PRECISION AGRICULTURE INITIATIVE FOR TEXAS HIGH PLAINS

2002 ANNUAL COMPREHENSIVE REPORT

Texas Agricultural Experiment Station and Texas Cooperative Extension

Principal Investigator: Calvin Trostle, Texas A&M—Lubbock, Route 3, Box 213AA, Lubbock, TX 79403; E-mail: c-trostle@tamu.edu; Phone: (806) 746-6101

Cooperators: Bruce Porter, TAES

Primary Research Location: Doug Sims farm, south of Brownfield, TX

Project Title: In-Field Correlation of *Bradyrhizobium* Nodulation with Soil Parameters and Peanut Yield in West Texas

Project Objectives (from original proposal): 1) Quantify variation of *Bradyrhizobium* nodule populations on peanut in response to soil chemical and environmental conditions or cultural practices;

2) Develop and evaluate use of the chlorophyll meter (indicative of low N status) as an indirect measure of crop N status in relation to nodulation activity and plant tissue nutrient content;

3) Relate the degree of nodulation in peanut to crop economic return.

Reporting Period: January 1, 2002 – December 31, 2002

A. Summary of Progress:

Objective 1—*Bradyrhizobium* nodule counts per peanut plant were obtained in August at research sites in south Terry Co. Additional on-farm nodule counts and general soil sampling (not specific to each grid point) were conducted at four other locations. As in 2001, we noted the inconsistency among plants at each grid point as 3 or 4 plants among 12 at each measurement point may have 5 or less nodules (when the average might be 40), whereas the other plants would be well nodulated. This points out that either producer practices or microenvironment may have a large influence on nodulation. Nodulation did correlate with peanut yield at the precision ag. site in Terry Co., r = 0.60, which was higher than in 2001 (r = 0.49-0.55). This may be explained in general in that 2002 was a "nodulation year" thus environmental factors, namely a hotter year, may have had a more pronounced effect (negative) on yield in 2001 when nodulation across the South Plains was poorer. Correlations of nodulation per plant and soil N were lower, r = 0.36. Soil N did correlate somewhat better with yield, r = 0.51. Typically, we assume that high soil N could reduce the degree of *Bradyrhizobium* or *Rhizobium* for legumes, but it appears that other factors (probably temperature, and especially moisture status and its effect early in the season on microbial survival).

In 2001, comparisons of either nodulation or hand-harvested yield correlated only poorly or not at all with the precision ag. combine yield maps in Gaines Co., and these comparisons were not available in 2002 as we worked apart from any yield mapping fields. This suggests that relying on the precision ag. combine to evaluate yield at specific points in the field may

be inappropriate, rather yield-mapping results are better suited for 'whole-field' averages, which is more in keeping with the intent of precision agriculture tools.

As noted in 2001 in Gaines Co., only low correlations were observed between the degree of nodulation and soil properties. Nodulation was only slightly negatively correlated with pH (r = -0.18) in 2002 (r = -0.29 in 2001), and soil Ca (indicative of high pH conditions in a caliche soil, r = -0.19, compared to r = -0.31 in 2001). The primary PA site for this work in 2002 had significant slope, but the evident caliche fragments visible in the soil surface was in fact less strongly caliche in terms of soil Ca than in previous years. Thus there was less variation in soil pH and soil Ca resulting in minimal effect on nodulation. *Bradyrhizobium* is expected to be lower in the condition of higher pH, caliche, and high soil N (which was not the case in 2002 for N). Other factors such as soil K, Mn, salts, etc. were only minimally correlated with peanut plant *Bradyrhizobium* number if at all. These results were similar to 2001 PA fields that were evaluated.

In general, overall we believe it is proving difficult to demonstrate *Bradyrhizobium* nodulation influenced by soil parameters when the scale of soil properties is in the range of 10-20'. This is in part due to the high variation in nodule number of individual plants thus it appears that it may be a matter of inches or 1-3' where differences in nodulation occurs. This does not lend itself to precision ag. technologies, but elucidating any effects will help ascertain if PA technologies are suitable for *Bradyrhizobium* application and management.

Objective 2—In 2001 in Gaines Co. modest correlations between *Bradyrhizobium* numbers per plant vs. leaf N (r= 0.25) and spad meter readings (r = 0.40) were obtained. In 2002, the nodulation comparisons were similar: leaf N, r = 0.28; spad meter, r = 0.51. The use of the chlorophyll meter as an index of peanut N status (or aerial hyperspectral measures) may prove to be a quick means for farmers to gauge N needs in the plant rather than rely on soil or plant tissue testing. For this approach to be highly reliable, however, we believe that r values will need to be above 0.7 else other uncertainties will preclude the accuracy that farmers and consultants will desire. Because nodulation correlations with leaf N and spad readings were low, little to no correlation was found with any ground-level spectral reflectance measure. This has been confirmed in other work for peanut by Bronson et al. at the AGCARES research farm at Lamesa, TX. Although the ground level spectral reflectance measures may be useful, the labor intensity required to obtain these readings would not be favorable compared to the possible use of the hyperspectral reflectance techniques other members of the High Plains PA team are using from low-flying aircraft.

Objective 3—Because the correlations are low the ability to pin down economic return to the degree of nodulation are inconclusive based simply on nodule numbers. Other small-plot work in terms of *Bradyrhizobium* rates and yield, particularly for liquid inoculants, has demonstrated that inoculation alone can add as much as 1600 lbs. peanut yield per acre ($280/A). The benefit, unfortunately, is often sporadic, and Texas Cooperative Extension testing in 2001 reported fields where no benefit was found due to inoculation yet N fertilizer response was measured. As noted above, however, 2002 was a year of high peanut *Bradyrhizobium* nodulation, and responses were greater for inoculation/nodulation than for N application. *Bradyrhizobium* inoculation is assumed on West Texas peanut fields, but nodulation of the peanut plant is not.

Education/technology transfer: Conventional non-PA work on *Bradyrhizobium* in peanuts has caught the attention of producers in that many have assumed effective nodulation, but it

is absent in many cases. Year 2001 work in Gaines Co. (three sites) and in 2002 across the South Plains (6 sites) notes the variability in soil properties and peanut yield potential. Results suggest that farmers can expect 400 to 1600 lbs./A peanut yield increases when fields are inoculated with *Bradyrhizobium*. But also of equal interest is a potentially similar yield response to nitrogen. What perplexes farmers and researches alike is that peanut yield response to N is highly variable. Most Texas South Plains most research sites in 2001 responded significantly to N. In 2002 no-significant yield responses to N were found among five on-farm tests using 0, 50, and 100 lbs. N/A. Peanut *Bradyrhizobium* and nodulation was demonstrated or discussed in six field tours and seven spring or fall crop meetings. Extension guidelines have been written noting correct handling and common mistakes of handling and applying *Bradyrhizobium* inoculants to peanuts in West Texas, including 'Questions and Answers about *Bradyrhizobium* and Inoculation for Peanuts.'

B. Milestones achieved: More questions have been generated about the relationship of *Bradyrhizobium* nodulation to peanut yield. At this point, we believe soil properties have less effect on *Bradyrhizobium* nodulation than first thought else we would see higher correlation between nodule number and activity in peanut vs. yield. Producers are learning to pay more attention to inoculation/nodulation, even scout for nodulation (particularly in advance of any mid-season N applications), similar to insect and disease scouting.

C. Publications: (Provide complete references)

D. Precision agriculture proposals: No new proposals submitted in 2002.

E. Precision Agriculture meetings attended/papers (posters) presented: None.

F. Other developments: