SENSITIVITY OF EARLY-MATURING VARIETIES TO POTASSIUM DEFICIENCY

G. R. Tupper, D. S. Calhoun,
and
M. Wayne Ebelhar
Agricultural Engineer,
Associate Agronomist,
and Agronomist
Mississippi Agricultural and Forestry
Experiment Station
Stoneville, MS

Abstract

Early maturing cotton varieties are more sensitive to potash deficiencies than late maturing varieties. Lint yields of the earliest maturing varieties were not maximized by yearly applications of 240 lb K_2O/A for 6 years. However, lint yield for the latest maturing variety was maximized with the 120 lb K_2O/A rate. Lint yield response to potassium generally increased with increasing earliness of varieties, as indicated by the reduced number of nodes above the uppermost first position cracked boll to the terminal for the earlier varieties.

Introduction

Potassium deficiencies in early maturing varieties have been noted for several years across the cotton belt by both producers and researchers (2, 3, 4, and 6). Lint yield was significantly increased by increasing both topsoil and subsoil potassium levels in a 5-year study at Stoneville as compared to increasing topsoil potassium levels alone (5). This paper will examine the effect of varietal earliness on yield response to applied potassium.

Materials and Methods

A non-irrigated experiment was initiated in 1990 at Stoneville, MS on a Bosket very fine sandy loam and Souva silt loam soil. The experimental design was a randomized complete block with 5 replications. Four rates of potassium (0, 120, 180, and 240 lb K_2O/A) were applied to the same plots in spring applications (50% surface broadcast and 50% deep banded) each year from 1990 to 1995 resulting in plots with a wide range of soil test K levels. Each year 120 lb N/A was applied preplant as urea-ammonium nitrate solution (32% N). Soil samples were taken after harvest from 0- to 6-inch and 6- to 15-inch deep in the drill. All soil samples were analyzed by the Mississippi Cooperative Extension Service (MCES) Soil Testing and Plant Analysis Laboratory at Mississippi State University. All potassium fertilizer treatments were expressed in lb K_2O/A and were repeated annually on the same plots. Muriate of potash (0-0-60) was used as the source of potassium.

Eight cotton varieties were selected ranging from very early to late maturities and planted in 1994 and 1995, after differences in soil test K levels had been established in the study. The varieties selected from very early to late maturities were: 'Stoneville 132' (St 132), 'Hartz 1215' (HZ 1215), 'SureGrow 125' (SG 125), 'Hartz 1330' (HZ 1330), 'Deltapine 50' (DP 50), 'SureGrow 501' (SG 501), 'Stoneville LA 887' (LA 887), and 'Deltapine 5415' (DP 5415). After defoliation, two rows of each plot (75 ft long) were spindle picked two times for yield determination. Representative samples of seed cotton were taken from each of the 32 treatments (replications combined) and ginned to determine lint percent. A small scale ginning system (20 saw gin stand) was provided by the USDA Ginning Laboratory at Stoneville for ginning the composite samples. The samples were ginned using the USDA recommended ginning machinery sequence with two lint cleaners. Data were subjected to analysis of variance and a 5% level of significance was chosen to separate means using Fisher's protected LSD procedure.

Results and Discussion

Prior to the initiation of the study, soil test potassium (K) levels were medium (M) in the 0- to 6-inch and low (L) in the 6- to 15-inch sample depths (Table 1). Soil test phosphorus (P) levels were high (H) at both sample depths.

Lint yields for the 2-year average are shown in Table 2. Applications of potassium significantly increased lint yields for all varieties. The two earliest varieties required the highest level of potassium applications (240 lb K_2O/A) to maximize yield. Deltapine 5415, the latest variety in the study, required the lowest potassium application level (120 lb K_2O/A) to maximize lint yield. All other varieties required the intermediate rate (180 lb K_2O/A) with the exception of SG 501 which produced the highest yield at the lowest potassium rate applied (120 lb K_2O/A). SureGrow 501 also produced the highest lint yield without potassium being applied.

Nodes above uppermost cracked boll (NACB) were used to estimate the relative earliness of the eight varieties. Lower NACB indicates earlier maturity. These data were taken from the Mississippi Cotton Variety Tests from Stoneville in 1994 and 1995, and Tunica in 1994 and averaged over the three locations/years (1). A regression curve representing NACB (relative maturity) and the highest average lint response obtained in 1994-1995 for the eight varieties is shown in Figure 1. An R^2 of 0.699 was significant at the 1% level for this relationship. As varietal earliness increased, (lower NACB) response to potassium increased.

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Figures 2 through 9 show the soil test K data (sum of 0"-6" plus 6"-15" soil test K) plotted against relative yield for 1994-1995. Relative yield is the yield of each plot divided by the highest plot yield each year times 100 to convert to percent. This allows one to put years together with the highest plot yield equal to 100% each year. TableCurve™ (Jandel Scientific Version 3.0) was used to select the best fit family of quadratic equations for each variety. The numerical values for A, B, and C in the equations in Fig. 1-9 are not listed in this preliminary report. Equations are listed to give the reader the general trend of the data and full analysis will be given at the end of four years. The figures are listed in order of variety maturity (NACB) from earliest to latest. In general, earlier maturing varieties required higher levels of soil test K to maximize lint yield and had higher levels of lint response to potassium applications. The data represent the first two years of a planned four year experiment. With two more potassium applications this data should show the soil test level needed to maximize lint yield under non-irrigated conditions for all eight varieties with this wide range in maturity.

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Table 1. Soil test values for soil phosphorus, potassium, and cation exchange capacity (CEC) prior to experiment initiation. Stoneville, MS 1990.[1/]

Soil sample depth	Available P level	Exchangeable K^+ level	CEC
(in)	(lb/A)	---------meq/100 g---------	
0-6	103 H	213 M	11.5
6-15	103 H	155 L	13.3

[1/]Soil samples were analyzed by MCES Soil Testing and plant Analysis Laboratory at Mississippi State University.

Table 2. Effect of split potassium applications on varieties, non-irrigated, 2-yr-avg (1994-1995).

	Annual **potassium applied (lb K_2O/A)**[1/]			
Variety	**0**	**120**	**180**	**240**
	----------------------lint yield (lb/A)----------------------			
St 132	709	758	872	899
Hz 1215	670	777	792	867
Sg 125	776	896	949	872
Hz 1330	646	730	744	675
Dp 50	748	843	872	823
Sg 501	833	949	889	854
La 887	755	844	878	776
Dp 5415	773	877	828	700
LSD (0.05) = 95				

[1/]Potassium applied each year 1990 through 1995 with 50% surface broadcast and 50% deep banded 6" to 15" deep in the drill.

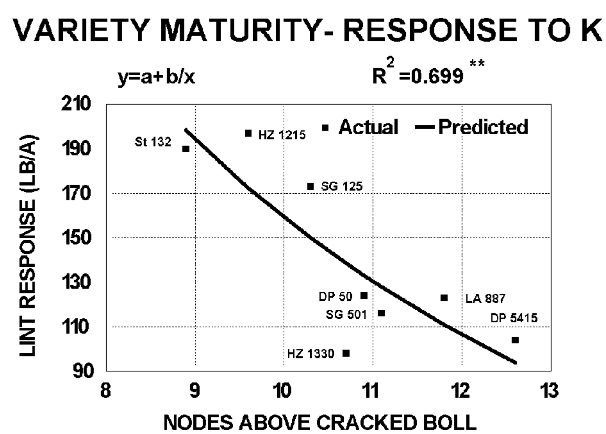

Fig. 1. Relationship of nodes above cracked boll to lint response from potassium, 1994-1995. (**=P≤0.01)

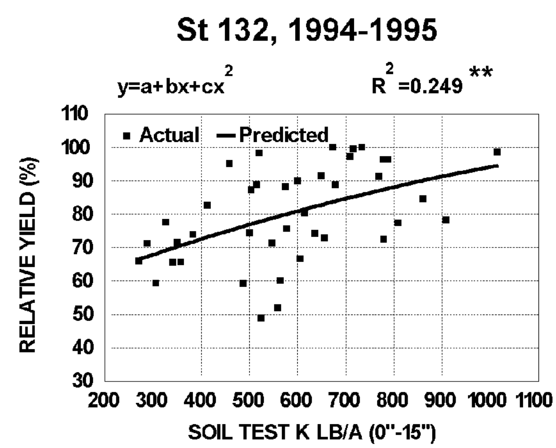

Fig. 2. Relationship of total soil test K (0"-15") to relative yield Stoneville 132 for 1994-1995. (**=P≤0.01)

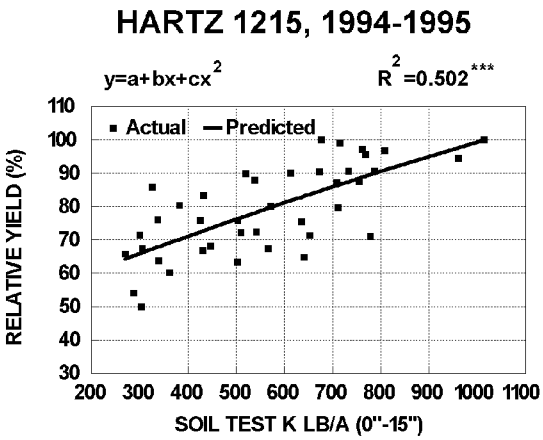

Fig. 3. Relationship of total soil test K (0"-15") to relative yield of Hartz 1215 for 1994-1995. (***=P≤0.001)

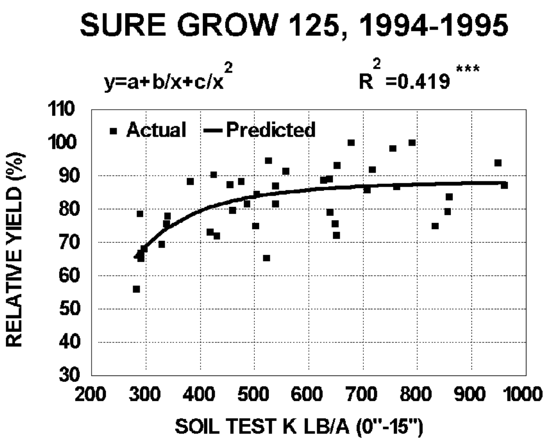

Fig. 4. Relationship of total soil test K (0"-15") to relative yield of SureGrow 125 for 1994-1995. (***=P≤0.001)

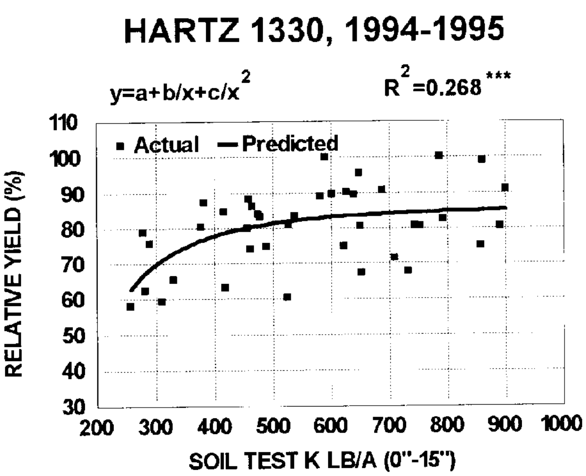

Fig. 5. Relationship of total soil test K (0"-15") to relative yield of Hartz 1330 for 1994-1995. (***=P≤0.001)

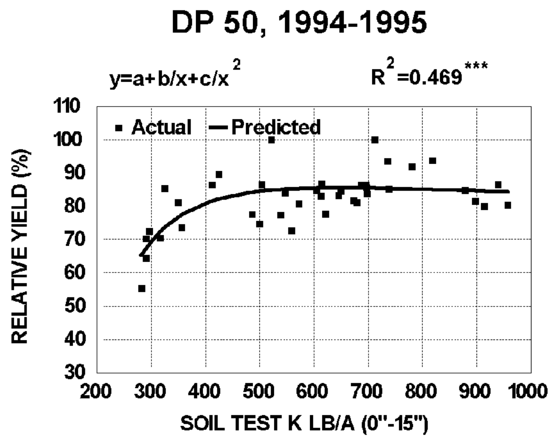

Fig. 6. Relationship of total soil test K (0"-15") to relative yield of DP 50 for 1994-1995. (***=P≤0.001)

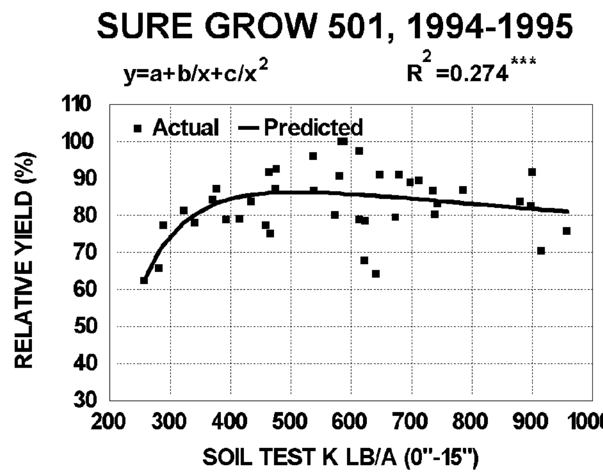

Fig. 7. Relationship of total soil test K (0"-15") to relative yield of SureGrow 501 for 1994-1995. (***=P≤0.001)

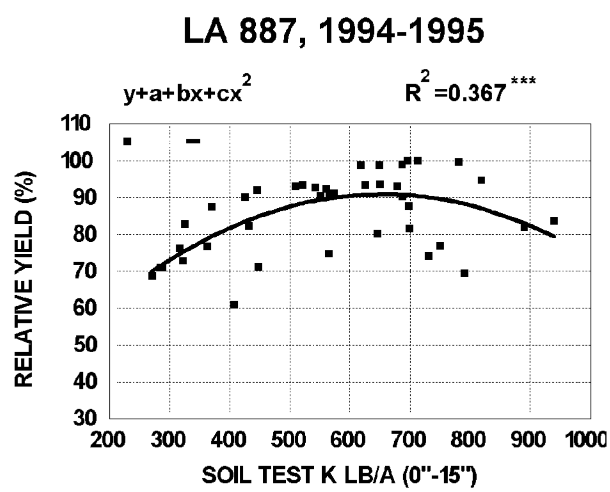

Fig. 8. Relationship of total soil test K (0"-15") to relative yield of LA 887 for 1994-1995. (***=P≤0.001)

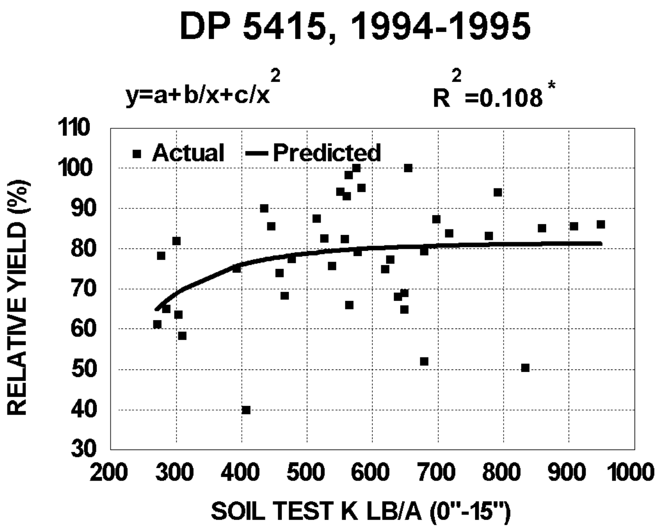

Fig. 9. Relationship of total soil test K (0"-15") to relative yield of DP 5415 for 1994-1995. (*=P≤0.05)