STUDIES OF PIX AND FOLIAR FERTILIZATION WITH KNO_3 IN COTTON

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Abstract

Foliar applications of KNO_3 following Mepiquat Chloride were evaluated in 1998-2000 for effect on cotton yield and fiber quality to test the hypothesis that earlier maturing cotton with a shorter fruiting window should have a higher demand for K. Treatments were (1) an untreated control, (2) foliar KNO_3 (11.2 kg/ha) at 1,2,3, and 4 weeks after first flower, (3) Mepiquat Chloride at pinhead square (0.438 L/ha) and first flower (0.876 L/ha), and (4) foliar KNO_3 + Mepiquat Chloride (treatments 2 and 3 combined). Lint yield tended to respond best to PIX used in combination with foliar KNO_3 in two out of three years. Mepiquat Chloride used alone or in combination with K generally decreased plant height. In two out of three seasons, uniformity and strength were slightly improved by use of PIX in combination with KNO_3 as compared to KNO_3 alone. High soil K levels and extreme hot, dry conditions during the peak boll development stage appeared to reduce contributions to lint yield and quality by the use of foliar KNO_3 following PIX in these studies. Therefore, growers of irrigated cotton should closely monitor soil fertility levels and weather conditions during the growing season in order to insure discriminate use of PIX in combination with KNO_3 for maximum lint yield and fiber quality.

Introduction

Due to its indeterminate growth habit, cotton (*Gossypium hirsutum* L.) requires judiciously managed inputs throughout the season. Potassium (K) is needed during all cotton growth stages but is inefficiently absorbed by roots (Rosolem and Mikkelsen, 1991). Previous research in the Cotton Beltwide showed that applications of foliar K during the peak boll development stage can increase yields and improve fiber quality, even when K deficiencies may not be visually apparent (Oosterhuis, 1990). Potassium deficiencies in cotton can be related to modern cultivars with higher yields and smaller fruiting windows as well as soil fixation and inadequate root growth (Oosterhuis, 1994).

The application of foliar K to cotton can quickly and efficiently correct K deficiencies. However, cotton yield response to foliar K may be influenced by a variety of factors and is not consistent with time and location (Mitchell, 1994). Research conducted in Arkansas (Oosterhuis et al., 1991) shows that Mepiquat Chloride (MC, PIX), a plant growth regulator (PGR), can be used to control vegetative growth and improve yield and maturity of cotton grown under irrigated or dryland conditions. PIX causes earlier maturity, allows a shorter fruiting window, and generally increases yield; therefore, the concomitant use of PIX and foliar K in combination needed further study. We hypothesized that the use of PIX will lead to higher yields and earlier maturity which will necessitate a bigger demand for K over a shorter fruiting window. Therefore, our objectives were (1) to evaluate the benefits of applying KNO_3 and PIX in combination on cotton yield and fiber quality and (2) to determine what effect foliar KNO_3 and PIX in combination have on plant growth parameters and nutrient status of irrigated cotton.

Materials and Methods

Cotton (cv. Suregrow 125) was planted into a moderately well-drained Hebert silt loam (SE Arkansas) or Dubbs-Dundee silt loam (NE Arkansas) on approximately 15 May each year. Plots consisted of four 0.93 m wide rows, each 12 m long. Treatments were arranged in a randomized complete block design with six replications. The treatments were (1) An **untreated control**, (2) **foliar KNO_3** (foliar K) (11.2 kg/ha) at 1,2,3, and 4 weeks after first flower, (3) **PIX** at pinhead square (0.438 L/ha) and first flower (0.876 L/ha), and (4) **foliar KNO_3 + PIX** (treatments 2 and 3 combined). Potassium (28 kg/ha) and phosphorous (29 kg/ha) were applied preplant. Liquid 32% nitrogen was applied in split sidedress applications at the second true leaf (50 kg/ha) and pinhead square stages (60 kg/ha). Foliar KNO_3 at 4.3 kg K/ha was applied for four consecutive weeks starting one week after first flower (FF) with a CO_2 backpack sprayer calibrated to deliver 93.5 L/ha. Plant height and number of main-stem nodes were measured on one meter length of row at key phenological stages [FF, first flower + 3 weeks (FF+3), and harvest.] Ten petioles (fourth node from the upper-most fully expanded leaf) were collected for nutrient analyses from each of two yield rows at FF and FF + 3. Final lint yield was determined by mechanically harvesting the two center rows of each plot. Components of yield and fiber quality were determined by hand-picking 1-m length from each of two yield rows and counting the number of bolls. Irrigation, insect, and weed control measures were conducted according to Extension recommendations for optimum cotton yield in Arkansas.

Results and Discussion

Number of Main-Stem Nodes

In 1998, we counted significantly fewer main-stem nodes at FF+3 in the PIX and foliar K + PIX treatments compared to the control and foliar K treatments (Table 1). In 1999 and 2000, the number of nodes did not differ between treatments at FF+3 although the trend was toward fewer nodes where PIX or foliar K + PIX was applied.

Plant Height

In 1998, plant height was significantly shorter in both the PIX and foliar K + PIX treatments compared to the foliar K or control treatments at FF+3. In 1999, only PIX treated plants were shorter than the control plants at FF+3. In 2000, plant height was significantly reduced by PIX at FF+3 in comparison to the foliar K treatment but not the control treatment. These observations were similar to results from previous research conducted on PIX in Arkansas (Oosterhuis, 2000).

Petiole K Concentration

In 1998 and 1999, there was no significant effect of the foliar treatments on petiole K concentration at FF+3 (Table 2). There were no clear trends between treatments for petiole K concentration at FF+3.

Boll Weight

In 1998, 1999, and 2000, boll weights did not differ among the four treatments (Table 3) although, in 1999 and 2000 the foliar K treatment tended to show a numerically higher boll weight compared to the other treatments.

Number of Open Bolls

In 1998, the number of open bolls from the PIX treatment was significantly greater compared to the control or foliar K treatments (Table 4), whereas, in 1999 and 2000, there were no differences between treatments for the number of open bolls at harvest. However, we noted that foliar K had a slightly greater number of open bolls at harvest compared to the other treatments in 1999 followed by the PIX treatment in 2000.

Lint

Though no significant differences in lint yield existed between treatments in 1998 and 2000, we observed some interesting trends (Table 5). Applications of PIX alone or PIX followed by foliar KNO_3 showed an 18 and 21% lint yield increase in 1998 over the control treatment, respectively. In 2000, lint yields increased by 5 and 6.5% from the PIX and foliar KNO_3

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+ PIX treatments, respectively. Foliar KNO_3 alone increased lint yield 4.7%. The numerical increases we observed in the number of open bolls appeared to be the primary support for increased lint yields associated with these treatments.

In 1999, foliar K showed a significantly greater lint yield compared to the control, PIX, or PIX + foliar K treatments. Apparently, the extreme hot, dry conditions encountered during the peak flowering and boll development stages tempered the low lint yield response to PIX.

When averaged over three growing seasons, foliar K, PIX, and foliar K + PIX treatments had numerically greater lint yields compared to the control. Overall, foliar K showed a higher (control + 6.1%) lint yield increase over the other treatments.

Fiber Quality

Micronaire was not significantly affected by the foliar treatments in 1998, 1999, or 2000 (data not shown). PIX alone tended to slightly increase micronaire in 1999 and 2000. Lint uniformity responded significantly to PIX alone in 1998, but was not different from the control in 1999 and 2000 (data not shown). Lint strength was not significantly different between any of the treatments in 1998, 1999, or 2000 (data not shown).

Conclusions

- Lint yield tended to respond best to PIX used in combination with foliar KNO_3 in two out of three years.
- PIX used alone or in combination with foliar K generally decreased plant height and to a lesser extent the number of main-stem nodes.
- In two of three seasons, lint uniformity and strength were slightly improved by use of PIX in combination with KNO_3 as compared to KNO_3 alone.

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Table 1. Plant height and number of main-stem nodes at three weeks after first flower (FF+3) from cotton grown in NE (Clarkedale) and SE (Rohwer) Arkansas during the 1999, 1998, and 2000 seasons.

	FF+3					
	Main-stem Nodes			Plant Height		
Treatment	1998	1999	2000	1998	1999	2000
	----------#----------			----------cm----------		
Control	17a[1]	18.4a	17.6a	130a	106a	97ab
Foliar K	16.3b	18.0a	17.6a	129a	95ab	102.9a
PIX	16.3ab	17.0a	17.3a	112b	82b	90b
F. K + PIX	15.3b	17.0a	17.3a	114b	91ab	93ab

[1]Numbers within a column followed by the same letter are not significantly different ($p \leq 0.05$).

Table 2. Comparison of foliar-applied KNO_3 and PIX combination on petiole K concentration during 1998 and 1999.

	Petiole K		
Treatment	1998	1999	0
	----------%----------		
Control	4.4a[1]	4.6a	4.5
F. K	4.3a	4.7a	4.5
PIX	4.5a	4.2a	4.4
F. K + PIX	4.2a	4.5a	4.4

[1]Numbers within a column followed by the same letter are not significantly different ($p \leq 0.05$).

Table 3. Boll weight response to foliar applications of KNO_3 applied in combination with PIX after the first flower stage in 1998, 1999, and 2000.

	Boll Weight		
Treatment	1998	1999	2000
	----------g/boll----------		
Control	4.4a[1]	4.0a	4.2a
F. K	4.2a	4.3a	4.3a
PIX	4.3a	4.2a	4.2a
F. K + PIX	4.4a	4.2a	4.2a

[1]Numbers within a column followed by the same letter are not significantly different ($p \leq 0.05$).

Table 4. Number of open bolls response to foliar applications of KNO_3 applied alone or in combination with PIX in 1998, 1999, and 2000.

	Open Bolls		
Treatment	**1998**	**1999**	**2000**
	----------#/m^2----------		
Control	47.8b[1]	89.6a	84.0a
F. K	47.0b	92.3a	84.5a
PIX	50.0ab	83.5a	87.7a
F. K + PIX	59.0a	82.5a	82.4a

[1]Numbers within a column followed by the same letter are not significantly different ($p \leq 0.05$).

Table 5. Lint yield from cotton grown in NE (Clarkedale) and SE (Rohwer) Arkansas in 1998, 1999, and 2000.

	Lint			
Treatment	**1998**	**1999**	**2000**	**0**
	----------kg/ha----------			
Control	733a[1]	1466b	1568a	1256
F. K	730a	1624a	1646a	1333
PIX	867a	1331b	1654a	1284
F. K + PIX	887a	1354b	1670a	1304

[1]Numbers within a column followed by the same letter are not significantly different ($p \leq 0.05$).