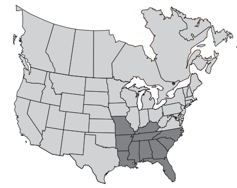
IPNI
INSIGHTS
INTERNATIONAL PLANT NUTRITION INSTITUTE

2006 Research Program Summaries – Southeast Region

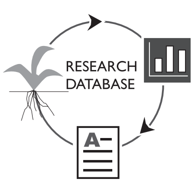


August 2007
Part 2 of 2

Cotton, Citrus, Forages, Forestry, and More

CHANGE is inevitable and has become an integral part of our world today. With this new issue of *INSIGHTS,* we have some important information on recent changes to highlight. The Potash & Phosphate Institute (PPI) ceased to exist at the end of 2006 and the International Plant Nutrition Institute (IPNI) was introduced at the beginning of 2007. At that time, **Dr. Cliff Snyder** was named Nitrogen Program Director for the new organization, with responsibility across North America and other IPNI program regions. He had served as Southeast Region Director for PPI over the past several years. Effective June 1, **Dr. Steven B. Phillips** joined the IPNI staff and is now the Southeast Region Director for IPNI. Contact information for both Dr. Snyder and Dr. Phillips appears with their photos.

In the past, you have probably received information from PPI through a publication called *News & Views.* That title has been discontinued and *INSIGHTS* is a new publication from IPNI.



Economic and environmental pressures have increased in recent years, making it more important than ever that nutrient rate, source, timing, and placement decisions are made correctly. Sound economic and environmentally responsible decisions are impossible in the absence of current nutrient management research. This report (Part 2) and its companion (Part 1) advance the science of nutrient management for the variety of food, fiber, and forestry crops produced in the Southeast U.S. The Foundation for Agronomic Research (FAR) is now affiliated with IPNI. The research projects reported here are supported in part by IPNI, FAR, and other cooperators. More information about the projects summarized here is available at these websites: >**www.ipni.net/research**< or >**www.farmresearch.com**<.

Please refer to the first INSIGHTS (Part 1 of 2) for a report from other studies conducted in the Southeast Region in 2006.

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Arkansas

Cotton and Soil Response to Application of Potassium

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This field study evaluated the effect of cotton cultivar (short and long-season) and K fertilization on seedcotton yield, petiole K concentration, and Mehlich-3 extractable K. The experimental design was a randomized complete block with a split-plot treatment where cotton cultivar (Stoneville 5599 and DeltaPineland 445) was the main-plot factor and K rate (0, 30, 60, 90, 120, and 150 lb K_2O/A) was the subplot factor. Initial soil test K was 96 ppm.

Cotton cultivar or cultivar x K rate did not have any significant effect on seedcotton yield, petiole K concentration, or post harvest soil test K within the 0 to 6-in. depth. Averaged across both cultivars, seedcotton yield ranged from 2,347 to 3,261 lb/A and was significantly ($p = 0.04$) increased as K application rate increased. Numerically, the highest yield was produced with application of 150 lb K_2O/A. Seedcotton yield of all treatments that received > 90 lb K_2O/A (2,965 to 3,261 lb/A) was significantly higher than the zero-K check (2,347 lb/A). Averaged across both cultivars, petiole K increased with increasing rate of K application and tended to decrease as the cotton plant developed. Potassium application rate significantly ($p = 0.0003$) and linearly increased Mehlich-3 extractable K within the 0 to 6-in. depth. Mehlich-3 extractable K in the control and plots that received 150 lb K_2O/A were 66 and 97 ppm, respectively. The data indicate that K fertilizer application was needed to increase seedcotton yield and petiole K levels and to improve soil K availability. *AR-29F*

Florida

Phosphorus/Potassium Soil Test Calibration and Effects on Fresh Citrus Fruit Quality

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***Project Cooperator:** Robert Rouse*

Some Florida citrus growers apply P fertilizer on a regular basis, but tree response is rare because residual soil P is usually sufficient. It is important to judiciously use P fertilizer due to environmental concerns of P loss. Citrus producers want to use soil testing to guide fertilization, but no true calibration exists. Unlike P, K leaches readily in Florida's sandy soils, so K fertilization almost always provides a positive response. The objectives of this project are to calibrate a citrus soil P test and to determine the effects of K fertilizer rate on yield and fresh fruit quality of grapefruit and oranges. Our research grove was planted in November 1998 and we have monitored it annually.

The 2005-2006 growing season was severely impacted by Hurricane Wilma, which crossed south Florida on October 23 to 24, 2005. Leaf tissue was sampled as usual during the summer, but the hurricane removed most of the fruit from the grapefruit trees. The trees also suffered considerable leaf loss, but they were not permanently damaged. The orange trees also lost fruit, but enough was left to obtain a juice sample. The relationship between grapefruit leaf tissue P and soil test P in 2005 revealed a critical soil test P value of 9 mg/kg. Grapefruit leaf P was in the low range only when soil test P was below the critical value, which is interpreted as very low in the current UF-IFAS system. Orange tree leaf P was not related to soil test P, and all orange leaf P values were optimum or greater. Neither orange juice Brix nor acid were sensitive to soil test P. Potassium fertilizer response data (i.e., leaf K analysis, juice quality) confirmed that the optimum annual K_2O rate for oranges is 200 lb/A, but the optimum may be higher for grapefruit (in the range of 250 to 300 lb/A) if the response variable considered is leaf tissue K. *FL-19F*

Soil Fertilization of Perennial Pasture Systems

***Project Leader:** Dr. Cheryl Mackowiak, University of Florida, NFREC, 155 Research Rd, Quincy, FL 32351. Telephone: 850-875-7126, e-mail: clmackowiak@ifas.ufl.edu*

***Project Cooperator:** Ann Blount*

Adoption of comprehensive forage fertilization practices can improve dryland forage hay production, quality, and tolerance to diseases without compromising environmental quality. Field studies are being conducted at three Florida locations, using three forage species (i.e., bermudagrass, bahiagrass, and perennial peanut) to compare K as potassium chloride (KCl) with and without supplemental potassium magnesium sulfate ($K_2SO_4 \cdot 2MgSO_4$, as K-Mag®) on forage yield, quality, and tissue mineral content. In addition, soil cores are being collected to determine fertilization effects on soil nutrient status over time. The K is applied at two rates (24 lb or 48 lb K_2O/t of hay removed) following each cutting. All plots, excluding the check plots, receive N at 60 lb/t hay removed and P fertilizer rate was based upon Florida IFAS recommendations. Control plots receive N without any K.

Bermudagrass has shown the greatest response to fertilization treatments, where plots not receiving $K_2SO_4 \cdot 2MgSO_4$ had declining yields. Low soil S, and plant tissue S less than approximately 0.18%, resulted in chlorotic plants, with yields nearly 50% lower than yields from plots receiving $K_2SO_4 \cdot 2MgSO_4$. Sulfur deficiency in bermudagrass presented itself in the first year on the Spodosol soil and the third year on the Entisol soil. The Ultisol soil contained enough residual S to support bermudagrass growth during the 3 years of this study. Bermudagrass had declining yields on plots excluding K if soil K was low and tissue K fell below approximately 1.5%. Additionally, Helminthosporium (leaf spot disease) infection was much greater on K-deficient bermudagrass. Bahiagrass and perennial peanut have larger root/rhizome nutrient storage capacity than bermudagrass, so treatment differences did not appear as quickly. Low tissue S and K began to result in declining bahiagrass yields at some locations in 2006. Perennial peanut has yet to show a yield response to fertilization practices. However, tissue K and S contents in perennial peanut approached critically low values in 2006, suggesting that nutrient-related yield declines may occur in 2007. *FL-22F*

Comparing Nitrogen and Sulfur Fertilizer Sources for Tomato Production

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Project Cooperator: Jack Rechcigl

The objective of this research is to evaluate the effect of ammonium sulfate nitrate (ASN) as a source for N and sulfur (S) compared with other commercially available fertilizers in tomato production near Balm, Florida. The study was initiated in the fall of 2006 at the Gulf Coast Research and Extension Center in 30 ft. plots having 5 ft. alleys and 15 tomato plants per plot. The soil belonged to the Zolfo series (sandy, siliceous, hyperthermic Oxyaquic Alorthods). The fertilizer sources were: (ASN- 26% N, 14% S), ammonium nitrate (AN- 34% N), ammonium sulfate (AS- 21% N, 24% S), and potassium sulfate (PS- 23% S, 55% K). Treatments compared a control to AN, AS, AN+PS, and ASN+PS at both 200 and 300 lb N/A. These treatment combinations also resulted in S rates of 0, 229, and 334 lb/A. Total marketable fruit weight from two harvests was measured and tissue S concentration assessed at 14 weeks after treatment.

There were significant treatment effects on both total marketable fruit weight and S concentration in the tissues. Orthogonal contrasts of both the N and S variables revealed that addition of S, either as PS or as ASN, increased tomato yield and S concentration in the leaf tissues. Interestingly, the same treatments (AN + PS and ASN + PS) which had higher yields than AN alone also had higher tissue S. There were no differences in yields or tissue S concentrations between: 1) AN and AS, and 2) AN + PS and ASN + PS. These preliminary results indicate that S fertilization has a significant effect on tomato yield at this location in Florida. Further research will be conducted in spring 2007 to confirm these findings. *FL-24F*

Georgia

Enhancing Thinned Slash Pine Volume Production and Product Class Distribution with Competition Control and Fertilization on Flatwoods Spodosols

Project Leader: Dr. E. David Dickens, University of Georgia, Warnell School of Forest Resources, PO Box 8112 GSU, Statesboro, GA 30460. Telephone: 912-681-5639. Fax: 912-681-0376. e-mail: ddickens@arches.uga.edu

Project Cooperators: David Moorhead, Coleman Dangerfield, and Bryan McElvany

Fertilization and competition control studies were installed in two thinned slash pine stands in southeast and south Georgia (Ware and Wayne counties) in 2001. The objectives are to: 1) quantify the magnitude and duration of response to lime, fertilization with 200-115-65 lb N-P_2O_5-K_2O/A , and competition control using herbicides, mowing, or burning; 2) measure diameter distribution and tree product class volume changes over time, and 3) evaluate the economics of these activities over a 5 to 8-year period. Both thinned slash pine stands are growing on low pH (3.8 to 4.2), low fertility Spodosols that are deficient in N, P, K, and magnesium (Mg) based on soil P and foliar N, P, K, and Mg measurements.

There were no significant differences between treatment means at Ware County for all growth parameters tested for 2 years (3 years in the case of limed plots) after treatment. This may be due to the slash pine stand being thinned later (i.e., at 23 versus 16 years) and a low live crown ratio of 24 to 27%, versus 36 to 38% for the younger Wayne County slash pine site. We plan to re-measure the trees in January and February of 2007, 4 years after the fertilizer and herbicides were applied.

It is early to draw any major conclusions from the Wayne County study after 4 years, but some trends are developing. The dbh (i.e., diameter at 4.5 ft.) response in the first 2 years (2001 to 2003) was slightly greater (54% of total) than the second 2-year period (2003 to 2005, 46% of total) for all treatments, whereas the total height increment during the first 2-year period was less than the second 2-year period (61% of the 4-year total). Height and volume per acre increment (as % of the 4-year total) for the herbicide treatment was greater than the NPK treatment during the second 2-year period. Therefore, in this case, the diameter response tended to occur before the height response, and the height response to NPK tended to be before the herbicide response. The response to herb+NPK was slightly greater than additive [(fert – control) + (herb – control)] for dbh, volume/tree, volume/A, and chip and saw (CNS) volume/A increment. There were significant CNS and pulpwood volume 4-year shifts, with herbicide+NPK and mow+NPK producing significantly more CNS volume than the control, herbicide, and mow only, and the herbicide+NPK producing significantly less pulpwood volume than the control and herbicide only. The NPK fertilizer, herb+NPK, and mow+NPK treatments produced an extra $162, $265, and $258/A wood revenue when compared to the control over the 4-year period. *GA-24F*

Loblolly Pine Stand Fertilization at Mid-Rotation to Increase Small and Large Sawtimber Volume

Project Leader: Dr. E. David Dickens, University of Georgia, Warnell School of Forest Resources, PO Box 8112, Statesboro, GA 30460. Telephone: 912-681-5639. Fax: 912-681-0376. e-mail: ddickens@arches.uga.edu

Project Cooperator: David Moorhead

The University of Georgia (UGA) Warnell School of Forestry and Natural Resources (WSFNR) installed a replicated fertilizer study on Chuck Leavell's Charlane Plantation, located in Twiggs County, Georgia, in 2005. Seven of nine thinned loblolly pine stands showed NP, NPK, NPKS, and copper (Cu) deficiencies based on soil and foliar sampling on February 27, 2004. Leaf area index (LAI) estimation taken in July 2004 showed that these stands also had LAIs below optimal levels, indicating a good probability of response to N. Two fertilizer trials using fertilizer treatments and an untreated control (planted in 1978, thinned in 2002-03) were established February 15 and 16, 2005. One-time fertilizer application levels were 200 lb N/A + 50 lb P + 80 lb K + 60 lb S + 5 lb Cu/A. The Bullard Bluff East tract had 8 plots with two replications of NP, NPK, NPKSCu, and a control. The Bullard Bluff West tract had 15 plots with three replications of NP, NPCu, NPKCu, NPKCu, NPKSCu, and a control. The N and P sources were urea and diammonium phosphate (DAP), the K source was potassium chloride (KCl), the Cu source was copper sulfate, and the S source was ammonium sulfate. Untreated control plots will serve as reference plots.

The major objectives are: 1) quantify the magnitude and duration of wood volume response to the fertilizer combinations, 2) determine changes in product class distribution, 3) determine the cash flow and rate of return for each fertilizer combination compared to unfertilized control plots, and 4) discern when fertilizers are to be re-applied to maintain wood volume gain. Baseline soil (10 core samples to make a composite sample, with one composite sample/plot at 0 to 6 in. depth) were taken in each plot prior to treatment and annually post-treatment. All living crop trees in each plot were aluminum tagged, numbered, and measured for diameter at 4.5 ft. (dbh), total height, live crown length, and defect(s) prior to treatment (January 2005), with repeated measurements planned 2 and 4 years post-treatment. Rainfall patterns were excellent the year after fertilization, but there was drought in 2006. A low-cost ($15/A for product) foliar-active herbicide (glyphosate with a surfactant) was applied at a rate of 3 qts/A with an ATV and boomless sprayer at 15 gpa in August 2004 on BBE (pre-fertilization) and in August 2005 on BBW (post-fertilization). Plot LAI is being estimated annually, and foliage samples are being collected each dormant season for nutrient analyses. A field day is being planned for the spring of 2008 to share 2-year post fertilization findings and economic fertilization guidelines. It is anticipated that many forest landowners will be able to make educated and informed fertilization decisions in thinned loblolly pine plantations from this project. *GA-26F*

Missouri

Fescue Sulfur Fertilization—Hay and Pasture

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Project Cooperator: David Dunn

In 2004, a sulfur (S) fertility study was begun on a non-renovated Ozark fescue pasture located in south central Missouri near West Plains. A fence was constructed to keep cows out of a hay test area which was used for evaluating 0, 9, 12, and 24 lb S/A as ammonium sulfate applied in late March each year from 2004 to 2006. At the same time as S application, rates of ammonium nitrate were applied, crediting N from ammonium sulfate, to provide a total of 50 lb N/A total for all treatments except check plots. Diammonium phosphate and potassium chloride (KCl) were applied with S treatments as part of an 8-year P and K buildup program. In late August, a rate of 30 lb N/A from ammonium nitrate was applied to all plots except the check. Plots were harvested three times in 2004, and twice in 2005 and 2006. Grab samples were collected from each plot for laboratory nutrient analyses.

Tissue tests of hay from the first harvest each year showed fescue S concentration was increased significantly with the 12 and 24 lb S/A rates. Averaged across years, leaf tissue in plots without S fertilizer contained 0.167 to 0.181% S. South central Missouri had low rainfall conditions in the summer months of 2005 and 2006. Although tissue S was increased from fertilization, no significant fescue dry matter hay increase was found at this location. Significant hay yield increases were found from N and P/K fertilization compared to the non-fertilized check. *MO-27F*

Use of Ammonium Sulfate on Tall Fescue Pastures to Reduce Costs and Improve Forage Quality in Missouri

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About half of Missouri's 12 million acres of tall fescue receive N fertilizer either in the spring or late summer to increase yields. Because ammonium nitrate production is being phased out and urea has ammonia volatilization problems, growers need comparative information on new N products for pastures. Our primary objective was to compare ammonium sulfate, ammonium nitrate, urea, ESN® coated urea, Nurea®, Nurea with a 10% polymer coating, and mixtures of ammonium sulfate with urea and ESN as N sources for tall fescue in spring and late-summer applications. In 2006, plots established at the Bradford Research and Extension Center replaced those at the Forage Systems Research Center (FSRC). Another year of data was collected at the Southwest Missouri Research and Education Center (SWC). Each of the fertilizer sources were applied in mid-March (spring, Experiment 1) and mid-August (late-summer, Experiment 2) at each location. The N fertilizer application rate was 75 lb N/A. For the spring application, forage was harvested in late May, late July, and mid-October to measure season-long pasture production. For the late-summer application, plots were harvested in early December and indicate the suitability of each source for growing "stockpiled" forage for winter grazing.

In experiment 1, our preliminary data for the first two years indicate that only the initial harvest responded to N applied in March. Nearly 80% of the annual dry matter was harvested at the first sampling date in May. No product was overwhelmingly consistent in producing high yields. Ammonium sulfate ranked in the top producing group at nearly all harvests and locations and its performance is perhaps the most surprising data from this experiment. Another somewhat surprising result was that ammonium nitrate, urea and ammonium sulfate proved to be nearly equal N fertilizer sources for tall fescue in spring. Each year, both locations received ample moisture within 5 days of the fertilizer application to get urea into the soil solution. Preliminary data show that a spring application of 75 lb N/A increased yields by approximately 2,250 lb/A over the unfertilized control or about 30 lb of additional forage for each pound of N fertilizer applied. Soil moisture affected this relationship drastically as the range was 987 to over 4,800 lb/A.

In experiment 2, for N applied in late-summer, many of the products yielded similarly and in most cases 10 or more of the products showed equal yields. Consistently, ammonium sulfate, ammonium nitrate, and urea had comparable yields in 3 of 4 site-years. Tall fescue fertilized with urea yielded 35% less than plots fertilized with ammonium nitrate during the dry autumn of 2005 in Mt. Vernon. This is a classic example of the risk associated with using urea for late-summer applications. The polymer coated urea has not shown much promise as a substitute for urea or ammonium nitrate for spring or late-summer N applications at this location. *MO-30F*

Mississippi

Determination of Potassium, Magnesium, and Sulfur as Limiting Factors in Cotton Production on Blackland Prairie Soils

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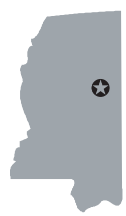

The objectives of this study are to: 1) determine individual response functions of cotton leaf K, magnesium (Mg), and sulfur (S), and cotton lint yield, to varying rates of applied K, Mg, and S, and 2) compare these individual responses to those obtained as a result of potassium magnesium sulfate ($K_2SO_4{\cdot}2MgSO_4$) application, supplied as KMag®. This project was established in April 2004 and the proposed length of study was through the 2006 growing season. Treatments included 0, 36, 72, and 108 lb K_2O/A as potassium chloride (KCl); 0, 9, 18, and 27 lb Mg/A as magnesium nitrate; 0, 18, 36, and 54 lb S/A as ammonium sulfate; and K_2O-Mg-S at 0-0-0, 36-9-18, 72-18-36, and 108-27-54 kg/ha as $K_2SO_4{\cdot}2MgSO_4$, with 50% of the K derived from KCl. Total N applied to all treatments was 120 lb N/A.

Lint yield increased linearly from 685 to 1,243 lb/A with an increase in K fertilizer input from 0 to 108 lb K_2O/A. Response to Mg was inconsistent, but treatments with Mg yielded an average of 1,085 lb lint/A compared to 958 lb/A for the no Mg check. Yield responded quadratically to increasing S rates with a maximum lint yield of 1,187 lb/A at 36 lb S/A and 863 lb/A with no S. Lint yield response to $K_2SO_4{\cdot}2MgSO_4$ was similar to the response to applied K rates, but with a slight curvature. Yields were 751 lb lint/A with no $K_2SO_4{\cdot}2MgSO_4$ and 1,163 lb/A with the largest $K_2SO_4{\cdot}2MgSO_4$ rate. The dramatic response to applied K rates from either source (KCl or $K_2SO_4{\cdot}2MgSO_4$) provides more evidence on the importance of K in no-tillage cotton, especially in dry years. Leaf sampling was not possible due to a herbicide spray mishap one week prior to the scheduled leaf sampling at early bloom. *MS-13F*

Tennessee

Nitrogen and Potassium Effects on Physiology and Yield of Contrasting Cotton Varieties

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Project Cooperators: C.C. Craig, Jr., Carl Michaud, and Tracy Bush

Cultivar differences in yield response to N and K nutrition have been observed in modern cultivars, but the underlying reasons for these differences are needed to improve fertilizer recommendations. For this reason, we continued three interrelated studies within long-term soil fertility plots in a Memphis-Loring silt loam at Jackson, Tennessee. They include: 1) variety response to K, 2) variety response to N at different K levels, and 3) response of an indeterminate cultivar to extremes of K fertility. Two cultivars with contrasting growth habits, FM 960BR and DP 555BG/RR, were planted with no-tillage in replicated 4-row plots on May 3, 2006. In plots receiving 60 and 120 lb K_2O/A/yr, dry matter partitioning was determined at early bloom and cutout. All plots were spindle-picked at 140 and 156 days after planting, and earliness was measured as percent of total yield picked at first harvest.

Applying K fertilizer in excess of recommended rates affected the two cultivars differently in this year of the study. Total lint yield of the more indeterminate DP555 responded less to K than the more determinate FM960, but maturity of DP555 was delayed with excess K fertility. This delay was presaged by increased partitioning to leaf tissue during early bloom, and reduced partitioning to reproductive organs in DP555 by cutout, relative to FM960. This pattern suggests that the more indeterminate cultivar responded to additional K by partitioning more biomass to vegetative organs at the expense of reproductive development, unlike the determinate cultivar. Yield of the more determinate cultivar, FM960, responded to higher K rate only at a higher than recommended N rate, suggesting that its yields may have been N-limited at 80 lb N/A. In a companion study, very high K rates increased total lint yields of DP555 by 88% over the zero-K treatment, but significantly delayed maturity and increased micronaire. Additional research is needed in Tennessee to improve K fertilizer recommendations for cotton and to determine the yield and fiber quality effects of this delay in the event of cool weather before harvest. *TN-19F*

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