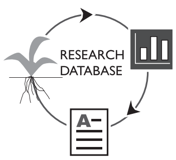
INSIGHTS
IPNI
International Plant Nutrition Institute

Research for Managing Crop Nutrients

August 2008

RESPONSIBLE management of crop nutrients requires research. Research is one step in the development process of best management practices (BMPs) that specify the right source of nutrient to be applied at the right rate, time, and place. Scientists need to test these practices for their impact on productivity, profitability, cropping system sustainability, and environmental health.



This issue of *INSIGHTS* features the brief Interpretive Summaries related to research projects supported by IPNI in the Northeast Region. This information and even more detail on each project can be found at the research database at our website: >**www.ipni.net/research**<.

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Delaware

Potassium Fertilizer Requirements of Corn and Soybean on Delaware Soils

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This study was initiated in 2006 in response to producer concerns of whether current recommendations maintain soil K. Objectives were to evaluate corn and soybean yield responses, K removal, and soil test K changes over time. In 2006, corn responses were evaluated at three sites ranging in K fertility. Soybean responses were evaluated at two sites...one high and one low in soil K. Neither corn nor soybeans responded to applied K in 2006, even though yields were high at four of the five sites. Concentrations of N, P, and K were generally lower than book values for both corn and soybean grain, by 20 to 30% for corn, and by 11 to 16% for soybean.

In 2007, the same sites received the same K fertilizer treatments. Owing to record drought conditions from June through mid-August, irrigation was unable to keep up. Yields were modest and did not respond to applied K. Monitoring of responses is planned to continue in 2008. A few more years will be required to answer producer questions about declining soil test levels. The nutrient removal data confirm the declining trend in grain nutrient concentrations associated with genetic changes, especially in corn. *DE-04F*

Maryland

Building a Maximum Yield Cropping System for Corn, Wheat, and Doublecropped Soybeans

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Project Cooperator: William Kenworthy

Sixteen N sources were evaluated on winter wheat in 2007. The crops were grown with and without tillage on a Mattapex silt loam soil. Sources containing ammonium sulfate or ammonium nitrate tended to produce modestly higher yields. Slow-release forms of N and elemental S did not boost yields when applied with timings similar to those used with the more soluble sources. *MD-06F*

Evaluation of Fertilizer Nitrogen Applications with and without Ammonium Sulfate in Selected Vegetable Crops

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The objective of this study is to evaluate the effectiveness of ammonium sulfate (AS) in a rotation of potatoes with wheat/doublecrop soybeans, corn, and single-crop soybeans under irrigation with different levels of tillage.

Fertilizers containing AS produced slightly lower potato

Notes and Abbreviations: N = nitrogen; P = phosphorus; K = potassium; S = sulfur; ppm = parts per million.

yields in 2006 and slightly higher yields in 2007, compared to conventional N sources, with at best an average yield benefit of 1 to 2%. Fertilizer containing AS boosted wheat yields by 17% in 2007 compared to sources containing urea and ammonium nitrate. Applied to corn in 2007, AS modestly increased yields. Nitrogen fertilizers applied to doublecrop soybeans resulted in no yield benefits in 2007. *MD-11F*

New York

Development and Implementation of a Fertilizer BMP Guide for Northeastern Dairy-Based Cropping Systems

Project Leader: Dr. Harold Reetz, Foundation for Agronomic Research, 107 S State St Ste 300, Monticello, IL 61856-1968. Telephone: 217-762-2074. E-mail: hreetz@ipni.net

Dairy farms in the Northeastern USA have made a lot of progress in adopting BMPs for managing their impacts on the environment. Many of these BMPs emphasize manure management. This project focuses on fertilizer BMPs appropriate to the cropping systems that support dairy farms.

Nutrient cycling on dairy farms is intensive. Large amounts of nutrients are both removed from the field in the harvest of forages, and returned in the form of manure. Nutrients also flow onto the farm in the form of purchased feed inputs, and they leave the farm in the form of milk, animals, and other materials sold. Fertilizers still play an important role on dairy farms. Applying them at the right rate, the right time, and in the right place optimizes profitability and resource use efficiency, and minimizes impact on the environment.

This project is supported by a Conservation Innovation Grant from USDA-NRCS. Since January 2006, a team—consisting of participants from Cornell University, Cornell Cooperative Extension, USDA-NRCS-NY, IPNI, Soil and Water Conservation Districts, crop consultants, and producers—has been meeting to discuss critical development needs for fertilizer management information. An assessment of fertilizer management for over two dozen selected farms has shown considerable diversity among them, but also that producers are conscientious in their fertilizer use. The team has agreed that the most important information needed is on fertilizer credits when cover crops are included in the crop rotation. Field demonstrations have focused on conservation tillage, cover crops, and the integration of fertilizer management to suit those practices. Participating producers have made presentations on their tillage and nutrient management practices at field meetings in New York and to participants of the InfoAg 2007 conference in Springfield, Illinois. A literature review to determine the effect of cover crops on the nutrient needs of following crops was conducted. The first edition of the BMP introductory guide developed by the team will be available soon. *NY-08F*

Ohio

Impact of Rotation, Phosphorus, and Potassium Fertilization on Soil Productivity and Profitability

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Project Cooperator: Edwin Lentz

Growers in the eastern Corn Belt often fertilize the whole rotation rather than the individual crops. Typically, in the fall prior to corn planting, farmers supply enough P and K to satisfy the nutrient needs of both corn and the following soybean crop. This practice has proved to be a viable option for corn-soybean rotations on soils with adequate nutrient levels, but questions arise for producers in a 3-year rotation of corn-corn-soybean. Studies in 2005 found that K boosted soybean yields in only one of four soil types, and by only 3%, and that earlier planting did not affect the need for K. In 2006, studies assessing P and K fertilization strategies were started in three locations. Two rotations were compared: corn-corn-soybean, and corn-soybean. These rotations were fertilized following soybeans, at P and K rates corresponding to zero, once, and twice the crop removal for the rotation. Corn yield was increased at one location by application of both P and K fertilizer. Optimum fertilization boosted yields from the range of 213 to 215 bu/A up to 223 to 225 bu/A. The other two locations did not show consistent yield increases.

In 2007, each location had corn in the first rotation and soybeans in the second. Neither crop responded to the P and K treatments, even though the soybean crop produced yields as high as 66 bu/A. Drought reduced corn yields to a range of 122 to 159 bu/A. Changes in soil test levels are being monitored.

Continuing this experiment will be essential to provide answers to producers increasing the frequency of corn in their crop rotations in response to biofuel demand. *OH-16F*

Ontario

Yield Response of Intensively Managed Corn and Soybean to Potassium Fertilizer Rate and Placement

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Project Cooperators: John Lauzon and Greg Stewart

The goal of this project was to examine the variation in corn and soybean yield response to varied input intensity applied across a field landscape. The objectives were to identify parts of the landscape that are most responsive to increased input levels, and to determine the particular constraints to crop growth at these locations during various stages of crop development. Seven strips of high-input treatments... comparing normal and high rates of K across normal and deep placement, and normal and high inputs of N, P, and plant density...were applied in the fall of 2001 along the full length of a large field in preparation for corn and soybeans. The treatments were repeated in 2003 and 2004 under a corn-soybean rotation. Starting in the fall of 2004, tillage and fertility treatments were applied only to corn, with soybeans relying on residual fertility.

In 2007, a new corn hybrid (Northrup King N45-A6) produced a top yield of 200 bu/A. As in previous years, intensive management produced yields about 10% higher than those obtained with normal management. Intensively managed corn also had 5% greater crude protein concentration in the grain, and 18% greater N concentration in the stover. Stalk nitrate was higher in treatments receiving high rates of both N and K. In contrast to the 2006 season in which treatments did not differ, residual soil nitrate levels in 2007 were 57% higher following intensive compared to normal management. Soybeans yielded 6% higher following intensively managed corn.

The project has provided 6 years of valuable data documenting the potential economic and environmental viability of intensive crop management. The project at this site was terminated with the 2007 season, and resources are being directed to a new project on ecological intensification of corn cropping systems. *ON-24F*

Optimizing Application of Phosphorus and Potassium to Processing Tomatoes under Drip Irrigation

Project Leader: Dr. Tiequan Zhang, Research Scientist, Agriculture and Agri-Food Canada, Greenhouse and Processing Crops Research Center, Harrow, Ontario N0R 1G0. Telephone: 519-738-2251, 476. E-mail: zhang@agr.gc.ca

Recent research has indicated that processing tomatoes require higher rates of N when grown with fertigation. The objective of this research is to determine optimum rates of P and K for the higher yields obtained in this production system. Four rates of P, from 0 to 180 lb P_2O_5/A, were applied in a factorial combination with four rates of K from 0 to 640 lb K_2O/A, starting in the spring of 2006. Soil test levels were 45 to 50 ppm Olsen-P, considered high for tomatoes, and 140 to 180 ppm ammonium-acetate K.

Under fertigation, applying rates of 200 to 360 lb K_2O/A produced optimal marketable yields over 50 t/A. Without irrigation, yields were less than half as high, but high rates of K boosted marketable yield by up to 4 t/A. Soil profile nitrate was lower following fertigation, confirming the high nutrient use efficiency of this very productive system. Soluble solids as measured by Brix increased linearly with applied K. Neither P nor K were found to affect lycopene in either 2006 or 2007. This project is planned to continue in 2008. *ON-28*

Virginia

Effect of Nitrogen Source and Rate on Yield and Quality of Stockpiled Fescue

Project Leader: Dr. Mark Alley, Virginia Tech, Dept. of Crop, Soil & Environment Sciences, 416 Smyth Hall, Blacksburg, VA 24061. Telephone: 540-231-9777. E-mail: malley@vt.edu

Project Cooperators: Elizabeth Yarber and A.O. Abaye

Tall fescue is grown on more than 24 million (M) acres in the east-central and southeastern USA. It is the primary forage base for more than 9 million beef cows in this region. One of tall fescue's strongest and most under-utilized attributes is its ability to be stockpiled for winter grazing. This study was designed to determine the effect of N source and rate on the yield and nutritive value of stockpiled tall fescue. Sources compared included urea, ammonium nitrate, ammonium sulfate, urea with Agrotain®, controlled-release urea (ESN® and Nitamin®), poultry litter, processed poultry litter (Microstart 60®), and pelleted biosolids.

In the fall of 2006, yields and crude protein concentrations increased linearly in response to applied N. Sources did not differ in their effect on yield, but did differ in their effect on crude protein. The controlled-release source (ESN®) produced the highest crude protein levels at all three sites, significantly greater than urea in most cases and other sources occasionally. Pelleted biosolid, tested at only one location, did not increase crude protein as well as other sources, including urea with Agrotain®. Preliminary results from 2007 indicate that with much drier conditions during stockpiling, differences among sources are greater.

Results thus far show promise for use of N products designed for enhanced efficiency, but also demonstrate that their efficacy will be dependent on weather as well as soil and crop conditions. *VA-21F* ■

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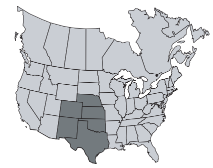
Research in the Southern and Central Great Plains Region



August 2008

CONTINUING investigation into new technologies and improved efficiency is vital to any and all industries. Accordingly, IPNI continues a tradition of supporting agronomic research for the future of our industry.

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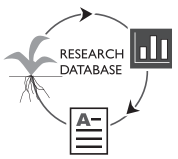

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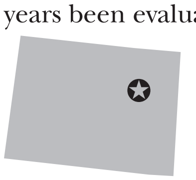
Colorado

Spatial Removal of Nutrients by Corn

Project Leader: Dr. Raj Khosla, Colorado State University, Department of Soil and Crop Sciences, CO4 Plant Sciences, Fort Collins, CO 80523-1170. Telephone: 970-471-1920. Fax: 970-471-2758. E-mail: rkhosla@lamar.colo.edu

Project Cooperators: Dwayne Westfall, Kim Fleming, and Tim Shaver

Research at Colorado State University has for several years been evaluating the impact of precision nutrient and pesticide strategies on environmental quality and production efficiency. Quantifying the N requirements of maize is an important component of this research. Previous work has shown that Normalized Difference Vegetation Index (NDVI) sensor technology is effective in determining in-field maize leaf N concentrations and spatial variability. This technology can also be used to predict maize grain yield early in the season, resulting in the potential for improved N management decisions. The main objective of this project is to use crop and soil variables in conjunction with NDVI to accurately predict the grain yield of irrigated maize.



Sensor NDVI readings were collected using two active hand-held remote sensors (NTech's Red GreenSeeker©, and Holland Scientific's Crop Circle©) at two northern Colorado field sites over maize growth stages V8, V10, V12, and V14. Ancillary crop and soil data was also collected including maize leaf N content, soil N content, plant height, and chlorophyll (SPAD) readings. Preliminary results indicate that at growth stages V8 and V10, leaf N and NDVI were highly correlated, and leaf N content was the most important variable in predicting grain yield. At the later growth stages (V12 and V14), NDVI, leaf N content, and plant height were comparable predictors of grain yield. However, using multiple variables rarely increased the correlation with grain yield at any of the growth stages evaluated. *CO-12F*

Kansas

Effect of Long-Term Nitrogen, Phosphorus, and Potassium Fertilization of Irrigated Corn and Grain Sorghum

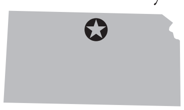
Project Leader: Dr. Alan Schlegel, Kansas State University, Southwest Kansas Research and Extension Center, Rt 1, Box 148, Tribune, KS 67879. Telephone: 316-376-4761. E-mail: schlegel@ksu.edu

This long-term western Kansas study was initiated in 1961 to evaluate responses of irrigated continuous corn and grain sorghum to N, P, and K fertilization. Furrow irrigation was used through 2000, and sprinkler irrigation since 2001. No yield benefit to corn from K fertilization was observed in the first 30 years and soil K levels remained high, thus the K treatment in the corn study was discontinued in 1992 and replaced with a higher P rate. Nitrogen treatments for corn and grain sorghum were 0, 40, 80, 120, 160, and 200 lb N/A. Phosphorus treatments for corn and grain sorghum were 0, 40, and 80 lb P_2O_5/A, and 0 and 40 lb P_2O_5/A, respectively. The K treatments for grain sorghum were 0 and 40 lb K_2O/A.

The 2007 results of this project continue to show that P and N fertilizer inputs are critical to the optimization of irrigated corn and grain sorghum production in western Kansas. Nitrogen alone increased corn yield by as much as 110 bu/A, while N and P applied together increased yield by up to 180 bu/A. Application of 120 lb N/A (with P) was sufficient to produce >90% of maximum yield in 2007, which was slightly less than the 10-year average. Phosphorus fertilizer increased yield by 80 bu/A at 120 lb N/A. Application of 80 instead of 40 lb P_2O_5/A increased yields 8 bu/A. Nitrogen fertilizer alone increased sorghum yield by as much as 70 bu/A, while N plus P increased yield by as much as 90 bu/A. Application of 40 lb N/A (with P) was sufficient to produce >85% of maximum yield, although yields continued to increase up to 120 lb N/A in 2007. Potassium fertilization has had no effect on sorghum yield over the course of the study. This is one of the few continuous, long-term crop nutrition studies in the U.S.A. Support will continue in 2008. *KS-23F*

Maximizing Irrigated Crop Yields in the Great Plains

Project Leader: Dr. W.B. (Barney) Gordon, Kansas State University, North Central Kansas Experiment Fields, 1300 60 Road, Courtland, KS 66939. Telephone: 785-335-2836. Fax: 785-335-2239. E-mail: bgordon@oznet.ksu.edu



Several years of irrigated field research in north central Kansas clearly demonstrated the importance of complete and balanced nutrition in the production of high-yield corn. However, fertilization of soybeans in a common corn/soybean rotation has traditionally been secondary to corn fertilization, as the crop is usually left to scavenge nutrients remaining after corn. This study was started in 2004 as an expansion of the original corn research to determine the benefit of direct fertilizer application to sprinkler-irrigated soybeans.

Treatments in this study were row spacing (30 in. and 7.5 in.), plant population (150,000 and 225,000 plants/A), and seven fertility treatments. The N, P, and K fertility treatments consisted of a low P application, low P-low K, low P-high K, high P-high K, NPK, and an unfertilized check. Phosphorus application rates were 30 (low) or 80 (high) lb P_2O_5/A, and K treatments were 80 (low) or 120 lb (high) K_2O/A. The NPK treatment consisted of 20-80-120 lb N-P_2O_5-K_2O/A. In 2005, manganese (Mn) at 5 lb Mn/A was applied along with the NPK treatment to evaluate the effect of Mn on glyphosate-ready soybeans. Initial (2004) soil test values were: pH 6.5; 23 ppm Bray-1 P (very high); and 236 ppm exchangeable K (very high). All fertilizer was broadcast in mid-March.

Soybean yield has not been affected by row spacing or plant population in any year of this study. However, fertilization has had a significant impact on soybean yield every year. In the first 2 years, the high P-low K treatment produced a maximum yield increase over the unfertilized check, with a 2 year average increase of 33 bu/A. Applying additional K or adding N did not increase yields over the high P-low K treatment. Adding Mn to the NPK treatment increased yield by 5 bu/A in 2005. However, in 2006 yield was maximized by the low P rate, with additional P, K, and Mn showing no advantage. The low P rate in 2006 increased yield by about 30 bu/A over the unfertilized control. In 2007, the low P and K rates increased yield over the control by 33 bu/A, from 49 to 82 bu/A. The maximum yield response in 2007 was with the complete N-P-K-Mn treatment where yield was 90 bu/A...41 bu higher than the zero fertilizer check. The addition of Mn resulted in a 5 bu/A yield increase and N fertilization provided no yield advantage in 2007. This work has demonstrated the importance of direct fertilization of soybeans in high-yield environments. It has continued for 4 years with relatively consistent results and will not be continued in 2008. *KS-33F*

Effect of Nitrogen and Phosphorus Starters on Yield, Yield Components, and Nutrient Uptake of Short-Season Corn Grown in Conservation Tillage Systems

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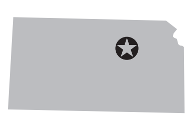
Project Cooperator: David Mengel

Corn acreage has been on the rise in southeastern Kansas in recent years because of the introduction of short-season hybrids. These hybrids reach reproductive stages earlier than full-season hybrids and thus enable avoidance of mid-summer droughts that are often severe on the upland, claypan soils of the region. However, soil fertility and other management options have not been well defined for short-season corn production in southeastern Kansas. The objective of this project is to determine the effect of N and P rates applied as starter fertilizers on yield, yield components, and nutrient uptake of short-season, rain-fed corn planted with reduced or no tillage. Starter N rates were 20, 40, and 60 lb/A, and P rates were 0, 25, and 50 lb P_2O_5/A. Total N and P rates in all cases (except the control) were balanced to 120 lb N and 50 lb P_5O_5 in order to isolate starter effects.

Yields in the first year of this project (2006) were low due to dry conditions. In contrast, the spring of 2007 was unusually wet, with rainfall frequent enough to interfere with timely planting. By the time conditions at the study site were dry enough to allow planting, the optimal window had passed. So the decision was made not to plant. Therefore, there are no results to present from this study for the 2007 season. The study will resume in 2008. *KS-35F*

Manganese Response of Conventional and Glyphosate-Resistant Soybean

Project Leader: Dr. Nathan Nelson, Kansas State University, Agonomy, 2708 Throckmorton Plant Sciences Center, Manhattan, KS 66506-5501. Telephone: (785) 532-5115. Fax: (785) 532-6094. E-mail: nonelson@ksu.edu



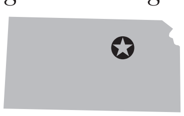
Weed control benefits of glyphosate resistant (GR) soybeans have resulted in nearly complete adoption of GR soybean varieties by U.S. producers, despite an apparent yield decrease that accompanies this decision. Although the reasons for the yield decrease are not known, there is some evidence that GR soybeans have reduced manganese (Mn) uptake compared to conventional soybeans. Therefore, Mn additions may help overcome the apparent yield disadvantage of GR soybeans. The objectives of this study are to: i) evaluate nutrient uptake, distribution, and biomass accumulation in a GR soybean cultivar compared to a non-GR sister line, and ii) determine the response of a GR and non-GR soybean cultivar to soil and foliar Mn applications. Field plots were established at five locations (Scandia, Manhattan, Ashland Bottoms, Rossville, and Ottawa) in North Central and Eastern Kansas in 2006 and 2007 to compare conventional and GR soybean response to three rates of soil applied and two rates of foliar Mn. Response variables include yield, biomass, plant height, Mn uptake, and leaf, and grain Mn concentrations.

Application of Mn increased GR soybean yields between 6 and 14 bu/A at the Scandia site, but results were inconsistent at the other sites. Conventional soybeans were not responsive to Mn at any of the locations in 2006, but were responsive at the Scandia site in 2007. Over all, soybean yields were greater at the Scandia location compared to the other locations for both years, suggesting that the yield increase from Mn application to GR soybeans may only occur in high yielding environments (>60 bu/A). Trends indicated a yield response to both soil-applied and foliar-applied Mn, but the results were inconsistent across locations. Preliminary plant analyses show that there was no significant difference in Mn uptake between the GR and non-GR varieties. There were some differences in nutrient partitioning, where the non-GR soybeans had more K remaining in the leaves at R6 growth stage. Further analysis of 2007 data will be conducted to confirm these observations. *KS-36F*

Nitrous Oxide Emissions from Bermudagrass Turf Fertilized with Slow Release and Soluble N Sources

Project Leader: Dale Bremer, Kansas State University, Department of Horticulture, Forestry & Recreation Resources, 2021 Throckmorton, Manhattan, KS 66506. Telephone: 785-532-1429. E-mail: bremer@ksu.edu

Project Cooperators: Jack Fry and Jason Lewis



The majority of nitrous oxide (N_2O), an important greenhouse gas (GHG), emissions in the USA are from agriculture. Most of these emissions come from the soil and are linked to soil management and nutrient use. Although most attention given to this issue has been focused on production agriculture, an important component that is often overlooked is the contributions from turfgrass areas. One estimate indicates that there are about 40 to 50 million acres of urbanized land covered with turfgrasses (e.g., golf courses, lawns, parks, sport fields). Because turfgrasses often receive fertilizer N, these urban areas have the potential for significant contribution to overall N_2O emissions. One best management practice that may help achieve the goal of reduced GHG emissions from turf is the use of controlled release N fertilizers. The objective of this work is to quantify N_2O emissions from bermudagrass turf fertilized with a conventional soluble N fertilizer (urea), a slow-release polymer coated N fertilizer, and an organic (manure) source of N.

Emissions of N_2O increased after application of each of the N fertilizer sources in 2007. Emissions from urea were sometimes higher than either of the controlled-release sources. In general, N_2O emissions among treatments returned to pre-fertilization levels after 7 to 10 days. Cumulative emissions of N_2O during the first year were not statistically different among N sources. Emissions tended to increase after irrigation or precipitation. The relationship between soil temperature and N_2O emissions was weaker than between soil moisture and emissions, although emissions were lower during winter when soils were colder. There were no significant correlations between N_2O emissions and soil ammonium and nitrate levels.

Strict interpretation of the data indicates that fertilizer source did not affect overall N_2O emissions from turfgrass. However, variability is high in this type of data collection, which complicates statistical detection of differences among treatments. The study will be repeated in 2008. *KS-37F*

Nebraska

Ecological Intensification of Irrigated Corn and Soybean Cropping Systems

Project Leader: Dr. Achim Dobermann, University of Nebraska, Department of Agronomy and Horticulture, 279 Plant Science, PO Box 830915, Lincoln, NE 68583-0915. Telephone: 402-472-1501. Fax: 402-472-7904. [Note: Dr. Dobermann is now with the International Rice Research Institute (IRRI).]
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Project Cooperators: K.G. Cassman, T.J. Arkebauer, R.M. Caldwell, R.A. Drijber, J.L. Lindquist, J.P. Markwell, L.A. Nelson, W.L. Powers, W.K. Russell, J.E. Specht, M. Soundararajan, and D.T. Walters

An interdisciplinary research program on ecological intensification of irrigated maize-based cropping systems was established in 1999 at the University of Nebraska to (i) improve understanding of the yield potential of corn and soybean and how it is affected by climate and management, (ii) develop approaches for managing continuous corn and corn-soybean systems at 80 to 95% of the yield potential, (iii) conduct integrated assessment of productivity, profitability, input use efficiency, energy balance, and environmental consequences of intensified cropping, and (iv) develop a scientific basis and decision support tools for extrapolation to other locations.

The work in this reporting period was aimed at modeling nutrient uptake and removal requirements of maize and designing a framework for estimating N fertilizer requirements in maize grown with best management practices (BMPs). A database of maize nutrient uptake was assembled using field studies conducted in Nebraska and in Southeast Asia. Different modeling approaches were used to estimate balanced N, P, and K uptake requirements for specific yield targets in specific climates. The same approach was also used to develop generic models for estimating grain nutrient removal. The framework for estimating N fertilizer requirements for maize was designed to be flexible in terms of user input availability so as to provide maximum utility. Key parameters were identified, including agronomic efficiency, recovery efficiency, yield without fertilizer, and expected yield response from added fertilizer. Readily available variables that are potentially linked, either directly or indirectly, to these key parameters were identified and will be evaluated. This project is part of a greater effort to develop a global maize nutrient decision support system. *NE-11F*

Texas

Using Supplemental Foliar Potassium Fertilization to Improve the Nutritional Quality and Stress Tolerance of Muskmelon

Project Leader: Dr. John L. Jifon, Texas A&M University, Texas Agricultural Experiment Station, 2415 E Hwy 83, Weslaco, TX 78596. Telephone: (956)968-5585. Fax: (956)969-5620. E-mail: jljifon@agprg.tamu.edu

Project Cooperator: Gene Lester

Cantaloupe (muskmelon) fruit quality attributes such as sugar content, aroma, and texture are directly related to K-mediated processes. However, during fruit growth and maturation, soil K supply alone may be inadequate to satisfy K requirements. A previous south Texas glasshouse study has demonstrated that supplemental foliar K applications can overcome this apparent deficiency. However, the suitability of K sources for foliar application was not investigated.

This study has evaluated the effects of six foliar K sources [potassium chloride (KCl), potassium nitrate (KNO_3), monopotassium phosphate (MKP), potassium sulfate (K_2SO_4), potassium thiosulfate (KTS), and potassium metalosate (KM)] on fruit quality parameters of field-grown muskmelon 'Cruiser'. Experiments were conducted in 2006 and 2007 at Weslaco, Texas. Weekly foliar K applications were established starting at fruit set and continued to fruit maturity. Although soil K levels were very high, supplemental foliar K treatments resulted in generally higher K concentrations in plant tissues, suggesting that K uptake from the soil solution was not sufficient to optimize tissue K accumulation. Fruit from plots receiving supplemental foliar K had higher external and internal fruit firmness, and higher soluble solids concentrations (SSC) than the zero K control fruit. All the foliar K sources studied had positive effects on fruit quality parameters except for KNO_3, which tended to result in less firm fruit with lower SSC values. Fruit yields in 2006 were not affected by supplemental foliar K spray, but in 2007 yields differed significantly among the foliar K sources with treated plots generally having higher yields than the control plots.

These results demonstrate that the apparent K deficiency caused by inadequate uptake can be alleviated by supplemental foliar K applications and that the effectiveness of foliar K fertilization depends not only on source of fertilizer K, but also on environmental conditions affecting plant growth and development. The results are consistent with previous controlled environment findings that supplementing soil K supply with foliar K applications during fruit development and maturation can improve muskmelon fruit quality by increasing SSC, firmness, and sugar contents. *TX-52F*

Evaluation of Potassium Magnesium Sulfate and Potassium Magnesium Sulfate + Phosphorus Compared to Potassium Chloride for Production of Tifton 85 Bermudagrass on Coastal Plain Soils

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Coastal bermudagrass has been the standard against which other hybrid forage bermudagrasses are evaluated. However, Tifton 85, a recently-introduced hybrid bermudagrass, has better nutritive value, is more digestible, and has greater yield potential than does Coastal. Data on response of Tifton 85 bermudagrass to applied plant nutrients is limited. Scientists at Texas A&M at Overton (east Texas) are addressing this need. A 6-year study was completed in 2006 where responses to N, K, S, and chloride (Cl^-) were evaluated. The current study was adapted from the 2006 effort. The objectives of this work are to determine the effects of N, K, and magnesium (Mg) rates, and K source...i.e., potassium magnesium sulfate or K-Mag® ($K_2SO_4 \cdot 2MgSO_4$), potassium chloride (KCl), and a specialty fertilizer called ACT 62D (6-26-8-14S-7Mg-1Zn) on Tifton 85 bermudagrass production, nutrient uptake, and changes in extractable nutrient content in a Darco loamy fine sand.

Five harvests were made in 2007, a year with above normal rainfall. The 120 lb N/A rate applied for each harvest did not significantly increase bermudagrass dry matter (DM) yield compared to the 60 lb N/A rate. Increasing the K rate to 134 lb K_2O/A significantly increased yield in the first harvest. In the second and fifth harvests, DM production was significantly increased by 268 lb K_2O/A. In the third and fourth harvests made following above-normal rainfall in July and August, DM yield was optimized at the 402 lb K_2O/A treatment. There was no statistical advantage to applying more than 268 lb K_2O/A for total 2007 production. Source comparisons indicate that dry matter yield was significantly increased by application of Potassium magnesium sulfate+KCl in the second harvest, indicating a response to S or Mg, and by ACT 62D+KCl in the third harvest. Total yield in 2007 was significantly greater with ACT 62D+KCl than any other K source. Statistically significant interactions of N and K on DM yield occurred in all except the second harvest, and this interaction was significant in total DM yield as well. This was the first year of this study. It is scheduled to continue in 2008. *TX-53F* ■

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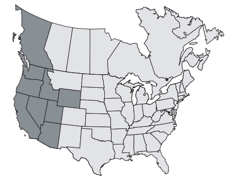

August 2008

Taking Statistics to the Field

THE VERY IDEA of statistics seems to frighten many people. While the math can sometimes be intimidating, the general concepts of statistics are used in everyday decisions. For example, will I need my umbrella today? When do I need to fill up my gas tank? Who will win the big game? Or, will my crop respond to additions of fertilizer? Understanding a few basic concepts will help you make decisions and get the most from your nutrient additions.

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Mean and Median

Most everyone is familiar with the concept of the mean value, generally called the average. This is useful if the measurements are "normally distributed", meaning that half of the observations are greater than the average and half are less than the average. For example, if you have an "average" yield, then half of your fellow growers had a greater yield than you and half had a smaller yield than you.

Sometimes measurements and observations are not uniformly distributed. When this occurs, it is helpful to take a median measurement. For example, suppose the incomes of 11 people were averaged together. If 10 of the people were agronomists and one was a billionaire, their average income would make it appear as if they were all millionaires. However, using the median value, the salaries would be ranked in order from low to high and the middle salary (agronomist number 6) selected as the median—a much more representative number!

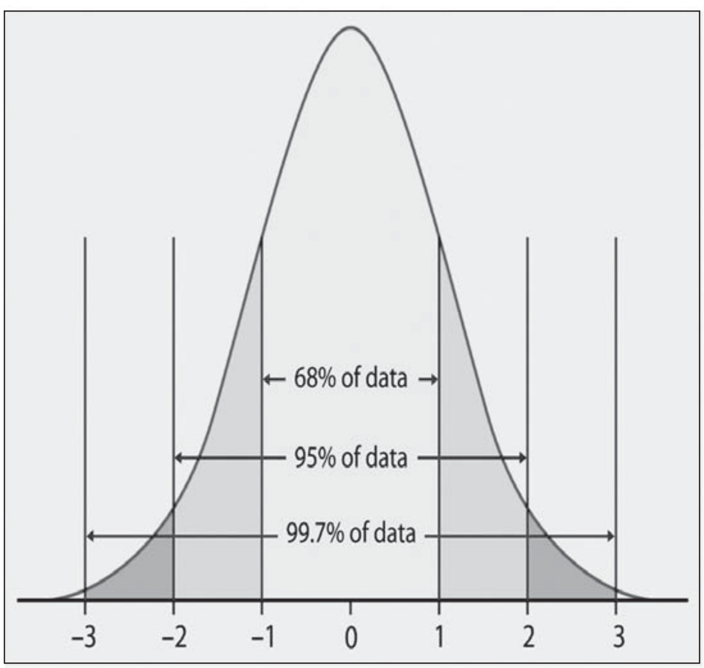

Figure 1. The distribution of samples around the mean of zero. One standard deviation greater or less than the mean accounts for 68% of the samples, two standard deviations around the mean account for 95% of the samples, while three standard deviations account for 99.7% of the data.

Standard Deviation and Variation

The standard deviation is a calculation that tells you how close all the measurements are to the overall mean. When the measurements are close together, the standard deviation is small. When the measurements are widely spread around the same mean, then the standard deviation is large. Calculating the standard deviation is not complicated with the help of a computer, but not simple to do with a pencil alone.

By graphing it out, the concept of standard deviation is not difficult to understand. One standard deviation in either direction from the mean accounts for 68% of the measurements. Two standard deviations from the mean account for about 95% of the observations, while three standard deviations represent about 99% of the measurements (**Figure 1**).

Since the standard deviation of two different groups of measurements (for example, comparing seeds per pod with apples per tree) cannot be directly compared, dividing the standard deviation by the mean value puts the variation on the same footing. This provides a measure called the coefficient of variation (CV), often expressed as a percentage by multiplying the CV by 100. A high CV indicates large variability in the measured data.

Abbreviations and notes: P = phosphorus; K = potassium; ppm = parts per million.

Applying Statistics to Soil and Tissue Analysis

• Soil

Every agronomist knows that there is usually considerable variability in the nutrient content of soils and crops within a field. For example, a study in Oklahoma measured soil P concentrations in 10 ft. increments across a 500 ft. line (**Figure 2**). The mean value of the 50 samples was 47 ppm P, with a standard deviation of 14 (and a CV of 30%).

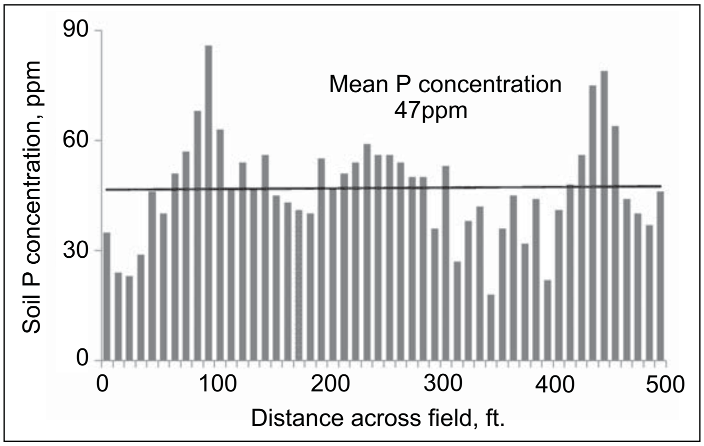

Figure 2. Soil P concentration in 50 soil samples taken across a field near Stillwater, Oklahoma (extracted with Mehlich-3 solution)[1].

While knowing that the mean P concentration across the field was 47 ppm, the other statistics are useful too. For example, the mean alone does not reflect that 21 locations across the field were over the average of 47 ppm or the 25 locations were under the average.

Suppose that the grower in this example was trying to achieve a soil P concentration of 47 ppm in the field. On average, the field has already reached that point, but over half of the sites are actually below this value.

Let's see what would happen if the grower wanted to make sure that 99% of the locations in the field were above the critical value of 47 (or three standard deviations). Using the average of 47 ppm plus 42 (3 x standard deviation of 14) equals 89 ppm of soil P. Remember that achieving this soil concentration may not be economically, agronomically, or environmentally desirable, but it will keep 99% of the soil sampling locations above the critical value.

• Tissue

Leaves from a California almond orchard were sampled across the field in 50 tree rows and analyzed for nutrients (**Figure 3**). The average of the leaf samples was 2.05% K, with a standard deviation of 0.27. The grower far exceeded the University of California–Davis recommendation of 1.4% K in this orchard, but has done it with careful reasoning. In this orchard, all but one row of trees now meets or exceeds the 1.4% K recommendation. If the grower had fertilized to a field average of 1.4% leaf K, half of the trees would fall below this recommendation and nut production would likely be limited. Instead, the grower has increased the average leaf K to over 2% to make sure that very few trees contain less than the recommended concentration and potentially suffer yield losses.

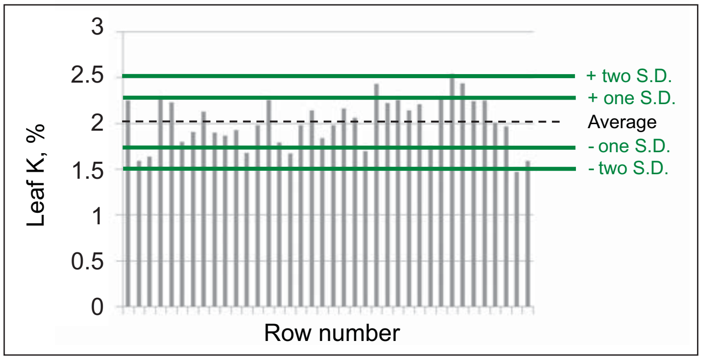

Figure 3. Leaf K concentrations from 50 rows of almonds in Yuba County, California. The average K concentration and the two standard deviations are shown. Data source: F. Niederholzer, Univ. of Calif. Cooperative Extension

The decision to exceed the "average" tissue concentrations in favor of boosting all of the trees above the critical limit will depend on several factors. Certainly the economic return from the additional yield from the fertilizer investment needs to be carefully considered. Nutrients such as K have no adverse environmental impact from heavy application rates. However, the environmental considerations from additional N application will demand additional management to avoid undesirable losses.

When multiple soil or plant tissue samples are combined before sending them to the lab, it is not possible to get additional statistics beyond the mean. However, laboratory analytical expenses are lessened when multiple samples are combined in order to pay for fewer analyses. The decision to combine multiple samples or to analyze more individual samples depends on the objectives.

Statistics may seem to be an unnecessary bother on the farm, but these two examples illustrate how keeping careful track of soil and tissue analysis can aid in making meaningful management decisions. Use all of the tools available to intensify yields to their highest sustainable level. Consider the variability in your fields that may be holding back the "average" yields and how the great advancements in precise use of fertilizers can help you move to the next level by applying just what your crop needs. ■

[1]Source: http://soil4213.okstate.edu/2006/PrecisionManagement_2006.ppt

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