RyzUp: Post-application Environment Controls Growth Responses in Cotton

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ABSTRACT

RyzUp is a gibberellic acid-based plant growth promoter for cotton. The objective of this study was to determine whether growth responses of cotton to RyzUp application depend on post-treatment environmental conditions defined by temperature and potential evapotranspiration. The experiments were conducted at the Texas A&M University Agricultural Research and Extension Centres in Corpus Christi and Uvalde, TX, during the 1996 and 1997 seasons. Results showed that the cotton's growth responses to RyzUp depended strongly on year, location and timing of application within year. Responses of both plant height and number of fruiting positions to RyzUp appeared to be inversely related to cumulative atmospheric water demand during the 15 days following treatment. Practical implications of this finding point towards possible fine-tuning the management of RyzUp application, depending on prevailing or near-future weather conditions.

Introduction

RyzUp is a gibberellic acid-based plant growth regulator for cotton. Expected effects on plant growth include promotion of internode elongation, leading to increased plant height and longer branch stems (Hansen *et al.*, 1996; Larson *et al.*, 1997). Effects on growth of field-grown cotton, however, have been inconsistent. This may derive from over-riding environmental effects that mask the growth-promoting activities of this plant growth regulator.

Two of the main factors controlling growth are known to be temperature and plant water status, determined by the interaction of factors including atmospheric water demand, soil water availability, as well as physiological and morphological plant characteristics that control water uptake and loss. Expansive growth in plants increases curvilinearly with temperature over a minimum threshold of 15.6°C (Mauney, 1986). Expansive growth is also controlled by plant water status (Hsiao, 1973; Boyer, 1985). The greater the atmospheric water demand, the higher the chances for inhibition of expansive plant growth through deterioration of plant water status. Unlike the more continuous influence of temperature on plant growth, the effect of plant water status is more like a discrete on/off switch depending whether it is above or below a threshold.

The objective of this study was to determine whether growth responses of cotton to RyzUp depend on post-treatment environmental conditions defined by temperature and potential evapotranspiration (atmospheric water demand).

Materials and Methods

The experiments were conducted at the Texas A&M University Agricultural Research and Extension Centres in Corpus Christi and Uvalde, TX, during the 1996 and 1997 seasons. The soils at the experimental sites are a Victoria clay-Orelia fine sandy clay loam complex in Corpus Christi and a Uvalde silty clay loam in Uvalde. Triple superphosphate at a rate of 67 units of P_2O_5 per ha was applied broadcast before planting. Yellow herbicides were broadcast and incorporated before planting at both locations. Pre-emergence herbicides were also applied at both locations. Deep furrow irrigation was applied three weeks before planting in Uvalde to provide adequate soil moisture for germination and growth during early season. Nitrogen was broadcast at a rate of 100 kg/ha and incorporated to the beds with rodweeder immediately before planting in Uvalde. In Corpus Christi, 135 kg/ha of N was applied pre-planting and an additional 19 kg/ha was applied side-dress. Upland cotton (cv. Deltapine 5409 in 1996 and NewCot 33b in 1997) was planted to a plant population of about 100,000 plants per ha in 0.96-m rows in mid March in Corpus Christi and early April in Uvalde. Plots were 6 rows wide and 30 m long. Insect pests were controlled by aerial or ground applications of insecticides as needed. In-season irrigation was provided using a drip system in Corpus Christi, while in furrow irrigation was used in Uvalde in 1996 and a low-pressure overhead sprinkler irrigation system was used in 1997.

RyzUp was applied at a rate of 277 ml/ha broadcast (or 138 ml/ha banded) once at the 3rd to 5th true leaf stage, once at the 5th to 7th true leaf stage, and twice at the 3rd to 5th and at the 5th to 7th true leaf stages. Treatments,

included an untreated control, were in randomised complete blocks with four replications .

Vegetative growth was assessed by measuring plant height from the cotyledon node to the newest unfolded main-stem leaf and the number of fruiting positions on sympodial branches to provide a measurement of fruiting potential.

The two parameters describing the environment of the 15-day period following each of the single applications of RyzUp were the cumulative degree days over 15.6°C and the cumulative potential evapotranspiration (PET) calculated using the Penman equation (Penman, 1963). The Penman method to estimate PET integrates four environmental factors affecting the drying power of the atmosphere, namely solar radiation, air temperature, air humidity and wind.

The dependency of growth on post-treatment environment was analyzed by plotting plant height and the number of branch nodes against cumulative degree days over 15.6°C and cumulative PET. Two years, two locations, and two single application treatments provided eight paired data points for each of these relationships.

Results and Discussion

Growth responses to RyzUp applications. Plant height in Corpus Christi was reduced by 6% from a value of 0.9 m by the single application at the 3-5 leaf stage in 1996. None of the treatments had any effect in Uvalde where height averaged 0.6 m. A single application in Corpus Christi at the 3-5 leaf stage in 1997 increased plant height by 9% over a value of 0.92 m while in Uvalde, plant height tended to be increased by 3% over a value of 0.9 m with the single application of RyzUp at the 5-7 leaf stage.

The number of fruiting positions per plant tended to decrease from a value of 50 with the single applications of RyzUp in Corpus Christi in 1996. Similarly, in Uvalde, the number of fruiting positions tended to decrease from a value of 28 with the single application at the 3-5-leaf stage and significantly decreased with the application at the 5-7 leaf stage. In 1997, opposite effects were observed at both locations. In Corpus Christi, the number of fruiting positions tended to increase with single the application at the 5-7-leaf stage and the double application over the control value of 32 per plant. In Uvalde, the number of fruiting positions also tended to increase over a control value of 32 per plant but only with the double application of RyzUp.

These data showed that the growth responses of cotton to RyzUp applications strongly depended on year, location, and timing of application within year.

Environment dependency of growth responses. The relationships between plant height and the number of branch nodes to cumulative degree-days over 15.6°C were broadly dispersed without indication of tendencies (plots not shown). The relationship between plant height and the number of fruiting positions to cumulative PET, on the other hand, showed well defined trends (Fig. 1 and 2). Positive effects of RyzUp applications on plant height and number of fruiting positions were observed when cumulative PET was below 75 mm and 70 mm, respectively. Conversely, decreased plant height and number of fruiting positions were associated with higher cumulative PET.

Practical implications of this finding point towards possible fine-tuning the management of RyzUp application depending on prevailing or near-future weather conditions. Several consecutive days of rainy and/or cloudy weather would certainly decrease PET and, therefore, increase the possibility of attaining positive growth effects of RyzUp application.

While decreased growth was concomitant to decreased yield in both locations in 1996, increased growth did not result in increased yield in 1997. Other yield-limiting factors could have masked the RyzUp effects.

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Figure 1. Relationship between plant height of cotton treated with RyzUp relative to that of untreated cotton. Cumulative PET is the potential evapotranspiration accumulated during 15 d after treatment.

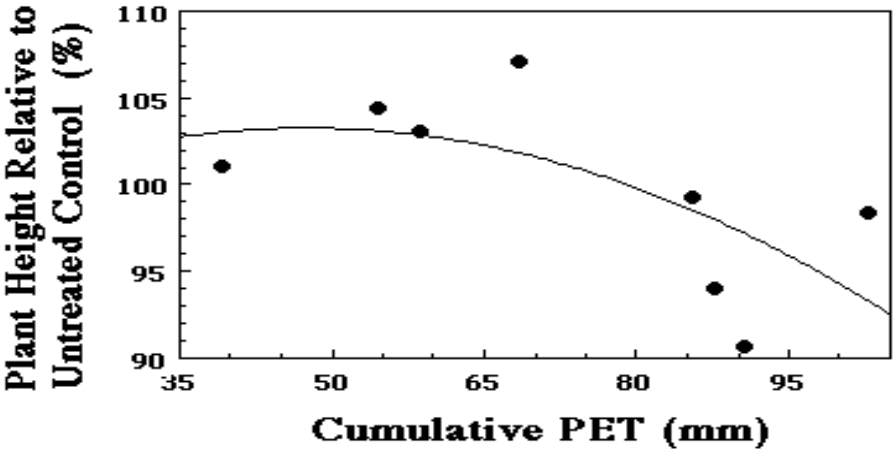

Figure 2. Relationship between number of fruiting positions in cotton treated with RyzUp relative to that of untreated cotton. Cumulative PET is the potential evapotranspiration accumulated during 15 d after treatment.