MISSISSIPPI SOYBEAN PROMOTION BOARD
PROJECT NO. 22-2015 (YEAR 4)
2015 Annual Report

Title: Soil P/K Correlations with Plant Tissue/Yield

PI: Bobby R. Golden (bgolden@drec.msstate.edu)

BACKGROUND AND OBJECTIVES

The adoption of grid soil sampling by producers in the Mississippi delta has increased. In general, producers who employ grid sampling on their farms do so through consultant services, which utilize private laboratories in the area for soil analysis.

Private laboratories and numerous surrounding states utilize the Mehlich-3 soil test extractant. Currently, Mississippi utilizes the Lancaster extractant to determine soil nutrient availability. Producers and consultants have expressed concerns over different soil test based fertilizer recommendations between Lancaster and Mehlich-3 extracted samples. Little to no data are available that correlates Mehlich-3 extractable nutrients to soybean yield in Mississippi. Also, it is unclear when Lancaster soil test phosphorus (P) or potassium (K) was correlated with soybean yield in Mississippi (Lancaster 1980), or when fertilizer recommendations were last updated since Lancaster's attempts. Most of the author's work utilized cotton to set soil test ranges and fertilization recommendations.

Field trials were conducted at numerous locations within the state of Mississippi, both on research stations and on producer fields, to evaluate soybean response to potash and phosphorus fertilization. Attempts will be made to identify sites that have a range of soil test P and K values (i.e. low to high) prior to crop establishment. Each experiment will be arranged as a randomized complete block design with no less than 6 replications of each P or K rate, plus an unfertilized control.

Plant tissue will be collected at the R1 to R2 stage of soybean growth and development from one of the top three nodes with fully expanded leaves from no less than 20 plants within each plot, followed by analysis for elemental concentration. Soybean yield will be harvested with a small plot combine at maturity and reported at a standard moisture content of 13.0%.

To determine if sites are responsive to potash fertilization, single degree of freedom contrasts will be used to compare the mean yield of soybean receiving any rate of K fertilization against the mean yield of the untreated control. Each site year will be analyzed independently.

Following identification of yield responsiveness, soybean yield data will be transformed into a relative yield. Relative soybean yield and tissue concentrations will be subjected to both Proc REG and Proc NLIN to attempt to identify a soil test critical value for both the Lancaster and Mehlich-3 soil test extractants, using a multiple model approach to determine best fits.

The overall objectives of the project are listed below.

1. Evaluate soybean yield response to K fertilization rate
2. Evaluate soybean yield response to P fertilization rate

3. Correlate Lancaster and Mehlich-3 soil test P and K with Plant indices (tissue concentration and relative soybean yield)

REPORT OF PROGRESS/ACTIVITY

2012

Activities initiated to fulfill objective one during 2012 included field trial testing at six locations within the Mississippi Delta region. Individual trials were placed in Bolivar, Humphreys, and Washington Counties with two trials occurring at the DREC and the remainder in production fields. Of the six harvested trials only two positive responses to potash fertilization was observed (Fig 1.). At the Bolivar Co. responsive site, soybean yield increased with increasing potash rate (p-value = 0.0178). For soybeans cultivated at the Bolivar Co. site approximately 120 lbs K_2O were needed to maximize soybean yield (Fig 1.). Similarly, at the Humphrey's Co. site, soybean yield also increased positively with increasing potash rates (p-value = 0.0654). Soybean yield at the Humphrey's site was lowest (60.58 bu/acre) with No Potash application, and greatest (70.45 bu/acre) when 160 lbs K_2O/acre was applied. In general, soybean yield increase from potash application at the responsive sites ranged from 7-10 bushel greater when potash was applied compared to the untreated control plots.

Soybean tissue K concentration from trifoliate leaves collected at the R2 stage of growth and development followed a similar trend as the soybean yield data. Tissue K concentration was only positively influenced by potash fertilization on the sites were yield responses to potash were observed. At the Bolivar Co. site tissue K concentration increased by approximately 0.3 percent when potash fertilizer was applied compared to untreated plots (Fig 2). Similar to soybean yield, soybean tissue K concentration increased with increasing K_2O application rates (p-value0.0146). Soybean Tissue K at R2 at the Humphrey's Co. site also increased with increasing K rate (p-value 0.0649; Fig 2.). Overall soybean tissue K concentrations were greater at the Humphery's Co. site than at the Bolivar Co. Site. Large gains in overall tissue concentration where not observed, but where significant.

It is important to note that neither responsive site showed widespread visual potash deficiency symptomology. The lack of visual symptoms is important in interpreting aiding in interpreting figure 3 and the tissue concentration data. I feel that at the two responsive sites soil test K was not extremely low and would perhaps fall at or close to the critical level for which a potash recommendation may be made. These 2012 data gave a good start to revising soybean fertilization recommendations for potash in Mississippi. These preliminary data although limited, suggest that soybean yield increases may not be observed at soil test K levels above 150 ppm.

For objective two, there is little to report as no response to phosphorus fertilization or fertilization level was observed during the 2012 testing season. Soil test P in all the testing locations were greater than current established values where a response would have been observed.

2013

Activities to fulfill objective one during 2013 included field trial testing at five locations within the Mississippi Delta region. Individual trials were placed in Carroll, Coahoma, Humphreys, Leflore, and Washington Counties. One trial was placed at the DREC while all remaining trials were placed in production fields. The trial in Humphreys Co. was lost due to the producers harvesting through the plot area. In 2013, there is little to report as no trials were statistically responsive to potash fertilization. Across locations yields differed dramatically, with soybean yield from the untreated control ranging from 54 bu/ac (Carroll Co; Double crop beans) to 93 bu/ac (Leflore Co; ESPS Beans). Soybean yield response to potash fertilization trials at all harvestable locations in 2013 is presented in figure 3. Soybean tissue K concentration was similar across research locations and within a research location across potash fertilization rates (Fig 4). This result was expected due to the lack of yield response associated with potash fertilization rate in 2013.

For, Objective two, we conducted phosphorus response trials at the same locations in 2013 at the potash response trials. Dissimilar, to 2012, we observed responses to phosphorus fertilization rate at three of the four testing locations. At the DREC, soybean yield increase from phosphorus fertilization occurred at only the greatest (150 lb P_2O_5/ac) rate of fertilization (p-value = 0.0395). Soybean yield was 96.1 bu/ac compared to the untreated control yield of 84.5 bu/ac. At the Coahoma Co location we observed our greatest response to P fertilization to date (p-value=0.0268). Soybean yield increased with increasing P_2O_5 rate across the range of application rates. Mean soybean yield from the untreated control (62.2 bu/ac) was approximately 22% less than yield from 150 lb P_2O_5/ac (79.4 bu/ac). At the Leflore Co, site single degree of freedom contrast suggested that 60 lb P_2O_5/ac (92 bu/ac) produced greater soybean yield than the untreated control (88 bu/ac), however all other application rates produced similar yield to the untreated control. Soybean yields for all P correlation calibration trials conducted in 2013 are presented in figure 5. Soybean tissue response to phosphorus fertilization is shown in Fig 6. In general, soybean tissue P concentration was not influenced by P fertilization rate, although yield differences were observed. This preliminary data may suggest that tissue sampling at R2 may not be the appropriate time to sample. Tissue sampling for P may need to be conducted earlier in the season. At R2, all tissue concentrations from each application rate, for each location were above the sufficiency level required by soybean to maximize yield.

<u>2014</u>

Unfortunately we lost one off station location due to trials being harvested through by the combine driver. In 2014, all trials for objective did not statistically respond to K_2O fertilizer application. Soil test K at the three harvestable full season trials ranged from 183 to 230 mg k/kg. Based on historical research and the current model with this data set, each of the sites would have been anticipated to not respond positively. At the Offstation Washington Co. site (Clay loam soil) relative yield from the untreated control was 99.56% with actual yield ranging from 56 to 59 bu/ac depending upon fertilization level. At the DREC site (VFSL soil) soybean yield ranged from 85 to 91 bu/ac. Interestingly, at the DREC site yields tended to trend downward with increasing fertilization level, whereas the greatest yield was achieved with 0 lb K_2O acre and the lowest yield observed when 200 lb K_2O was applied. A second clayey textured site in Washington Co also did not respond to potash fertilization in 2014. Mean soybean yield at this site ranged from 63 to 68 bu/ac. Soybean yield at the second Washington Co site trended upward with increasing K_2O fertilization rate numerically. Soybean yield responses for K_2O testing sites in 2014 are presented in figure 7.

Similar to the Potash sites, the sites where phosphorus testing in 2014 was conducted also failed to respond to fertilization. At the DREC site yields were relatively flat across P_2O_5 application rate and ranged from 91 (0 lb P_2O_5) to 93 bu/ac. soil test phosphorus at the DREC site was 37 ppm by Mehlich-3, and 51 ppm by Lancaster method. Most models observing yield response to P using Mehlich-3 have a join point of 30 ppm. Therefore this slight was close to historical models where a medium soil test range would generate a recommendation. At Washington Co. Site 1, yield was non responsive to P_2O_5 application rate. This result was expected as soil test P was 55 or 60 mg/kg, with both values residing well above the range we generally expect to respond to fertilization. Yield at the Washington Co 1 site ranged from 56 to 59 bu/ac with no clear trend associated with increasing or decreasing soil test P level. At the final location that was harvestable, the Washington Co 2 site, we also failed to observe a response to P fertilization in 2014. Soil test P at the #2 site would have suggested that a response to fertilization would be expected based on current and historical models. Soil test P by the Lancaster method (27 mg/kg) would have resulted in the soil being placed in the low category, and the very low category if using the Mehlich-3 method (12 mg/kg). This observation alone in 2014 underscores the fact that new models are needed and that non responsive sites are just as valuable as responsive sites when generating new and/or updated soil test correlation/calibration curves.

2015

During 2015, research was established on numerous sites. We concluded the season with four harvestable sites for objective 1 and three harvestable sites for objective 2. In 2015 we encountered responsiveness at multiple sites for objective 1 that evaluates soybean response to K fertilization rate (Fig 13). Soil test K at the four harvestable locations ranged from 52 to 310 mg/kg Lancaster K and 48 to 253 mg/kg Mehlich 3 K. At the DREC location on a very fine sandy loam no response to K fertilization rate was detected for either grain yield (p=0.9426) or tissue K concentration (p=0.2885). Soil test K at this site was generally in the range we not expect to see a response to fertilization. Average across potash grain yields at the DREC sandy loam site were 74 bu/ac while tissue K concentration was 2.65 % K. At the Clay soil site in Washington Co. soil test levels were greatest and no response to either grain yield (p=0.6520) or tissue K concentration (p=0.2462) was observed. Mean grain yield averaged across K application rates was 58 bu/ac while tissue K concentration average 2.2% K. At two sites one in bolivar Co. and one in Washington Co responses to potash were observed. At each of the response locations soil testing indicated a need for potash. At the Shaw site grain yields increased linearly as potash rate increased up to 160 K_2O/ac (p= 0.0048). The untreated control produced 37 bu/ac, while the maximal yields produced in the trial were achieved with 200 lb K_2O/ac (52 bu/ac). The greatest increase in yield (49 bu/ac) occurred when 80 lbs K_2O was applied which produced statistically similar yields to 200 lb K_2O/ac. At the Bolivar Co. site soybean yields increased as potash rate increased up to 120 lb K_2O/ac that was not different than 200 lb K_2O/ac (p=0.0001). The untreated check produced 47 bu/ac while the maximal yield of 56 bu/ac was produced with 120 lb K_2O/ac

Phosphorus testing in 2015 occurred at three sites (Fig. 14). At DREC-1. No response to P fertilizer was expected due to the soil test phosphorus levels within the field. Soil test P for testing sites during 2015 ranged from 45 to 82 mg/kg Lancaster P and 17 to 78 mg/ kg Mehlich-3 P. Average soybean yields across all P_2O_5 rates was 79.5 bu/ac. Tissue P concentrations at R1 slightly differed (p=0.0568) with the greatest two P_2O_5 rates producing significantly more P in tissue than rates less than 120 lb P_2O_5/ac. At the Clay soil site in Washington Co. grain yields were positively influenced by the addition of P_2O_5 fertilization (p=0.0406). At Washington Co. the first application rate (30 lb P_2O_5/ac) produced the greatest soybean yield (74 bu/ac) while the untreated produced the lowest (70 bu/ac). All other application rates up to 150 lb P_2O_5/ac produced similar yield as 30 lb P_2O_5/ac. Although a yield response was detected at the Washington Co. site, no response in Tissue P concentration at R1 was observed (p=0.9165). No response to P fertilization was observed at the Bolivar Co. site with a mean soybean yield averaged across all P_2O_5 rates of 46.4 bu/ac. Tissue P concentration at Bolivar Co. was also unaffected by P_2O_5 fertilization.

Overall Goal - Objective 3

2013

Objective 3 results are ongoing. Figure 7 and 8 represents correlation between Mehlich-3 and Lancaster soil test correlations for K and P, respectively. The Correlation is in the preliminary stages and the second year added much needed data for the P curve. We currently have data on 14 sites for K and 11 sites for P, as stated in the protocol to achieve a scientifically adequate correlation at least 35 to 40 site years are needed. Therefore these data for figures 9 and 10 are preliminary and will look vastly different at the termination of the project once all data is collected. Once a critical mass of data is collected for regression analysis to be conducted, interpretation of a critical level and standardized equations will be generated to correlate soybean tissue concentration and yield to soil test P and K levels.

2014

After three years of data we have amassed enough samples to attempt to generate a correlation between the Lancaster and mehlich-3 soil test values. The results of the initial correlation are presented in figures 11 and 12 for K and P respectively. Initial attempts at correlation between the two extraction methods suggest that each soil test can accurately predict the other when K is the nutrient of choice. However when evaluating Lancaster P and Mehlich-3 P correlations there appears to be some slight discrepancies (i.e. no one to one relationship). In the future additional variable will be added to determine external factors that solve the point where Lancaster and mehlich-3 P deviate. We are still in the infancy of this project in relation to observing a critical soil test level for Yield response to soil test K or P regardless of extraction procedure. However, for K it appears that we are getting close to defining a critical level around 150 ppm.

2015

After four years of data the trend between Lancaster and mehlich-3 soil test values is becoming clearer. The results of soil sample correlations are presented in figures 11 and 12 for K and P respectively to date from all replicate samples. Correlation between the two extraction methods suggest that each soil test can accurately predict the other when K is the nutrient of choice with a very strong relationship (R^2 0.99; P=<0.0001). However when evaluating Lancaster P and Mehlich-3 P correlations there appears to be a little more wobble with Lancaster P generally extracting more P than Mehlich-3, and the relationship widens as concentrations in the soil increase. We are closer to identifying a soil test critical level for K and P but data added to the model in 2015 supports the initial observations in 2014. More data is needed to clearly define a critical level for both P and K.

IMPACTS AND BENEFITS TO MISSISSIPPI SOYBEAN PRODUCERS

This research will directly influence the Mississippi soybean industry by providing a set of Mississippi soil test recommendations that could be applied to soil test data from laboratories that utilize Mehlich-3 as an extractant. The research will also be valuable in updating current recommendations for soybean recommendations based on the Lancaster extraction method currently utilized by Mississippi State University's Soil Test Laboratory.

The research will also provide data based on newer high yielding cultivars, The ESPS, and new and evolving production practices. USDA-NASS estimates that approximately 17 and 19% of soybean acres in Mississippi receive P and K fertilization annually. These data would immediately affect those producers who annually apply P and K, and perhaps bring heightened awareness to those who do not or provide economic balance for those producers who over-apply nutrients. If successfully correlated the data could provide a university based prescription equation for variable rate nutrient application based on grid sampling.

END PRODUCTS–COMPLETED OR FORTHCOMING

Publications: (6)

<u>2015</u>

MBJ 2015. States "Big 4" row crops post record yields in 2014. Mississippi Business Journal (May 29,2015)

Floyd, A. 2015. Experts give tips to prevent yield loss in soybeans. Growing Georgia. [On-Line] Available at: http://growinggeorgia.com/features/2015/02/experts-give-tips-prevent-yield-loss-soybeans/

Soybeans 2016 Planning Budgets. 2015. Mississippi State University Extension Service Publication P-2921.

Golden, B.R. 2015. Fertilizing soybean in Mississippi. Mississippi soybean promotion board fact sheet. Osborn-Barr, St. Louis, Mo.

Mississippi soybean, 2015. Soil Sampling – the first step toward a profitable growing season. Mississippi soybean promotion board fact sheet. Osborn-Barr, St. Louis, Mo.

Mississippi soybean, 2015. Mississippi soybean production best management practices guide. Mississippi soybean promotion board production guide. Osborn-Barr, St. Louis, Mo.

Catchot, A., D. M. Dodds, J. Gore, B. R. Golden, J. A. Bond, T. Irby, D. Cook, and T. W. Allen. 2015. Reminder: Scout schools start next week. [Online] Available at http://www.mississippi-crops.com/2015/05/23/reminder-scout-schools-start-next-week/
Catchot, A., D. M. Dodds, T. Irby, J. A. Bond, T. W. Allen, B. R. Golden, J. Gore, and D. Cook. 2015. 2015 scout schools set for Mississippi. [Online] Available at http://www.mississippi-crops.com/2015/04/08/2015-scout-schools-set-for-mississippi/

2014

Golden, B.R. 2014. Diagnosing nutrient deficiencies in Mississippi soybeans. [Online]. Available at: http://www.mississippi-crops.com/2014/06/14/diagnosing-nutrient-deficiencies-in-mississippi-soybeans/

Irby, J.T., and B.R. Golden. 2014. Soybean crop update and replant decisions. [Online]. Available at: http://www.mississippi-crops.com/2014/06/13/soybean-crop-update-and-replant-decisions/

Print Article United Soybean Board. 2014. Using Post Harvest Soil sampling as part of your soybean nutrient management program. [On-Line] Available at http://unitedsoybean.org/article/using-post-harvest-soil-sampling-as-part-of-your-soybean-nutrient-management-program/

Print Article MBJ. 2014. MSU scientists evaluating soil-testing recommendations. Mississippi Business Journal. Sept 25, 2014.

Presentations at Conferences: (33)

2012

Technical Presentation; Mississippi Agricultural Consultants Association. Soil Fertility for cotton and soybean. Starkville, MS (February 14-15)

Technical Presentation; Pioneer Consultants Conference. Soil Fertility for corn and soybean in the Midsouth. Tunica, MS (February 23-24, 2012)

Technical Presentation; Mississippi Agricultural Consultants Association. Fall Soil Fertility Update. Cleveland, MS (September 13, 2012)

Production Meeting Presentation; Mississippi ASA, Optimizing soybean and corn rotations with soil testing. Grenada, MS (November 13, 2012)

Production Meeting Presentation; Mississippi Row Crop Short Course; Corn and soybean fertility programs; Starkville, MS (December 4, 2012)

2013

Golden,B.R. and J. Nichols. 2013. Fertility needs for maximizing soybean yield. In Proc. Consev. Cotton and Rice Conf. Mid America Farm Pub. Baton Rouge, La. Jan 31- Feb 1.

Golden, B.R. 2013. Current soil test correlation and calibration research in Mississippi. Southeast Regional Information Exchange Group-6. Baton Rouge, LA June 16-18, 2013.

Montgomery, G.B., B.R. Golden, S.A. Shinkle, and T.W. Allen. 2013. Management Considerations for Mid-Southern Soybean Production. In Annual meetings abstracts [CD-ROM]. ASA, CSSA, and SSSA, Madison, WI. Tampa, FL. Nov 3-6, 2013.

Mississippi Agricultural Consultants Association – Soil test correlation and calibration for soybean and corn; Starkville, MS (Feb 5-6, 2013)

Tri State Soybean Grower Meeting – Fertility needs for maximizing soybean yield; Stoneville, MS (Jan 4, 2013)

United Soybean Board – Optimal Rotation Intervals for Soybean and Corn; Little Rock, AR. (Feb 3, 2014)

Mississippi Agricultural Consultants Association – Soybean and Corn Fertility Management; Starkville, MS (Feb 5-6, 2014)

Mississippi Row Crop Short Course – Precision Agriculture Technologies for Soil Fertility; Starkville, MS (Dec 4, 2013)

Mississippi Agricultural Consultants' Association Research Exchange – Update on upland row crop fertility; Cleveland, MS (October 23, 2013)

2014

Mississippi Agricultural Consultants Association – Soybean and Corn Fertility Management; Starkville, MS (Feb 5-6, 2014)

Kraus, N and B.R. Golden. 2014. Late soybean planting doesn't mean change in variety. USB/MSSB Update. May 19, 2014.

Agronomic crops extension retreat – 2014 soil fertility update for soybeans, corn and rice; Hamilton, MS (June 26, 2014)

Lowndes county crop update – 2014 fertilizer considerations for soybean and corn; Hamilton, MS (July 8, 2014)

Mississippi Agriculture Industries Council; Certified Crop Advisor Training – 2014 fertility challenges for rice, corn and soybean; Orange Beach, AL (July 30, 2014)

Mosaic Fertilizer Composite plots field tour – Maximizing Nutrient use in Corn and soybean; Stoneville MS (August 21, 2014)

Farm Bureau Commodity Directors Tour – Soybean and corn fertilizer management; Stoneville, MS (August 6, 2014)

Mid-South Soybean Board - Soybean and corn rotation sulfur balances; Portageville, MO (August 12, 2014)

Farm Bureau young farmers and ranchers field tour – Row Crop Research at the DREC; Stoneville, MS (August 15, 2014)

Bell, L., B.R. Golden, J.L. Oldham and M.W. Ebelhar. 2014. Soybean response to potassium and phosphorus fertilization in Mississippi. . In Annual meetings abstracts [CD-ROM]. ASA, CSSA, and SSSA, Madison, WI. Long Beach, CA. Nov 2-5, 2014. (Volunteered)

B.R. Golden. 2014. Updating current soil test recommendations for MSU planning and implementation; Stoneville MS (Sept 2, 2014)

B.R. Golden. 2014. Pillow Planting Company; Nutrient Management Plans for Corn and Soybean; Stoneville, MS (Sept 30, 2014)

Golden, B.R. 2014. Soil Sampling for Fertility Management. MSSPB Video. Oct 7, 2014. [On-Line] Available at: https://www.youtube.com/watch?v=_Z-jPblhJNU&list=UUe2_hAnfIGf2eQSBPGSptpg

B.R. Golden. 2014. Silent Shade Plantation; Nutrient Management planning for whole farm with emphasis on Corn, Soybean, and Rice. Belzoni, MS (Oct 1, 2014)

Mississippi ASA Meeting – Soil fertility Concerns for Soybean and Corn; Grenada MS. (Nov 12, 2014)

Mosaic Fertilizer Information Exchange – Soil Fertility Status in Mississippi; Plymouth, MN (November 10, 2014)

Mississippi Agriculture Consultants Information Exchange; What's going on in the Fertility world; Stoneville, MS (Oct 2, 2014)

Beck Ag Soybean Educational Session – Early season issues impacting Soybean yield; National call in radio show (Dec 10, 2014)

2015

Oldham, J.L., K.K. Crouse, B. Macoon, M.W. Shankle, M.W. Ebelhar, and B.R. Golden. 2015. Four years and counting: An update on seasonal soil testing variation. . In Annual meetings abstracts [Online]. ASA, CSSA, and SSSA, Madison, Minneapolis, MN. Nov 15-18, 2015. Available at: https://scisoc.confex.com/scisoc/2015am/webprogram/Paper93802.html (Volunteered)

Ross, W.J., B.R. Golden, M.D.Furhman, T. Irby, G. Stevens, J. Lofton, C.B. Neely, R.W. Schnell, L. Falconer, D. Hathcoat. M. Rhine, and L. Bell. 2015. An evaluation of crop rotation and soil nutrients in the Midsouth. In Annual meetings abstracts [Online]. ASA, CSSA, and SSSA, Madison, WI. Minneapolis, MN. Nov 15-18, 2015. Available at: https://scisoc.confex.com/scisoc/2015am/webprogram/Paper93703.html (Volunteered)

Field days: (5)

2012

Field Day Presentation; Delta Research and Extension Center Agronomic Crops Field Day, Soybean phenology and soil test correlation/calibration . Stoneville, MS (July 19, 2012)

Field Day Presentation; Main campus Mississippi State University; Corn zinc fertility and soybean phenology; Starkville, MS (July 19, 2012)

2013

Delta Research and Extension Center Irrigation management turn row tour; Soybean growth stages and identification; Stoneville, MS (August 30, 2013)

2014

Delta Research and Extension Center Early-season field day – Corn and Soybean Fertility; Stoneville, MS (April 30, 2014)

Verona Field Day – Update on Cotton OVT, What's on the Horizon and mid-season fertilizer management; Verona, MS (August 7, 2014)

2015

NONE

Workshops: (15)

2012

Production Meeting Presentation; Delta Ag Expo, Current issues in soybean fertility. Cleveland, MS (January 17-18, 2012)

Production Meeting Presentation; County Meeting. Soil fertility questions with changing production practices. Yazoo City, MS (February 22, 2012)

Industry Update; Mississippi Agriculture Industry Association. Soil fertility update. Orange Beach, AL (July 23-27, 2012)

Production Meeting Presentation; Delta Crop Summit, Soybean and Corn Fertility Programs, Stoneville, MS (November 14, 2012)

2013

Delta Ag Expo Soybean Roundtable – Potassium deficiency in soybean; Cleveland, MS (Jan 16-17, 2013)

Lowdes county crop update – 2013 Soybean soil fertility update on correlation calibration; Hamilton, MS (Jan 14, 2014)

Itawamba county mid-season crop update – 2013 soil fertility update on correlation calibration; Baldwyn, MS (July 16, 2013)

Agronomic crops extension retreat – 2013 soil fertility update on current corn and soybean issues; Hamilton, MS (June 6, 2013)

Jimmy Sanders/Pinnacle Ag Inc., Certified Crop Advisor Training – Current issues in row crop fertility; Monroe, LA (Aug 7, 2013)

Jimmy Sanders/Pinnacle Ag Inc., Certified Crop Advisor Training – Current issues in row crop fertility; Birmingham, AL (Aug 1, 2013)

Jimmy Sanders/Pinnacle Ag Inc., Certified Crop Advisor Training – Current issues in row crop fertility; Stoneville, MS (July 31, 2013)

Mississippi Agriculture Industries Council; Certified Crop Advisor Training – Fertilization programs for corn and soybean; Orange Beach, AL (July 24, 2013)

2014

Delta Research and Extension Center ANR row crops workshop – Know your fertilizers; identification and use; Stoneville, MS (April 30, 2014)

Agronomic crops extension retreat – 2014 soil fertility update for soybeans, corn and rice; Hamilton, MS (June 26, 2014)

MSU Row Crop Short Course – Fertility concerns headed into 2015. Starkville, MS (Dec 2, 0214)

2015

GFK Data – Common Soil fertility practices in MS; National Call in show (December 21, 2015)

Ayers Delta Group - Soil Fertility and its importance; Yazoo City, MS (November 10, 2015)

Ayers Delta Group – Soil Fertility and its importance; Rolling Fork, MS (November 9, 2015)

IHL Tour – Importance of Fertilizer BMPS for Mississippi Delta; Stoneville, MS (October 8, 2015)

MACA information exchange – What's new in the fertility world; Stoneville, MS (October 1, 2015)

Jimmy Sanders Agronomic Training – BMPS for Rice, Corn and Soybean; Rayville, LA (September 24 2015)

Monsanto Educational – Soil testing and its importance for corn and soybean; Memphis, TN (September 9, 2015)

Mosaic field tour – Fertilizer products for corn and soybean; Stoneville, MS (August 13, 2015)

Agronomic Crops Agent Training – Soil fertility Primer; Hamilton, MS (June 18, 2015)

BASF agronomic crops tour – Soybean and corn soil fertility to maximize production, Leland MS (June 24, 2015)

MSU Scout School – Know your fertilizers, Fertilizer ID; Starkville, MS (June 4, 2015)

MSU Scout School – Know your fertilizers, Fertilizer ID; Verona, MS (June 2, 2015)

MSU Scout School – Know your fertilizers, Fertilizer ID; Clarksdale, MS (May 28, 2015)

Farm Bureau Spring Tour – Row crop update for Rice and Soybean; Stoneville, MS (May 15, 2015)

Beck Ag Soybean Educational Session – Late season issues impacting Soybean yield; National call in radio show (Feb 20, 2015)

MSSPB/USB Soybean Management Seminar Series – Digging Deeper to Protect your Soybean Yield – Soil Fertility; Rolling Fork MS (February 11, 2015)

MSSPB/USB Soybean Management Seminar Series – Digging Deeper to Protect your Soybean Yield – Soil Fertility; Stoneville MS (February 10, 2015)

Mississippi Agricultural Consultants Conference – Soil Sampling Methodologies in Mississippi; Starkville, MS (February 4, 2015)

MSSPB/USB Soybean Management Seminar Series – Digging Deeper to Protect your Soybean Yield – Soil Fertility; Cleveland MS (January 22, 2015)

Monsanto Consultants Conference – Optimal fertility programs for corn and soybean; Memphis, TN (January 9, 2015)

Jimmy Sanders Agronomic Training – Fertilizer needs assement for corn, soybean, and rice; Stoneville MS (January 6, 2015)

Graphics/Tables

Figure 1. Soybean yield Increase as a function of potash fertilizer rate at two responsive sites managed for correlation calibration trials during 2012.

Figure 2. Soybean tissue K concentration as a function of potash fertilizer rate at two responsive sites managed for correlation calibration trials during 2012.

Figure 3. Soybean yield increase as a function of potash fertilizer rate at all sites managed for correlation calibration trials during 2013.

Figure 4. Soybean tissue K concentration as a function of potash fertilizer rate at two responsive sites managed for correlation calibration trials during 2013. *(Soybean tissue data for Carroll Co. has not been received back from laboratory yet)*

Figure 5. Soybean yield increase as a function of phosphorus fertilizer rate at all sites managed for correlation calibration trials during 2013.

Figure 6. Soybean tissue P concentration as a function of phosphorus fertilizer rate at two responsive sites managed for correlation calibration trials during 2013. *(Soybean tissue data for Carroll Co. has not been received back from laboratory yet)*

Figure 7. Soybean yield increase as a function of potash fertilizer rate at all sites managed for correlation calibration trials during 2014.

Figure 8. Soybean yield increase as a function of phosphorus fertilizer rate at all sites managed for correlation calibration trials during
2014.

Figure 9. Relationship between soil test K level and relative soybean yield for research trials managed during 2012 - 2014.

Figure 10. Relationship between soil test P level and relative soybean yield for research trials managed during 2012 - 2014.

Fig 11. Relationship between Lancaster extractable K and Mehlich-3 extractable K on research soil samples to date (2012-2015).

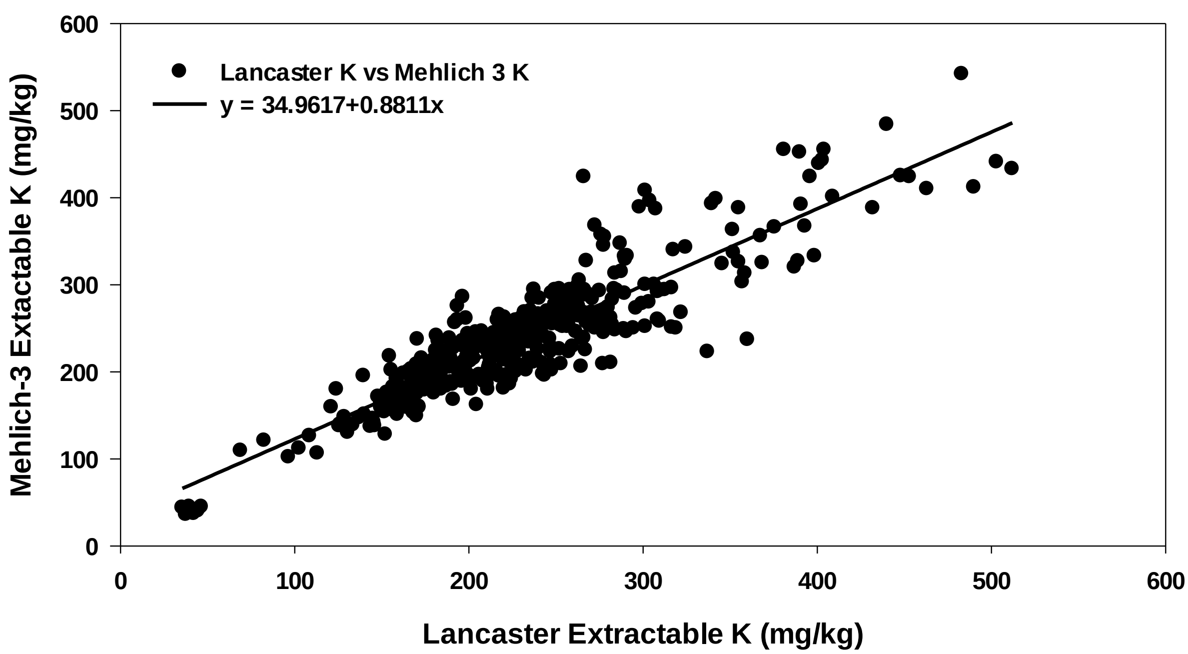

Fig 12. Relationship between Lancaster extractable P and Mehlich-3 extractable P on research soil samples to date (2012-2015).

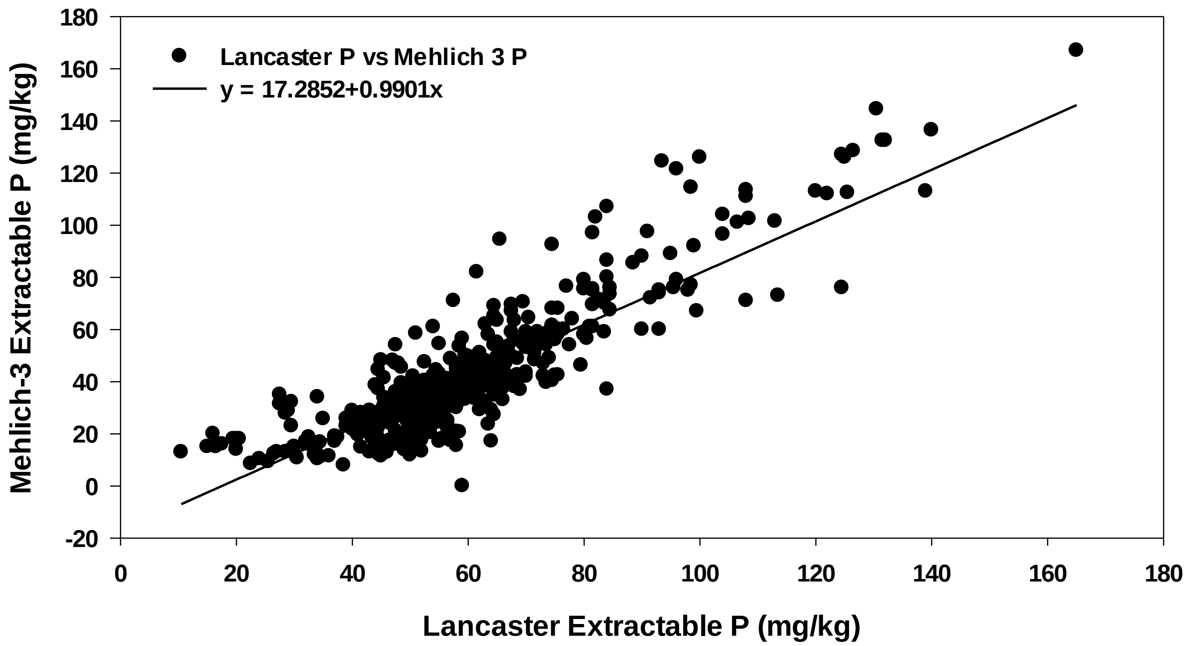

Figure 13. Soybean yield increase as a function of potash fertilizer rate at all sites managed for correlation calibration trials during 2014.

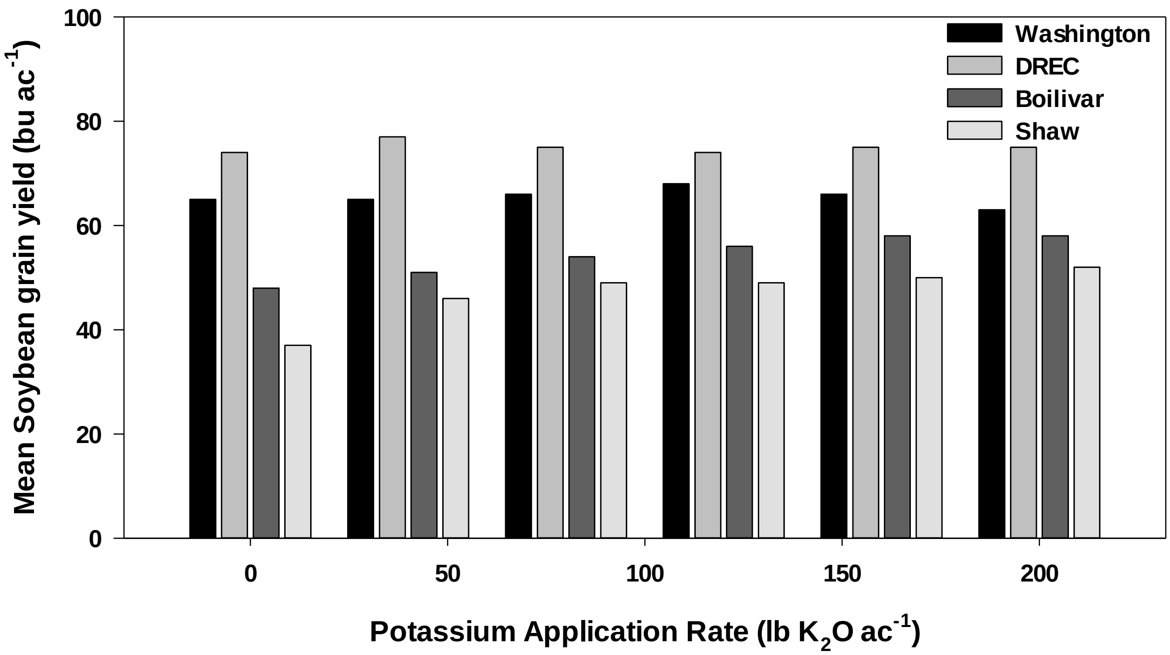

Figure 14. Soybean yield increase as a function of phosphorus fertilizer rate at all sites managed for correlation calibration trials during 2015.