RESIDUAL NITROGEN EFFECTS IN A COTTON-CORN ROTATION

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Abstract

Cotton-corn rotation is a common practice in the mid-South but little is known about the year-to-year management of fertilizer and soil nitrogen (N) for this cropping system. A 5-yr field study was performed to determine the optimal nitrogen fertilizer rates for cotton and corn in rotation, including residual N following the respective crops at different N rates and yield levels. Experiments were conducted on Commerce silt loam and on irrigated Gigger silt loam. The treatments were cotton-corn rotations with 0, 150, 200 and 250 lb N/acre for corn and 0, 25, 50, 75, 100, and 125 lb N/acre for cotton. Residual cotton N increased corn yield only when no fertilizer N was applied to the corn and the cotton fertilizer N rate exceeded 75 lb/acre. Residual corn N increased cotton plant growth and yield when the cotton fertilizer N rate was 50 lb or less on Gigger silt loam and 75 lb/acre or less on Commerce silt loam. There was no yield response to residual corn N when the cotton fertilizer N rate exceeded 50 lb/acre on Gigger silt loam or 75 lb/acre on Commerce silt loam. The yield response of cotton to residual corn N was larger on Commerce silt loam than on Gigger silt loam. Residual corn N lowered the fertilizer N needed for optimal cotton yield by 30%. Most of the residual N from corn was not used by the following cotton crop, suggesting that residual corn N was not readily available for uptake by cotton.

Introduction

Rotation of cotton with corn has become a common practice in the mid-South. This cropping system typically increases cotton yield compared with continuous monocrop cotton (Boquet and Hutchinson, 1993; Ebelhar and Welch, 1989). Previous research that established the optimal N rates for cotton and corn production was limited to monocrop culture (Boquet et al., 1994; Ebelhar, 1990; McConnell, et al., 1993).

Residual N has been shown to be an important component of the total N supply of cotton when cotton is grown in monocrop culture (Boquet et al., 1995). The role of residual N in cotton-corn rotations, however, has not been well defined. The objective of this study was to determine the effects of fertilizer and residual N in a cotton-corn rotation, and establish the optimal fertilizer N rates for each rotational crop.

Materials and Methods

Field experiments were conducted from 1996 through 2000 on Commerce silt loam at the Northeast Research Station in St. Joseph and on irrigated Gigger silt loam at the Macon Ridge Research Station in Winnsboro. The N rates applied to corn were 0, 150, 200, and 250 lb/acre and to cotton N were 0, 25, 50, 75, 100, and 125 lb/acre. The corn N rates were on main plots, which were 24 40-inch rows 50 feet long. The cotton N rates were on subplots, which were four 40-inch rows 50 feet long.

Data were collected on plant growth variables, N concentration of plant tissues and yield. Treatment effects were determined by analysis of variance and treatment means were separated by the LSD test, p = 0.05.

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Results and Discussion

Corn

The optimal N rate for corn yield was 150 lb/acre in all years on both soil types. This was consistent with results from previous research (Mascagni and Burns, 2000). Cotton residual N had little effect on corn yield (Figure 1). Residual N from the cotton crop increased yield of the following corn crop only when no fertilizer N was applied to the corn and the cotton fertilizer N rate exceeded the optimal rate of 75 lb/acre. Under these conditions, the corn yield increase from residual cotton N was about 15 bu/acre.

Of the 150 to 250 lb/acre fertilizer N applied to corn, 75 to 90 lb/acre were recovered in the corn grain. Nitrogen not found in the grain and therefore not removed from the field (75 to 160 lb N/acre) was considered to be residual N potentially available for use by the following cotton crop.

Cotton

Residual N from the preceding corn crop affected cotton growth and yield. Significant yield interaction effects occurred between residual N, fertilizer N and soil type. On Gigger silt loam, residual corn N increased cotton plant growth and yield when the cotton fertilizer N rate was between 0 and 50 lb/acre (Figure 2). The yields obtained with 50 lb/acre fertilizer N + residual corn N were equivalent to the yields obtained with 75 lb/acre fertilizer N. With application of more than 50 lb N/acre, there was no yield response to the residual N left over from the previous corn crop. Even with the apparent high levels of corn residual N, there was no increase in yield above that obtained with application of the optimal fertilizer N rate only. Thus, the optimal fertilizer N rate where residual N was present was 50 lb/acre, with higher residual N resulting in higher cotton yields. Residual corn N lowered the fertilizer N needed for optimal cotton yield on Gigger silt loam by 30%. when corn received 150, 200 or 250 lb N/acre. Application of as much as 150 lb/acre excess N to corn did not carry over in sufficient quantity to supply all of the N fertility required by the following cotton crop

Cotton lint yields averaged about 200 pounds higher on the Commerce silt loam than on Gigger silt loam, despite the fact that the latter received supplemental irrigation. The yield responses of cotton to residual corn N were also larger than those obtained on Gigger silt loam. Similar to the Gigger soil, the optimal fertilizer N rate for cotton on Commerce soil was affected by the N rate applied to the previous corn crop (Figure 3). With application of fertilizer N rates of 0 to 75 lb/acre, cotton yields were increased by all residual corn N rates. When the fertilizer N rate applied to cotton was 50 lb/acre or less, cotton yields were higher following corn residual N rates of 200 and 250 lb/acre than 150 lb/acre. Thus, some of the excess N applied to corn was carried over to the following cotton crop. With application of 250 lb N/acre to corn, yields of the following cotton crop were optimized with application of only 25 to 50 lb N/acre. With application of 200 lb N/acre to corn, yields of the following cotton crop were optimized with a fertilizer N rate of 75 lb/acre. When cotton received more than 75 lb N/acre, there was no yield increase from residual N, regardless of the rate applied to the preceding corn crop.

Summary

Cotton produced in continuous monocropping on silt loam soils usually requires a fertilizer N rate of 75 lb/acre to optimize lint yield. Rotated with corn, optimal cotton yields on Gigger silt loam were obtained with a fertilizer N rate of 50 lb/acre. On Commerce silt loam, cotton following corn fertilized with 0, 150 or 200 lb N/acre required 75 lb/acre fertilizer N, to optimize yields, but yields at all N fertility levels were higher than on Gigger silt loam. Following corn fertilized with an excessive N rate of 250 lb/acre, cotton on Commerce silt loam benefited from residual N. Most of the residual N from corn was not used by the following cotton crop, suggesting that residual corn N was not readily available for uptake by

cotton. Excess N applied to corn did not carry over in sufficient quantity to supply all of the N fertility required by the following cotton crop.

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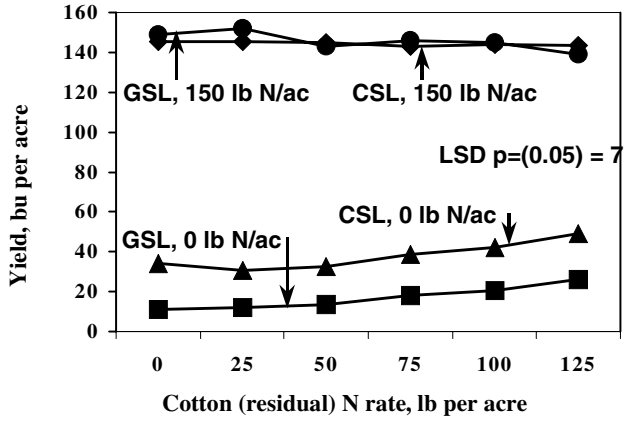

Figure 1. Corn yield response with 0 or 150 lb/acre fertilizer N to Cotton (residual) N rates of 0 to 125 lb/acre on Gigger silt loam (GSL) and Commerce silt loam (CSL), 4-yr avg.

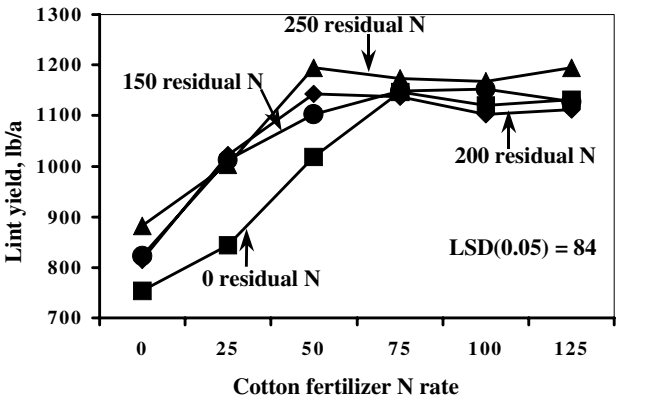

Figure 2. Response of cotton yield to fertilizer N rate, following corn (residual) N rates of 0, 150, 200 or 250 lb/acre on Gigger silt loam at Winnsboro, 4-yr. avg.

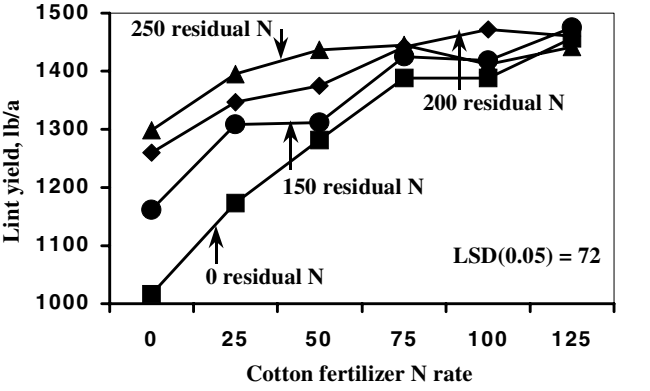

Figure 3. Response of cotton yield to fertilizer N rate, following corn (residual) N rates of 0, 150, 200 or 250 lb/acre on Commerce silt loam at St. Josephs, 4-yr. avg.