. Development and testing of UF began shortly after World War II. IBDU was developed in Japan and became available in the United States in the late 1960s. Sulfur-coated urea (SCU) appeared a few years later. The tree care industry has been slow to adopt these sources, possibly because they are more expensive than soluble fertilizers and there has been less research than in the turfgrass industry to support their use. The Davey Company developed and patented a slow-release fertilizer with UF as the exclusive nitrogen source in 1977. Previous data have shown that nitrate leaching from UF is minimal, and we are planning a study in cooperation with Nu-Gro Technologies, suppliers of Nitroform UF, to quantify leaching and biological performance on woody ornamentals grown under landscape conditions at our headquarters in Kent, Ohio.

Literature Cited

Alexander, M. 1972. Accumulation of Nitrate. National Academy of Sciences. Washington, D.C.

Brown, K.W., J.C. Thomas, and R.L. Duble. 1982. Nitrogen source effect on nitrate and ammonium leaching and runoff losses from greens. Agron. J. 74:947–950.

Rieke, P.E., and Ellis, B. G. 1974. Effects of nitrogen fertilization on nitrate movements under turfgrass, pp 120–130. In Roberts, E.C. (Ed.). Proc. 2nd Int. Turfgrass Research Conference. Blacksburg, VA, June 1973. Am. Soc. Agron., Madison, WI.

Sartain, J.B. 1992. Relative N leaching losses from selective slow-release nitrogen sources, pp 131–136. In Freeman, T.E. (Ed.). Turfgrass Research in Florida. University of Florida, Gainesville, FL.

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My impression is that many arborists and landscape maintenance professionals are largely unaware of the potential problems associated with tree fertilization. It has been well documented that excessive tree fertilization can increase pest susceptibility, stimulate excessive growth, increase maintenance costs, reduce tolerance to environmental stress, elevate soil salinity, cause marginal leaf burn damage and root damage, and contaminate ground and surface water.

Tree fertilization commonly is thought of as a means to manage tree health, improve leaf color, or increase growth rate. Although soil fertility is only one factor that can influence tree health, appearance, or rate of growth, recommendations to fertilize trees are often made without a careful analysis of environmental conditions, soil fertility, or other soil factors. What tree care practitioners often fail to recognize is that poor plant performance usually is associated with unfavorable environmental conditions (e.g., soil compaction, drought, poor soil aeration, unfavorable soil pH, or inappropriate tree care practices, such as incorrect planting technique, irrigation, or pruning). Trees stressed by drought, poor soil aeration, inadequate light, root disease, or other factors usually do not respond to fertilization unless these problems are mitigated.

Many arborists and their clients consider rapid growth desirable and associate tree health and rapid growth. Contrary to what they may believe, rapidly growing trees often are less tolerant of environmental stress and more susceptible to pest problems than slower-growing trees. The reason is that in rapidly growing trees, much of the available energy is used for shoot (vegetative) growth rather than root growth and defense.

Tree health, more aptly, is the ability to resist injury from environmental stress and to adapt to changing conditions. Genetics, physical environment, climatic events, disease, mechanical injury, site disruptions, age, and cultural practices, affect tree health. Growth rate alone is not necessarily a measure of health. For instance, slow growth may indicate that a tree has altered its growth rate or root/shoot ratio to adapt to environmental change or ambient growing conditions. Health in a general sense refers to reasonable growth, appearance, pest resistance, and resilience to stress.

Growth rate increases when water and nutrient levels are favorable. In general, such conditions tend to favor shoot growth rather than root growth. This can lead to relatively large trees with disproportionately small root systems. Such trees often are less tolerant of environmental stress.

Moderate fertilization, when warranted, can improve growth and appearance and improve tree health. Bear in mind, however, that trees generally are adapted to relatively low levels of nitrogen. Overfertilization favors the buildup of sap-feeding insects or exacerbates canker and root disease problems.

Nitrates from nitrogen-based fertilizers are particularly mobile in the soil water and can move readily into the groundwater. Phosphorous is much less mobile but can contaminate bodies of water in suspended sediment from soil erosion. Both enhance growth of algae and other aquatic organism, greatly reducing oxygen levels of the water, causing fish death. Judicious application of fertilizers can minimize these problems. Slow-release formulations and appropriate irrigation practices can help avoid runoff and leaching.

Arborist and landscape maintenance specialists usually favor complete fertilizers—those containing nitrogen, phosphorous, and potassium—even though the latter two elements may not be deficient in their locality. Although nitrogen deficiency can significantly reduce tree growth, symptoms of nitrogen deficiency are relatively rare in urban and rural trees. Perceptible nitrogen deficiencies are most prevalent in sandy or silty soils low in organic matter and in poorly drained soils. Deficiencies also may develop on sites where the soil organic matter is gradually depleted by regular removal of leaf litter or by competing vegetation and crops (fruit and nuts). The level of phosphorus and potassium usually is sufficient in most soils for normal tree growth. Potassium, however, may be deficient in subsoils, especially those low in organic matter. Even though the level of phosphorous may be low in some soils, mychorrhizal fungi aid in its absorption. Phosphorus does not move readily in the soil and tends to be found close to the surface in organic matter. It also forms insoluble salts in strongly acid or alkaline soils and thus is largely unavailable.

Fertilization can be a useful tool to promote rapid growth in nursery trees; encourage moderate growth in young, established trees; maintain health in mature trees; and correct known nutrient deficiencies. An understanding of how trees respond to changes in soil fertility and moisture availability is critical to the effective use of fertilizer and irrigation in the landscape. The main objective of tree care should be to improve or maintain plant health by providing a favorable and stable growing environment.

Note: Submissions to the AREA Forum are invited opinions of the authors and are not juried papers. —Editor