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EXTENSION

Institute of Food and Agricultural Sciences

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

Flatwoods Citrus

Vol. 6, No. 9 **September 2003**

Dr. Mongi Zekri
Multi-County Citrus Agent, SW Florida

UPCOMING EVENTS

Seminar at the *Hendry County Extension Office, LaBelle*

Thursday, September 18, 2003, 8:30 AM – 12:00 Noon
Topics: **Harvesting Safety and Compliance Seminar** featuring information regarding Harvesting Safety, Agricultural Worker Protection Act (AWPA) Compliance, Simplifying Payroll Data Collection, Real-Time Monitoring of Crews, and Value Added Services to Help Harvesters Maintain Advantage, and **Citrus Yield Data and its Implementation Into a Precision Ag Program.**
Speakers: Neal Horrom, David Summers, Jeff Klopstad
1.5 CEUs for Pesticide License Renewal
2 CEUs for Certified Crop Advisors (CCAs)
Sponsor: GeoAg Solutions and AES (Agricultural Employee Services)
Following the seminar, we are planning a free BBQ lunch (Compliments of GeoAg Solutions and AES) for only who call 863 441 1200 no later than Monday, 15 Sept 2003. Furthermore, a drawing for a great prize (Free Flats Fishing Trip. It will be a guided, full-day, 3 person trip, fishing anywhere between 10,000 Islands and Charlotte Harbor. Snook, Tarpon, Reds, and more!).

Seminar Sponsors wanted
Please call to sponsor a seminar

Seminars/workshops at the Immokalee IFAS Center

Thursday, October 9, 2003, 9:00 AM – 12:00 Noon
Citrus canker training/certification and eradication program – Workshop
Speakers: Holly Chamberlain, Andy LaVigne, Tim Schubert, Tim Gottwald, Greg Carlton, and others
2 CEUs for Pesticide License Renewal
2 CEUs for Certified Crop Advisors
Sponsor: ?

Tuesday, October 21, 2003, 10:00 AM – 12:00 Noon
Use of plant growth regulators to enhance citrus cropping
Speakers: Drs. Ed Stover and Craig Campbell
1.5 CEUs for Pesticide License Renewal
2 CEUs for Certified Crop Advisors
Sponsor: ?

Tuesday, November 18, 2003, 10:00 AM – 12:00 Noon
Water supply issues for citrus growers, and Can the impoundments in citrus groves be used for irrigation water supply?
Speakers: Hugh English and Dr. Sanjay Shukla
2 CEUs for Certified Crop Advisors
Sponsor: ?

Tuesday, December 16, 2003, 10:00 AM – 12:00 Noon
Sensitivity of Flatwoods citrus to phosphorus and potassium, and How to adjust fertilizer programs based on leaf and soil analysis?
Speaker: Dr. Tom Obreza
2 CEUs for Certified Crop Advisors
Sponsor: ?

If you want to print a color copy of the Flatwoods Citrus **Newsletter, get to the Florida Citrus Resources Site at http://flcitrus.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

Nutrient Management for Optimum Citrus Tree Growth and Yield - Short Course

October 29, 2003, 8:30 AM – 4:00 PM
Lake Alfred CREC (See enclosed brochure)

Special Thanks to the following sponsors of the Flatwoods Citrus Newsletter for their generous contribution and support. If you would like to be among them, please contact me at 863 674 4092.

CITRUS NUTRITION ON CALCAREOUS SOILS -SUMMARY-

1. Calcareous soils are alkaline because they contain $CaCO_3$.

2. The availability of N, P, K, Mg, Mn, Zn, and Fe to fruit trees including citrus decreases when soil $CaCO_3$ concentration increases to more than 3% by weight. These soils generally have a pH value in the range of 7.6 to 8.3.

3. To avoid ammonia volatilization, fertilizers containing ammonium-N or urea should be moved into the root zone with rainfall or irrigation, or be incorporated into the soil.

4. Phosphorus fertilizer applied to calcareous soils becomes fixed over time. To maintain continuous P availability, P fertilizer should be applied on a regular basis.

5. Trees planted on calcareous soils require above normal levels of Mg or K fertilizer for satisfactory nutrition. Foliar sprays of magnesium and potassium nitrates are effective where soil applications are not.

6. The least expensive and most effective way to correct Zn and Mn deficiencies of fruit trees on calcareous soils is through foliar application of inorganic or organic chelated forms.

7. The easiest way to avoid lime-induced Fe chlorosis on calcareous soils is to plant trees budded on tolerant rootstocks.

8. The most effective remedy for lime-induced Fe chlorosis on nontolerant rootstocks involves the use of chelated Fe.

9. Sulfur products that act as soil acidulents can potentially improve nutrient availability in calcareous soils.

$CaCO_3$ Neutralizing Power of Several S Sources

Sulfur Source	Amount Needed to Neutralize 1,000 lbs $CaCO_3$
Elemental Sulfur	320 lbs
Concentrated sulfuric acid (66° Baume)	68 gallons
Ammonium sulfate 21-0-0-24S	900 lbs

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A County Faculty Vacancy

Position # 924440
Area Specialized Extension Agent, Citrus Extension Agent I, II or III
Highlands County (South Central District) Sebring, FL
Application Deadline: 8/31/03 or until position is filled.*
Date Available: 10/01/03
This agent provides educational leadership for programs addressing the needs of citrus production audiences in Highlands and surrounding counties, including the development, teaching, implementation, evaluation and promotion of sound educational programs to help growers more effectively interpret and use findings of science and technology. The agent will be expected to teach educational programs focused on Best Management Practices and Water Policy (irrigation/fertilization/integrated pest management), Labor (Laws/relations/shortage/productivity), Business (management, marketing, risk management), land and water policy, and other related topics.
The agent will deliver Extension programs in cooperation with specialists, researchers, and neighboring county agents. This agent must develop effective working relationships with advisory groups, producer groups, community leaders, media, related agencies, and the general public. The agent will work closely with the faculty at the Lake Alfred Citrus and Indian River Research and Education Centers, Highlands County Citrus Growers, and other related groups. Educational programs will also be implemented with a target audience of agricultural education teachers, 4-H leaders, FFA students, 4-H members and other youth. Practical experience in citrus industry or related industry would be helpful. The position requires a Master's or Ph.D. degree in agronomy, plant science, crop science, agricultural and biological engineering, soil and water science or closely related field.
Located in the South Central ridge area of Florida, Highlands County is dotted with lakes, the largest being Lake Istokpoga near the city of Lake Placid. The county is also home to Highlands Hammock State Park, one of the nation's outstanding natural areas. The largest private employers are in health care, citrus, agriculture, banking and lawn fertilizers and supplies. Citrus acreage in the county is approximately 77,000 acres. The position is located in Sebring, the County Seat. Highlands County is a drug free work place and requires drug testing as a part of pre-employment screening.

Interested parties can contact IFAS Personnel at 352-392-4777 or go to the web site to download an application directly at http://personnel.ifas.ufl.edu/howtoapply.htm

SOIL ACIDITY AND LIMING

With the exception of some native vegetation (e.g. pine trees) and a few acid-loving plants such as azaleas, blueberries, and gardenias, most plants and fruit trees including citrus do best in a slightly acid soil with a pH between 6.0 and 7.0.

Acid Soil Infertility

When the pH falls below 6.0, the availability of nutrients such as phosphorus, potassium, calcium, and magnesium decreases and the availability of the metallic micronutrients, like zinc, manganese, copper, and iron increases.

Problems in very acid soils

*Aluminum (Al) toxicity to plant roots
*Manganese toxicity to plants
*Calcium & magnesium deficiencies
*Molybdenum deficiency
*Phosphorus tied up by iron (Fe) & Al
*Poor bacterial growth
*Reduced nitrogen transformations

Problems in alkaline (high pH) soils

*Iron deficiency
*Manganese deficiency
*Zinc deficiency
*Excess salts (in some soils)
*Phosphorus tied up by calcium (Ca) and magnesium (Mg)
*Bacterial diseases and disorders

<u>Factors Affecting Soil pH</u>

Soils are not homogenous and the pH can vary considerably from one spot in the field to another. It also varies with depth. Soils in different geographic regions may have different pHs because of several factors including the parent material and the climate.

<u>Rainfall/leaching</u>. Rainfall affects soil pH. Water passing through the soil leaches basic cations such as calcium (Ca^{2+}), magnesium (Mg^{2+}), and potassium (K^+) into drainage water. These basic cations are replaced by acidic cations such as aluminum (Al_3^+) and hydrogen (H^+). For this reason, soils formed under high rainfall conditions are more acid than those formed under arid conditions.

<u>Fertilizers</u>. Both organic and non-organic fertilizers may eventually make the soil more acid. Hydrogen is added in the form of ammonia-based fertilizers (NH_4^+), urea-based fertilizers [$CO(NH_2)_2$], and as proteins (amino acids) in organic fertilizers. Transformations of these sources of N into nitrate (NO_3^-) releases H^+ to create soil acidity. Therefore, fertilization with fertilizers containing ammonium or even adding large quantities of organic matter to a soil will ultimately increase the soil acidity and lower the pH.

$$\mathbf{NH_4^+ + 2O_2\ (bacteria) \rightarrow NO_3^- + 2H^+ + H_2O}$$

Common Fertilizers and their Equivalent Acidity or Basicity

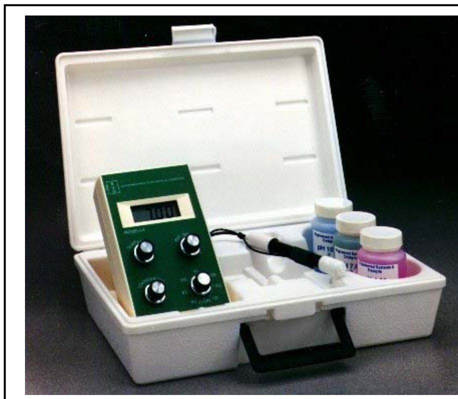
Material	% Nutrient in Material	Amount to supply one unit (20 lbs) of nutrient	$CaCO_3$ equivalent per unit (20 lbs) of nutrient*
Nitrogen fertilizers			
Ammonium nitrate	34	60	-36
Ammonium sulfate	21	98	-107
Anhydrous ammonia	82	24	-36
Diammonium phosphate	18	111	-71
Monoammonium phosphate	11	182	-107
Nitrogen solutions	28-32	71-63	-36
Calcium nitrate	15.5	129	+26
Potassium nitrate	14	143	+36
Sodium nitrate	16	125	+36
Urea	45	44	-36
Phosphorus fertilizers			
Diammonium phosphate	46	43	-21
Monoammonium phosphate	55	36	-28
Ordinary superphosphate	20	100	Neutral
Triple superphosphate	46	43	Neutral
Potassium fertilizers			
Potassium chloride	60-62	33-32	Neutral
Potassium nitrate	44	45	+11
Potassium magnesium sulfate	22	91	Neutral
Potassium sulfate	48-52	42-38	Neutral

***A minus sign indicates the number of pounds of pure $CaCO_3$ needed to neutralize the acidity created by 20 lbs of N, P_2O_5, or K_2O. A plus sign indicates that the material is basic and is equivalent to the number of pounds of pure $CaCO_3$ indicated.**

Plant uptake. Plants take up basic cations such as K^+, Ca^{++}, and Mg^{++}. When these are removed from the soil, they are replaced with H^+ in order to maintain electrical neutrality and the soil pH is reduced.

Raising Soil pH (Liming Acid Soils)

Soils are limed to reduce the harmful effects of low pH (aluminum or manganese toxicity) and to add calcium and magnesium to the soil. The amount of lime needed to achieve a certain pH depends on the pH of the soil and its buffering capacity. buffering capacity is related to the cation exchange capacity (CEC). The higher the CEC, the more exchangeable acidity (hydrogen and aluminum) is held by the soil colloids. As with CEC, buffering capacity increases with the amounts of clay and organic matter in the soil. Soils with a high buffering capacity require larger amounts of lime to increase the pH than soils with a lower buffering capacity.



Most soil testing laboratories use a special buffered solution to measure the exchangeable acidity. This is the form of soil acidity that must be neutralized for a change in soil pH. By calibrating pH changes in the buffered solution with known amounts of acid, the amount of lime required to bring the soil to a particular pH can be determined.

Lime reduces soil acidity (increases pH) by changing some of the hydrogen ions (H^+) into water (H_2O) and carbon dioxide (CO_2). A Ca^{++} ion from the lime replaces two H^+ ions on the cation exchange complex. The carbonate (CO_3^-) reacts with water to form bicarbonate (HCO_3^-). These react with H^+ to form H_2O and CO_2. The pH increases because the H+ concentration has been reduced.

$$\text{Soil Colloid}\begin{matrix} H^+ \\ H^+ \end{matrix} + CaCO_3 \rightarrow \text{Soil Colloid-}Ca^{++} + H_2O + CO_2$$

*__Dissolution of lime:__ $CaCO_3 + H_2O \rightarrow Ca^{2+} + HCO_3^- + OH^-$

*__Neutralization:__

H+ (soil solution) + $OH^- \rightarrow H_2O$

H+ (soil solution) + $HCO_3^- \rightarrow H_2O + CO_2$

(Neutralization is caused by the carbonate in lime, not the calcium)

An acid soil can become more acid as basic cations such as Ca^{2+}, Mg^{2+}, and K^+ are removed, usually by crop uptake or leaching, and replaced by H^+.

Liming Materials

The most common liming materials are calcitic or dolomitic agricultural limestone. These are natural products made by finely grinding natural limestone. Since natural limestone is relatively insoluble in water, agricultural limestone must be very finely ground so it can be thoroughly mixed with the soil and allowed to react with the soil's acidity. Calcitic limestone is mostly calcium carbonate ($CaCO_3$). Dolomitic limestone is made from rocks containing a mixture of calcium and magnesium carbonates. Either will neutralize soil acidity. Dolomitic limestone also provides magnesium. Not all materials containing calcium and magnesium are capable of reducing soil acidity. Gypsum ($CaSO_4$) does not reduce soil acidity.

$CaSO_4 + 2H_2O \rightarrow Ca(OH)_2 + H_2SO_4$

These 2 products neutralize each other.

Application and Placement of Lime

Time of year. Lime may be applied at any time during the year. Application in early fall and spring or prior to soil preparation is recommended. Caustic liming materials such as burned lime, hydrated lime, or wood ashes to actively growing plants are not recommended.

Lime placement. Since ground limestone is relatively insoluble in water, maximum contact with the soil is necessary to neutralize the soil acidity. Lime will not move into the soil like water-soluble fertilizers. The recommended amount of lime should be thoroughly mixed with the topsoil. As soon as moisture is present, the lime will begin to react. Coarse lime particles react more slowly than very fine particles. Therefore, using very finely ground limestone and thoroughly mixing it are necessary to achieve the desired soil pH change within a few months.

Overliming

While a correct liming program is beneficial for plant growth, excessive liming can be detrimental because deficiencies and imbalances of certain plant nutrients may result. The practice of estimating lime requirement without a soil test is risky because it can lead to overliming.

Overliming causes the soil pH to increase beyond the range of optimum plant performance. Reduced plant growth is usually associated with deficiencies of micronutrients such as Mn, Fe, zinc (Zn) or copper (Cu), which become less available as soil pH increases. Overliming is costly -- it costs to buy and apply the lime, and it costs in terms of reduced plant performance.

The principal factors contributing to overliming are: (1) application of lime to soil without testing or determining if lime is needed, (2) liming to soil pH levels much higher than those necessary to achieve the desired plant response, (3) liming to supply calcium (Ca) and/or magnesium (Mg) as nutrient elements without sufficient regard to the effect of lime in raising the soil pH.

If there is a need for Ca or Mg as nutrients and an increase in soil pH is not desired, another source of Ca or Mg should be used. Gypsum (calcium sulfate) and magnesium sulfate or oxide can supply Ca and Mg without affecting soil pH.

Calcium sources

Source	Chemical formula	Calcium carbonate equiv. (pure form)
Burned lime (Quicklime)	CaO	179
Hydrated lime (Builder's lime)	$Ca(OH)_2$	135
Dolomitic lime	$CaCO_3 \bullet MgCO_3$	109
Calcitic lime	$CaCO_3$	100
Basic slag (by-product)	$CaSiO_3$	80
Marl (soft carbonates)	$CaCO_3$	70 to 90
Gypsum	$CaSO_4$	0
Calcium nitrate	$Ca(NO_3)_2$	20
Ordinary superphosphate	$Ca(H_2PO_4)_2 + CaSO_4$	0
Concentrated superphosphate	$Ca(H_2PO_4)_2$	0

CITRUS NUTRITION ON CALCAREOUS SOILS

Calcium carbonate ($CaCO_3$) can occur naturally in soils or can be added through irrigation with water from the aquifer. Calcareous soils are alkaline (have pH values greater than 7) because of the presence of $CaCO_3$. The pH of these soils range from 7.6 to 8.3 regardless of $CaCO_3$ concentration, unless a significant quantity of sodium (Na) is present. Special nutritional management is required to grow citrus successfully on calcareous soils. However, planting citrus trees on these soils may not be economically feasible. The presence of $CaCO_3$ affects the availability of almost all nutrients.

NITROGEN (N)

Nitrification, which is the conversion of ammonium (NH_4^+) to nitrate (NO_3^-) by soil bacteria, is most rapid in soils with pH values between 7 and 8. Ammonia volatilization is the loss of N to the atmosphere through conversion of the ammonium ion to ammonia gas (NH_3). Volatilization of ammoniacal-N fertilizer is significant when the soil surface pH is greater than 7. Nitrogen loss through ammonia volatilization on calcareous soils is a concern when ammoniacal N is applied on the soil surface and remains there without moving it into the soil. When applying dry fertilizer containing urea or ammoniacal N, the fertilizer should be moved into the root zone through irrigation or mechanical incorporation if rainfall is not imminent. Applying a portion of the required N fertilizer foliarly (urea, potassium nitrate, calcium nitrate) will improve the N status. Applying N with irrigation water (fertigation) and scheduling irrigation to maintain the N in the root zone is a sound method to prevent large N leaching losses.

PHOSPHORUS (P)

When P fertilizer is added to a calcareous soil, it undergoes a series of chemical reactions with Ca. These reactions decrease P solubility through a process called P fixation. Consequently, the long-term availability of P to plants is controlled by the application rate of soluble P and the dissolution of fixed P. Applied P is available to replenish the soil solution for only a relatively short time before it converts to less soluble forms of P. Phosphorus fertilizer should be applied each year in newly planted groves until the groves begin to bear fruit. As the trees approach maturity, P applications can be limited to once every few years. Diagnostic information from leaf and soil testing can help determine whether P fertilization is necessary.

MAGNESIUM (Mg) & POTASSIUM (K)

It is often difficult to increase Mg and K uptake with fertilizer applied to calcareous soils. High Ca levels suppress Mg and K uptake by citrus trees through the competition of Ca, Mg, and K. In cases where soil-applied fertilizer is ineffective, the only means of increasing leaf Mg or K concentration is through foliar application of water-soluble fertilizers, such as magnesium nitrate, potassium nitrate, or monopotassium phosphate. A solution of 20 lbs KNO_3 per 100 gallons of water has been shown to raise leaf K, especially if applied several times during the year. For citrus on noncalcareous soils, nitrogen and potassium fertilizer applications with a 1:1 ratio of N to K_2O are recommended. If leaf testing on calcareous soils reveals that high levels of soil Ca may be limiting K uptake, the K_2O rate should be increased by about 25% to have a N:K_2O ratio of 1:1.25.

ZINC (Zn) & MANGANESE (Mn)

At alkaline (high) pH values, Zn and Mn form precipitous compounds with low water solubility, decreasing significantly their availability to plants. On alkaline soils, soil applications of Zn and Mn fertilizers are ineffective. The least expensive way to correct effectively Zn and Mn deficiencies is through foliar sprays. Preliminary research data indicate little difference in magnitude of foliar uptake, regardless of the form of carrier or chelate applied.

IRON (Fe)

Iron is considerably less soluble than Zn or Mn in high pH soils. Thus, inorganic Fe contributes relatively little to the Fe nutrition of plants on calcareous soils. Citrus rootstocks vary widely in their ability to overcome Fe deficiency. The easiest way to avoid lime-induced Fe chlorosis in citrus trees to be planted on calcareous soils is to use tolerant rootstocks. Existing Fe chlorosis can be corrected through soil application of Fe chelates. Foliar application of iron compounds has not proven satisfactory on citrus trees because of poor translocation within the leaf. Furthermore, foliar sprays of Fe have the possibility to cause fruit and leaf burn.

SULFUR PRODUCTS USED AS SOIL AMENDMENTS

Soil acidulents can improve nutrient availability in calcareous soils by decreasing the soil pH. Soils with visible lime rock or shell in the root zone would require repeated applications of a high rate of acidulent. Examples of S-containing acidulents include elemental sulfur (S) and sulfuric acid (H_2SO_4). These compounds act to neutralize $CaCO_3$ with acid. Ammonium sulfate [$(NH_4)_2SO_4$] acidifies the soil by converting NH_4^+ to NO_3^- during nitrification. The sulfate ion (SO_4^{2-}) alone possesses no acidifying power. Elemental S is the most effective soil acidulent. Although not an acidic material itself, finely ground elemental S is converted quickly to sulfuric acid in the soil through microbial action. Sulfuric acid reacts more quickly than any other material, but it is hazardous to work with and can damage plants if too much is applied at one time. Dilute concentrations of sulfuric acid can be applied safely with irrigation water and used to prevent Ca and Mg precipitates from forming in microirrigation lines. Repeated applications of sulfuric acid with irrigation water will tend to lower soil pH within the wetted pattern of the emitter.

The soil within the wetted pattern of a microirrigation emitter often becomes alkaline when the water contains bicarbonate, while the surrounding soil may be neutral or acidic. To lower the soil pH in this situation, acid or acidifying fertilizer must be applied to the wetted pattern only.