BAHIAGRASS IMPACTS ON COTTON IN A PEANUT/COTTON ROTATION
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Abstract

Many years of research and long term rotation plots have documented the value of native perennial grasses on crop yield and soil quality. These same studies show that organic matter and nitrogen decreased for 80-100 years while in an annual cropping systems before leveling off. At the same time fertilizer rates had to be increased to make up for this nitrogen deficit to maintain yield. Research shows that this same benefit can be gained from perennial grasses being rotated with annual crops. Bahiagrass is the main perennial grass grown in the Deep South and can be used in a peanut/cotton rotation. Our research has shown that bahiagrass in rotation with cotton will increase total cotton root biomass by 30-40% compared to cotton in the peanut/cotton rotation and results in an increase in above ground biomass of 50-60%. Perennial grass had a positive impact on water infiltration, lowered soil mechanical resistance, increased LAI and plant biomass, and increased deep soil moisture. With all of the positive impacts on the soil and growth of the cotton plant, yields were not significantly higher in any of the years 2004-2006 but had a tendency to be higher each year while peanut yields were significantly higher every year in the grass system. Further research is needed to determine management needs of cotton after bahiagrass to confer improved plant growth into yield.

Introduction

Farming has always been a risky business due to uncertain weather conditions along with pests and low or varying prices received for the commodity and high input costs. Growers need a way to diversify, lower production costs, and enhance environmental stewardship while increasing yields. A perennial grass in rotation with annual cash crops has been shown to do all of the above and may be one of the magic bullets to help reduce greenhouse gas emissions. Conservation tillage has been a practice that has help to lower production cost and has been accepted by the farming community as a standard practice on many farms due to its many benefits. However, crop yields and production costs have not been changed significantly. The importance of crop rotation as a way to improve soil conditions, reduce disease and pests, increase yield and improve farm sustainability is well documented. Peanut and watermelon growers have long preferred to plant after bahiagrass due to enhanced yield and quality of the crop. However, most growers say that they have not figured out how to implement bahiagrass in their normal farming system economically on rented land. Many have pointed out (Reeves 1997) soil health benefits of perennial grasses. Results of research has shown improved soil water infiltration, reduced nitrate and ammonium leaching to ground water, higher earthworm population densities (Katsvairo et al. 2006; Wright et al. 2004). An important component in the success of the bahia grass rotation with other crops is the ability of the bahiagrass roots to penetrate the compaction layer. The roots of the subsequent crops can explore deeper soil profiles and hence mine nutrients and moisture from deeper soil layers. In addition, more moist soils and better water infiltration rates are enhanced with perennial grasses in the system.

Even though climate is conducive to multi-cropping and many crops can be grown, soils of the Coastal Plain have a natural compaction layer that starts at 15-20 cm depth and extends to about 30 cm deep which severely restricts root growth for crops in the southeast (Kashirad et al., 1967; Campbell et al., 1974). Unless deep tillage is done to loosen up these soils, following crops have shallow roots and then the crop become susceptible to even the smallest amount of moisture stress under the sandy conditions. Elkins et al. (1977) reported that perennial grasses such as bahiagrass and Bermuda grass can develop a deep root system which penetrates through the compaction layer. When the roots die, they decay and leave root channels which impact many positive attributes to soils structure and health.
and improved pore size as well as channels for following crop roots to follow (Elkins et al. 1977; Long and Elkins, 1983; Wright et al., 2004). Elkins et al. (1977) calculations showed that a plant with a rooting depth of 15 cm could experience water stress after only 3 days without rainfall. However, if the rooting depth was 152 cm, the plant would not experience water stress for a month after rainfall. Perennial grasses have deeper roots and would therefore need less irrigation water than more shallow rooted crops and can have a major impact on water availability of following crops.

Wright et al. (2006) reported mixed results for cotton yield in sod based vs. the conventional peanut/cotton rotation in Florida. They attributed the lack of clear differences between the rotations to confounding effects of N in the new system. N uptake is closely tied to root proliferation, with the larger and extensive rooting system likely to result in greater N uptake. At the same time root development can be a function of rotation used.

Our objectives were to determine rotation influence on cotton growth and factors that contribute to growth under different rotations.

**Materials and Methods**

Two rotation studies were initiated in Quincy, FL in 2000 to determine if introducing bahiagrass, a perennial grass, to the conventional peanut/cotton rotation caused differential growth patterns and result in yield increases as noted with peanut. The rotations for the first study were cotton-peanut-cotton-cotton (C-P-C-C) in respective years vs. the commonly used rotation of bahiagrass-bahiagrass-peanut-cotton (B-B-P-C).

Cotton was grown each year using cover crops and conservation tillage as recommended by the Florida extension service. LAI was determined with a LI 2000 Licor instrument and chlorophyll readings were made periodically through the season to determine crop growth in the different systems. Plant heights were taken near harvest followed by harvest and ginning of cotton samples.

**Results and Discussion**

In 2003, cotton in the bahiagrass rotation had larger root systems by 30-40% including diameter, length, and width. This also occurred in 2004. As a result of this a larger biomass or total top growth was found in comparison to cotton in the conventional systems (peanut/cotton rotation). While there were no differences in N concentration between the rotations, the cotton in the sod rotation had the higher total N uptake which was probably due to larger root systems. This is just a further indication of a more robust plant and probably able to withstand stress conditions than plants in the conventional rotation.

In 2005, there was not the difference noted as there was between the rotations as in both 2003 and 2004. LAI, plant growth, and yield were similar for cotton in the bahiagrass rotation or in the cotton/peanut rotation for 2005. However, yields were very high (3 ½ bales per acre) in 2005 as noted in Figure 1 below. Nitrogen uptake was similar for the bahia rotation and the first year of cotton after peanut but was lower for the second year of cotton after peanut in the conventional rotation (Fig. 2). This is probably due to the smaller root system noted in the conventional rotation as compared to the bahia rotation.
In 2006 chlorophyll readings as well as LAI measurements were taken weekly to determine if nitrogen may be a limiting factor in the bahiagrass system since it was noted in the previous years that higher uptake occurred in that system. There was no indication that nitrogen was limiting in any of the cotton and levels in all of the systems were similar (Figure 3).

As in each of the previous years (2003-2005) there was no significant difference in cotton yield even though plant height and LAI was significantly higher for the bahiagrass rotated cotton (Figure 4). However, as in 2 of the previous 3 years there was a tendency for the cotton following peanuts in the bahiagrass system to have higher...
yields. This is thought to be due to less stress on the plant during the season due to better soil health (moisture, less compaction, etc). Yield of cotton immediately after peanut in the bahiagrass rotation was almost 200 kg/ha higher than for cotton following cotton in the peanut/cotton rotation in 2006 but was not significantly different from the other treatments.

Fig. 4 Cotton lint yield in three rotations in 2006

Conclusion

Bahiagrass increased each of the parameters that are considered healthy soil aspects of the bahiagrass rotation as compared to the peanut/cotton rotation. Cotton in sod rotation had bigger root biomass as compared to cotton in the traditional peanut cotton rotation. In 2004 LAI and other growth parameters were higher for the bahiagrass rotated cotton than the cotton/peanut rotation. Perennial grass had a positive impact on water infiltration, lowered soil mechanical resistance, increased LAI and plant biomass, and increased deep soil moisture. With all of the positive impacts on the soil and growth of the cotton plant, yields were not significantly higher in any of the years but had a tendency to be highest yielding each year. However, economics of the system look better when you include the higher average yield of the cotton in the bahiagrass rotated system and add benefits from cattle and from 30-50% higher yields of peanuts in this rotation as compared to the traditional peanut/cotton rotation. The Southern Conservation Tillage Conference will be held in Quincy, Florida on June 25-27, 2007 and will highlight the sodbased rotation with talks and field demonstrations.

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References


