COTTON RESPONSE TO K AS INFLUENCED BY TILLAGE, VARIETY, AND SOIL

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Abstract

Throughout the mid-south and southeastern U.S. cotton growing regions, response to fertilizer K is well documented. With shifts to no-tillage and an array of available varieties ranging in maturity from early to full season, maximizing profitability relative to K fertilization is presenting new challenges. Research suggests greater soil K may be necessary for no-tillage especially on high cation exchange capacity soils. Overall, varieties ranging in maturity are responsive to increasing soil test K with early maturing varieties being more responsive in some situations. Lint micronaire generally increases with increasing K fertilization.

Introduction

Managing K availability in cotton production is essential to maximizing photosynthetic capacity and yield potential. To maximize profitability from K fertilization, growers should have an understanding of how management practices and varying soil conditions can influence yield and lint quality. Therefore, the objectives of this review are: 1.) Examine tillage, soil, and variety influences on cotton response to soil K and K fertilization, 2.) Explore reasoning for observed responses, and 3.) Justify K management strategies.

Physiological K Response

Cotton has a long history of responding to fertilizer K from the mid-south to the southeastern growing areas. The incidence of K deficiency continues in modern production in these areas. As cotton variety adoption shifted more towards early to mid-season types, questions in regards to K uptake rates and requirements have arisen as these varieties seemed to be more prone to K deficiency, especially once fruiting is initiated. Due to a shift in dry matter partitioning as a result of breeding more determinate cultivars (Bange and Milroy, 2004), K drawdown from plant reserves is rapid and evidenced with the expression of deficiency symptoms.

Research conducted at Mississippi State suggested a lack of response to K under conventional tillage management (Fig. 1). However, when tillage was eliminated the response to K was obvious on a Leeper silty clay loam soil. On a Marietta loam soil, yield responded to K fertilization under both tillage systems, but appeared to be more responsive under no-tillage (Fig. 2). On a Loring silt loam soil in Jackson, TN, a similar response to fertilizer K rates was observed (Fig. 3). No-tillage appeared to result in slightly greater yield benefit across the applied rates.

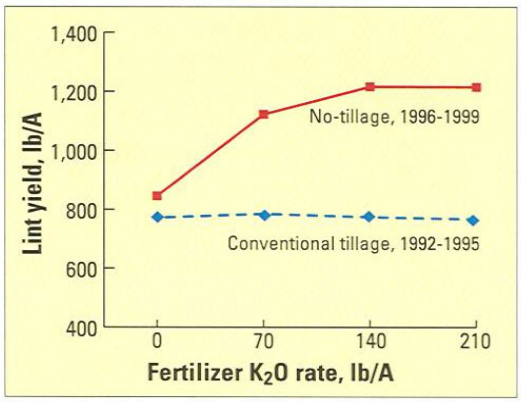

Fig. 1. Cotton lint yield response to fertilizer K rates and tillage on a Leeper silty clay loam at Mississippi State, MS (Varco, 2000).

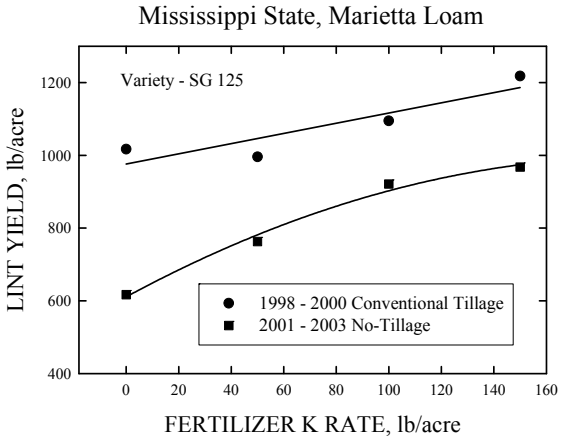

Fig. 2. Cotton lint yield response to fertilizer K rates and tillage on a Marietta loam at Mississippi State, MS.

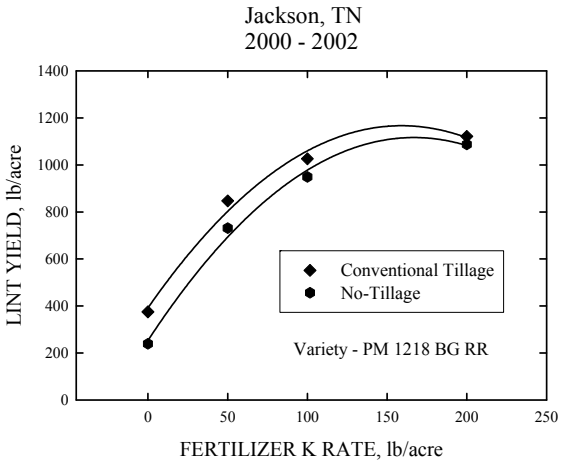

Fig. 3. Cotton lint yield response to fertilizer K rates and tillage on a Loring silt loam at Jackson, TN.

Improved water-use efficiency was apparent with no-tillage management at Mississippi State, MS (Fig. 4). With a decline in growing season rainfall, yield decline was most dramatic where no K was applied and with 70 lb K_2O/acre. At greater rates, cotton yield became less sensitive to variations in rainfall.

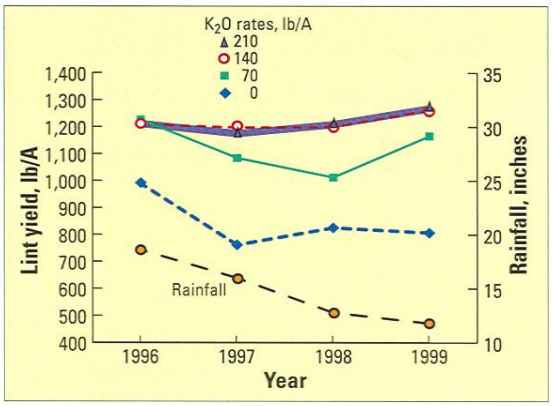

Fig. 4. Yearly lint yield response by no-till cotton to varying fertilizer K rates and rainfall on a Leeper silty clay loam at Mississippi State, MS (Varco, 2000).

Variety Effects

Variety response to varying soil test K levels is shown in Fig. 5. An early-mid season variety DP445 BG/RR was compared with the mid-full season variety DP555 BG/RR on a Marietta loam soil. The trends suggest that both varieties were highly responsive to soil test K levels with DP555 BG/RR showing greater yield potential across the range of soil test K levels in this soil. These results suggest that regardless of maturity, cotton is highly responsive to varying soil test K levels. In contrast, results for no-till cotton on a Loring silt loam soil suggest that the early season variety PM1218 BG/RR was more responsive to K fertilization in terms of yield and % 1st harvest (Table 1). Interestingly, DP555 BG/RR responded to the higher K rate with a reduction in % 1st harvest, but not in total yield. The high yielding conditions may have contributed to the differences observed here.

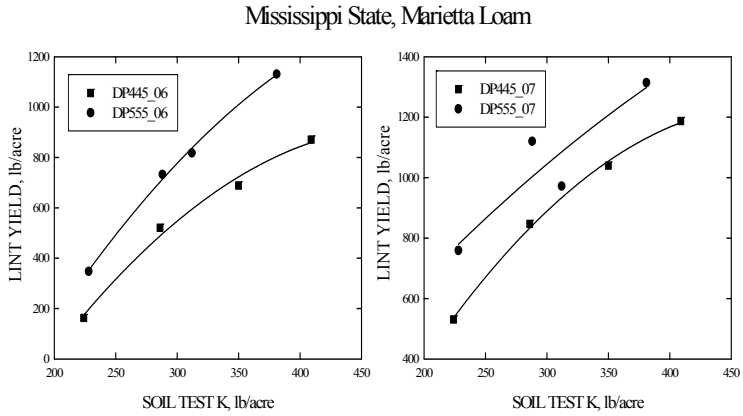

Fig. 5. Lint yield response to soil test level K in 2006 and 2007 as influenced by variety maturity.

Table 1. Percentage first harvest and lint yield response to fertilizer K rates as influenced by variety maturity on a Loring silt loam, Jackson, TN (Clement-Bailey and Gwathmey, 2007).

Variety	K Rate, lb/acre	% 1st Harvest	Total Lint Yield, lb/acre
PM 1218 BG/RR	50	89.9	1676
PM 1218 BG/RR	100	87.5	1846
DP 555 BG/RR	50	78.8	1869
DP 555 BG/RR	100	72.4	1877

Lint Quality Response

Potassium effects on lint quality was studied at two locations in Tennessee and Mississippi. Micronaire was most responsive to increasing fertilizer K rate as shown in Fig. 6. A price discount would have been applied when no K was applied at Ames Plantation regardless of tillage as micronaire values were less than 3.2. With respect to a discount due to excessive micronaire, 90 lb K/acre at Jackson, TN approached the upper limit of 4.9. A premium would have been received for some of the treatment rates at both locations in Mississippi and Tennessee. Overall it is apparent that increasing fertilizer K rate increases micronaire values.

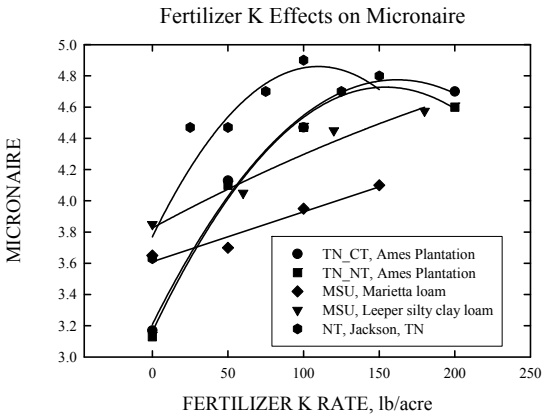

Fig. 6. Average micronaire response to fertilizer K rates for the years 2000–2002 on a Grenada silt loam at Ames Plantation, TN, 1998–2001 on a Marietta loam and 2000–2001 on a Leeper silty clay loam at Mississippi State, MS, and 2001–2003 on a Loring silt loam, Jackson, TN.

Summary

To avoid mid- to late season K deficiency, consider increasing fertilizer K rate when switching to no-tillage, and utilize soil and plant tissue in combination with up-to-date soil and plant tissue information. Address spatial issues as K deficiencies appear to be more localized in fields. Understand and know variety characteristics relative to K response, especially when it comes to quality. Varieties which tend to have a high micronaire will only be increased further with excessive K fertilization.

References

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