FINAL REPORT: This experiment was initiated by Dr. Roger Teal and was turned over to Dr. R. Scott Tubbs on May 24, 2007 at planting of peanuts. The trial was established at the University of Georgia Lang Farm in Tifton, GA. Three cover crops were planted in November 2006, consisting of crimson clover, rye, and wheat. These were established for eight row plots that were 24 feet wide and 60 feet long. Four replications were used, and a total of six treatments per replication were planned. Cover crops were killed on April 9, 2007 and the area was strip-tilled on May 18. Conventional tillage treatments were not established prior to planting, when I assumed the responsibility of this experiment. Thus, the six treatments included each of the three cover crops with inoculated or non-inoculated peanut seed at planting, set up in a randomized complete block in a factorial design. The variety GA-03L was planted at a rate of six seed per foot of row in single rows on May 24, 2007 using a two-row Monosem precision air planter. Planting depth was 2.25 inches and Thimet brand insecticide was applied in-furrow at the rate of 6 pounds per acre. Within 24 hours of planting, Sonolan (1 qt/acre), Strongarm (0.44 oz/acre), and Valor (3 oz/acre) herbicides were applied and watered in with 0.5 to 0.75 inches of irrigation as the base weed management program. Plots were irrigated on an as needed basis. All other production practices, including disease and insect management, were based on University of Georgia recommendations.

Biomass samplings were taken approximately every 3-4 weeks throughout the season. At each sampling, cover crop residue was removed from a 5.25 ft² area and soil samples were taken from the same area at the 2- and 8-inch depths. Peanut plants were also removed and separated into vegetation, pods, and roots when there was sufficient plant material for measurement. All plant tissue and soil samples were analyzed for nutrient concentration via the University of Georgia Soil, Plant & Water Analysis Lab in Athens. At the end of the growing season, yield, percent total sound mature kernels (%TSMK), and plant stand were evaluated. All data were subjected to Analysis of Variance and Fisher’s Protected Least Significant Difference test at p=0.05 for statistical means comparisons.
Results and Discussion

Although a large volume of data were analyzed, few analyses had significant differences between inoculated and non-inoculated peanuts, therefore the majority of the results and data to be discussed will focus on the cover crop effects. Also, only the 2-inch soil depth results will be displayed. For further information about the supplemental analyses not shown here, please feel free to contact the principal investigator of this project.

Treatment comparisons that are significantly different are followed by a different letter. For figures with multiple dates, only dates with significant differences among treatment means have a letter next to them. If no letters are present, then there were no significant differences among treatments for the given date.

Peanut Yield, Grade, and Stand at Harvest

There were no significant differences in yield (Fig. 1), grade (Fig. 2), or plant stand (Fig. 3) based on cover crop effect. Thus, according to these data, peanuts can be produced equally as well in strip-till regardless of whether the preceding cover crop is crimson clover, rye, or wheat. It should be noted that continuous cropping of legumes can lead to pest outbreaks and nutrient management issues in the long run. However, these results show there is not an immediate decline in peanut production from following a legume with a legume, so use of crimson clover as a cover crop prior to peanut can be an occasional option.
Breakdown of cover crop residues occur most rapidly early in the season when there is regular tractor activity in the field (Fig. 4). This consistent field traffic from strip-till, planting, and spraying operations causes cover crop residue in the tractor tire row middle to be pulverized, giving more surface area for soil microorganisms to decompose the material. Using two-row equipment maximizes the number of passes through the field and should increase the rate of decomposition compared to use of four row or larger equipment. The increase in cover crop residue on the Aug. 28 sampling date (Fig. 4) is likely due to experimental error (varying cover crop density, personnel collecting samples, etc.). It is not a result of re-growth of cover crop material.

The only significant differences for peanut vegetation and pods among cover crop treatments occurred early in the season when vines or pods were still small (Figs. 5 and 6). In each of those cases, peanuts in the rye plots were statistically larger than in either wheat or crimson clover plots. However, this effect did not continue and no differences were observed as plants and pods increased in size. Peanut roots also only had a difference on one date (Aug. 28), where crimson clover plots had the most roots by weight (Fig. 7), which may be linked to early uptake of N released from crimson clover compared to the immobilization of N by small grains. Yet, there were no differences as plants reached maturity.
**Nutrient analyses**

Nutrient analyses results were prepared based on how the data was received from the lab. Thus, soil nutrients are expressed in pounds/acre (lb/ac) and plant tissue nutrients are displayed as a concentration (% or ppm). Calcium, P, and K were determined by a Mehlich-1 extract. Total nutrient content is not expressed here, but is determined by multiplying biomass (dry matter) x nutrient concentration.

**Ca**

![Graphs showing nutrient cycling in peanut fields with different cover crops.](image)

Calcium is typically the most yield limiting nutrient in peanut farming. A deficiency can result in shrunken or non-existent kernels within pods, commonly referred to as “pops”. Runner peanuts need a soil Ca level of approximately 500 lb/ac to avoid deficiency. This experiment resulted in soil Ca levels in excess of the minimum requirements at all times during the trial (Fig. 8; no supplemental Ca was applied). The more rapid breakdown of crimson clover residue (Fig. 4), coupled with higher concentration of Ca in the tissue of the crimson clover (Fig. 9) contributed to keeping soil Ca level higher in crimson clover plots compared to rye or wheat. However, there were only differences in peanut vegetation Ca on Aug. 28, with peanuts following crimson clover having higher Ca concentration (Fig. 10). Pods had higher Ca concentration growing in rye residue on Aug. 28 (Fig. 11). Although, there were no differences in Ca concentration in peanut vegetation or pods regardless of cover crop at harvest.
Potassium deficiencies are rare in peanuts, especially when rotated with fertilized crops, as is the case in most peanut producing areas. The soil K level in this field was considered high throughout the course of the experiment (Fig. 12), and there were no statistical differences in the K level among cover crop effects during the growing season. Potassium level can get too high and a ratio of at least 3:1 Ca:K should be maintained in soils. Potassium concentration in cover crop tissue declined sharply after planting (Fig. 13). Since K is a mobile element, it appears to be leaving the cover crop tissue and being taken up by the peanut plant rapidly, as seen in the high concentration of K in peanut vegetation as early as July 6 (Fig. 14). The K concentration in both the soil and peanut vegetation declines as pods begin to develop (see Aug. 2 data in these figures), with high concentration of K in the early pod development stages (Fig. 15). However, the concentration of K in pods declines as pod fill and growth occurs, as the soil K levels begin a slight but steady increase for the remainder of the growing season. The amount of K removed by pods is rather low, and the majority of K is returned to the soil, especially if vines are left in the field upon harvest.
There are few reports of peanut yield response to Mg, even with extremely low soil Mg levels. Similar to K, soil Mg will typically be adequate when peanut is grown in standard crop rotations, as the peanut plant is highly efficient at utilizing available Mg. Also, Mg can get too high in the pegging zone, and some work has been done to relate Ca:(K + Mg).

No significant differences were observed in soil Mg levels (Fig. 16) throughout the season. Concentration of Mg in cover crop residue declined and then increased later in the season (Fig. 17). Peanut vegetation and pods both saw a decrease in Mg concentration for most of the season (Figs. 18-19). This dilution in concentration of mineral elements is common when there is an adequate supply of the mineral early on and the plant does not require supplemental amounts as the plant grows.
Nitrogen is the most mobile of all plant nutrients, which makes it difficult to get an accurate soil measurement. Since crimson clover is a legume and rye and wheat are grass crops, it is not surprising that the plant tissue analyses of the cover crops resulted in higher N concentration in crimson clover (Fig. 20). Since peanut is also a legume, it fixes it’s own N. Therefore, there were almost no differences in peanut vegetation and pod concentrations of N regardless of cover crop (Figs. 21-22). There was also an interaction effect for peanut vegetation N on July 6, with higher N concentration in non-inoculated peanuts in crimson clover residue. That same interaction showed higher N concentrations in inoculated peanuts in rye and wheat plots. Otherwise, there were no differences in N concentration for peanut vegetation or pods based on inoculation treatment.
Phosphorous is required in small amounts by peanuts since it is a good scavenger with a deep taproot, and P is usually only deficient in soils that have never been fertilized. Although there was significantly more soil P where crimson clover residue was decomposing for most of the season (Fig. 23), these soils were considered to be in the “Very High” range for peanut requirements for all treatments. When there is an adequate supply of P available, there is no benefit to having more than is needed. There was a higher concentration of P in crimson clover residue on two sample dates (Fig. 24), although there were no relevant differences in P concentration for peanut vegetation or pods (Figs. 25-26), aside from a lower concentration of P in remaining peanut vegetation at harvest.
Boron deficiencies may occur on weathered deep sandy soils, and usually do not result in yield decreases, but can cause kernel damage known as "hollow heart", affecting quality and grade. It is often recommended to apply 0.5 lb B/ac as a foliar application with early fungicides, but no supplemental B was applied in this test to determine the effect of residual B from cover crop decomposition. The concentration of B in cover crops was similar to the results of P, with crimson clover residue having higher concentrations on two sample dates (Fig. 27). Coupled with a more rapid breakdown of crimson clover tissue (Fig. 4) supplying more nutrients to the soil earlier in the season, there appeared to be an effect on B concentration in peanut vegetation in this study, with peanuts following crimson clover accumulating higher concentrations of B than wheat (on one date), and especially rye (on three dates) (Fig. 28). Yet, this did not translate to the pods, as there were no differences in B concentration among the cover crop treatments (Fig. 29).
Manganese deficiency is uncommon in peanut production when pH is at a normal level. Increasing pH will cause Mn to become less available and lowering pH causes Mn to become more available. If a soil has been limed, Mn may be less readily available and could require fertilization (low rates of foliar applied Mn fertilizer have been just as effective as much higher soil-applied rates). Leaf concentrations less than 20 ppm may result in deficiency symptoms. Few differences were observed in Mn levels in this study, and there was no distinguishable pattern to the differences (Figs. 30-33). However, cover crop residues increased in Mn concentration, meaning it is not being rapidly released as the cover crops decompose.
Zinc deficiencies may occur in high pH soils, low organic matter, high P, and high bulk density. They also tend to appear more readily in low soil temperatures (under 68 F). Since Zn moves slowly, accumulation leading to toxicity can become an issue. These data were well within the sufficiency range for soil and plant tissue. There were no differences in soils among cover crop treatments (Fig. 34). Crimson clover did tend to have the highest concentration of Zn compared to wheat (on three dates) and rye (on one date) (Fig. 35). But, there were no differences in concentration of peanut vegetation or pods on any date (Figs. 36-37).