SEED APPLIED PLANT GROWTH REGULATOR EFFECTS ON COTTON GERMINATION, EMERGENCE, AND GROWTH

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Abstract

A potential use for Plant Growth Regulators (PGRs) is the application of these chemicals to enhance germination, emergence, and early season growth of cotton. Applied to the seed, in-furrow, or as a foliar treatment, these chemicals are purported to provide beneficial plant responses during stand establishment and early season growth which are important in establishing yield potential. This study was conducted to evaluate the effects of seed applied PGRs on cotton germination, emergence, and early season growth. Nine commercially available materials (Arise, Cytoplex, Early Harvest, Maxon, PGR-IV, Pix, Ryzup, Stimulate, and Triggrr were applied to seed at 0.5x, 1.0x, and 2.0x the recommended rates. Laboratory results showed no significant differences in Cool Warm Vigor Index (CWVI) values when compared to the control in 1996. In 1997 sixteen of the treatments increased CWVI values when compared to the control. In the field study, no significant increases in stand establishment were noted due to the PGR treatments when compared to the control in either 1996 or 1997. In the greenhouse study (1996 and 1997), no significant differences in total root length were observed when compared to the control. Results from the controlled temperature chamber showed no significant differences in emergence among the treatments in 1996 or 1997.

Introduction

Plant growth regulators (PGRs) are natural and synthetic chemicals that influence physiological processes at low concentrations. PGRs are applied in cotton production systems to control vegetative growth and improve harvesting efficiency. Another potential use for PGRs in cotton production includes the application of these chemicals to enhance germination, emergence, and early season growth. PGRs have been investigated for usefulness during these early developmental stages to help overcome the potentially negative effects imposed by various environmental, cultural, and seed quality factors. Considering that there is a positive correlation between early season growth and final lint yield it is apparent that there is a need for management practices, which could enable the cotton plant to overcome the stresses it encounters during early season growth.

Several plant growth regulator formulations are registered for use in cotton as foliar, seed treatment, or in-furrow applications. Manufacturers of these PGRs purport beneficial plant responses, which include more rapid germination and emergence, increased root and shoot development, increased ability to withstand various stresses, and increased yields. Studies investigating the effects of seed applied PGRs on early season growth of cotton have shown beneficial responses (Egilla and Oosterhuis, 1996 and Steger and Oosterhuis, 1997). Thus, the objective of this study was to investigate the effects of several commercially available PGRs on germination, emergence, and early season growth of cotton when applied as seed treatments at 0.5x, 1.0x, and 2.0x the manufacturer's recommended rates.

Materials and methods

Treatments. The effects of the selected PGRs were investigated in four separate experiments utilizing laboratory, field, controlled temperature chamber, and greenhouse environments. Paymaster HS 200 was the cultivar used for this study in both 1996 and 1997. Treatments each year included nine plant growth regulators applied at three rates, 0.5x, 1.0x, and 2.0x, the recommend rates, and an untreated control (Table 1). PGRs included in this study were Arise, Cytoplex, Early Harvest, Maxon, PGR-IV, Pix, Ryzup, Stimulate, and Triggrr. Each of the 28 treatments included a standard fungicide treatment of Captan, Vitavax PCNB, and Apron at the recommended label rates. All PGRs, except for Ryzup, were applied to the seed with the fungicide material. Ryzup was applied to the seed after the fungicide material was applied.

Evaluation. Standard Warm and Cool Germination Tests were conducted in the laboratory. A Cool Warm Vigor Index (CWVI) was calculated by adding the results from the Warm Germination Test, counted at 4 days and the Cool Germination Test, counted at 7 days.

Treatments were planted in the field on May 16, 1996 and May 20, 1997. Data collected included an establishment index or the percentage of seeds planted that resulted in established plants at 28 days after planting (EI- 28).

Seed treated in 1996 and 1997 were planted in PVC tubes (4 inches in diameter and 12 inches long) and one seedling per tube was allowed to grow for 14 days and 36 days, respectively. Plants were then harvested; including the root system, measurements taken included total root length (TRL) (obtained using digital image analysis).

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In both 1996 and 1997 fifty seeds from each treatment were planted in sand filled plastic containers and placed in the controlled temperature chamber which was set at a constant 18°C. Stand counts were taken through 21 days after planting and an emergence rate index (ERI), combination of the rate and totality of emerging seedlings, was calculated.

Laboratory, controlled temperature chamber, and greenhouse experiments were conducted as completely randomized designs with three replications (except for the 1997 laboratory study, which used four replications). The field study was conducted as a randomized block design with three blocks. The data were analyzed using analysis of variance and the means were separated, if significant, according to Duncan's Multiple Range Test.

Results and Discussion

CWVI values in 1996 showed no significant differences among the treatments (Table 2). In 1997 Arise at 1.0x and 2.0x, Cytoplex at 0.5x and 1.0x, Early Harvest at 0.5x, Maxon at 0.5x, PGR-IV at 2.0x, Pix at 1.0x and 2.0x, Ryzup at 0.5x, 1.0x, and 2.0x, Stimulate at 0.5x and 2.0x, and Triggrr at 0.5x and 2.0x, significantly increased the CWVI values when compared to the control (Table 3).

In the field study no significant differences in stand establishment (EI-28) were observed among the treatments when compared to the control in 1996 (Table 2). In 1997 Ryzup significantly decreased stand establishment at 28 days after planting at all three rates when compared to the control (Table 3).

The greenhouse study showed no significant differences in total root length (TRL) in either 1996 or 1997 (Tables 2 and 3, respectively) even though relatively large ranges in numerical differences were observed.

Results from the controlled temperature chamber study showed no significant differences in emergence (ERI) among the treatments in 1996 or 1997 (Tables 2 and 3, respectively).

Conclusions

Results from this study, conducted under the conditions in 1996 and 1997 on one cotton variety, showed no significant beneficial growth response trends across years from the treatments used. These results indicate that the application of these PGRs to cotton seed would provide limited to no beneficial germination, emergence, or early season growth responses.

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Table 1. Summary of treatments.

Plant Growth Regulator	Recommended Rates
Arise	23 oz/ 100wt
Cytoplex	13.5 oz/ 100wt
Early Harvest	2 oz/ 100wt
Maxon	6 oz/ 100wt
PGR IV	6 oz/ 100wt
Pix	4 oz/ 100wt
Ryzup	1 oz/ 100wt
Stimulate	5 oz/ 100wt
Triggrr	4 oz/ 100wt

Table 2. Effect of PGR treatments in 1996.

Treatment	CWVI (-)	EI-28† (%)	TRL (cm)	ERI (-)
Control	152	75 a-e	851	2277
Arise 0.5x	161	80 a-c	938	2121
Arise 1.0x	155	75 a-e	880	2091
Arise 2.0x	160	82 a-c	1076	2287
Cytoplex 0.5x	156	69 b-e	864	2291
Cytoplex 1.0x	158	77 a-d	939	1891
Cytoplex 2.0x	160	85 a-b	934	2213
Early Harvest 0.5x	160	82 a-c	1143	2116
Early Harvest 1.0x	153	68 c-e	1141	1993
Early Harvest 2.0x	160	77 a-d	819	2196
Maxon 0.5x	156	73 a-e	1209	2000
Maxon 1.0x	149	77 a-d	1074	1964
Maxon 2.0x	148	83 a-c	1124	2022
PGR-IV 0.5x	161	82 a-c	1048	2314
PGR-IV 1.0x	155	81 a-c	1114	2161
PGR-IV 2.0x	160	76 a-d	973	2075
Pix 0.5x	170	78 a-d	1041	2192
Pix1.0x	153	77 a-d	1089	2208
Pix 2.0x	154	73 a-e	1048	2287
Ryzup 0.5x	160	64 de	1075	1944
Ryzup 1.0x	152	69 b-e	1142	2028
Ryzup 2.0x	171	60 e	1026	2246
Stimulate 0.5x	154	60 e	1094	2067
Stimulate 1.0x	155	86 a	1152	2097
Stimulate 2.0x	154	78 a-d	1013	2058
Triggrr 0.5x	158	80 a-c	940	2191
Triggrr 1.0x	159	79 a-d	1129	2359
Triggrr 2.0x	157	69 b-e	1099	2095
F value	ns	2.33**	ns	ns

†Means in the same column followed by the same letter are not significantly different at the 5% level of probability according to Duncan's Multiple Range Test.
**Significant at the 1% level of probability.

Table 3. Effect of PGR treatments in 1997.

Treatment	CWVI† (-)	EI-28† (%)	TRL (cm)	ERI (-)
Control	131 h	82 a-e	1258	922
Arise 0.5x	138 e-h	81 a-e	1123	1004
Arise 1.0x	146 b-g	78 b-e	1149	866
Arise 2.0x	150 a-f	79 a-e	1143	1026
Cytoplex 0.5x	151 a-e	78 b-e	1317	1117
Cytoplex 1.0x	150 a-f	89 a	1149	1076
Cytoplex 2.0x	135 f-h	74 e-f	1383	857
Early Harvest 0.5x	153 a-e	84 a-d	1197	1089
Early Harvest 1.0x	141 d-h	75 c-f	1335	1054
Early Harvest 2.0x	144 b-h	76 b-f	965	997
Maxon 0.5x	152 a-e	75 c-f	1291	1194
Maxon 1.0x	144 c-h	77 b-e	1163	1052
Maxon 2.0x	142 d-h	81 a-e	1193	1166
PGR-IV 0.5x	133 g-h	83 a-e	1118	788
PGR-IV 1.0x	144 b-h	85 a-b	1182	1164
PGR-IV 2.0x	147 b-g	80 a-e	1321	869
Pix 0.5x	142 c-h	81 a-e	1051	1119
Pix1.0x	146 b-g	80 a-e	1122	1122
Pix 2.0x	148 b-g	82 a-e	1217	1094
Ryzup 0.5x	154 a-d	68 f	1257	830
Ryzup 1.0x	164 a	67 f	1081	883
Ryzup 2.0x	159 a-b	51 g	1184	773
Stimulate 0.5x	146 b-g	74 e-f	1259	757
Stimulate 1.0x	142 d-h	75 d-f	1113	1029
Stimulate 2.0x	151 a-e	85 a-b	838	977
Triggrr 0.5x	157 a-c	78 b-e	1335	976
Triggrr 1.0x	144 b-h	82 a-e	1436	941
Triggrr 2.0x	152 a-e	84 a-c	1092	1166
F value	3.02**	6.97**	ns	ns

†Means in the same column followed by the same letter are not significantly different at the 5% level of probability according to Duncan's Multiple Range Test.

**Significant at the 1% level of probability.