Alabama Farmers Wheat and Feed Grain Committee

Title: Airborne Imagery for Rapid Crop Productivity Assessments

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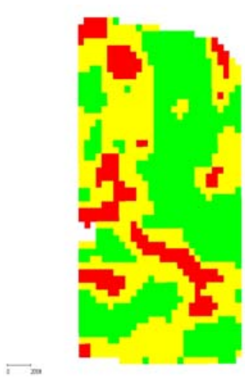
Location: Tennessee Valley, Upper Coastal Plain

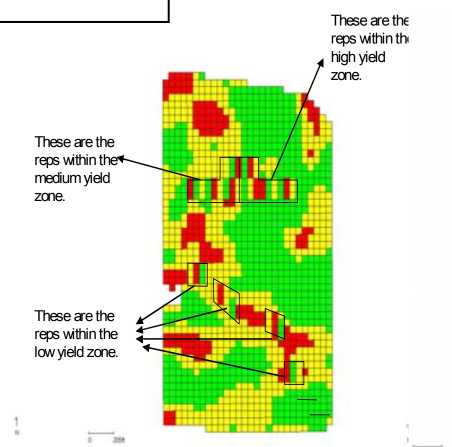
Progress Report for 2006

This project was conducted on Paul Clark's farms in Decatur, Alabama. Two cornfields that are located approximately 5 miles apart were divided into three management zones, "Low", "Medium", and "High" from previous yield records. They received preplant 40 lbs/acre of nitrogen as urea solution and then sideressed with 90, 130 and 160 lbs/A of nitrogen within each management zone that was replicated at least four times. During the 2006 growing season, a total of 96 soil samples at 0-15, 15-30, 30-45 and 45-60 cm depths were collected from "Low", "Medium" and "High" management zones on 04/27/06 (before any fertilizer was applied), 07/22/05 (late in the season) and 12/14/06 (after harvest). The soil samples were analyzed for pH, N, C, P, K, Ca, NO_3-N and NH_4-N. In addition, corn leaves were sampled on 06/29/06 and analyzed for C, N, K, Ca, Mg and other essential nutrients. Chlorophyll measurements were taken on 05/13/06 and 06/29/06. InTime (InTime Inc.,), an imaging company, made digital images of the cornfields on May 12; June 16 and July 2, 2006.

Field S1

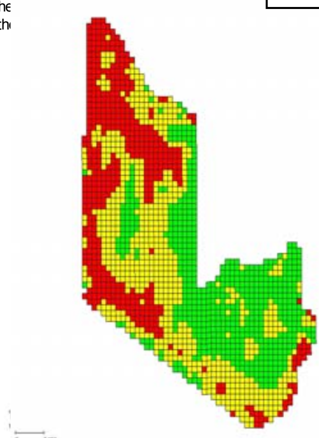


This is yield map from 2002 corn. Yield ranges are <80 (red); 80-120 (yellow) and >120 (green).

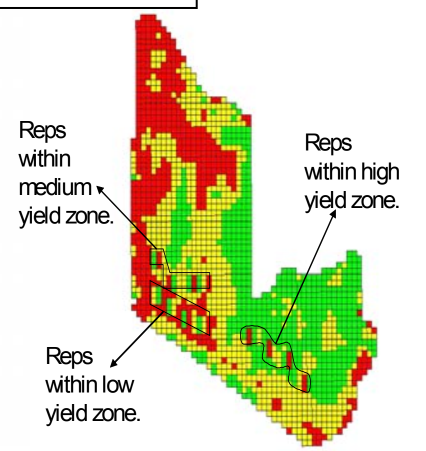


This is prescription map for 2004 corn. N rates are 14 gal (red); 26 gal (yellow) and 34 gal (green). Each rate is replicated 4X within each yield zone, these areas are marked. N is 32% solution and 40 lbs N applied pre-plant.

Field S5



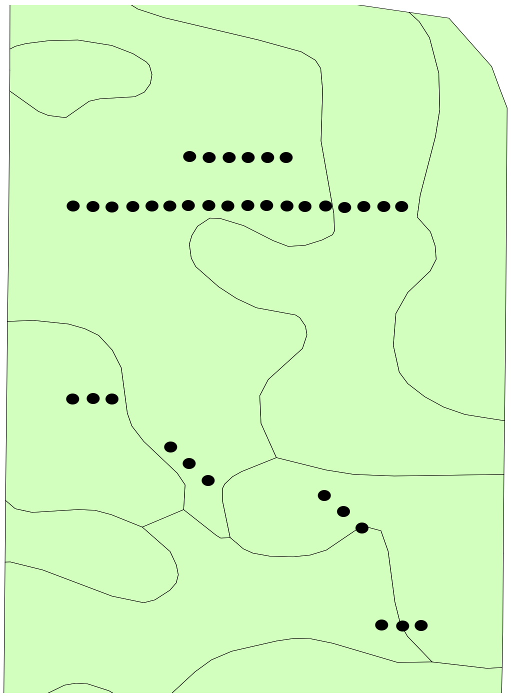
This is the yield map from 2003 cotton. Yield ranges are <750 (red); 750-1000 (yellow) and >1000 (green).



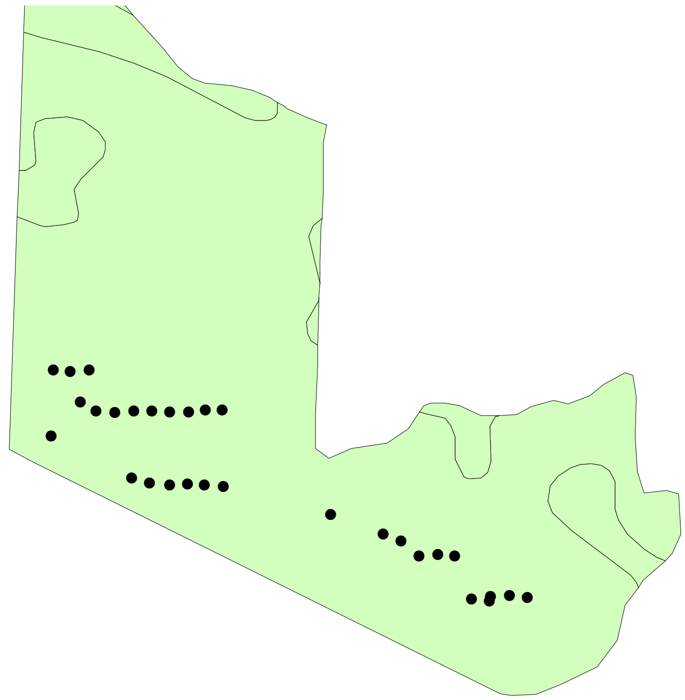
This is the prescription map for 2004 corn. N rates are 14 gal (red); 26 gal (yellow) and 34 gal (green). Each rate is replicated 4X within each yield zone, these areas are marked. N is 32% solution and 40 lbs N applied pre-plant.

Yield and prescription maps for 2002 and 2004, respectively, for the fields S1 and S5.

Field S1

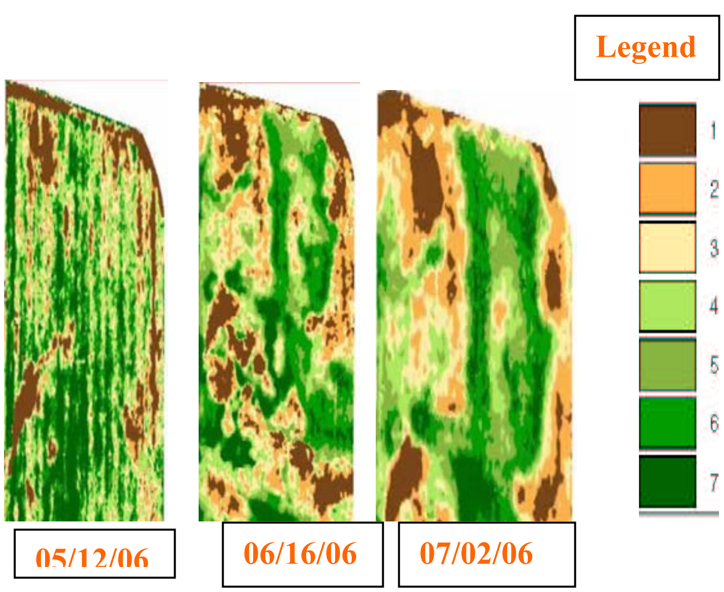


Field S5

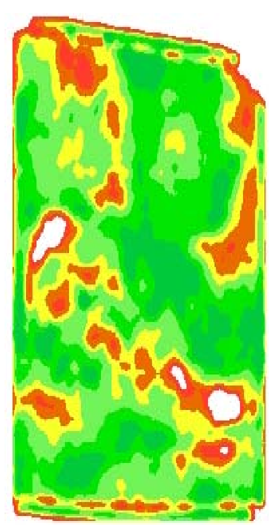


Soil sampling locations for Fields S1 and S5 for 2006 season

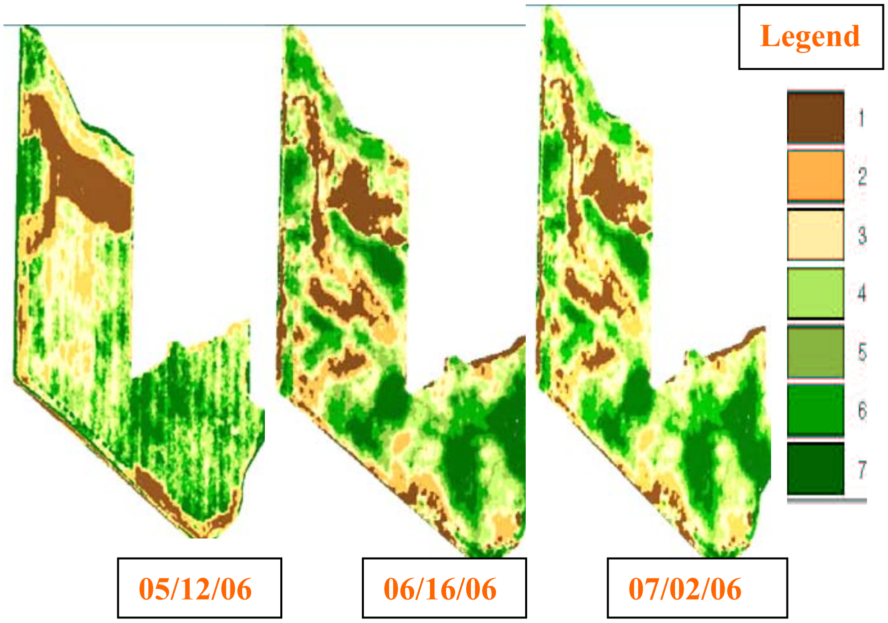
Soil samples were taken from each management zone from low, medium and high nitrogen treatments. But only one sampling location was replicated from each zone corresponding to the zone designation (i.e. in "High" management zone, the high nitrogen rate was duplicated and medium and low nitrogen rates were duplicated for the "Medium" and "Low" management zones, respectively). Only filed S1 was sampled during the mid season.



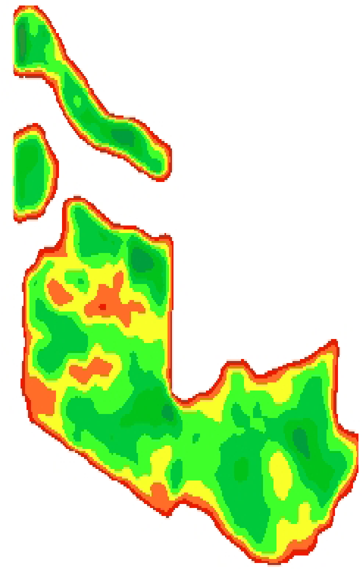
Classified Images of Field S1



Yield Density of Field S1 for 2006



Classified Images of Field S5

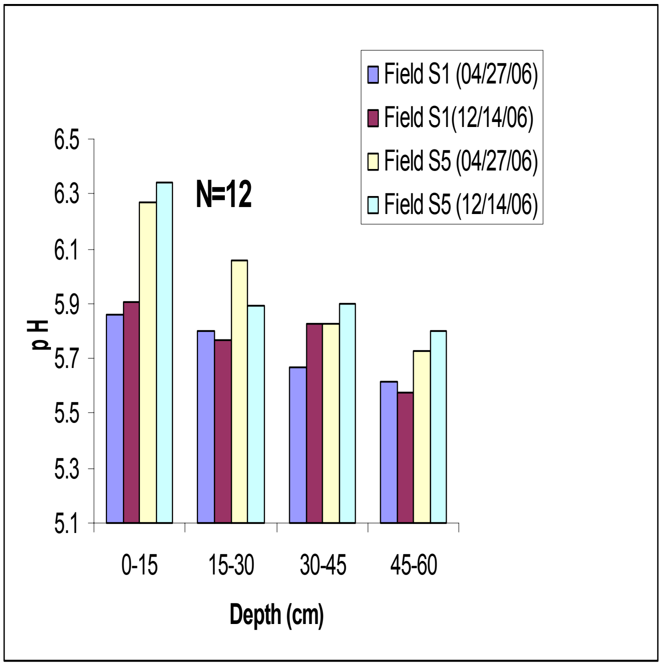


Yield Density of Field S5 for 2006

Results

Intime, (InTime, Inc), provided digital classified scout maps for the fields. The digital image of each field is divided into seven statistical classes based on "groundtruth" or field calibrations the company has stored in its database. As indicated on the legend for the images, #1 in the legend (the dark red) indicates the lowest biomass area, and #7 (the dark green) indicates the highest biomass. Three flyovers were ordered during this crop season and images were taken on 05/12/06, 06/17/06 and 07/02/06. This cropping year was not good for corn growers due to the severe drought that affected most of the Southern States. Only those with irrigation facilities and who planted early on were able to harvest a reasonable yield. Over all, there was a substantial decrease in yield in these fields.

The yield density for Field S5 is a good example of what had taken place during this season. Some areas of the field were not even worthy of harvesting as the result of the devastating drought. However, the use of imaging or sensing technology is a good tool for aggressive farmers who are determined to increase yield by identifying plant growth constraints and addressing them on timely fashion. These images do provide an opportunity to intervene when the plants show climax of stresses. Our plant parameter measurements (height and chlorophyll) and tissue analysis also indicated plants in the greener areas were physically healthy and had balanced chemical nutrients. The key to increase corn yield is going to be optimizing almost each segment of row and eventually each plant through precision farming.



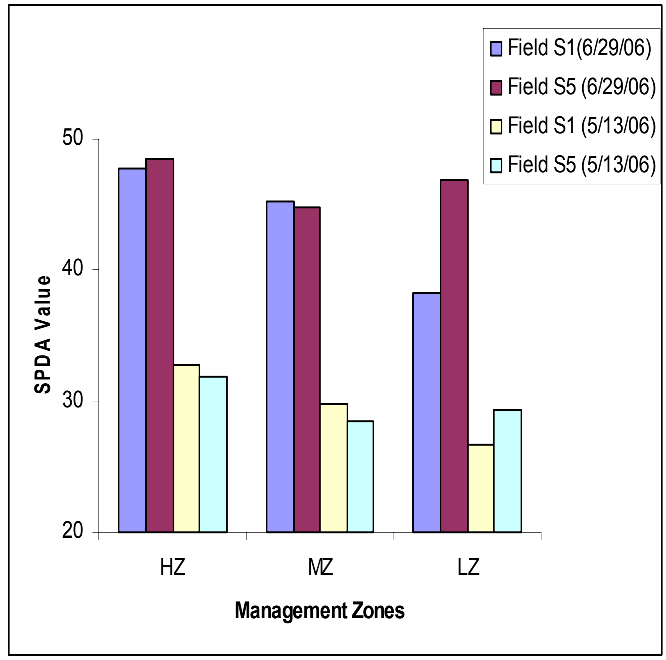


Figure 1: Soil pH for Fields S1 and S5 during 04/27/06 and 12/14/06 sampling dates.

Figure 2. Leaf chlorophyll index as measured by SPDA 502 during 05/13/06 and 06/29/06.

In general, the average pH value decreased with depth and there was significant effect of time of sampling for each field (Figure 1). The average pH value for Field S5 was greater than Field S1 at all depths. The overall pH values of the fields appear not to be a limiting factor for corn growth. Organic matter additions through corn roots and plant residues and nitrogen fertilizers could be the potential sources of the subsoil acidity. The low pH values in the subsoils actually warranted recommendation of lime according to the Auburn University soil test results.

Leaf chlorophyll measurements taken on 05/13/06 and 06/29/06 are given in Figure 2. Chlorophyll measurements were significantly affected by date of sampling. Except for the Low management "LZ" for Field 5, chlorophyll index values were not significantly different. Corn heights during the 05/13/06 measurements were greater than both "MZ" and "LZ" (data not shown). The rate of nitrogen fertilizer had less impact on corn chlorophyll compared to management zones. Similar result was obtained for leaf area index for the previous years.

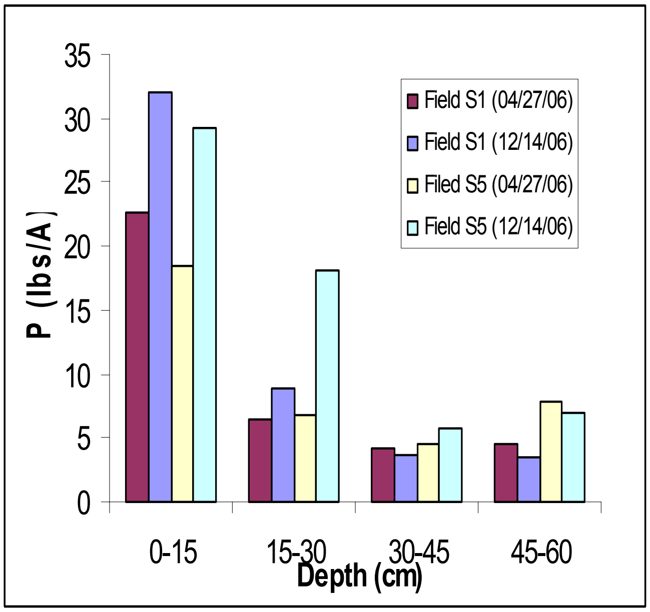


Figure 3: Soil phosphorus content.

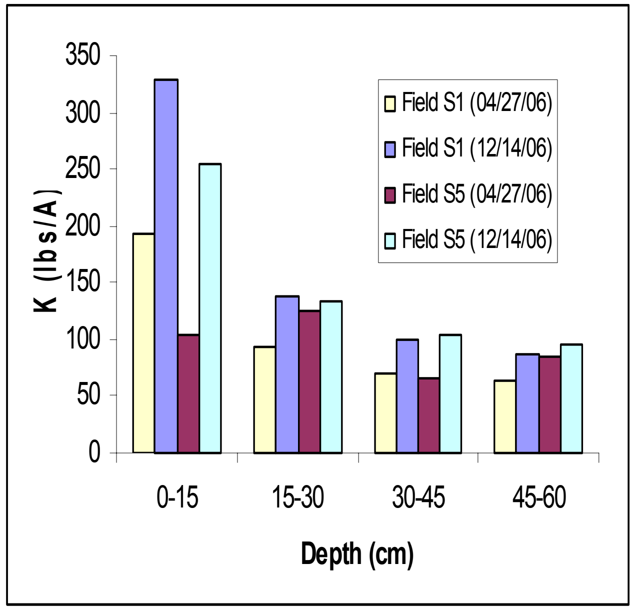


Figure 4: Soil potassium content.

Phosphorus content of the topsoil samples was significantly greater than the subsoils (Figure 3). Phosphorus does not move in the soils and this result is not unexpected. Phosphorus was also significantly greater in the topsoil samples during the 12/14/06 sampling compared to the 04/27/06. The source of this phosphorus could be fertilizer or plant root and residue decomposition. Most of these soil needed additional phosphorus fertilization for optimum corn growth.

Similar to phosphorus, potassium content of the top soil samples was significantly greater than the subsoils (Figure 4). This may be due to fertilization and organic matter in the topsoils. The soil contained adequate amounts of potassium for maximum corn growth.

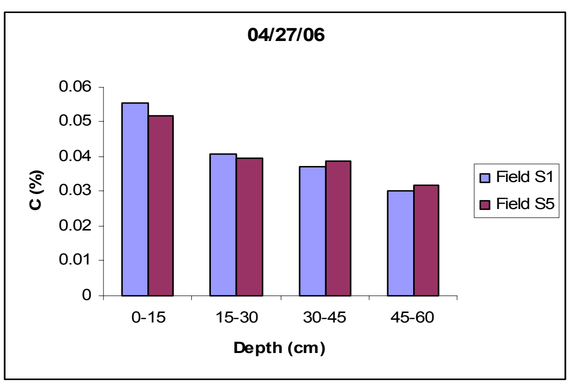


Figure 5: Soil carbon content.

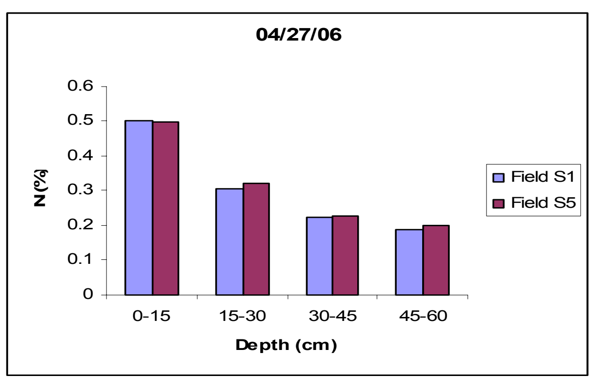


Figure 6: Soil nitrogen content.

The total soil carbon and nitrogen contents decreased as soil depth increased as indicated in Figure 5 and Figure 6, respectively, during the first sampling date. The two cornfields had similar contents of carbon and nitrogen throughout the profile. The results for the late sampling are not available yet. We plan to continue this project and will repeat on the alternating cornfields with additional sampling protocols during the 2007 crop season.