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RESPONSE OF MODERN COTTON VARIETIES TO MID-SEASON POTASSIUM FERTILIZATION

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Abstract

Six potassium treatment combinations were evaluated. Treatments were twenty-five pounds of K applied preplant and a control. Foliar application of five pounds at first square and the untreated control were evaluated in both combinations of preplant fertilizer. Five pounds of foliar K at peak bloom was applied and the untreated control in the treatments that received an earlier foliar application of K. The results supported the soil test recommendation of twenty-five pounds of potassium per acre. The data did not support the foliar application of potassium.

The varieties responded as expected except that BXN47 had much lower levels of petiole potassium than its close relative, STV474.

Introduction

Cotton is an important crop in Southeast Missouri and the relatively short growing season encourages producers to plant cotton varieties that mature quickly. These varieties achieve maximum yields by setting relatively greater number of bolls in a shorter time. This increased boll load per day requires that nutrients be available to the plant in greater rates per day. Potassium is an essential nutrient for cotton production because it is involved in maintaining plant water status, cell turgor pressure, and controlling the opening and closing of stomata. The opening of the stomata controls the availability of CO_2 and potassium has an indirect control over photosynthetic activity. Potassium is also involved in cellulose synthesis. Eighty-five percent of K movement in the soil is by diffusion. Since diffusion is a relatively slow process, K fertilization is required to maintain high levels of exchangeable K. Rapid plant growth and uptake may deplete K around the root surfaces. During peak flowering a cotton crop may require 3 to 4 lbs. of K per day and this may be larger than Southeast Missouri soils are capable of supplying.

Methods and Materials

A cotton study was conducted on a field at the University of Missouri-Delta Center Lee Farm (36°N, 89°W) in Pemiscot County, Missouri in 2001. The eight varieties of cotton were planted on a Tiptonville silt loam soil on May 8, 2001. Soil samples of the study area were collected from the 0 to 15-cm depth before planting. The soil test recommendation for K for this area was for a maintenance fertilization of 25 lbs./a of K_2O. Forty-two lbs./acre of KCl was applied on April 23, 2001 to plots scheduled for pre-plant K. The nitrogen recommendation was 100 lbs. N/a. Urea-Ammonium nitrate 32% liquid fertilizer was applied in a ¼ at planting and the remainder applied at first-square (June 18). Other than potassium fertilization the standard practices for cultivating dry land cotton in Southeast Missouri were employed.

The experimental design was a split plot with potassium treatment as main plot with variety as the sub-plot. The main plot K treatments are listed in table 1. These applications were made using a Schwiess 4 row self propelled high clearance sprayer on July 20 And July 31, 2001. The cotton varieties were STV 373, DP 1218BR, FM 958, FM 819, DP 436RR, PSC 355, STV 474, and BXN 47.

Plant height was measured three times during the growing season, 7-13, 8-3 and 9-20-2001. Average Node Above White Flower was determined on 8-3-2001. A boll count was conducted on 9-20-2001. Cotton petiole samples were collected from the fourth fully expanded leaf down. These samples were collected following each potassium application. The petioles were dried, ground, digested using H_2SO_4 and H_2O_2, and analyzed by atomic absorption.

On October 3, 2001 the two middle rows of each strip were mechanically harvested and the seed cotton weighed and recorded. The seed cotton was ginned using a 20 saw Continental gin stand preceded by an inclined cleaner and feeder extractor. The gin stand was followed by one stage of lint cleaning. Lint samples from each plot were sent to the International Textile Research Center for fiber quality analysis using a high volume instrument.

Statistical analyses of the data were preformed with SAS 6.1.2 (1990) using General Linear Modeling procedures. Fisher's Protected Least Significant Difference (LSD) was calculated at the 0.05 probability level for making treatment mean comparisons.

Results and Discussion

The plant height was increased by the twenty five pound application of potassium before planting. The later applications of potassium produced erratic results. Maturity was delayed by the application of potassium before planting as shown in the reduced nodes above white flower. Foliar applications gave inconsistent results. The petiole potassium was increased with the pre-plant application of potassium. Boll number and gin turnout were not significantly influenced by the fertilization. Lint yields were not significantly different but were numerically improved with the addition of pre-plant potassium. Lint yields were very high, especially considering the field had not been irrigated. No significant differences were found for any of the fiber properties, however trash appeared to be increased slightly with the pre-plant application. This would be expected with the delayed maturity.

Plant height was as expected with STV 474 and BXN47 being the taller varieties and the later maturing. As expected DP436RR was the shortest and cutout first as shown by the reduced number of nodes per white flower. Closely related lines of STV 373, STV474 and BXN47 all had large numbers of bolls. STV474 had a high yield while BXN, the Buctril resistant version of STV474 yielded 78 pounds less. The micronaire of DP1218BR was high as expected. However STV474 would be expected to be even higher. FM958 produced very long fiber length of 1.161 which was to be expected. The high strength of FM958 and FM819 was high as expected. All of the varieties had excellent fiber strength. As expected varieties with reduced fiber strength had improved elongation. Trash content was high in FM958 as expected since it is an okra leaf variety. PSC355 had a higher trash content than expected even though it is pubescent. The difference in petiole potassium is very different in STV474 and BXN47. STV474 is the recurrent parent of BXN47. These two lines are very similar other than the engineered gene.

Conclusions

The data supports the soil test recommendation of twenty-five pounds of potassium per acre to be applied before planting. This is shown by plant height, maturity, petiole potassium, and lint yield. There was little benefit shown with later applications of foliar potassium.

The varieties did perform very near to what would be expected from historical data. However the petiole potassium was very low in BXN47 when compared to STV474 which is its recurrent parent.

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Table 1. Potassium treatments and application dates for 2001.

Treatment #	Pre-plant K April 23, 2001	Peak bloom K July 20, 2001	Peak bloom K July 31, 2001
1	0	0	0
2	0	5	0
3	0	5	5
4	25	0	0
5	25	5	0
6	25	5	5

Table 2. Average plant growth parameters as effected by K treatments averaged across all varieties.

Treatment #	Plant Height 7-13-2001	Plant Height 8-3-2001	Plant Height 9-20-2001	N.A.W.F. 8-3-2001
1	20.2	30.4	31.4	4.99
2	19.8	28.8	30.9	5.16
3	20.6	29.1	31.6	4.97
4	20.6	30.1	32.3	4.88
5	22.0	31.1	33.2	4.69
6	21.7	29.8	32.1	4.57
LSD=0.05	1.2	1.5	NS	0.32

Table 3. Average plant growth parameters as effected by varieties averaged across all K treatments.

Variety	Plant Height 7-13-2001	Plant Height 8-3-2001	Plant Height 9-20-2001	N.A.W.F. 8-3-2001
STV 373	21.0	30.9	33.3	5.06
DP 1218BR	22.0	31.5	31.6	4.60
FM 958	19.2	27.2	30.2	4.41
FM 819	21.0	29.6	31.4	5.03
DP 436RR	19.6	26.9	27.8	4.32
PSC 355	20.4	29.1	32.4	4.78
STV 474	21.0	31.6	34.6	5.38
BXN 47	22.2	32.5	33.8	5.46
LSD=0.05	1.3	1.7	2.12	0.37

Table 4. Average petiole K % as effected by K treatments averaged across all varieties.

Treatment #	Petiole K% 7-31-2001	Petiole K% 8-3-2001
1	4.94	4.89
2	4.79	4.97
3	4.79	5.41
4	5.04	6.01
5	5.23	5.19
6	5.23	4.99
LSD=0.05	0.44	NS

Table 5. Average petiole K % as effected by varieties averaged across all K treatments.

Variety	Petiole K% 7-31-2001	Petiole K% 8-3-2001
STV 373	5.38	5.46
DP 1218BR	4.57	4.70
FM 958	4.73	5.37
FM 819	5.81	5.08
DP 436RR	4.56	6.15
PSC 355	4.24	4.32
STV 474	5.52	5.64
BXN 47	4.16	5.27
LSD=0.05	0.51	NS

Table 6. Average cotton lint yield parameters as effected by K treatments averaged across all varieties.

Treatment #	Boll #	Seed Cotton Weight	Lint Yields lbs/acre	Gin turnout
1	7.52	11.40	1018	.401
2	8.39	10.99	982	.401
3	7.99	11.15	1006	.406
4	8.84	11.34	1022	.404
5	7.72	11.70	1043	.400
6	8.69	11.43	1023	.402
LSD=0.05	NS	NS	NS	NS

Table 7. Average cotton lint yield parameters as effected by varieties averaged across all K treatments.

Variety	Boll #	Seed Cotton Weight	Lint Yields lbs/acre	Gin turnout
STV 373	9.38	10.72	977	.409
DP 1218BR	7.93	11.61	1070	.413
FM 958	7.02	11.41	1015	.400
FM 819	6.60	11.16	990	.398
DP 436RR	7.76	11.52	976	.380
PSC 355	8.66	11.64	1010	.390
STV 474	9.38	11.62	1083	.418
BXN 47	8.82	11.00	1005	.410
LSD=0.05	1.33	0.64	64	0.01

Table 8. Average fiber quality parameters as effected by K treatments averaged across all varieties.

Treatment #	Micronaire	Length	Strength	Elongation	Uniformity	Trash	+b
1	4.78	1.143	31.39	5.73	84.03	2.2	8.31
2	4.79	1.145	31.62	5.72	83.87	2.1	8.28
3	4.82	1.142	31.39	5.82	83.85	1.9	8.21
4	4.81	1.140	31.42	5.74	83.87	2.2	8.22
5	4.82	1.148	31.33	5.76	84.20	2.3	8.24
6	4.79	1.145	31.50	5.74	83.98	2.2	8.22
LSD=0.05	NS	NS	NS	NS	NS	NS	NS

Table 9. Average fiber quality parameters as effected by varieties averaged across all K treatments.

Variety	Micronaire	Length	Strength	Elongation	Uniformity	Trash	+b
STV 373	4.61	1.146	29.76	5.70	83.48	2.2	8.57
DP 1218BR	5.12	1.100	29.70	6.15	83.90	1.5	8.50
FM 958	4.77	1.161	33.91	4.40	83.93	2.0	7.89
FM 819	4.54	1.179	34.24	4.59	84.26	2.6	7.31
DP 436RR	4.80	1.157	30.31	6.35	84.27	1.7	7.94
PSC 355	4.99	1.137	32.28	6.90	84.70	2.8	8.36
STV 474	4.85	1.130	30.48	6.07	83.63	2.3	8.67
BXN 47	4.73	1.141	30.85	5.86	83.56	2.0	8.72
LSD=0.05	0.07	0.009	0.38	0.14	0.36	0.4	0.14