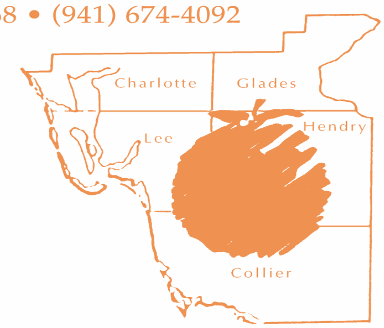
UNIVERSITY OF FLORIDA

EXTENSION

Institute of Food and Agricultural Sciences

Hendry County Extension • P.O. Box 68 • LaBelle, Florida 33975-0068 • (941) 674-4092

Flatwoods Citrus



Vol. 5, No. 2 February 2002	Dr. Mongi Zekri, Multi-County Citrus Agent

UPCOMING EVENTS

All seminars and workshops are held at the Immokalee IFAS Center.

Tuesday, February 5, 2002, 8:30 AM – 4:00 PM

Workshop on scouting for pests and diseases

Speakers: John Taylor and Drs. Pam Roberts, Steve Rogers, and Jeff Brushwein
Sponsor: Robert Gregg, Syngenta
6 CEUs for Pesticide License Renewal
6 CEUs for Certified Crop Advisors

Preregistration is required. Registration form was enclosed last month.
Registration fee is $10.00 (includes refreshments, lunch, and handouts).
To ensure lunch, registration is required no later than February 4.

Tuesday, February 19, 2002, 10:00 AM – 12:00 Noon

Water management and issues related to water regulations

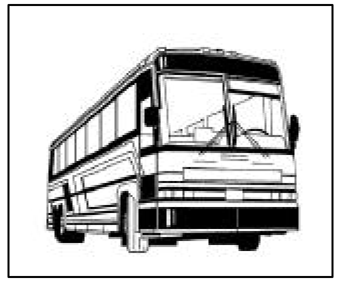
Speakers: Mary N. Gosa and Drs. Larry Parsons and Sanjay Shukla
Sponsor: Donna Muir Strickland, Monsanto
2 CEUs for Certified Crop Advisors

Following the seminar, we are planning a free lunch (Compliments of Monsanto) for only who call Sheila at 863 674 4092 no later than Friday, 15 February.

If you want to print a color copy of the Flatwoods Citrus Newsletter, get to the Florida Citrus Resources Site at http://www.fcprac.ifas.ufl.edu/
You can also find all you need and all links to the University of Florida Citrus Extension and the Florida Citrus Industry

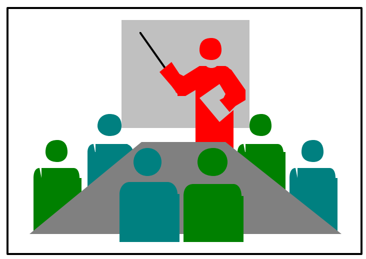
Friday, February 1 & 8, 2002, 9:30 AM – 11:30 AM
Dooryard citrus program for homeowners in Charlotte County
Speaker: Mongi Zekri
Coordinators: Ralph Mitchell & Holly Shackelford, Charlotte County Extension Office

Tuesday, March 19, 2002, 10:00 AM – 12:00 Noon
Precision Ag and application technology
Speakers: Neal Horrom, Mike Roberts and others
Sponsor: Keith Hollingsworth, Chemical Containers
2 CEUs for Pesticide License Renewal
2 CEUs for Certified Crop Advisors



Wednesday March 20 & Friday, March 22, 2002
Collier County Annual Agricultural Bus Tours
For more information, call the Collier County
Extension Office at 941 353 4244.

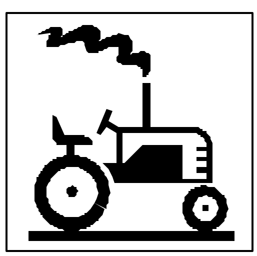
Tuesday, April 16, 2002, 10:00 AM – 12:00 Noon
Grove replanting and resetting strategies and Diaprepes and canker update
Speaker: Jack Neitzke and Drs. Fritz Roka & Clay McCoy
Sponsor: Shelby Hinrichs, New Farm Americas, Inc.
2 CEUs for Pesticide License Renewal
2 CEUs for Certified Crop Advisors



Thursday, April 18 & 25, 2002, 9:30 AM – 11:30 AM
Master Gardener Training in Charlotte County
Speaker: Mongi Zekri
Coordinators: Ralph Mitchell & Holly Shackelford, Charlotte County Extension Office

Wednesday, April 10, 2002 & Monday, April 22, 2002
Master Gardener Training in Lee County
Speaker: Dr. Mongi Zekri
Coordinator: Stephen Brown, Lee County Extension Office

Tuesday, May 21, 2002, 8:30 AM –12:00 Noon
Greasy spot and other fungal diseases
Speaker: Drs. Pete Timmer and Pam Roberts
Sponsor: Mike Raines, Griffin LLC
2 CEUs for Pesticide License Renewal
2 CEUs for Certified Crop Advisors



Saturday, June 1, 2002, 7:45 AM – 2:45 PM
Farm Safety Day
Coordinator: Dr. Mongi Zekri
2 CEUs for Pesticide License Renewal

Special Thanks to these sponsors of the Flatwoods Citrus Newsletter for their generous contribution and support. If you would like to be among them, please contact me at Phone: 863 674 4092, Fax: 863 674 4636 or E-mail: maz@gnv.ifas.ufl.edu

FLOWERING & FRUIT QUALITY OF CITRUS TREES

During the winter months in subtropical regions, the temperature normally falls below 70°F for several months. This causes growth to cease and the tree to become dormant for about 3 months. This dormancy, among other things, induces flowering when warmer temperatures in the early spring cause resumption of vegetative growth. In a tropical climate, there is no period of cold temperature to induce dormancy. However, with periods of less than ample soil moisture, flushes of bloom and vegetative growth normally follow periods of drought. It seems that there is an identifiable floral stimulating complex present near the apex or its subtending leaves that is manipulated by temperature, water status, and pruning.

Effect of vegetative growth. It is well known that vegetative growth is competitive with fruit growth for available nutrients such as sugars and minerals. Flushes of heavy vegetative growth will reduce the solids available to developing fruit, while a period of dormancy will increase the solids available. This competition for nutrients between vegetative growth and fruit development is one of the reasons reducing solids concentration often found in oranges produced in the tropics as compared with those produced in subtropical regions. Similarly, in some seasons, through its tendency to stimulate vegetative growth, irrigation in the dry fall and winter in Florida may reduce soluble solids in the fruit.

Effect of climate. There is considerable diversity among cultivars in their response to climate. For example, Navel orange develops its best eating and eye-appeal qualities in a Mediterranean type climate with cool, wet winters and hot, dry summers. The wet, humid climate of Florida does not have enough chilling in winter to produce Navels of prime quality. In most cases, the fruit tends to be large, coarse textured with poor color and low soluble solids and acids in the juice. Unlike the Navel, grapefruit cultivars develop the best internal quality in the warm climate areas of Florida with little winter chilling.

Fruit quality is affected by climatic conditions and production practices. Within fairly broad parameters of adequate soil and good cultural practices, climate is the most important component of the climate-soil-culture complex causing differences in yield and fruit quality among citrus producing areas. Among all the elements of climate impacting commercial groves, the temperature and rainfall during fruit development and growth are the dominant factors influencing fruit development, growth, and quality. Warm climates (Tropical) can advance maturity date by as much as 6 months for Valencia orange compared with a cooler (Mediterranean) climate.

Effect of water and temperature. Rainfall and irrigation are necessary at reasonable levels to assure good brix (soluble solids) accumulation, but excessive amounts of water results in oversize fruit with diluted soluble solids content. Year to year variation in temperatures and rainfall can result in up to 2 lbs soluble solids per box for Valencia orange. In a tropical climate, juice content and soluble solids accumulate fast, while acidity declines much more rapidly. Under such conditions, there is insufficient time for the fruit to accumulate high soluble solids levels and acidity declines so rapidly that the fruit quickly become insipid and dry out as they become senescent.

Effect of rootstock. Rootstock effects on fruit quality are well documented. However, it is not very clear how rootstock exert their influence. Furthermore, rootstock effects sometimes vary from year to year, from area to area, and with cultural practices. Rootstock effects on fruit quality are usually dramatic and can be easily seen without even taking measurements. One of the best known examples is the small fruit size of Valencia budded on Cleopatra mandarin rootstock. Fruit from trees on lemon rootstocks are usually large, have thick, poorly colored rinds, low juice, soluble solids and acids contents and tend to dry out. Fruit from trees on Citranges and Citrumelos tends to be of medium to large size with high juice, solids and acid levels.

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SOME OF THE FACTORS THAT AFFECT FLOWERING AND FRUIT PRODUCTION

Juvenility. Certain citrus varieties may have longer juvenility period than others and certain rootstocks may influence it more than others. Juvenility is believed to be controlled more by genetic makeup and by hormones than by anything else. For example, Hamlin can produce earlier and heavier marketable crop than Navel, Ambersweet, and Valencia. Swingle can promote earlier, heavier, and better quality fruit than Cleopatra mandarin.

Fruit. It is well established that shoots with fruit do not flower the following year. Thus, heavy crops are often followed by lighter ones, and some degree of alternate bearing can develop in some mandarin types. This can be overcome by pruning back a portion of the fruiting shoots during the heavy crop year during the bloom, after fruit set, or late in the spring. Holding crops of grapefruit and oranges on the tree long after their maturity is reached can reduce the subsequent crop.

Shade. Even though citrus trees can tolerate shade and still flower and fruit, maximum flowering occurs when leaves are fully exposed to the sun. Therefore, topping and hedging are extremely important for optimum flowering.

Tree vigor. Excessive vegetative vigor can reduce flowering. It is unlikely that excessive vigor results from well-scheduled and well-adjusted programs. However, excessive fertilizer and water may slightly delay fruiting of young trees. Excessive levels of leaf nitrogen (N) in particular for young trees can induce excess vigor and promote a vegetative rather than flowering tree. In contrast, low leaf N levels promote extensive flowering but fruit set and yields are poor. Therefore, it is important to maintain N levels in the optimum range.

Leaf loss. Leaves produce the food and the energy source for the trees. Excessive leaf loss will noticeably reduce flowering. The primary causes of leaf loss are freeze injury, salt and water stress problems including drought stress and flooding injuries, mites, greasy spot, herbicides and pesticide phytotoxicities. Loss of leaves can reduce flowering the following spring and fruit production. Excessive leaf loss in late summer, in the fall, and in early winter is the worst thing that can happen to citrus trees. Leaf loss in the fall from mite damage can be harmful, and greasy spot can cause devastating leaf loss and reduced flowering and fruiting.

Foliar application of urea. Winter application (6 to 8 weeks before bloom) of low biuret urea at 10-15 gal (18-28 lbs N) per acre can increase flowering and fruit set. To be on the safe side, liquid urea should not contain more than 0.25% biuret when foliarly applied. The pH of the solution should be between 5.5 and 6.5 to avoid phytotoxicity and maximize uptake. Urea solutions having extreme pH values can cause leaf burn and drop. Foliar application should be avoided under hot, stressed conditions.

Gibberellic acid (GA). Foliar spray of GA shortly before bloom will reduce the number of flowers. However, applied from full bloom to two-third petal fall, GA can effectively set and produce an excellent crop of seedless Robinson, Nova, Orlando, Minneola, or other self incompatible mandarin hybrid Cultivars. Care should be exercised because exceeding the recommended dosage or concentration of GA can result in severe leaf drop.

FERTILIZER MANAGEMENT

Fertilizer management should include calibration and adjustment of fertilizer spreaders, booms, pumps, or irrigation systems to accurately deliver fertilizer rates and place fertilizers within the tree rootzone. To improve fertilizer efficiency, soil and leaf analysis data should be studied, evaluated, and taken into consideration when generating a fertilizer program and selecting a fertilizer formulation. Fertilizer application should be split into 3 to 4 applications per year with a complete balanced fertilizer. For mature trees, the highest nutrient requirement extends from late winter through early summer. This coincides with flowering, heavy spring flush, fruit set, and fruit development and expansion. For best fresh fruit quality, nutritional requirements, particularly nitrogen (N), should decrease late in the summer and fall. Based on tree demands, 2/3 to 3/4 of the yearly fertilizer amount should be applied between February and June. In warm areas such as southwest Florida where tree growth can continue certain years during the winter, fertilizer applications should also be made in the fall to satisfy vegetative growth demand. However, fall fertilizer applications may sometimes delay fruit color development.

IFAS fertilizer guidelines for nonbearing citrus trees

Year in grove	Lb N/tree/year (range)	Lbs Fertilizer/tree/year (range)		Lower limit of application frequency	
		6-6-6	8-8-8	Dry	Fertigation
1	0.15 – 0.30	2.5-5.0	1.9-3.8	6	10
2	0.30 – 0.60	5.0-10.0	3.8-7.5	5	10
3	0.45 – 0.90	7.5-15.0	5.6-11.3	4	10

IFAS fertilizer guidelines for bearing citrus trees (4 years and older)

Oranges	Grapefruit	Other varieties	Lower limit of application frequency	
Lbs N/acre/year (range)			Dry	Fertigation
120 - 200	120 - 160	120 - 200	3	10

Rates up to 240 lbs/acre may be considered for orange groves producing over 700 boxes/acre and up to 180 lbs/acre for grapefruit groves producing over 800 boxes/acre.

Young trees planted on previously uncropped soils should receive fertilizer containing the following ratio of elements: nitrogen-1, phosphorus-1, potassium-1, magnesium-1/5, manganese-1/20, copper-1/40, and boron-1/300.

NUTRITION OF CITRUS TREES

<u>Nitrogen (N)</u>: Nitrogen is of special importance because plants need it in rather large amounts, it is fairly expensive to supply and it is easily lost from soil. A major factor in successful farming is the grower's ability to manage N efficiently. An abundant supply of the essential N compounds is required in each plant cell for a good rate of cell division and growth. Nitrogen occurs chiefly in the young, tender parts of plant tissues, such as tips of shoots, buds, and new leaves. The N, present mostly as protein, is constantly moving and undergoing chemical changes. As new cells form, much of the protein moves from the older cells to the newer ones, especially when the total N supply of the plant is low.

The proper functioning of N in plant nutrition requires that the other essential elements, particularly phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg), be present in adequate supply. If the supply of one or more of them is inadequate, the addition of much N to most common crops may not produce optimum growth. Such plants often are susceptible to diseases, mature late, and produce poor quality fruit. But if the nutrient balance and total supply are adequate, significant growth and dark green foliage will be exhibited. More N than any other element is used by citrus trees in leaf, flower, and fruit production although Ca and K are used in amounts almost as large.

Nitrogen is the key element in citrus fertilization and has more influence on tree growth and appearance, and fruit production and quality than any other nutrient element. Nitrogen affects the absorption and distribution of practically all other elements and appears to be of particular importance to the tree at bloom time. During this period, migration of N from leaves to flowers takes place. Trees grown with limited supplies of N may appear nearly normal but are undersized. Such trees are largely unfruitful or highly erratic in bearing habit. They bloom sparsely, flush irregularly, and produce very limited twig and leaf growth. Severe N starvation causes a general yellowing of the foliage. This is particularly true of well-nourished trees that subsequently have had their N supply reduced sharply. Trees that are constantly short of N are stunted with irregular and very short growth and have a thin canopy, twig dieback and low crop. The color of the fruit peel tends to be pale and smooth, and the juice has lower soluble solids and acid contents.

While the main cause of N deficiency is simply a lack of N in the soil, there may be other causes such as heavy summer rainfall and porous soil. There might be improper nitrification due to waterlogging that can result in a temporary deficiency of N that will be relieved by dry weather. Weak and old trees deficient in N can be improved by supplying two times the recommended rate at more frequent applications. The use of low biuret urea as a foliar spray is a very efficient and rapid way to supply and correct N deficiency.

Ammonium forms of N may produce better internal fruit quality than nitrate forms of N. Ammonium forms also reduce the soil pH but increase the demand for oxygen to the roots. For bearing citrus trees, there should be adequate N in the trees just before flower initiation and at the time of flowering and fruit set. There should be also enough N for fruit development. Nitrogen application made in the summer before the end of the rainy season is undesirable because it can reduce fruit quality. For young trees, adequate N should be supplied throughout the year to promote continuous rapid vegetative growth.

Phosphorus (P): Phosphorus is present in all living tissue. It is particularly concentrated in the younger parts of the plant, in the flowers, and in the seeds. Phosphorus is necessary for many life processes. It helps plants store and use energy from photosynthesis to develop roots. Phosphorus is also important for cell division.

Growth is reduced when the supply of P is too low. Phosphorus moves from the older tissues to the younger tissues. Therefore, deficiency symptoms appear first on older leaves, which lose their deep green color. Leaves are small and narrow with purplish or bronze, lusterless discoloration. Trees will exhibit limited flower development with reduced fruit set and fruit yield. The fruit will be coarse and rough in texture with a coarse, thick rind and a hollow core. The fruit will also have a high acidity in proportion to total soluble solids. Thus, fruit maturity will be delayed. Usually, the roots are stunted and poorly branched.

The cause of P deficiency is either a lack of P in the soil or a lack of available P. Phosphorus deficiency may occur in areas of high rainfall due to leaching and erosion. Under very acid soil conditions, P can become quickly unavailable. Phosphorus availability is also reduced in calcareous soils. Phosphorus deficiency can be corrected by applying superphosphate or any readily available source of P after confirmation of P deficiency by leaf and soil analysis.

Potassium (K): Citrus fruit remove large amounts of K as compared with other nutrients. During the time that fruit and seeds develop, K moves to them from the leaves. Potassium is necessary for several basic physiological functions such as the formation of sugars and starch, and normal cell division and growth. Potassium enhances fruit size, flavor, and color. It helps reduce influences of adverse weather conditions such as drought, cold, and flooding stresses.

Potassium is associated with almost every major plant function. Potassium helps regulate the carbon dioxide supply by control of the stomata opening. It improves the efficiency of plant use of sugars for maintenance and normal growth functions. Potassium works with P to stimulate and maintain rapid root growth.

The rate of photosynthesis drops sharply when trees are K deficient. Too much N with too little K can result in a back-up of the protein building blocks, set the stage for disease problems, reduce production of carbohydrates, reduce fruiting and increase fruit creasing, plugging and drop. Shortage of K can result in lost crop yield and quality. Moderately low levels of K will cause a general reduction in growth without visual deficiency symptoms. The onset of visual deficiency symptoms means that production has already been seriously impaired.

In Florida, low K fertilization will cause a slowing down in growth, small leaves, fine branches, compact tree appearance, an increase in susceptibility to drought and cold, reduction in fruit size, very thin peel of smooth texture, premature shedding of fruit, and lower acid levels in the fruit.

Potassium deficiency symptoms generally result from an insufficient supply of K in the soil. Potassium deficiency may occur on acid sandy soils where leaching may be considerable. Soils that have very high contents of Ca and Mg or heavy application of N may depress the immediate supply of K to plants. This is typical on some calcareous soils. Lack of soil moisture also reduces K uptake and may lead to K deficiency. If the supply of N and P is high relative to that of K, growth may be rapid at first, but the K concentration in the plant may become reduced to a deficiency level. Addition of K would be necessary to maintain the nutrient balance required for uniform and continued growth. In situations of high available K level and low N or P supply, luxury consumption of K is to be expected.

Under most soil conditions, K deficiency can be corrected by applying sulfate or muriate of potash to the soil. However, under fine textured soils, saline conditions or soils containing high Ca and Mg in the exchange complex, K applications to the soil are sometimes ineffective or slow to correct K deficiency. Foliar application of potassium nitrate or monopotassium phosphate can be very effective and rapid for correcting K deficiency.

Calcium (Ca): Calcium occurs mainly in leaves. Calcium is an important element for root development and functioning. Calcium is a constituent of the cell walls and is required for cell division. Calcium deficiency in citrus is very rare under field conditions. Plant growth and fruit yield can be reduced by inadequate Ca supply long before deficiency symptoms become evident.

Calcium deficiency produces small thickened leaves and causes loss of vigor, thinning of foliage and decreased fruit production. Severely deficient trees can develop twig dieback and multiple bud growth of new leaves. Trees grown under Ca deficiency produce undersized and misshapen fruit with shriveled juice visicles. Fruit from Ca-deficient trees are slightly lower in juice content but higher in soluble solids and acids.

Calcium deficiency usually occurs under acidic soil conditions due to leaching of Ca. Continued use of ammonium fertilizer and particularly ammonium sulfate accelerates Ca loss from soils. Use of muriate of potash and sulfur cause similar losses of Ca from the soil. Liming the soil not only neutralizes soil acidity but also supplies available Ca. Calcium deficiency can also occur under high salinity conditions due to sodium (Na). Under such situation, gypsum can correct the deficiency and reduce the deleterious effect of Na. Calcium deficiency can also be corrected by foliar spray of calcium hydroxide or calcium nitrate.

Magnesium (Mg): Magnesium is a part of the chlorophyll molecule. It is involved in photosynthesis and carbohydrate metabolism and synthesis of nucleic acids. Magnesium is related to the movement of carbohydrates from the leaves to other parts of the trees and also stimulates P uptake and transport. Magnesium deficiency has been a major problem on practically all citrus soils. In Florida, magnesium deficiency is commonly referred to as "bronzing".

Trees with inadequate Mg supply may have no symptoms in the new spring flush, but leaf symptoms will develop as the leaves age and the fruit expand and mature in the summer and fall. Magnesium deficiency symptoms occur on mature leaves following the removal of Mg to satisfy fruit requirements. During the summer, when a rapid increase in fruit size occurs, the symptoms appear on leaves close to the developing fruit. It has been shown that Mg deficiency symptoms appear as a result of translocation of Mg from the leaves to the developing fruit, although there may also be a translocation from older leaves to young developing leaves on the same shoot.

Alternate bearing is common in seedy cultivars growing under Mg-deficient conditions. The loss of wood as a result of defoliation reduces the fruit-bearing wood for the following year. Magnesium deficiency can result in a great reduction not only in fruit yield but also in fruit quality. It has been shown that fruit from Mg-deficiency trees is low in soluble solids and acids. Magnesium deficiency like other deficiencies makes trees more susceptible to cold injury than normal trees.

In Florida, Mg deficiency is caused primarily by low levels of Mg in the soil. It is particularly severe on acid light sandy soil from which Mg readily leaches. Leaching of added Mg is particularly serious and substantially rapid when the soil pH is 4.5 to 5.0. Under such conditions, the use of dolomite to bring the pH above 6.0 will furnish Mg at the same time. Soil application of Mg sulfate or oxide can be successful in correcting Mg deficiency when the soil pH is adjusted. Salinity, high potash chemical fertilizers, and manures have been shown to induce or aggravate Mg deficiency. Magnesium deficiency can also be attributed to calcareous soils relatively low in Mg or to unbalanced conditions in the soil due to excessive K or Ca.

In Florida, one foliar spray application of Mg is not always effective in correcting the deficiency when the amount of Mg needed is greater than that absorbed by the leaves. Foliar spray of Mg nitrate can be very effective when applied on the spring flush leaves when they are two-third to fully expanded but not hardened off. Leaves that have already developed the deficiency pattern will not completely recover when Mg is applied but deficiency symptoms can be prevented the following season.

Nutritional balance: Nutrient supply is closely and directly correlated with yield increases and total production. Both correct amounts and correct ratio of applied nutrients are critical to nutrient management and sustainability. Imbalance allows mining of the most deficient nutrients in the soil. If an element is below the critical level, yield production will fall even though the other elements are kept in good supply.

Nutrient balance is often confined to N, P, and K because of their need in relatively large amounts by crops. Indeed, they are most often the limiting factors in crop production. However, nutrient balance goes beyond N, P, and K and will not be achieved without adequate supply of the other nutrients. A balance of adequate levels of nutrients is a key component to profitability. Plant nutrients interact positively when properly balanced. For example, in the case of N fertilization, a shortage of another nutrient could have unused N in the soil, reduce N use efficiency and returns on investment, and increase the potential for nitrate leaching.

Balanced nutrition should be a high priority management objective for every grower. Plants require a balanced nutrition program formulated to provide specific needs for maintenance and for expected production performance. Properly nourished trees grow stronger, produce more consistently, have better disease resistance, and are more tolerant to stresses.

Fertilizer represents a relatively small percentage of the total cost of crop production, but it has a large effect on potential profitability. Visual symptomology, soil and plant analysis, field history, production experience and economics are all important guidelines in fertilizer rate decisions, and nutrient balance is the key to success.

BORON (B)

Boron is particularly necessary where active cell division is taking place. Boron plays an important role in flowering, pollen-tube growth, fruiting processes, nitrogen (N) metabolism, and hormone activity. Florida sandy soils are low in B, and a deficiency of this element in citrus occasionally occurs under field conditions. The deficiency may be aggravated by severe drought conditions, cool weather, heavy lime applications, or irrigation with alkaline water. Boron is very mobile in the soil profile of sandy soils and readily leaches by rainfall or excess irrigation.

Boron deficiency is known as "hard fruit" because the fruit is hard and dry due to lumps in the rind caused by gum impregnation. The chief fruit symptoms include premature shedding of young fruits. Such fruit have brownish discoloration in the white portion of the rind (albedo), described as gum pockets or impregnations of the tissue with gum and unusually thick albedo. Older fruit are undersized, lumpy, mis-shapen with an unusually thick albedo containing gum deposits. Seed fails to develop and gum deposits are common around the axis of the fruit. The first visual symptoms of B deficiency are generally the death of the terminal growing point of the main stem. Further symptoms are a slight thickening of the leaves, a tendency for the leaves to curl downward at right angles to the midrib, and sometimes chlorosis. Young leaves show small water soaked spots or flecks becoming translucent as the leaves mature. Associated with this is a premature shedding of leaves starting in the tops of the trees and soon leaving the tops almost completely defoliated. Fruit symptoms appear to be the most constant and reliable tool for diagnostic purposes.

Borax and other B compounds are generally used in treating citrus affected with B deficiency. They can be applied either foliarly or in the fertilizer. As a maintenance program, apply B in the fertilizer at an annual rate equivalent to 1/300 of the N rate. In Florida, foliar spray applications have been found much safer and more efficient than soil application. Soil applications frequently fail to give satisfactory results during dry falls and springs and may result in toxicity problems if made during the summer rainy season. Boron solubility in the soil is reduced at soil pHs below 5 and above 7. Foliar spray may be applied during the dormant period through post bloom, but preferably during early flower development. Treating at this growth stage is important because boron does not move very readily from other parts of the tree to the buds. Applying boron at this time will assist in flower initiation and pollen production, satisfy the needs for pollen tube growth, and enhance fruit set. For maintenance spray application, 0.25 lb/acre of B (1.25 lbs of soluble borate containing 20% B) may be used. Boron levels in the leaf tissue should not drop below 40 ppm or exceed 120 ppm (dry wt basis). Where deficiency symptoms are present, double the amount suggested. Use care not to apply more than the recommended amount because it is easy to go from deficiency to excess.

POSTBLOOM FRUIT DROP (PFD)

This fungal disease can attack all citrus varieties. It is more of a problem on Navels and Valencias. The last 3 seasons, due to the dry weather conditions during bloom, PFD was not a problem. However 4 years ago, it caused serious damage and significantly reduced fruit yield.

The fungus attacks flowers and causes the fruitlets to drop leaving persistent calices or buttons. The good news is that Dr. Timmer's estimation indicates that for each 100 buttons present, only 6 fruit were lost. The bad news is that millions of spores per button can survive to the next season. Extended bloom periods, frequent rains, and warm weather are favorable conditions for disease development. Once the bloom begins, groves with buttons from previous years should be inspected twice weekly. For the time being, Benlate is the most effective fungicide to control PFD; however, it was taken out from the market. If you still have it in stock, apply it at 2 lbs/acre or at 1.5 lbs/acre plus 5 lbs of Ferbam to reduce the risk of resistance to Benlate. Abound is moderately effective. To improve protection, 13 oz of Abound can be combined with 5 lbs of Ferbam. A model has been developed and is being improved to assist growers and production managers to determine the need and timing of fungicide applications. For more information, get your copy of the 2002 Florida Citrus Pest Management Guide and call your citrus extension agent to provide you with the PFD Hotline number. It is always advisable to remove weak and declining trees and put resets to maintain good yield per acre. Furthermore, the off-season bloom from declining trees within a block can provide a site for fungal spore buildup and can be a major contributor to PFD.

FLOWER THRIPS

They are about 1 mm long and yellow to straw colored. They have been found to cause injuries to developing flowers on navel and Valencia oranges. They feed on the flowers. Their damage can result in abortion of flowers and small fruitlets. High populations of thrips can cause economic loss in navel and Valencia orange by reducing fruit set. Examine individual flowers at random and observe their number. Residual activity of insecticides is very short (less than 7 days). Timing of one application to protect the major flowering period between maximum bud swell and full bloom should be considered. Delay will allow thrips to enter open flowers and reduce contact with the insecticide.

Remember, the recommended insecticides (Dimethoate, Ethion + oil, Lorsban) are toxic to honeybees.

GROUNDWATER QUALITY IN SOUTH FLORIDA CITRUS GROVES

By Dr. Sanjay Shukla, Water Resources Specialist
Immokalee IFAS Center

Nitrogen (N) and phosphorus (P) are two essential nutrients used for citrus production in South Florida. Plants take up a major fraction of fertilizer N and P. Unused N and P can take a variety of pathways, including soil storage, leaching beyond the root zone to ground water, or lateral movement to surface water. Excessive concentrations of both N and P in water can have adverse impacts on surface water bodies. Major factors affecting N and P move ment in the soil include weather, soil characteristics, and geology, as well as amount, type, and timing of fertilizer application. The extent of N and P leaching to groundwater differs considerably due to differences in relative mobility of these two nutrients in the soil.
Nitrogen in agricultural as well as natural soil can exist in either organic or inorganic forms. Inorganic forms include ammonium (NH_4) and nitrate (NO_3). Nitrate is much more mobile in the soil than ammonium. Higher mobility of nitrate combined with the rapid movement of water in the sandy soils used for citrus production in South Florida pose challenges for citrus growers to retain nitrate in the root zone and avoid leaching. Nitrate not taken up by citrus trees results in an economic loss for growers.
Phosphorus in the soil that is readily taken up by plants is usually expressed as the orthophosphate ion (PO_4^{3-}) (Ortho-P). Unlike N, P is not particularly mobile in most soils except in the sandy soils of South Florida, which have limited ability to chemically adsorb, or "fix" P and hold it against leaching. Crop uptake removes a large fraction of fertilizer P from the soil. Due to highly interactive surface and groundwater systems in South Florida, groundwater P can potentially move to the surface water.
Recently, the U.S. Geologic Survey (USGS) conducted a surficial groundwater quality survey for citrus groves in Southwest Florida. The study included a total of 31 wells located in groves of varying ages, varieties, and production practices. These wells were sampled in spring (April-May) 1998. Both N and P concentrations were measured. The water table at the sites varied between 2 and 4 feet below land surface.
Groundwater nitrate concentrations in citrus groves were low; 94% of the wells did not exceed the MCL of 10 mg/L (Figure 1). The MCL is the maximum contaminant level (10 mg/L for nitrate) set by U.S. EPA for contaminants in drinking water, including groundwater. It should be noted here that surficial groundwater in the groves is not used for drinking purposes. The median nitrate-N concentration (< 0.05 mg/L) was considerably less than the national median of 1.85 mg/L. Only 4 wells had nitrate between 2 and 10 mg/L. Two wells exceeded the MCL with concentrations between 10 and 16 mg/L. Due to a one-time sampling, it is difficult to determine the cause of high (> 10 mg/L) nitrate concentrations. One of the probable causes could be approximately 4-5 in. of above-normal rainfall during February 1998, most of which occurred within a 3-day period (total rainfall = 4.2 in). This excess precipitation may have caused a large fraction of the N and P fertilizer applied during the January-February period to move out of the root zone and reach the surficial aquifer and reside there till April-May or even longer.

Concentrations of ortho-P in the citrus groves varied from less than 0.001 to 0.78 mg/L with the median of 0.03 mg/L. Approximately 75% of the samples had ortho-P concentrations less than the national median of 0.11 mg/L (Figure 2). Ortho-P and nitrate detections were poorly related, probably due to the nature of their transport mechanisms.

Low nitrate concentrations in most of the citrus groves seem to indicate that sound N and water management are being practiced by citrus growers in Southwest Florida. Further, it is possible that the denitrification potential, a process which can reduce the groundwater nitrate, for these areas is high. For groves with high nitrate and ortho-P concentrations, repeated sampling may be needed to confirm if the high concentrations are persistent. If the elevated concentrations are confirmed, a review of current water and nutrient management practices followed by implementation of selected water and nutrient BMPs, if needed, should reduce any problematic nutrient concentrations in groundwater.

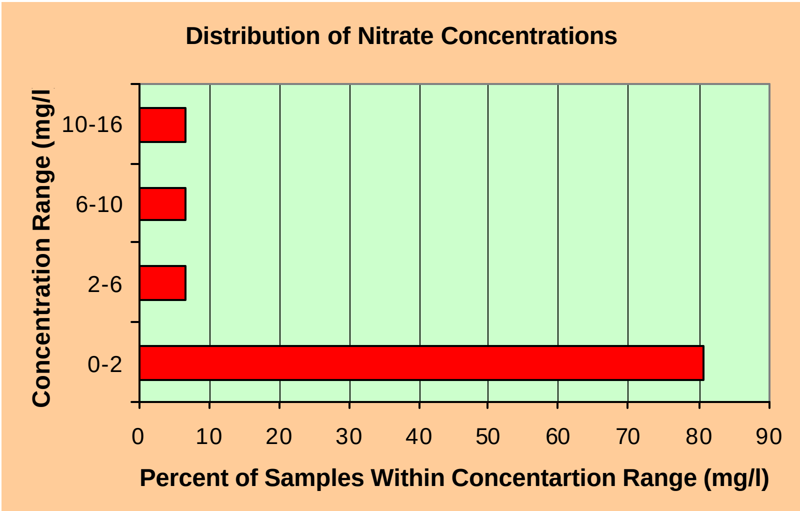

Figure 1

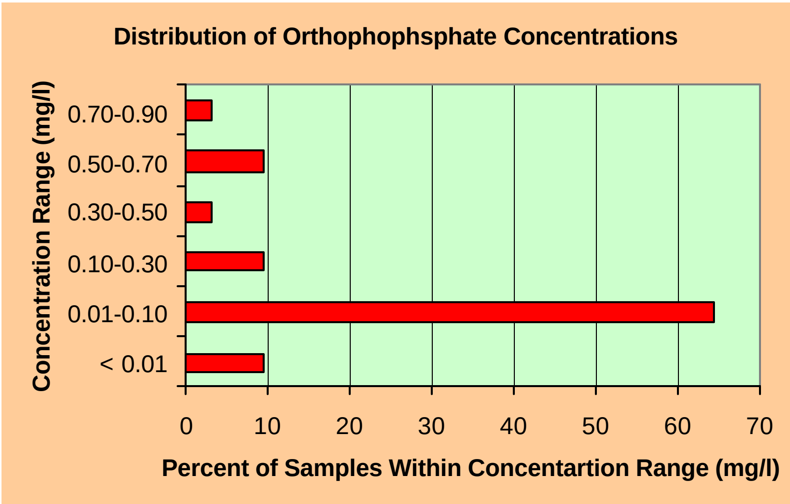

Figure 2

FLORIDA CITRUS AND INTERNATIONAL TRADE

Position of

Florida Citrus Mutual

When you look at the current world market for orange juice there are only two main players: Florida and Brazil. Production of orange juice between the two players makes up roughly 90 percent of the world market. The major difference between them is that Brazil exports 99 percent of its production while 90 percent of Florida's production is consumed domestically and 10 percent is exported

Importance of Citrus Industry to Florida's Economy

The unsubsidized Florida citrus industry has an economic impact of $9.1 billion to the state, employs 90,000 people and is typically the state's second largest industry after tourism.

Current Citrus Tariff

The current citrus tariff helps level the playing field for the two orange juice competitors and prevents Brazil from expanding the unprecedented degree of monopoly power it currently enjoys in overseas markets to that of the North American market. Eliminating or reducing the tariff, which is currently only $0.0785 per liter, would be a severe error from a cost benefit standpoint. First, it would severely cripple Florida's second-largest industry, as grower revenues and income each year would decline by the equivalent of $500 per acre (that would have represented an approximate 90 percent reduction in average 1999-00 per acre income). Second, it would increase the cartel-like control over both the world orange juice market and the market for processed oranges. U.S. consumers would be at the mercy of Brazilian processors, and may not realize any savings from a tariff reduction.

North American Orange Juice Market

The North American orange juice market is the leading orange juice market in the world. The development and growth of this market was to a large extent financed by Florida citrus growers, who have invested hundreds of millions of dollars through a self-imposed marketing and advertising tax. Any reduction in the current tariff would provide Brazil freer access to a market developed by Florida citrus growers for Florida citrus growers.

Approximately 95 percent of the North American orange juice market is from Florida and Brazil. The remaining 10 percent is either duty-free under the Caribbean Basin Initiative (CBI) or duty-reduced under NAFTA.

Production Differences

As depicted from the chart below, Florida out produces Brazil in terms of yield/acre and produces fruit in a more environmentally friendly manner. However, Brazil continues to enjoy production cost advantages, which are determined largely by differences in:

environmental regulations, worker protection standards, food safety regulations and governmental macroeconomic policies that impact exchange rates and relative labor costs. The major difference is seen in labor costs caused by the aforementioned factors. Unlike Florida production costs that steadily increase from year to year, Brazilian material and labor costs to producing and deliver oranges to the processing plant have declined by 20.7 percent or U.S. $0.07 since the 1992-93 season.

2000-01 Season	**Florida**	**Brazil**
Juice Production	1.335 billion SSE gallons	1.588 billion SSE gallons
Orange Acreage	665,529 acres	1.44 million acres
Export Percentage of Sales	10%	99%
Yields Per Acre	2,450 pounds/acre	1,550 pounds/acre
Production Costs	$0.70 per pounds solid	$0.30 per pounds solid
Pick & Haul Costs (Labor)	$2.00/box	$0.50/box

Advantages for Brazil

These cost advantages, combined with a cartel-like market structure, enable Brazilian producers to adjust prices in a predatory manner. Last year, Brazilian exporters lowered prices of bulk frozen concentrate orange juice (FCOJ) to European markets to less than $700 per metric ton; far below what Florida exporters could meet. Such prices can be sustained by Brazilian exporters for extended periods, even when they are below Brazil's average costs of production. Without the benefit of offsetting tariffs, Florida growers would have virtually no income during these periods.

Brazilian Dumping

There is a history of Brazilian dumping in the U.S. – Brazilian processors have been willing to sell at prices below production costs to gain market share and stifle competition. An antidumping order remains in effect at this time, applying dumping duties ranging from 2 percent to 27 percent to some imports of Brazilian orange juice. Any reductions in the U.S. tariff would further exacerbate the inequalities that have been endemic in this market for the past 20 years.

Tariff Must Not Be Altered

If the Florida citrus industry is to remain a viable $9.1 billion economic engine to Florida and continue to employ nearly 90,000 people, the current citrus tariff must not be altered in future trade agreements.