A WORD OR TWO ABOUT GARDENING

A guide to what ails your citrus tree

A previous article reviewed the range of backyard citrus that can be grown in Miami-Dade as well as presenting some pointers on tree installation and establishment. The present article deals with subsequent care; in particular how to make an informed diagnosis of what ails your tree when it appears to be 'sick'. There's an inclination on the part of many to adopt an empirical approach to finding a cure, experimenting with whatever pesticides are at hand. Worse is a belief that more must be better. All of this can be futile and even counterproductive, doing more harm than good. Using a hodgepodge of chemicals (especially above the labeled rate) can damage the tree, kill off beneficial organisms and endanger your own health. Only certain pesticides can be safely and legally used on citrus. The product label must list citrus otherwise use of the pesticide is illegal.

Rather than the shotgun approach, first try to narrow down the nature of the problem so you have an idea of what action is warranted. It may be that the probable cause is fairly obvious – aphids on new growth or scale insects on leaves or stems. Otherwise as a first step establish whether the cause is a pest/disease or is abiotic (non-infectious - nutritional, environmental or physiological). In the latter case pesticide use is clearly not the answer and you may need to attend to nutritional deficiencies and/or correct growing conditions.

Nutritional Problems: the most common nutritional problem is a lack of **nitrogen.** Foliage over the entire tree appears paler. As the deficiency progresses leaves become distinctly yellow, prematurely drop and the canopy appears sparse. If not corrected the tree eventually becomes stunted, producing a light crop of inferior fruit. At the other extreme, nitrogen in excess can cause fruit to develop thickened peel. For a mature producing tree apply you can use 11-15 lbs of a slow release 8/2/12 complete fertilizer per year split into 3-4 separate applications. For key lime apply no more than 3-4 lbs of fertilizer per year.

Where translocation of nitrogen is restricted due to injury or diseases (e.g., foot rot, see below) a veinal chlorosis develops (leaf veins become yellow). In this instance soil nitrogen may well be adequate but uptake is compromised.

Deficiency symptoms of manganese, zinc and iron are visible as a yellowing of ***new*** leaves (interveinal chlorosis). Lack of **manganese** causes the mid and lateral leaf veins to appear prominently outlined dark green against a much lighter green mottled background. Leaves become paler and develop scattered grey necrotic areas between the veins. **Iron** deficiency causes similar symptoms except the mid and lateral veins are not as prominent and a network of smaller veins is visible against a much paler background. As the severity of the deficiency increases, interveinal areas become pale yellow then appear almost bleached. There are no necrotic areas as seen with manganese deficiency. Left untreated die-back of the tree occurs and fruit production declines. **Zinc** deficiency is first seen as yellow blotches in between lateral leaf veins with the whole leaf eventually becoming yellow

apart from the main mid and lateral leaf veins. Severe zinc deficiency also causes leaves to become smaller (little leaf) and somewhat misshapen.

Chlorotic leaves are also seen with **magnesium** deficiency but in this instance symptoms occur on ***older*** growth. Yellowing is first seen at the leaf base spreading to the entire leaf save for a distinctive wedge shaped green area astride the mid rib immediately above the junction of the leaf blade and petiole. Rather than the canary yellow seen with nitrogen deficiency, magnesium deficient leaves eventually become a bronzy yellow before dropping from the tree. Often deficiency symptoms are first noticed in summer as the new crop of fruit undergoes rapid development, depleting nearby mature leaves of magnesium.

In Miami-Dade the above trace element deficiencies are principally due to local alkaline soils rendering each element unavailable for uptake by the tree. For all except iron correct trace element deficiencies via foliar feeding using an appropriate spray mix to run-off 3-4x per year. Look in local garden centers for concentrated trace element mixes labeled for use on citrus. Iron is best supplied as a soil drench, chelated as Fe-EDDHA (Sequestrene 138 or equivalent product). Local citrus trees may well suffer concurrent deficiencies of two or more of the above trace elements – if the leaves appear bleached then an iron deficiency is at least part of the problem.

Unlike the above elements, a deficiency of **potassium** is more likely to express itself in fruit (which become small, thin skinned and drops) than foliage. Leaf symptoms are seen only when the deficiency is pronounced and consist of yellowing of leaf margins with brown necrotic areas. A lack of potassium should not be a problem for trees receiving regular applications of a balanced slow release fertilizer.

Environmental problems: Try to alleviate problems due to environmental factors by planting in an area protected from direct winds and ensuring even soil moisture. **Wind injuries** can be merely cosmetic such as the scarring that occurs when developing fruit rubs against neighboring stems or more serious if it is lacerated by nearby tree spines. This can be mistaken for bird damage and in either case can result in small fruit abscising if the injuries are extensive. High winds can cause newly emerging leaves to become torn and distorted. It is also difficult to prevent fruit from splitting (especially thin skinned varieties) or dropping as can happen on excessively **rain soaked soil** in late summer-fall. Selecting a site with excellent drainage and ensuring the trees are not lacking potassium can help.

Sunscald of the leaf *underside* occurs if exposed to direct sun with resulting raised brown spots (gum spots). More serious is sunscald damage to the trunk, a risk for newly planted and storm damaged trees. The trunk should be protected from direct exposure to the sun (use water soluble latex paint diluted 1:1 with water).

Chemical Injuries: Improper or careless use of pesticides can cause damage that simulates disease, pest damage or nutritional deficiencies. For instance, copper based fungicides (considered one of the safest of pesticides) can cause small dark brown leaf spots on citrus leaves if used above the recommended rate. Leaf spots due to spray damage are usually more evenly spaced than those due to disease or arthropod pests. In some instances spray damage can cause leaves to yellow or appear blighted (oil and sulfur if used within 3 weeks of one another). Be careful using **herbicides**. Root uptake of atrazine, found in local weed and feed products,

can cause an interveinal chlorosis which may be mistaken for a nutritional problem. Avoid using products containing the herbicide in the vicinity of tree feeder roots.

Some of the symptoms described above can be confused with one another or those due to infectious diseases and pests. Together with symptoms review the trees past history regarding nutrition (or lack thereof), climatic factors and use of pesticide/herbicides. This may provide additional evidence to narrow down the nature of the problem (e.g., tree rarely given fertilizer or nearby use of a weed and feed product). Once abiotic causes can be eliminated then consider the diseases and pests discussed below.

Infectious Diseases: There are several proactive measures that can lessen the risk of disease in backyard citrus:

Choice of variety (including rootstock)

A free draining site (this includes use of suitable backfill) that affords full sun exposure (for rapid drying of wet foliage).

Preventing moisture build up at the base of the trunk by keeping the surrounding area free of weeds and organic mulch and taking care in positioning sprinkler heads.

Avoiding tree injuries, especially to the lower part of trunk (e.g., careless use of garden implements).

The above precautions are especially important regarding phytophthora foot and root rot, a not uncommon problem on Miami-Dade's rock soils. *Phytophthora* sp. (soil dwelling water molds) cause foot rot when contaminated soil is splashed onto the lower part of the trunk and the pathogen gains entry via cracks in the bark. Infection causes gummosis (oozing of amber fluid from small breaks in the bark) with later peeling of dead bark at the margins of the infected area. The lesion can spread up and around the trunk above the bud union (most rootstocks have at least some resistance to infection). If similar symptoms are seen below the graft they are more likely due to mushroom root rot (Armillaria) having progressed from infected roots into the base of the trunk.

Foot rot of young trees can quickly girdle the trunk and kill the tree. On older trees infection is often limited to one side of the trunk with the lesion drying and becoming callused. Rot occurs underneath the bark destroying the cambium (layer of cells from which new bark and vascular tissue is formed) which in turn limits the trees ability to translocate nutrients. This first manifests as a veinal leaf chlorosis, with subsequent leaf drop and die back of new growth. Small lesions on the trunk can be excised with a sterile sharp pruning knife and the wound treated with a copper based fungicide. More effective control can be affected by applying costlier systemic fungicides directly to the trunk (contact Miami-Dade Extension Office for more information).

Phytophthora can also cause a rot of the tree's fibrous roots, especially on heavy, wet, poorly oxygenated soils and is a risk after extensive flooding. While sour orange rootstock exhibits good resistance to foot rot, it is not as resistant to fibrous root rot. Infected trees rarely die but lack vigor exhibiting yellowing leaves, dieback with a resulting sparse canopy and a reduced crop.

Citrus canker is one of two bacterial diseases that have severely impacted Florida citrus. For homeowners canker will usually be a largely cosmetic problem causing

some leaf spotting and a rind blemish (fruit still edible). Where more severe, leaf and/or fruit drop occur and new growth dies back. The disease is caused by a highly contagious bacterium, *Xanthomonas citri*, which is readily spread by a combination of wind and rain. Local mechanical transfer of bacteria from tree to tree can easily occur during the course of yard work. Where there is pre-existing damage from citrus leaf miner, symptoms including those on more resistant varieties such as Valencia become much more pronounced. This means far more bacteria on leaf surfaces facilitating greater potential spread of the disease.

On foliage initial symptoms are usually found toward the edge of the leaf and consist of small oily spots. The bacteria within these spots induce increased cell division of underlying leaf tissue (hyperplasia) which breaks through the leaf surface as a canker. At first soft and yellowish, cankers become corky and more tan in color often crater-shaped with a water stained margin, and pronounced yellow halo. On infected fruit raised grayish brown corky lesions with a yellow halo are seen, while severely infected new stems have a crusty appearance and often split. In order to afford some protection to a new crop copper based fungicides can be applied during the first 60 days post fruit set. This is the period when fruit is most susceptible to infection. In Miami it coincides with the dry season (late winter into early spring) when the risk of disease transmission is reduced. In contrast during summer the disease spreads readily and the aim now is to afford some protection to new growth flushes. Trees should be sprayed with a copper based fungicide plus 1% ultra-fine horticultural oil applied when new leaf expansion is about 20%.

Citrus greening is another bacterial disease of citrus, officially known as **huangbongling (HLB)** the phonetic version of the Chinese name for the disease which means “yellow dragon”. Unlike canker, HLB is a systemic disease which is eventually fatal and spread in the field by an insect vector rather than physical means (the bacteria can be spread in the nursery through grafting tools). The pathogen, *Candidatus* Liberobacter spp., colonizes phloem elements in the trees vascular system (transports products of photosynthesis from leaves to other parts of the tree). The prefix *Candidatus* is used to designate bacteria for which there is insufficient information to afford a full taxonomic rank. In essence this is due to an inability to culture them in the laboratory.

This inability to culture the bacterium has complicated diagnosis of HLB. A definitive diagnosis involves a relatively costly molecular procedure that involves amplifying minute amounts of the *C.* Liberobacter DNA present in samples taken from trees suspected of being infected. Disease progress is slow and it can take several years before visible symptoms appear. Initially the leaves on one or more shoots develop a patchy yellow mottle that can be confused with other causes such as a nutritional problem, Phytophthora root rot or water logged soil. There are subtle differences: the yellowing in HLB can go across leaf veins (usually interveinal where trace element induced) and the color contrast is not as pronounced. Fruit symptoms are more definitive: those from infected trees are small, misshapen, with a bitter taste and never fully ripen. Within 2-3 years of the first visible symptoms an infected tree will become totally unproductive but should be removed as soon as

HLB is confirmed to lessen spread of the disease. If you have questions regarding suspected citrus greening call the help line at 800 282-5153.

Spread of HLB is by means of a psyllid (*Diaphorina citri*), insects that resemble tiny cicadas. Closely related to aphids, both require a new growth flush as a food sources for juvenile forms. Feeding causes severe distortion of new leaves but unlike aphids adult psyllids persist and feed on mature foliage. Both aphids and psyllids produce copious amounts of honeydew on which black sooty mold grows. Adult psyllids produce a conspicuous waxy secretion which is a useful diagnostic tool. Apart from young trees, where extensive leaf damage can set back growth, psyllid damage is not important. It is their role as vectors of HLB that is of concern, transmission of bacteria occurring as soon as a carrier psyllid commences feeding. Another rutaceous plant, *Murraya paniculata* (orange jasmine – popular as hedge material), is the preferred host for *D. citri*. If you have orange jasmine in your landscape and notice distorted new growth and sooty mold check for psyllids. The remaining citrus diseases are all due to various fungal pathogens.

Citrus scab produces symptoms that can be mistaken for those of citrus canker causing raised scabby pustules on fruit and leaves of grapefruit, tangerines and their hybrids. Lesions found on foliage differ from citrus canker in lacking a water-stained margin or halo and the leaf surface opposite the raised scab is indented. Infected leaves become twisted while the scabby lesions formed on fruit at first yellowish brown become a dull grey. On grapefruit lesions may appear flatter, resembling damage due to wind scar. For homeowners control of scab is rarely warranted.

Alternaria brown spot is a disease of Dancy tangerine and its' numerous hybrids (e.g., Mineola and Orlando tangelos and Sunburst tangerines). Small dark brown leaf spots develop a yellow halo but are not raised as in citrus canker or scab. Large blighted areas may form with fungal toxins spreading from infect areas along leaf veins turning them yellow then brown. Die back of infected shoots can occur and newly formed fruit if infected will drop from the tree. For both scab and alternaria prolonged wetting of foliage favors disease establishment.

Anthracnose causes a **post bloom fruit drop (PFD)** presaged by symptoms first seen when the fungus infects flower petals which initially turn a light orangey brown then darker brown and dry. Infection then cause newly formed fruitlets to absciss (detach) leaving behind flower remnants referred to as buttons (the floral disc and calyx). Buttons often persist on the tree for up to a year. The presence of buttons is indicative of PFD especially if flowering coincided with a period of wet weather. In Miami-Dade flowering of most citrus varieties, apart from limes, occurs during late winter during the dry season - avoid overhead irrigation. Unlike the preceding two diseases, copper based fungicides are not very effective against PFD.

Lime anthracnose is a disease found only on key limes where as well as PFD it causes new leaves to become blighted and fall with die-back of new shoots (referred to as withertip). Control is difficult and it is easier to lessen the risk of disease by limiting the use of nitrogen containing fertilizers so as to reduce the amount of soft new growth susceptible to infection.

Two other fungal diseases, **melanose** and **greasy spo**t are quite common on local citrus. The former is found on all citrus especially grapefruit but despite sometimes

causing severe rind blemish is of minor concern for the homeowner. On infected fruit raised brownish pustules give the rind a rough sandpaper-like feel. Blemishes can form a tear stain or droplet pattern depending on how infective spores were splashed onto the fruit. Since infective spores are produced on dead wood, its removal during winter pruning is an effective means of control. Large areas of the rind can become affected (mudcake melanose) if infection occurs right after fruit set. Symptoms can be mistaken for the russet colored blemishes due to citrus red mite. In the latter case damaged rind does not have a rough feel and symptoms are confined to surfaces not exposed to direct sun.

Greasy spot can affect all citrus but symptoms range from most severe on limes and grapefruit (including tangelos) to less so on sweet oranges with tangerines least susceptible. On leaves infection is first seen as yellow blotches followed by brown leaf spots on the underside of the leaf. These darken becoming visible on both leaf surfaces as black greasy spots, though leaves may drop before this happens. Leaf drop occurs several months after infection, late fall through winter, and can be pronounced. It is advisable to rake up any fallen leaves since infective spores are produced in leaf litter. Application of a copper based fungicide plus 1% ultra-fine horticultural oil late May to June and again some time in late July is advisable if greasy spot was present during the previous year.

A parasitic algae (*Cephaleuros*) produces grayish green leaf spots which eventually turn a conspicuous rusty brown. Similar symptoms are seen on infected limbs, plus cracked bark and even die back if girdling occurs. Disease is encouraged by constant high moisture (e.g., shade), and is most prevalent on Tahitian limes. Copper based fungicides applied during summer give excellent control.

Arthropod pests Before using an insecticide examine your tree carefully to see if there are actually any insects that could be the source of your problem. Aphids, scale insects, mealybugs, whiteflies and psyllids are usually visible to the naked eye. Apart from armored scales, black sooty mold is a tell tale sign indicating current or recent feeding activity of these insects. **Soft scale insects** are not normally considered a serious threat to mature producing trees. **Snow scale** is an armored scale that is an occasional cause of serious damage, including tree death, where extensive populations develop. Snow scale is found on the trunk and tree limbs, looking at a distance like a heavy sprinkling of salt (homeowners have mistaken this as a fungus). Control can be difficult as oil alone is often ineffective.

Like psyllids (see above) **aphids** cause little significant damage to citrus, but are important as vectors of disease including the citrus tristeza virus, transmitted most efficiently by the brown citrus aphid. Wingless adults are black, shiny, conspicuous, pear shaped insects, the largest of the aphids infesting Florida citrus. Although tristeza occurs in Florida it has as yet not been recorded in Miami-Dade.

Mites frequently infest both leaves and fruit with **spider mites** able to cause significant leaf drop in spring especially in combination with prolonged periods of dry windy weather. Depending on the species of spider mite, infested leaves can appear dry with a dusty silvery appearance or develop raised yellow areas and become distorted. Spider mite populations decline rapidly with the increased humidity of summer and early fall. **Citrus red mite** damage to fruit was mentioned above and is

mainly cosmetic, though a heavy infestation can cause fruit drop. **Broad mites** cause severe leaf distortion and rind blemish. Sulfur may afford some control while ultra-fine horticultural oils can be used against red mites or spider mites.

There are natural controls which help control citrus pests, especially whiteflies, aphids, and many scale insects. Chemicals should only be used once it is evident that large populations are developing. If you see clouds of whiteflies wait 10-12 days to permit nymphs to develop then apply an oil spray to the leaf undersides. For control of psyllids contact your local Extension Office.

Once again I am grateful for the expert input from Dr Carlos Balerdi, Commercial Fruit Tree Agent at The Miami-Dade Extension Office.

John McLaughlin June 22, 2006