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IMPACT OF WINTER ANNUAL GRAZING AND CONSERVATION TILLAGE ON SOIL PROPERTIES AND CROP PRODUCTIVIY IN A COTTON-PEANUT ROTATION IN THE COASTAL PLAIN

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Abstract

Soils of the southern USA are often degraded, with low soil organic carbon (SOC) content. Soil management strategies that improve soil quality include conservation tillage, cropping intensification, and inclusion of sod-based rotations. Crop rotation is critical to cropping intensification and has long been recognized as being agronomically and economically beneficial. Short-term forage rotations with row crops not only offer reduced economic risks for producers but also could increase SOC, improving soil quality and productivity and enhancing profitability for producers.

Recent research in Alabama found that contract grazing of stocker cattle in winter-early spring (100 to 140 days) offers returns from $70 to $225 acre^{-1}. Such a system is ideal for small farmers with limited capital and offers potential for added income for producer's doublecropping cotton (*Gossypium hirsutum* L.) behind winter grazing of annual pastures. However, winter-annual grazing may result in excessive soil compaction, which can severely limit yields. While in-row subsoiling at planting is frequently used to alleviate soil compaction for cotton grown on sandy coastal plain soils, tillage requirements for cotton following winter-annual grazing have not been researched or developed.

This experiment was conducted between 2000 and 2003 at the Alabama Agricultural Experiment Station's Wiregrass Research and Extension Center in southeastern Alabama. The soil was a Dothan loamy sand (Plinthic Paleudults). Winter forage and tillage system were evaluated in a strip plot design with four replications. Winter forage (main plots) were oat (*Avena sativa* L.) and ryegrass (*Lolium mutiflorum* L.) planted with a no-till drill. Grazing was continuous as contract grazing from January to April at a stocking rate of two head/acre. Duplicate plots were divided for peanut (*Arachis hypogaea* L.) and cotton and rotated each year. Tillage systems for cotton (subplots) included: moldboard with disk leveling, chisel and disk; and non-inversion deep tillage (none, in-row subsoiling or paratilling) with and without disking. We evaluated soil strength and infiltration in 2003, and soil organic carbon initially in 2000 and at the end of the study in 2003. Animal daily gain, seed cotton yield and net cash return were evaluated for 2001, 2002 and 2003.

Forage species did not affect soil strength. Strict no-till presented the highest soil strength, and soil compaction was reduced with deep tillage (in-row subsoiling or paratilling tillage). Conventional tillage (chisel + disk) presented lower soil strengths in the first 12-in depth (range 4-16 bars). On average, infiltration from a sprinkling infiltrometer was 11% greater following oat than ryegrass. Strict no-tillage had the lowest infiltration percentage of water applied (36 and 37% for oat and ryegrass, respectively), but non-inversion paratilling increased infiltration in no-tillage to 86 and 78% for oat and ryegrass, respectively. There was little difference in total SOC among treatments, however, SOC was stratified in the 0-2 cm depth with no-till and deep tillage + no-till, suggesting an improvement in soil quality due to increased surface SOC.

Cotton lint yields were affected by years, forage species and tillage systems. Cotton yields were on average 6% greater following oat than ryegrass (3262 and 3068 lb seed cotton acre^{-1} for oat and ryegrass, respectively). Strict no-tillage (2458 lb seed cotton acre^{-1} averaged over forages and years) resulted in the lowest seed cotton yields (24% less than the mean) for both species and non-inversion subsoiling (in-row subsoiling or paratilling) was necessary to maximize yields.

Net returns from winter-annual grazing were between $64 to $83 acre^{-1} year^{-1}. There were no differences between oat and ryegrass in net returns ($80 and $73 for ryegrass and oat, respectively). The top 10 varieties in the early season non-irrigated

cotton variety trials at the Experiment Station averaged 2656 lb acre^{1}seed cotton for the period 2001-2003. This compared to an average of 3165 lb seed cotton acre^{1} for the same years in our study, demonstrating that doublecropping cotton following grazing is an excellent way for cotton producers to diversify operations and improve income.

In conclusion, integrating winter annual grazing with cotton in the Coastal Plain can be achieved using non-inversion deep tillage following oat in a conservation tillage system without decreasing cotton yield, providing producers extra income while protecting the soil resource.