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YIELD RESPONSE OF COTTON TO A CARBOXYLIC-ACID-BASED PLANT GROWTH REGULATOR IN THE SOUTH TEXAS COASTAL PLAINS

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Abstract

Foliar application of Promote 125, a carboxylic-acid-based plant growth regulator, at the time when cotton plants are heading towards cut-out, may delay the onset of internal energy/substrate deficits long enough to produce one or two more bolls and/or bigger bolls. The objective of this study was to evaluate the effects of application rates of the plant growth regulator Promote 125 on growth, yield, and fiber quality of cotton grown under deficit irrigation and dryland conditions. The study was conducted at the Texas A&M University Agricultural Research and Extension Center in Corpus Christi, TX, during the 2000 and 2001 seasons. Treatments included two rates of Promote 125: 2.0 oz./c and 4.0 oz./ac applied at 7 nodes above white flower. Promote 125 applied at 2.0 oz./acre appears to be a promising plant growth regulator to increase yields in cotton. The magnitude of yield increases over the untreated controls measured in 2000 under deficit irrigation and in 2001 under dryland conditions were important; 173 lbs./acre (13% increase) and 165 lbs./acre (17% increase), respectively. The yield component associated with yield increase could not be clearly identified from these experiments. While the yield increase observed in 2001 resulted from a significant increase in the number of bolls per plant, this effect was not observed in 2000. Boll size (lint per boll) was not a factor in the yield increase resulting from the applying Promote 125 at 2 oz./ac.

Introduction

Promote 125 is a carboxylic-acid-based plant growth regulator available for cotton. Carboxylic acids are precursors of acetyl coenzime A (Roberts and Caserio, 1977). Acetyl coenzime A is directly involved in the biosynthesis and metabolism of fatty acids, such as palmitic, stearic, oleic, and linoleic acids, biosynthesis of carbohydrates, and the Krebs Cycle- a primary source of energy compounds in plants (Salisbury and Ross, 1985).

Growth of cotton plants, in particular the production of new leaves and sympodial branches, is gradually inhibited during boll filling as an increasing amount of substrate (mainly carbohydrates and nitrogenous compounds) is directed to the biosynthesis of boll structures (Guinn, 1986). This gradual inhibition process leads to cutout, i.e., the cessation of flowering (Mauney, 1986). The onset of cut-out is accelerated by a high boll set relative to the plant's photosynthetic capacity (a combination of photosynthetic leaf area and photosynthetic capacity per unit leaf area) and the presence of water and/or nutrient deficits. This imbalance of substrate production (supply) relative to substrate demand limits the production of bolls.

We hypothesize that foliar applications of this carboxylic-acid-based plant growth regulator at the time when cotton plants are heading towards cut-out, perhaps about 7 nodes above white flower, may delay the onset of this "energy/substrate crisis" long enough to produce one or two more bolls and/or bigger bolls.

The objective of this study was to evaluate the effects of application rates of the plant growth regulator Promote 125 on growth, yield, and fiber quality of cotton grown under deficit irrigation and dryland conditions.

Materials and Methods

The study was conducted at the Texas A&M University Agricultural Research and Extension Center in Corpus Christi, TX, during the 2000 and 2001 seasons. The soil at the experimental site is a Victoria clay-Orelia fine sandy clay loam complex. Broadcast fertilization and yellow herbicide, were applied before planting and incorporated by disking. Fertilization rates were: 60 lbs./acre of P_2O_5, 150 lbs./acre of N, 20 lbs./acre of S, and 4 lbs./acre of Zn in 2000 and 40 lbs./acre of P_2O_5, 90 lbs./acre of N, 20 lbs./acre of S, and 4 lbs./acre of Zn in 2001. The experiments were conducted under two contrasting soil water regimes: deficit irrigation in 2000 and dryland in 2001. Upland cotton cv. Paymaster 1218BG/RR and TamCot Pyramid were planted in 2000 and 2001, respectively, with a vacuum precision Monosem NG Plus planter. Planting dates were 29 March 2000 and 26 March 2001. Target plant population was 41,267 plants/ac (3 plants/ft at 38'-inch row spacing). Ground and aerial applications of insecticides as needed controlled insect pests.

Treatments included two rates of Promote 125: 2.0 oz./c and 4.0 oz./ac applied at 7 nodes above white flower. Application dates were on 20 June 2000 and 6 June 2001, when plant height, number of mainstem nodes, and mainstem node of first position bloom were: 69 cm, 16, and 9, respectively, in 2000 and 66 cm, 15 and 8, respectively, in 2001. Treatments were applied with a four-row plot sprayer (Model 3220-GC 2wd Lee Spyder Spray-Trac, Lee Company, Inc., Idalou, TX). Plots were four rows wide and 75 ft long. Treatments were arranged in a randomized complete block design with four replications.

Rainfall and irrigation amounts were 142 mm (5.6 in.) and 183 mm (7.2 in.), respectively, in 2000. Irrigation was applied from early squaring to early bloom by means of an aboveground drip line system. In 2001 (dryland growing conditions), in-season rainfall amounted 140 mm (5.5 in.).

Upon defoliation, yield measurements were made by handpicking 1/1000 of an acre from one of the two central rows in each plot and ginning for lint turnout determination. Plant growth measurements and yield components were measured from sample of 10 contiguous plants.

Results and Discussion

Plant Population

Final plant stands were not significantly different among treatments in 2000 or 2001. Plant population was less than 5% different from the target 41,267 plants/ac (3 plants/ft) in 2000. In 2001, however, plant population was decreased to 27,800 plants/ac, about 30% lower than the target population due to germination losses.

Plant Height

Plant height was not significantly affected by treatments in 2000 or 2001. Plant height of the UTC was 63.5 cm in 2000. In 2001, however, plant height with Promote125 at 2 oz./ac was marginally higher than that of the UTC (60.2 cm vs. 55.4 cm, P=0.1353).

Mainstem Nodes

The number of main-stem nodes was not significantly affected by treatments in 2000 or 2001. Average number of main-stem nodes was 16.1 per plant in 2000 and 2001.

Height-to-Node Ratio (HNR)

HNR (or the average length of main stem internodes) was not significantly affected by treatments in either year. Average HNR was 4.0 cm in 2000 and 3.6 cm in 2001.

Sympodial Nodes

The number of sympodial nodes (a variable representing fruiting potential) was not affected by treatments in 2000 or 2001. Average number of sympodial nodes was 20.5 per plant in 2000 and 19.7 per plant in 2001.

Fruit Retention

Fruit retention was not significantly affected by treatments in 2000 or 2001. Average fruit retention was 39.0% in 2000 and 46.3% in 2001.

Bolls Per Plant

There were no significant differences in the number of open bolls per plant in 2000 (Figure 1). The average number of open bolls per plant across treatments was 7.9 per plant in 2000. However, the number of open bolls per plant was significantly increased with Promote 125 at 2 oz/ac and 4 oz./ac in 2001 (Figure 2); bolls per plant were 9.6 (P=0.0450) and 9.7 (P=0.0388), respectively, while that of the UTC was 7.6.

Lint Turnout

Lint turnout was largely unaffected by treatments. Average lint turnout was 38.2% in 2000 and 40.9% in 2001. In 2001, lint turnout with Promote125 at 4 oz./ac was only marginally lower than the UTC (40.3 vs. 41.6 %, P=0.1321).

Weight of Individual Bolls (Lint)

Effects of Promote 125 on weight of individual bolls (lint per boll in g) were opposite in 2000 and 2001. In 2000, boll weight showed slight tendency to increase with increasing rate of application, but the difference between the UTC and Promote 125 at 4 oz./ac was only statistically marginal (1.70 g vs. 1.87 g, respectively, P=0.1210) (Figure 3). In 2001, however, the weight of individual bolls with Promote125 at 4 oz./ac was marginally lower than the UTC (1.85 g vs. 2.03, respectively, P=0.1615) (Figure 4).

Lint Yield
Treatment with Promote 125 at 2 oz./acre increased lint yields significantly in both years (Figures 5 and 6). Lint yield was increased 13% in 2000 (P=0.0683), from 1312 lbs./acre to 1485 lbs./acre, and 17% in 2001 (P=0.0228), from 963 lbs./ac to 1128 lbs./ac.

Micronaire
Micronaire, a measure of fineness and maturity, was not affected by the application of Promote 125 at these rates. Micronaire averaged 46.75, a value within the base range.

Length
Fiber length was not affected by the application of Promote 125 at these rates. Length averaged 0.999 inches.

Uniformity
Uniformity of fiber length was marginally better (83%) with Promote 125 at 2.0 oz./ac. Uniformity of the untreated control was 82 %.

Strength
Fiber strength was not affected by the application of Promote 125 at these rates. Strength averaged 27.825 grams per tex, an average value of fiber strength.

Conclusions

- Promote 125 applied at 2.0 oz./acre at the stage of 7 nodes above white bloom appears to be a promising plant growth regulator to increase yields in cotton. The magnitude of yield increases over the untreated controls measured in 2000 under deficit irrigation and in 2001 under dryland conditions were important; 173 lbs./acre (13% increase) and 165 lbs./acre (17% increase), respectively.

- The yield component associated with yield increase could not be clearly identified from these experiments. While the yield increase observed in 2001 resulted from a significant increase in the number of bolls per plant, this effect was not observed in 2000. Boll size (lint per boll) was not a factor in the yield increase resulting from the applying Promote 125 at 2 oz./ac.

- These results indicate that the use of Promote 125 may become an important tool to increase yields and profitability of cotton crops. More research in needed to confirm these results and further evaluate application rates and timing of application in both irrigated and dryland cotton.

Acknowledgements

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References

Salisbury F.B. and C.W. Ross. 1985. Plant Physiology. Wadsworth Publishing Company. Belmont, CA.

Roberts, J.D. and M.C. Caseiro. 1977. Basic Principles of Organic Chemistry. W.A. Benjamin, Inc. Menlo Park, CA.

Mauney, J.R. 1986. Vegetative growth and development of fruiting sites. Pp. 11. In J.R. Mauney and J.McD. Stewart (Eds.) Cotton Physiology. Number One, The Cotton Foundation Reference Book Series. The Cotton Foundation, Publisher. Memphis, TN.

Guinn, G. 1986. Hormonal relations during reproduction. Pp. 113. In J.R. Mauney and J.McD. Stewart (Eds.) Cotton Physiology. Number One, The Cotton Foundation Reference Book Series. The Cotton Foundation, Publisher. Memphis, TN.

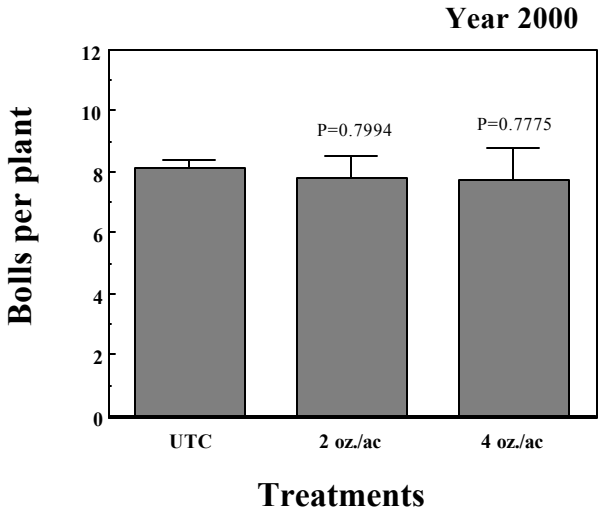

Figure 1. Average bolls per plant harvested in untreated plots (UTC) and plots treated with Promote 125 at 2 oz./ac and 4 oz./ac. Experiment under deficit irrigation. Corpus Christi, 2000. Statistical note: Probability of null hypothesis is shown on top of corresponding bars. T-line on top of bars indicates magnitude of standard error.

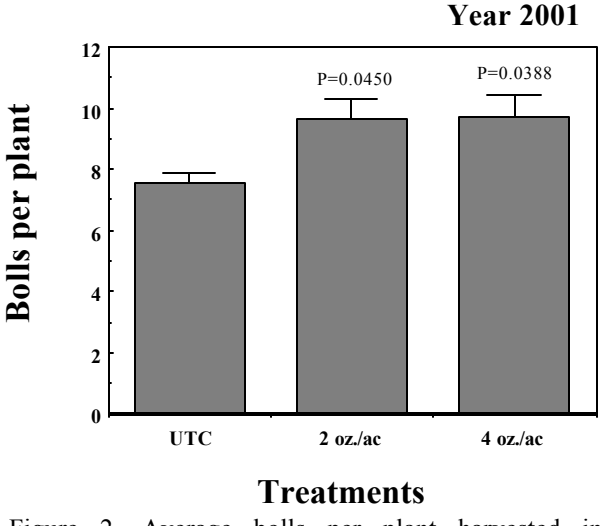

Figure 2. Average bolls per plant harvested in untreated plots (UTC) and plots treated with Promote 125 at 2 oz./ac and 4 oz./ac. Experiment under dryland conditions. Corpus Christi, 2001. Statistical note: same as in Fig. 1.

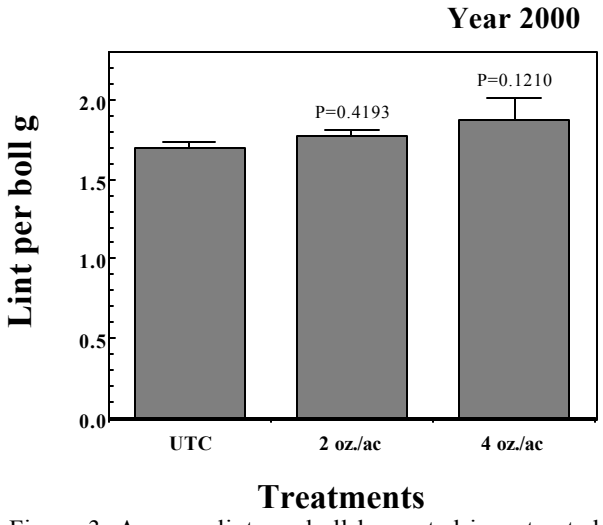

Figure 3. Average lint per boll harvested in untreated plots (UTC) and plots treated with Promote 125 at 2 oz./ac and 4 oz./ac. Experiment under deficit irrigation. Corpus Chris ti, 2000. Statistical note: same as in Fig. 1.

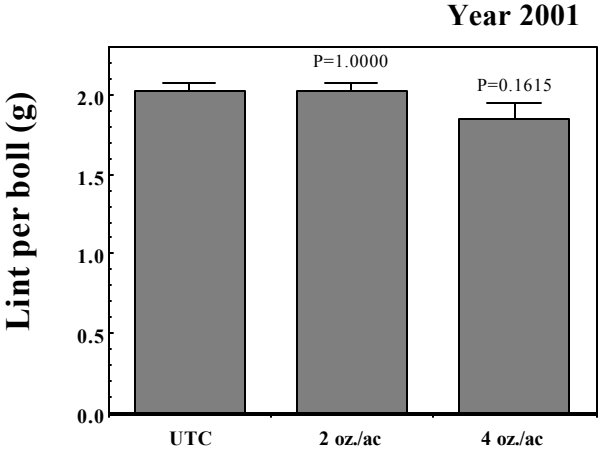

Figure 4. Average lint per boll harvested in untreated plots (UTC) and plots treated with Promote 125 at 2 oz./ac and 4 oz./ac. Experiment under dryland conditions. Corpus Christi, 2001. Statistical note: same as in Fig. 1.

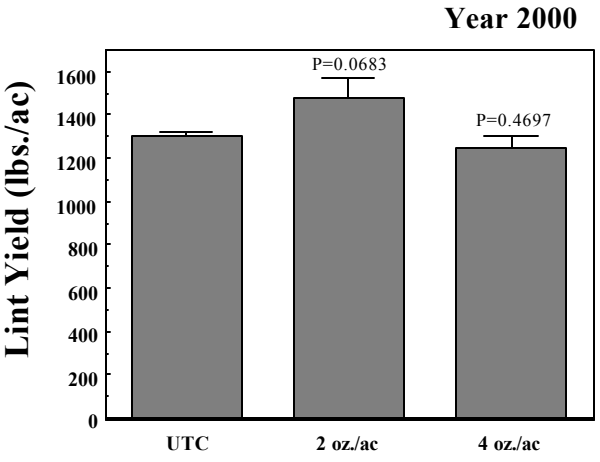

Figure 5. Lint yield of untreated plots (UTC) and plots treated with Promote 125 at 2 oz./ac and 4 oz./ac. Experiment under deficit irrigation. Corpus Christi, 2000. Statistical note: same as in Fig. 1.

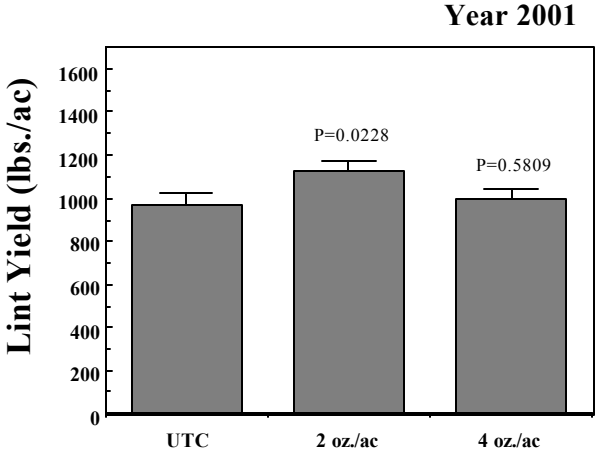

Figure 6. Lint yield of untreated plots (UTC) and plots treated with Promote 125 at 2 oz./ac and 4 oz./ac. Experiment under dryland conditions. Corpus Christi, 2001. Statistical note: same as in Fig. 1.