A WORD OR TWO ABOUT GARDENING

Feeding your landscape plants – macro and micro nutrients

In the last article the properties of Miami-Dade soils were considered as they relate to maintaining healthy landscape plants. The focus was on soil pH and fertility, the latter with respect to the macro nutrients nitrogen, phosphorus and potassium (N,P,K). It was clear that Miami-Dade soils are very alkaline (pH 7.4 - 8.5), lack potassium and nitrogen with most of the phosphate bound to calcium and largely unavailable for uptake by plants.

Most of the present article will consider what are referred to as plant secondary nutrients (calcium, magnesium and sulfur) as well as the more important trace elements. First though, it is necessary to complete the discussion of plant N, P and K requirements by reviewing deficiency symptoms associated with these macro nutrients. All three are regarded as mobile within the plant. This means that each can be withdrawn from mature parts of the plant in order to support new growth. As a result, deficiency symptoms are seen first in older growth. A deficiency of nitrogen causes an overall yellowing of the plant, first seen in older leaves. Fewer new side shoots develop and stems become thin and stiff. The tips of new shoots may appear burnt, and the undersides of leaves on some plants (e.g., tomatoes) can develop a reddish color. Plants are smaller in size. Excess nitrogen can also be a problem, encouraging vegetative growth at the expense of flowering (e.g., mango, litchi and citrus as well as bougainvillea and many other tropical flowering trees and shrubs). This new growth is often soft and succulent making it more susceptible to disease – e.g., withertip in key lime, various fungal diseases of turf grass.

Plants differ in how much nitrogen they require. Among vegetables, sweet corn, cabbage, lettuce, tomatoes and peppers require more than beans and peas. Turf grass should receive about 1lb of nitrogen per 1000 sq ft (preferably with 50% in slow release form) sometime in March, and a second application in September. Apply nitrogen as part of a complete balanced fertilizer that contains phosphorus and potassium as well as the secondary macro nutrients (especially magnesium) and trace elements. High levels of nitrogen render turf grass more susceptible to wilting, especially during winter – a lower nitrogen fertilizer should be used for a fall application. Turf grass growing where it is shady also requires less nitrogen.

In general the fertilizer nitrogen applied to turf grass is usually adequate for surrounding shrubs and ornamental/shade trees once they are established. Fruit trees, whilst bearing a crop, will need more nitrogen than ornamental trees. Some well known landscape shrubs require additional nitrogen, including most roses, hibiscus, gardenia and ixoras. In contrast, succulents (e.g., agaves, aloes and crassulas) require far less nitrogen than other landscape plants - an excess is liable to encourage rotting.

Signs of a potassium deficiency are also first seen in older leaves, initially as a yellow (chlorotic) zone around the leaf margin, which then becomes scorched and necrotic (dead). Scattered necrotic areas may form elsewhere within the leaf. Although more commonly associated with palms (see previously archived articles at

http://miami-dade.ifas.ufl.edu/publications.htm), K deficiency symptoms can develop in the following landscape plants: black olive, orchid trees (*Bauhinia*), mango, various gingers and heliconias, ornamental (and edible) bananas and tree philodendron (*P. selloum*). Potassium is essential in the formation of carbohydrates and proteins, maintaining plant cell water balance and regulating transpiration (external water loss). Plants lacking potassium wilt more readily and are more susceptible to disease. Signs of K deficiency can develop on soils high in sodium, or if excessive amounts of nitrogen or magnesium (e.g., Epsom salts) are used. The latter two scenarios are more often observed in landscape palms. Excess potassium is not usually a problem though it can lead to magnesium deficiency and interfere with nitrogen uptake. In general fertilizers with a higher proportion of potassium than nitrogen are used to promote fruit and flower production and those with higher nitrogen to encourage vegetative growth (young, developing trees and shrubs, or periods where a major growth flush can be expected, as in turf grass).

Phosphorus is taken up in two ionic forms, preferentially as $H_2PO_4^-$ but also as HPO_4^{2-} , especially if the soil pH is high. It is also mobile within the plant. Deficiency symptoms are rarely seen in local landscape plants. Where phosphorus is lacking, growth slows, leaves develop a brown to purple color and flowering is reduced. Phosphorus is most needed by plants undergoing rapid growth, such as many annual bedding plants and cool season leafy vegetables, where it is essential for the prompt development of a strong root system. Established trees and shrubs, especially those in a warm climate such as Miami-Dade require least amounts of phosphorus.

Of the three secondary plant macronutrients; calcium (Ca), magnesium (Mg) and sulfur (S), the one most often associated with deficiency symptoms is magnesium. Calcium is abundant in local soils as Miami limestone ($CaCO_3$), to an extent that can directly interfere with magnesium uptake. Since magnesium is mobile in most plants, symptoms are first seen in older leaves. The first sign is usually a chlorotic area at the leaf tip which spreads around the leaf margins (at this stage it can be confused with a K deficiency). A “fishbone” pattern of interveinal chlorosis then develops often with a wedge shaped area at the leaf base remaining green. Apart from being an essential component of chlorophyll (the green pigment in leaves that is essential for photosynthesis), magnesium is needed as a co-factor for several plant enzymes. Enzymes are protein molecules that act as catalysts (facilitate chemical reactions) in living organisms.

Symptoms of Mg deficiency are more common in palms (especially *Phoenix* spp., date palms), but the following landscape plants are known to exhibit symptoms: orchid trees (*Bauhinia*), poinsettias, some species of *Podocarpus* and *Pittosporum*, cycads, screw pines (*Pandanus*), anthuriums and heart-leaf philodendrons. Magnesium can be applied as a foliar spray (e.g., magnesium nitrate or as part of a proprietary nutritional spray), or to the soil as Epsom salts ($MgSO_4$) or kieserite. Epsom salts are rapidly moved beyond the plants root zone during rainy weather, while kieserite (a natural mineral form of $MgSO_4$) is released more slowly into the soil but is difficult to find.

Apart from forming the “cement” (as calcium pectate) that joins plant cells together, calcium plays an important role in plant cell division and as a cofactor for several enzymes. Plant parts undergoing rapid cell division (developing root tips, leaf/flower buds and fruit) are therefore especially susceptible to a calcium deficiency. Although there is abundant calcium in local native soils, it is necessary to add a calcium source, such as dolomitic limestone, if you are making up a soil mix from scratch for use in containers or a raised bed. Even where there is sufficient calcium in the soil, problems can arise due to a localized deficiency within the plant. This is seen locally in the blossom end rot of several vegetables, especially tomatoes. There is also evidence that this is the cause of internal breakdown (soft nose/jelly seed) seen in certain mango cultivars. A localized deficiency of calcium causes an early loss of integrity of the cell walls of the developing fruit, with a subsequent breakdown of the surrounding tissue.

For blossom end rot in tomatoes at least, a number of factors are considered to affect calcium availability. Soil that is too dry or too wet will lead to reduced calcium uptake. If too dry there will be insufficient soluble calcium, if too wet the roots will be starved of oxygen and cease to grow. Transportation of calcium in the plant is related directly to the rate of transpiration - the largely passive process by which water is taken up from the soil and lost to the atmosphere through the leaves. During periods of low humidity the rate of transpiration increases causing more of the calcium taken up to be transported to the foliage and less available for the developing fruit. Even though the above conditions may be of limited duration, if they coincide with a period of early fruit development, blossom end rot symptoms will eventually become visible. Since calcium exhibits such limited mobility within the plant, applying foliar sprays containing Ca will not correct blossom end rot. For those mangos prone to internal breakdown, avoid excessive nitrogen and do not allow fruit to fully ripen on the tree.

The previous article described how Miami-Dade’s high pH soils render many of the trace elements unavailable for plant uptake. In the case of iron, deficiency symptoms are similar to those observed for manganese, and it can be difficult to distinguish between the two. Both cause interveinal chlorosis seen first on new leaves (neither element is mobile within the plant). There are subtle differences: in manganese deficient plants leaf yellowing develops first at the leaf margins with the leaves appearing less chlorotic. As symptoms progress, scattered areas of necrotic tissue develop. This is not a feature observed with iron deficiency where the leaves eventually become totally chlorotic or can even appear bleached. In contrast to Mn, during the earliest stages of Fe deficiency the mid and lateral veins are outlined green, while in between a network of fine veins is visible against a paler background. In both instances the visual symptoms reflect the role Fe and Mn play in the synthesis (manufacture) of chlorophyll.

Plants grown on Miami-Dade soils that exhibit yellowing or bleached leaves should be suspected of suffering from iron deficiency. Some of the more common landscape plants showing symptoms include: orchid trees, ixora, gardenia, *Lonchocarpus* spp.(Florida lilac), *Cassia fistula* (golden shower tree), azaleas, heliconias, carambola, mango, litchi, bougainvillea, Barbados cherry, macadamia

and citrus. Many of the same plants can also exhibit signs of manganese deficiency, with the addition of: *Ficus retusa*, allamandas, jasmine, red maple, *Clerodendrum.*spp., cycads, crape myrtle, ligustrums, *Plumbago*, crape jasmine and sweet viburnum. Manganese deficiency is also commonly seen in various palms, whereas iron deficiency is rare, restricted to palms growing in excessively wet soil. There are many other less familiar plants used in local landscape that can show signs of a deficiency of one or both of these nutrients. Do not apply manganese or iron unless required. Whilst manganese and zinc (see below) can be applied as foliar sprays, iron is more effective applied in a chelated form (EDDHA-Fe) as a soil drench. Foliar applications of iron can cause a green speckling of highly chlorotic leaves.

Like iron and manganese, the high pH soils of Miami-Dade render zinc (Zn) largely unavailable for plant uptake. Since zinc is immobile within the plant, deficiency symptoms are seen first in new growth. Among other functions, zinc is necessary for the activation of auxins (plant hormones necessary for growth). It is therefore not surprising that zinc deficiency symptoms relate principally to plant growth. Internodes become shortened (stunted growth) and leaves dwarfed or misshapen (little leaf), and rosetted in severe cases. Leaves can also become chlorotic, but not to the extent seen in manganese or iron deficiencies. In some instances a lack of zinc will reduce flowering. Locally grown plants that have shown symptoms of zinc deficiency include the following: citrus, velvet apple (*Diosporys blancoi*), loquat, Barbados cherry, orange jasmine, Surinam cherry, macadamia, mango and lychee.

The remaining trace elements are rarely the cause of nutritional problems in Miami-Dade. Insufficient copper will cause reduced growth with thickened cupped leaves. Although potentially a problem on alkaline soils, the widespread use of copper based fungicides probably supplies all that is needed. Excessive copper in soils is toxic to plants. Molybdenum deficiency is usually associated with acidic soils, while insufficient information is available for nickel and cobalt. Boron deficiency, which causes stunted/distorted growth has been recognized recently as a problem in Miami-Dade, at least as far as palms are concerned. Symptoms in palms are varied making diagnosis difficult. Use low application rates to correct any deficiency, as boron readily becomes toxic if applied in excess.

Signs of nutritional problems can also result from diseased roots or pathogenic soil nematodes. If a previously healthy plant does not respond to applications of a balanced fertilizer and/or nutritional supplements, suspect an underlying disease or pest problem. There are other factors to consider. For instance, uptake of nutrients (particularly phosphorus) in many plants is highly dependent on mycorrhizal fungi. These fungi form an intimate association with plant roots, markedly improving nutrient uptake. In return the fungi have access to a source of inorganic carbon. Pine trees will not succeed unless mycorrhizal fungi are present, and this is one of the reasons they frequently fail locally as landscape plants in suburban yards.

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