

PRECISION AGRICULTURE INITIATIVE FOR TEXAS HIGH PLAINS

2001 ANNUAL COMPREHENSIVE REPORT

Texas Agricultural Experiment Station and Texas Agricultural Extension Service

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Primary Research Location: Seminole, TX

Project Title: Spatial characterization of soil properties: effect on peanut yield

Project Objectives:

- 1) To correlate soil chemical properties with peanut yields determined with the GPS-referenced yield monitor, and determine critical nutrient/chemical levels.
- 2) To correlate mid-season, multi-spectral reflectance (16 bands) with leaf nutrients.

Reporting Period: January 1 2002 – December 31 2002

A. Summary of Progress:

Objective 1. To correlate soil chemical properties with peanut yields determined with the GPS-referenced yield monitor, and determine critical nutrient/chemical levels.

Objective 2. To correlate mid-season, multi-spectral reflectance (16 bands) with leaf nutrients.

Introduction:

Second to water and seasonal heat units, soil chemical properties strongly affect peanut yield in the High Plains. Preliminary observations for example, indicate a negative correlation between soil Ca and peanut yield. Additionally, soil test calibration data for peanut is lacking in West Texas. Precision agriculture approaches, such as variable-rate fertilization, first require good understanding of the correlation between soil nutrients and peanut yield, preferably on a large, landscape scale.

Objectives:

- 1) To correlate soil chemical properties with peanut yields determined with the GPS-referenced yield monitor, and determine critical nutrient/chemical levels.
- 2) To correlate mid-season, multi-spectral reflectance (16 bands) with leaf nutrients.

Materials and Methods:

We conducted these activities on the 34 acre, peanut half of one of J. Grissom's circles near Seminole in 2002. We sampled 68, GPS referenced 0.5-acre-grid points for soil samples (two per GPS point) at 0-6, 6-12, 12-24, and 24-36 inches. Soils were analyzed for NO₃-N at all depths. The surface 0-6 inches were analyzed at a commercial laboratory for pH, Mehlich-3-P, Olsen-P, K, Ca, Mg, Zn, Fe, Mn, and EC. Particle size distribution was also done on the top layer. Mid-season we recorded multi-spectral reflectance at a 0.5 m height at the 60 GPS points. Leaf samples taken at these spots were analyzed for N and other macro- and micro-nutrients. Circular areas of yield map data points, 20 m in diameter were extracted around each GPS point, using ArcView. Statistical analysis included correlation of soil nutrients and mid-season leaf nutrients with yield. Additionally we regressed plant nutrients and final yield on principle components of the soils properties and on the multi-spectral reflectance data using partial least squares regression.

Results and discussion:

Peanut yields in the study area ranged from 2600 to 6800 lb/ac. Twenty-six percent of the variation in peanut yield at the 68, GPS-referenced peanut yield zones was explained by five

common factors, which were in turn based on 14 soil properties. The soil properties which had the strongest effect on peanut yield were soil NO₃ and K, which both had negative effects, although the soil NO₃ effect was marginal. Adding mid-season plant macro- and micronutrient concentrations to the analysis only improved the coefficient of determination (R²) from 0.26 to 0.33.

Multispectral (16-band) reflectance of the mid-season peanut canopy was most strongly correlated with leaf N. Partial least squares regression of leaf N, P, K on five common factors extracted from the sixteen wavebands yielded R²s of 0.47, 0.19, and 0.22, respectively. Soil P ranged from the low to high (16 to 41 ppm) with a mean of 26 ppm. Soil K on the other hand, tested high or very high at all points (118 to 219 ppm). Mean soil Ca was 373 ppm, which is at the critical level suggested by Oklahoma State University and well below the critical level of 600 ppm Ca cited by Texas A&M University. The range of soil Ca was 251 to 610 ppm.

In summary, this research underscores a main hypothesis of site-specific management. Spatial variation in soil properties and nutrient levels results in corresponding spatial variation in peanut yield. An example of this is that high soil K areas of the 34-ac study area, generally had the lowest peanut yields. Negative correlation between leaf Ca and leaf K suggests that high K may in fact be interfering with Ca uptake in peanut. Site-specific Ca fertilization should be tested for peanut production in the low Ca and high K areas of fields.

B. Education/technology transfer:

Bronson, K.F.* and S. Maas. New Technologies: Precision Agriculture. 50th Annual Agricultural Chemicals Conference. 28 August, 2002, Lubbock, Texas.

*Speaker

B. Milestones achieved:

Successfully completed three years of this landscape-scale, peanut yield, soil properties study.

C. Publications:

Published Abstracts

Bronson, K.F., J.D. Booker, J.W. Keeling, and J.L. Mabry. 2000. Remote sensing of in-season nitrogen requirements for irrigated cotton in the Southern High Plains. 2000 Proceedings Beltwide Cotton Conferences vol. 2. p. 1407. National Cotton Council of America, Memphis, TN.

Li, H., R.J. Lascano, J. Booker, L.T. Wilson, and K.F. Bronson. 2000. Landscape-scale assessment of soil tillage, water, plant reflectance, and lint yield variability in irrigated cotton. Agronomy Abstracts. 2000. Annual Meetings. p. 324. American Society of Agronomy, Madison, WI.

Chua, T., K.F. Bronson, R.J. Lascano, J.W. Keeling, A.R. Mosier, J. Bordovsky, C. Green, and J.D. Booker. 2001. In-season nitrogen management for lepa- and sub-surface drip-irrigated cotton. 2001 Proceedings Beltwide Cotton Conferences vol. 1. p. 588. National Cotton Council of America, Memphis, TN.

Bronson, K.F.*, J.W. Keeling, T. Wheeler, R.J. Lascano, P. Dotray, A. Brashears, S. Searcy, K. Siders, J.D. Booker, J. Booker, R. Boman, H. Li, and T. Chua. 2001. On-farm testing of site-specific management for irrigated cotton. 2001 Proceedings Beltwide Cotton Conferences vol. 1 p. 567. National Cotton Council of America, Memphis, TN.

Chua, T., K.F. Bronson, J.W. Keeling, A.R. Mosier, J.D. Booker, and R.J. Lascano. 2001. Use of multi-spectral reflectance for nitrogen management of irrigated cotton. Agronomy Abstracts. 2001. Annual Meetings. [CD-ROM computer file] American Society of Agronomy, Madison, WI.

Booker, J.D., K.F. Bronson*, T. Chua, J.W. Keeling, R.J. Lascano, and R.K. Boman. 2001. Multi-variate analysis of multi-spectral reflectance to identify nutrient deficiencies in cotton. Agronomy Abstracts. 2001. Annual Meetings. [CD-ROM computer file] American Society of Agronomy, Madison, WI.

Booker, J.D., K.F. Bronson*, J.W. Keeling, T. Chua, R.J. Lascano, R.K. Boman, S. Searcy, and A. Brashears. 2001. Grid vs. landscape position or soil type based soil sampling strategies for the High Plains. Agronomy Abstracts. 2001. Annual Meetings. [CD-ROM computer file] American Society of Agronomy, Madison, WI.

Bronson, K.F.*, J.W. Keeling, T. Wheeler, R.J. Lascano, J.D. Booker, R.K. Boman, S. Searcy, and T. Chua. 2001. Response of cotton to variable-rate phosphorus, landscape position and soil type. Agronomy Abstracts. 2001. Annual Meetings. [CD-ROM computer file] American Society of Agronomy, Madison, WI.

Li, H., R.J. Lascano, J. Booker, L.T. Wilson, K.F. Bronson, and E. Segarra. 2001. Autoregressive analysis of spatial association of cotton lint yield with soil water, phosphorus, and landscape position. Agronomy Abstracts. 2001. Annual Meetings. [CD-ROM computer file] American Society of Agronomy, Madison, WI.

Li, H., R.J. Lascano, J. Booker, L.T. Wilson, K.F. Bronson, and E. Segarra. 2001. Identify factors causing cotton spectral reflectance variability using principal component analysis. Agronomy Abstracts. 2001. Annual Meetings. [CD-ROM computer file] American Society of Agronomy, Madison, WI.

Bronson, K.F.*, J.D. Booker, T.T. Chua, J.W. Keeling, R.K. Boman, and T. L. Provin. 2002. Soil test phosphorus extract comparisons for cotton using grid soil data. 2002 Proceedings Beltwide Cotton Conferences. [CD-ROM computer file] National Cotton Council of America, Memphis, TN.

Chua, T., K.F. Bronson, A.R. Mosier, J.D. Booker, J.W. Keeling, and C.J. Green. 2002. Nitrogen-15 recovery for surface and sub-surface irrigated cotton. 2002 Proceedings Beltwide Cotton Conferences. [CD-ROM computer file] National Cotton Council of America, Memphis, TN.

Bronson, K.F.*, S.J. Officer, R.J. Lascano, S. Maas, J. Booker, and J.D. Booker. 2002.

Relationship between soil properties and electrical conductivity in the Southern High Plains. Agronomy Abstracts. 2002. Annual Meetings. [CD-ROM computer file] American Society of Agronomy, Madison, WI.

*Speaker

Journal articles

Bronson, K.F., C.L. Trostle, A. M. Schubert, and J.D. Booker. 2003. Leaf nutrients and yields of irrigated peanut in the Southern High Plains: Influence of nitrogen, phosphorus and zinc fertilizer. Commun. Soil Sci. Plant Anal. (Submitted).

Experiment Station publications and web page bulletins

Bronson, K.F. , C. Trostle, M. Schubert, J.L. Mabry, and J.D. Booker. 2000. Nitrogen, Phosphorus, and Zinc Management for Irrigated Peanut at AG-CARES, Lamesa, Texas, 1999. Dawson County 1999 Annual Report - Agricultural Complex for Advanced Research and Extension Systems. p. 39. Texas Agric. Extn. Serv. and Texas Agric. Exp. Stn.

Bronson, K.F., C.L. Trostle, M. Schubert, J.L. Mabry, and J.D. Booker. 2002. Nitrogen, Phosphorus, and Zinc Management for Irrigated Peanut at AG-CARES, Lamesa, Texas, 2001. Dawson County 2001 Annual Report - Agricultural Complex for Advanced Research and Extension Systems. p. 42-43. Texas Agric. Extn. Serv. and Texas Agric. Exp. Stn.

Proceedings of Meetings

D. Precision agriculture proposals:

Cost effective production management of peanut in the Texas Southern High Plains, \$22,000, 1999-2000, National Peanut Foundation (Co-investigator)

Water quality and nutrient management, \$25,000, 1999-2000, Texas Peanut Producers' Board (Co-investigator)

West Texas peanut nutrition-rhizobium/nitrogen, \$25,000, calcium and micronutrients, 2000-2001, Texas Peanut Producers' Board (Co-investigator)

Spatial correlation of soil chemical properties and peanut yield, \$ 19,000, 2001-2003, Texas State Legislature Special Initiative (Principle investigator)

E. Precision Agriculture meetings attended/papers (posters) presented:

Bronson, K.F., A.M. Schubert, C.L. Trostle, J.D. Booker, and T.T. Chua. 2002. Landscape-Scale Spatial Characterization of Soil Properties and Peanut Yield. [CD-ROM computer file]. In: P.C. Robert et al. (eds.) Proceedings of the 6th International Conference on Precision Agriculture, Minneapolis, MN, Jul. 14-17, 2002, ASA, CSSA, and SSSA, Madison, WI.

F. Other developments: (Anything that impacted research progress, positive or negative)
