STARTER FERTILIZER AND THE METHOD AND RATE OF POTASSIUM FERTILIZER EFFECTS ON COTTON GROWN ON SOILS WITH AND WITHOUT WINTER GRAZING BY CATTLE

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Abstract

A three year field study was conducted on a Decatur silt loam (Rhodic Paleudult) in north Alabama. The objective of the study was to evaluate the effects of winter grazing on the K and starter fertilizer needs of cotton (*Gossypium hirsutum* L.). Grazed and non-grazed treatments were established by planting a wheat (*Triticum* spp.) cover crop in the fall and allowing cattle to graze for 35 to 65 days prior to planting using a strip-tillage system. After grazing, fertility treatments were established in the killed wheat. Fertility treatments consisted of 3 rates of K (0, 40, and 80 K_2O/acre), 3 methods of K application: 1) surface broadcast, 2) in-row, band application at a depth of 12 inches, and 3) surface band application using a spacing of 20 inches and two rates of starter fertilizer: 1) no starter, and 2) 150 lb/acre of a liquid 15-15-0. Seed cotton yields were affected by grazing of the winter cover crop prior to planting but not by the method of K fertilizer application. Starter fertilizer consistently gave slightly higher yields with a significant response occurring in two out of three years.

Introduction

In Alabama there are over 400,000 acres of winter annuals that are grazed prior to the planting of summer row crops. Field tests conducted in North Alabama have shown that grazing by cattle will affect the tillage requirements for cotton. Yield reductions in cotton due to grazing have been associated with soil compaction caused by the grazing animals. In one field test visual, late season symptoms of K deficiency were most prevalent in cotton following winter grazing. Little if any information is available to evaluate cotton response to starter or K fertilizer when following winter grazing by cattle.

A field study was initiated in 1989 at the Tennessee Valley Substation located at Belle Mina in North Alabama. Objectives of this three year field study were to 1) compare efficiency of deep banding of K fertilizers with broadcast applications on the soil surface, 2) determine if the method of K application will influence the need for starter fertilizer, and 3) to determine if winter grazing influences the need for starter fertilizer and deep banding of K fertilizer.

Materials and Methods

A field study was located at Auburn University's Tennessee Valley Substation located in the Northern tier of Alabama. Soil within the test areas was mapped as a Decatur silt loam (Rhodic Paleudults). Each year a new location was chosen. Soil pH of the sites was 6.2, 6.2 and 5.7 in 1989, 1990, and 1991, respectively. Cation exchange capacity was 10, 11 and 8.5 meq/100 g in 1989, 1990 and 1991, respectively. Organic matter was 1.5, 1.5 and 1.6% in 1989, 1990, and 1991, respectively. Soil test ratings for P and K were medium to high based on the dilute double acid extractant.

The experimental area was planted to wheat in the fall. Cows and calves were placed within the "grazed" area and allowed to graze the wheat for periods of 65, 41 and 35 days in 1989, 1990, and 1991, respectively. The cattle were given access to the experimental areas in late January or early February and removed in early April. Wheat in the gazed and ungrazed areas was killed with paraquat prior to the application of fertilizer treatments.

Treatments consisted of rates of K, methods of K application and rates of starter fertilizer. Three methods were used 1) broadcasting after chiseling with a Brown-Hardin Ro-Till, 2) Band applied approximately 12 inches deep on 20 inch centers behind the chisel of a Brown-Hardin Ro-Till, and 3) dribbling on 20 inch centers after chiseling with a Brown-Hardin Ro-Till. Potassium was applied at rates of 0, 40, and 80 lb/acre K_2O. Fluid K fertilizer was made by mixing reagent grade KOH and water. The volume rate of application was 20 gallons/acre. Starter fertilizer treatments consisted of no starter and 150 lb/acre (i.e. 15 gallons/acre) of a 15-15-0. The starter also supplied 10 lb S/acre, 3 lb Zn/acre, and 0.5 lb B/acre. The starter was made by mixing a 32-0-0 solution with ammonium polyphosphate and water. Plots were 40 feet long and 26.6 feet (8 rows) wide. Additional N was applied at a rate of 90 lb/acre. Within a grazing treatment, fertility treatments had a factorial arrangement within a randomized complete block design with 4 replications.

Fertilizer treatments were applied and cotton planted on 21 April, 20 April, and 24 April in 1989, 1990, and 1991, respectively. "Delatpine 50" was planted with a John Deere planter using a seeding rate of 7 seeds/foot. In 1990, there was severe seedling damage shortly after emergence due to wind blown sediments. As a result of this wind damage the experimental area was replanted on 25 May. At maturity, the two center rows of each plot were picked using s spindle picker for yield determinations. During 1990, rainfall was 44% below the 30 year average rainfall for the months of July through September (Table 1). In 1991, the dry months

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were June and July. The rainfall received during these two months was 54% below the 30 year average.

Results and Discussion

Cotton following winter grazing by cattle produced lower yields as compared to the ungrazed areas in 1989 and 1991 (Table 2). Grazing during these two years resulted in an average yield reduction of 14% as compared to the ungrazed areas. In 1990, the grazed area produced the highest yields.

Seed cotton yields for both grazing systems were not affected by the method of fluid K fertilizer application (Table 3). Yields of cotton following grazing by cattle were not affected by the rate of K (Table 4). In 1989, the application of 40 lb K_2O/acre to the ungrazed area increased seed cotton yields by 303 lb/acre whereas the response obtained in 1990 was 323 lb/acre. Increasing the rate above 40 lb K_20/acre did not result in any further increases in seed cotton yields. During 1991, the application of K to the ungrazed system resulted in a yield decrease.

In general, starter fertilizer under the grazed system tended to increase seed cotton yields during all three years of the study (Table 5). For the ungrazed system the application of starter tended to increase cotton yields during 1989 and 1991. A significant increase in yields due to starter was obtained in 1989 and 1991.

Summary

Seed cotton yields were decreased during 2 years of this 3 year test when cotton was planted following a winter cover crop that had been grazed by cattle. During the two years that a yield reduction was observed, winter grazing reduced yields by an average of 14%. A reduction in seed cotton yield due to winter grazing was attributed to soil compaction. Penetrometer readings showed that the cattle had compacted the surface soil to a depth of approximately 6 inches.

Seed cotton yield did not respond to the method of K fertilizer application (broadcast, dribble, deep banding) during either year of the test. A response to the rate of K was obtained only for the ungrazed system. During the first and second year of the test the application of 40 lb K_2O/acre under the ungrazed system increased seed cotton yields by an average of 313 lb/acre. This response was obtained on two different sites that were on the boarder between medium and high soil test ratings for K. In the third year of the test the application of K to the ungrazed system resulted in a slight yield decrease.

Except for the ungrazed system in 1990, the use of a multinutrient starter consistently gave slightly higher seed cotton yields. A significant response to starter was obtained in 1989 and 1991, during which seed cotton yields were increased by an average of 8.1%.

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Table 1. Rainfall received during the 1989, 1990 and 1991 growing seasons as compared to the long term average.

Month	1989	1990	1991	Long Term Average
	inches			
May	3.35	5.03	9.01	4.36
June	12.64	3.89	1.57	3.38
July	5.52	3.83	1.98	4.54
August	1.61	1.22	3.69	3.23
September	5.89	1.46	3.41	3.71
Total	29.01	15.43	19.66	19.22

Table 2. Seed cotton yields as affected by winter grazing by cattle.

Year	Grazed	Ungrazed
	lb/acre	
1989	1963	2327
1990	1933	1633
1991	1477	1654

Table 3. Seed cotton yields as affected by winter grazing by cattle an d the method of K fertilizer application.

Method	1989	1990	1991
	lb/acre		
Grazed System			
Broadcast	1986	1830	1489
Deep Band	1959	1971	1474
Dribble	1934	1997	1468
$LSD_{(0.10)}$	NS	NS	NS
Ungrazed System			
Broadcast	2232	1632	1658
Deep Band	2371	1633	1687
Dribble	2254	1634	1618
LSD(0.10)	NS	NS	NS

Table 4. Seed cotton yields as affected by winter grazing by cattle and the method of K fertilizer application.

K_2O Rate	1989	1990	1991
	lb/acre		
Grazed System			
0	1887	1966	1528
40	2044	1943	1476
80	1955	1888	1427
LSD(0.10)	NS	NS	NS
Ungrazed System			
0	2148	1416	1766
40	2451	1739	1559
80	2408	1744	1637
LSD(0.10)	213	NS	158

Table 5. Seed cotton yields as affected by winter grazing and by starter fertilizer (150 lb/acre of 15-15-0).

Starter.	1989	1990	1991
	lb/acre		
Grazed System			
Yes	2051a	1983a	1524a
No	1875b	1882a	1430b
Ungrazed System			
Yes	2361a	1586a	1718a
No	2293a	1680a	1590a