COMPARISONS OF PIX® PLUS AND ADDITIONAL FOLIAR *Bacillus cereus* IN COTTON

R. C. Nuti*, T. K. Witten, P. H. Jost and J. T. Cothren
Texas Agricultural Experiment Station
Texas A&M University
Department of Soil and Crop Sciences
College Station, TX

Abstract

Mepiquat chloride (MC) which is commonly applied to cotton (*Gossypium hirsutum* L.) to control vegetative growth is thought to cause a shift in the partitioning of photoassimilates from vegetative to reproductive growth. Redistribution of assimilates between vegetative and reproductive growth may be one means by which yields can be increased. While MC has been shown to consistently reduce internode length and plant height, reduction in the total number of nodes has also been often observed, along with inconsistent yield responses. Pix® Plus combines MC with *Bacillus cereus* (BC), a bacterium that purportedly enhances plant growth. This combination of products allows for the control of excessive vegetative growth while potentially promoting reproductive growth. An experiment was conducted to determine if additional applications of BC changed the effectiveness of Pix® Plus. All treatments received 8 oz/A Pix® Plus at MHS and EB, while three treatments received a 1 oz/A application of BC at PHS, EB, or EB + 3 weeks. An additional treatment received 1 oz/A BC at all three timings. Pix® Plus treatments showed typical trends of MC applications, where height and node production was reduced compared to the UTC. Moreover, all treatments receiving Pix® Plus tended to have a lower vegetative to reproductive ratio than the UTC at EB. The impact of these characteristics on yield, boll distribution patterns, boll weights, and lint quality will be addressed.

Introduction

Cotton (*Gossypium hirsutum* L.) frequently exhibits excessive vegetative growth. Producers use plant growth regulators (PGRs) to alter this growth habit. Research has shown that mepiquat chloride (MC) can effectively control height in cotton, resulting in a more manageable crop (Fernandez et al., 1991; Reddy, 1996). However, a reduction in the number of main-stem nodes is often observed following MC treatment, thereby reducing possible fruiting sites (Hodges et al., 1991). In addition to reducing vegetative growth, MC may also shift photoassimilates from vegetative to reproductive structures; however, yield responses with MC have been inconsistent (Underbrink, 1999). Kerby et al. (1986) documented that increases in yield with MC application are associated with enhanced boll retention on lower nodes. In an effort to overcome the inconsistent yield responses to MC, Pix® Plus was developed. Pix® Plus is a combination of MC and *Bacillus cereus* (BC), a purported growth enhancer. BC is the bacterial base for a biochemical with PGR activity (Parvin and Atkins, 1997). It is hypothesized that this combination of MC and BC should still provide height control, and also stimulate node development and boll retention.

Objective

To evaluate the effects of Pix® Plus with and without additional foliar applications of BC on growth and yield parameters of cotton.

Materials and Methods

Field studies were conducted at the Texas A&M Agricultural Experiment Station in Burleson county. Cotton cv. 'Stoneville BXN-47' was seeded April 29, 1999 and grown under irrigated conditions. Treatments were applied at 20 gallons per acre using a compressed air small plot sprayer. All treatments except the untreated check (UTC) received Pix® Plus as an area standard of 8 oz/A at matchhead square (MHS) and early bloom (EB). Timings of additional applications of BC are shown in Table 1.

Data Collected

Plant Height and Node Counts
Leaf Density
V/R Ratios
Boll Distribution Patterns
Lint Yield

Experimental Design and Analysis

The experimental design was a 6 x 6 Latin Square. Statistical analysis was performed using the General Linear Model Procedure in SAS. Means were separated using Fisher's Protected LSD Test at the 5% significance level (SAS, 1989-1996).

Results and Conclusions

All Pix® Plus treatments significantly reduced plant height compared to the UTC (Figure 1). However, main-stem node counts also tended to be reduced (Figure 2). While plant growth from PHS to harvest was greatest for the control, additional applications of BC after EB tended to increase growth relative to no additional BC or applications of BC made prior to EB (Figure 3). Similar trends were also observed for node production from PHS to harvest (Figure 4). These data suggest that later season or multiple applications of BC, as in treatment BCx3, may stimulate node production, thus compensating for reductions in node numbers caused by MC.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:684-687 (2000)
National Cotton Council, Memphis TN

Consistent with previous research (Fernandez et al., 1991), leaf density was increased for all Pix® Plus treatments compared to the UTC (Figure 5). Elevated leaf densities are often associated with increased chlorophyll content (Gausman et al., 1980).

Vegetative to reproductive biomass ratios (V/R) were numerically reduced by additional applications of BC to Pix® Plus treatments (Figure 6). The reduced V/R ratio observed with the EB treatment may appear to be abnormal since the BC was applied only three days prior to sampling. However, Hodges et al. (1991) indicated that the effects of MC on canopy photosynthesis occur rapidly. These data suggest that BC may also trigger rapid responses in plants. Results of these reduced V/R ratios were evident in the plant mapping data taken at harvest, where all Pix® Plus treatments retained a higher percentage of bolls on the first 8 nodes (Figure 7). The presence of a greater percentage of bolls at lower nodes indicates that boll set occurred earlier in the season. In drought conditions, early boll set may reduce problems associated with late season water stress. This increased early boll set may also contribute to more rapid crop maturity, and to a reduction in late season insect pressures.

Lint yields were not different between the treatments (Figure 8). Environmental conditions may have masked the effects of the treatments on yield. The 1999 production season was typified by timely precipitation and optimal growth temperatures, which minimized plant stresses.

Future Research

- ! To determine if there is an optimum concentration or maintenance population of BC to enhance cotton production.
- ! To evaluate the benefits of variable rates of BC at specific stages of cotton development.
- ! To ascertain whether the benefits of BC are greater expressed in dryland conditions rather than under irrigation.

Literature Cited

Fernandez, C.J., Cothren, J.T., and McInnes, K.J. 1991. Partitioning of biomass in well-watered and water-stressed cotton plants treated with mepiquat chloride. Crop Sci. 31:1224-1228.

Gausman, H. W., Walter, H.,Rittig, F.R., Escobar, D.E., and Rodriguez, R.R. 1980. Effect of mepiquat chloride (Pix) on CO_2 uptake of cotton plant leaves. p. 1-7. *In* A. Abdel-Rahman- (ed.) Proc. 7th Annual Meeting of Plant Growth Regul. Working Group, Dallas, TX. 13-17 July 1980. Longmont, CO.

Hodges, H.F., Reddy, V.R., and Reddy, K.R. 1991. Mepiquat chloride and temperature effects on photosynthesis and respiration of fruiting cotton. Crop Sci. 31:1302-1308.

Kerby, T.A., Hake, K., and Kelley, M. 1986. Cotton fruiting modification with mepiquat chloride. Agron. J. 78:907-912.

Parvin, D. and R. Atkins. 1997. Three years experiences with a new PGR-*Bacillus cereus* (BC). *In* Proc. of 1997 Beltwide Cotton Conferences, Vol. 2, 1396-1398.

Reddy, A.R., Reddy, K.R., and, Hodges, H.F. 1996. Mepiquat chloride (Pix)-induced changes in photosynthesis and growth of cotton. Plant Growth Regul. 20:179-183.

SAS Institute. 1989-1996. The SAS System for Windows, Release 6.12. SAS Institute Inc. SAS Campus Drive, Cary, N.C.

Underbrink, S. M. 1999. Agronomic differences in growth and yield between *Bt* and conventional cotton treated with mepiquat chloride. M.S. Thesis. Texas A&M University.

Table 1.

Treatment:	BC	Timing
UTC	-	-
Pix Plus	-	-
PHS	1 oz/A	Pinhead Square (PHS)
EB	1 oz/A	Early Bloom (EB)
EB+3	1 oz/A	3 weeks after EB
BCx3	1 oz/A	PHS, EB, and 3 weeks after EB

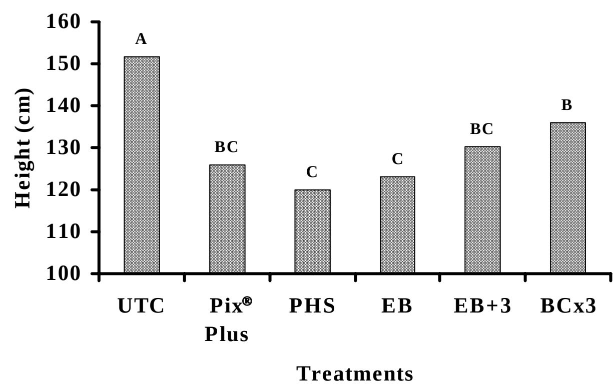

Figure 1. Height at Harvest. (*p=0.0003*).

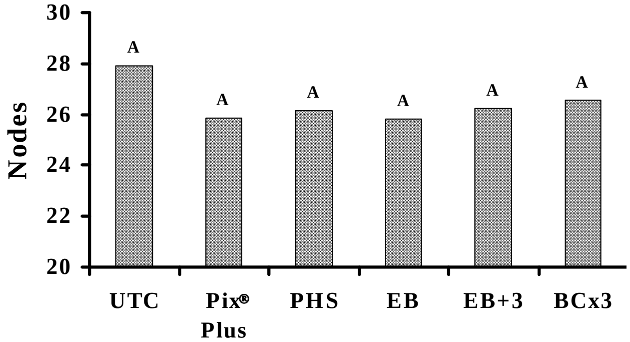

Figure 2. Nodes at Harvest. (*p=0.1366*).

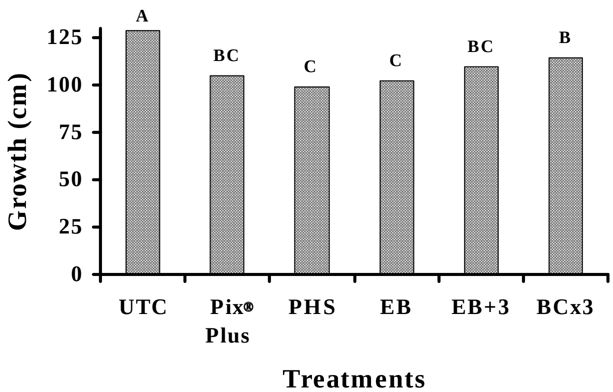

Figure 3. Growth from PHS to Harvest. (*p=0.0007*).

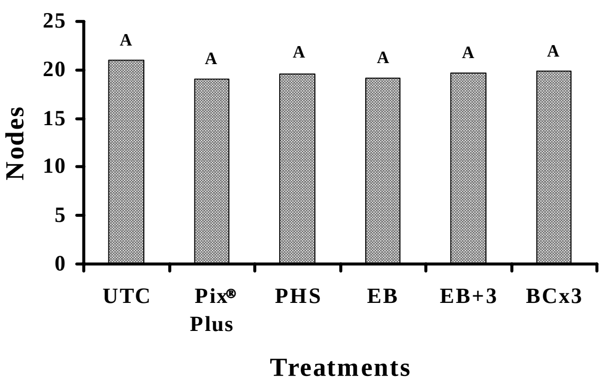

Figure 4. Node Addition from PHS to Harvest. (*p=0.1127*).

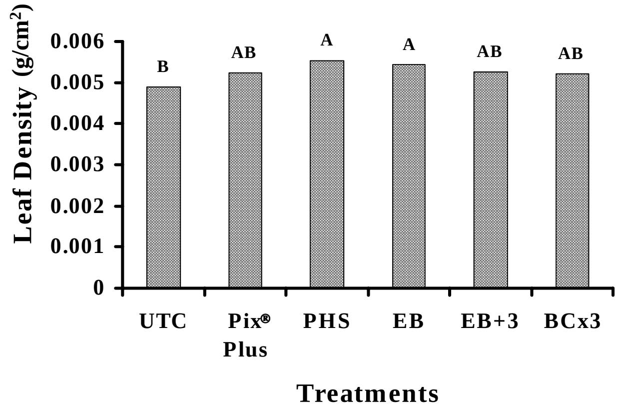

Figure 5. Leaf Density. (*p=0.0424*).

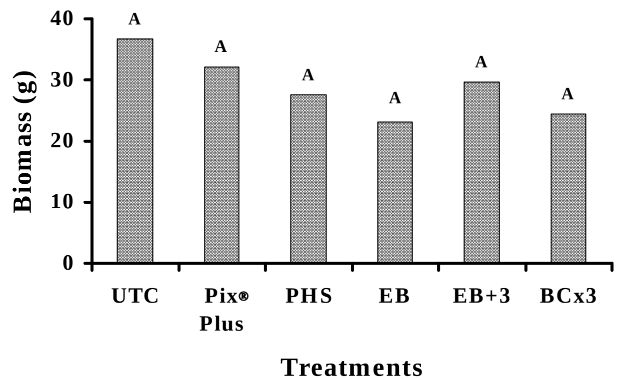

Figure 6. Vegetative to Reproductive Biomass at EB. (*p=0.0820*).

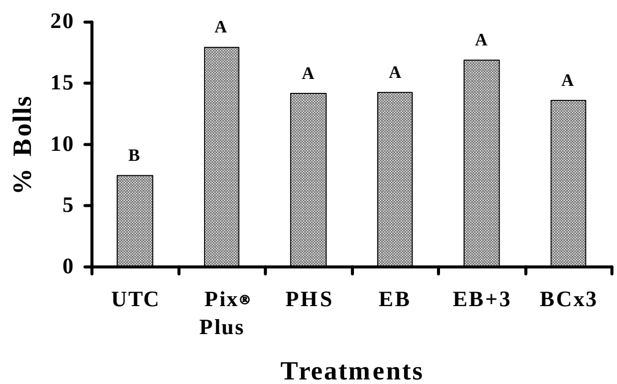

Figure 7. Percent Bolls up to Node 8. (*p=0.0345*).

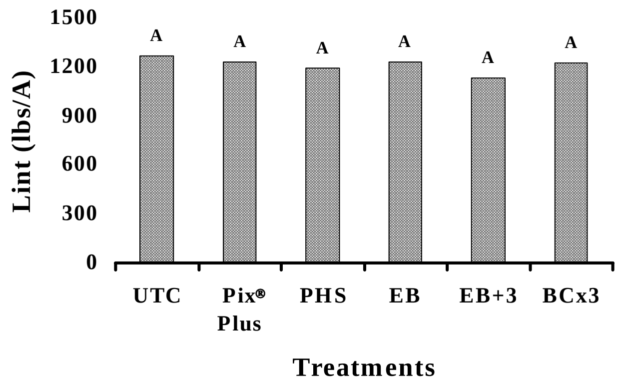

Figure 8. Cotton Yield. (*p=0.1633*).