EFFECTS OF RYZUP®(GA3) ON THE GROWTH AND DEVELOPMENT OF EARLY SEASON COTTON

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Abstract

Abbott Laboratories registered RyzUp_ plant growth regulator in 1995 for use in early season cotton management. The active ingredient in RyzUp_, 4% gibberellic acid (GA3), has been known for many years to increase growth of plants by promoting cell expansion and division. Greenhouse studies showed that growth parameters such as leaf area and height, and physiological parameters such as photosynthesis, could be increased by 20 to 30% with a 2 gram GA3 per acre application. These same basic trends were also observed in field trials conducted in major cotton production areas.

Introduction

Early season cotton undergoes a lag phase in vegetative growth for approximately six weeks after emergence, during which time the crop may experience intense insect pressure, cool temperatures, and other environmental stresses. This combination of phenomena may increase the time required to develop optimum leaf area and subsequent canopy closure. RyzUp (4% gibberellic acid; GA3) may be used as a tool to help overcome early season stress associated with many types of poor growing conditions. Timely canopy closure can result in advantages such as greater light interception, increased competitiveness against weed species, and decreased soil water evaporation. To evaluate the effects of RyzUp on cotton, experiments were conducted under greenhouse and growth chamber conditions, as well as in the field under small replicated plot and large block conditions.

Materials and Methods

Greenhouse - Conditions in the greenhouse ranged from approximately 30ºC during the day to 20ºC at night. Daylength was supplemented to provide a 14 hour photoperiod. Treatment solutions were applied as foliar sprays at several rates to approximate a 15 gallons of water/acre ground application. The plants were treated at the 3 to 7 leaf stage. Growth responses were typically measured one and two weeks after treatment. For photosynthetic measurements, plants were placed in growth chambers at 20ºC 14 days after treatment with a photosynthetically active radiation value at canopy level of ~800μE s^{-1} m^{-2}. Gas exchange characteristics were measured by infrared gas analysis on intact leaves using a LiCor LI-3000 Portable Photosynthesis System (Lincoln, NE). Leaf area was measured using a LiCor LI-3000 Portable Area Meter. Data from Figures 1, 2, 3 and 4 were analyzed by Duncan's separation of means test with significance at 0.95.

Field Trials - Small plot replicated trials and large block demonstrations were conducted in major U.S. cotton growing regions. In small plot trials, leaf area, node number , and height data were collected 10 days to two weeks after treatment (WAT). Node number and height data were collected from demonstration trials. Data from Figure 9 were analyzed by t-test with a significance level of 0.95.

Results and Discussion

Greenhouse - Leaf area and height were significantly increased in most cases in the 3 varieties tested, DPOL50, DPL90, and HS26. Increasing the rate of RyzUp from 2 to 6 grams per acre did not necessarily increase the leaf area response in greenhouse studies (Fig. 1). Only leaves tht had begun to expand were affected by the treatment (Fig 2). The respnse to GA3 was restricted to tissue that was present at the time of treatment. It is well known that GA3 is rapidly metabolized by plant tissue, thus the response was predictaby short lived. In the greenhouse, height appeared to be somewhat more sensitive to rate than leaf area (Fig 3). Photosynthesis on a unit area basis was not significantly increased, however, calculated on an individual leaf basis, the larger leaves which resulted from RyzUp treagment provided greater photosynthetic surface area (Fig 4).

Field Trials - In small plot replicated trials, full rate banded applications were generally more effective than broadcast applications, even when the broadcast rate was high (Fig 5). However, good results with broadcast applications were seen in some large block trials (see Figs 8 and 9). Discrepancies in these results may be due to a number of variables, including type of equipment used, trial location, and variety. A study to determine the effect of nozzle arrangement on response showed that one nozzle banded over the top of the row was more effective than 3 directed nozzles, presumably due to the wider band sprayed by more nozzles (Fig 6). A study comparing the effects of surfactants on effiacy showed no significant increase of leaf area over RyzUp alone with any product (data not shown). In small plot trials, height increases seen 10 to 14 days after treatment were not significant by the time plants reached early bloom (data not shown). Hail damaged cotton in Texas was treated with RyzUp to determine whether it would speed recovery and avoid the time and cost associated with replanting. Height, nodes per plant, and squares per plant were all positively affected by RyzUp

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within two weeks after treatment (Fig 7). Data from large block trials collected at sites in Texas and the Southeast showed, in most caes, the node number height and leaf area (when taken) were increased by the treatments (Figs 8, 9, 10).

Conclusions

It is well known that GA3 promotes cell expansion and division in plant tissue. Limited leaf area is one of the major causes of the growth lag in the early stages of cotton development (Gutherie et al., 1995; Kerby et al., 1987; Oosterhuis, 1995). We have shown that RyzUp, applied during the lag phase of early season cotton growth, led to more rapid canopy development during the period when young plants can utilize extra photosynthetic capacity the most. The implications of slow vegetative development include a negative effect on earliness, the potential of reduced yield, and additional pesticide costs to maintain a late crop (Gutherie et al, 1995; Ashley, 1965). One of the reasons that modern cotton cultivars bear earlier and heavier is because of the more rapid establishment of optimum leaf area index (Wells and Meredith, 1984). RyzUp may provide the grower with a production tool that can boost vegetative mass of the young crop despite setbacks often suffered during the beginning of the season.

Strong, early vegetative development, along with good pest and weed control, is the best way to maximize the crop's potential for earliness and improved yield. Growers can safely use RyzUp in their production cycle to promote growth in a controlled, consistent manner before the transition to reproductive growth begins. Abbott Laboratories, the world's largest producer of plant growth regulators, manufactures RyzUp using the strictest measures of quality assurance. Through continued usage of RyzUp, growers will help refine the best modes of application, rates, and timings for different regions and environmental niches across the Cotton Belt.

References

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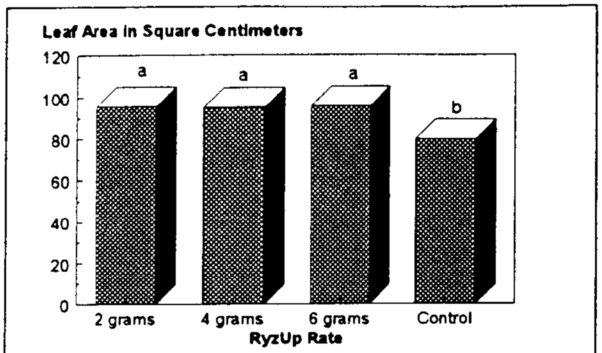

Fig. 1. The effect of rate of RyzUp on leaf area two weeks after application. Greenhouse trial, DPL50, 5th primary leaf.

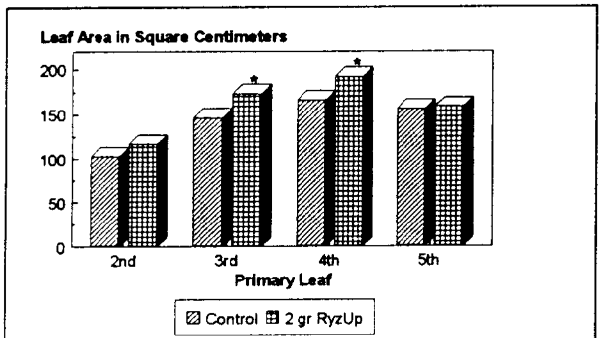

Fig. 2. Effect of Ryzup on leaf area by leaf position. Application of 3 gr/acre made when 5th true leaf was <1 sq. cm. in size. Data taken 2 weeks after treatment. * designates significance at .95. Greenhouse, HS26.

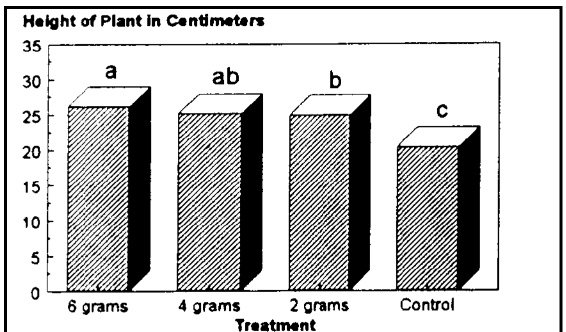

Fig. 3. Effect of Ryzup rate on plant height. Data taken 2 weeks after treatment. DPL50, greenhouse.

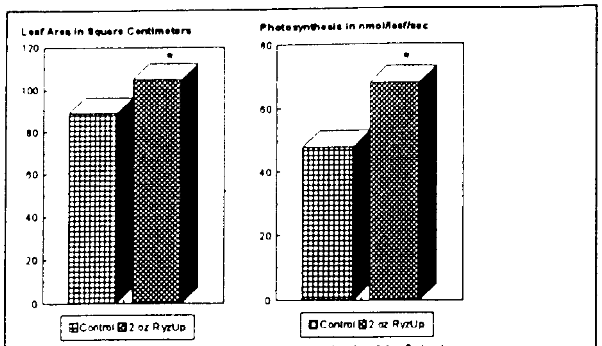

Fig. 4. Effect of RyzUp on leaf area and photosynthesis of the 3rd primary leaf. Data taken 2 weeks after treatment, greenhouse, DPL90.
* designates significance at .95.

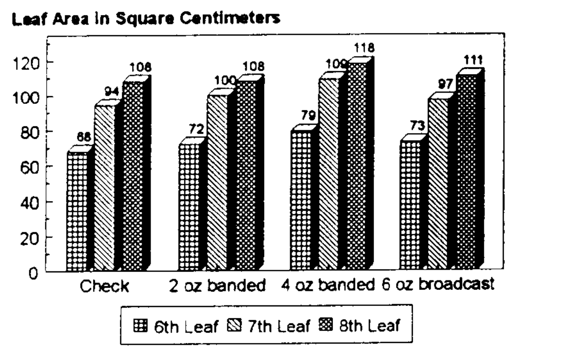

Fig. 5. Effect of rate of RyzUp and application method on leaf area of the 6th, 7th, and 8th primary leaves. Mexia, TX, SV132.

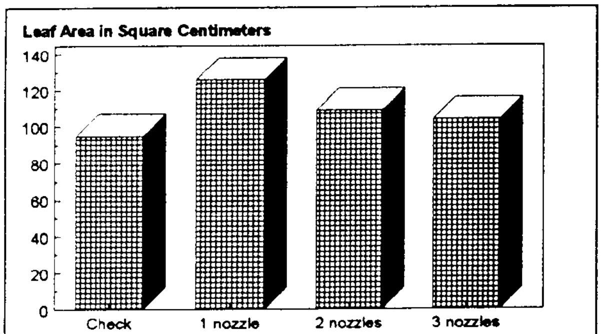

Fig. 6. Effect of nozzle arrangement on leaf area of the 9th primary leaf. 4 oz/acre RyzUp, DPL 50, Mississippi.

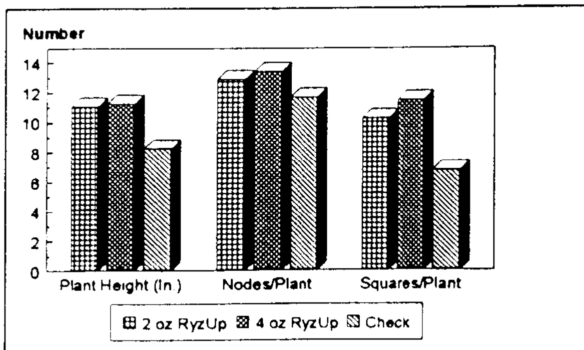

Fig 7. Effect of RyzUp on hail damaged cotton. Application at pre-squaring. Data taken 2 weeks after treatment. HS26, Ft. Stockton, TX.

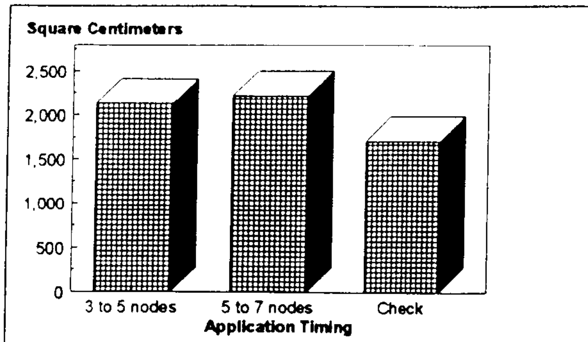

Fig. 8. Effect of RyzUp on leaf area at 2 application timings, 2 oz/acre broadcast. Total leaf area/10 plants/rep, 3 WAT, HS26, Dawson Co., TX.

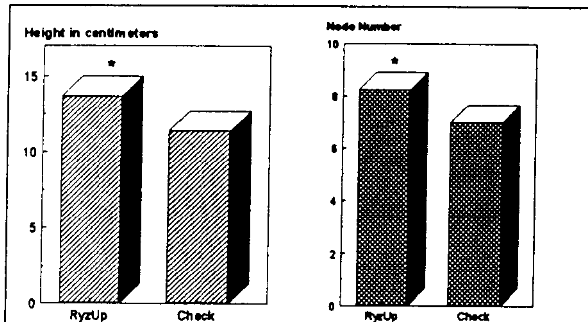

Fig. 9. Height and node data 2 weeks after treatment. DPL50, Robstown, TX.
* designates significance at .95. RyzUp rate 4 oz/acre broadcast.

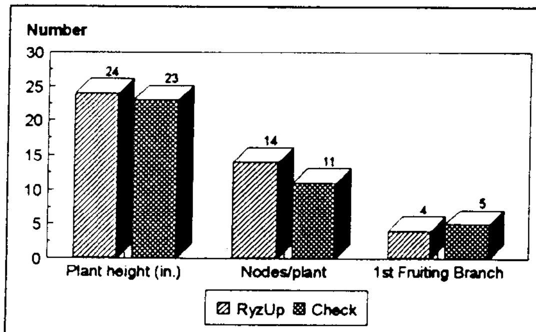

Fig. 10. Effect of RyzUp on height, node number, and first fruiting branch. Rate was 2 oz/acre on the band, DPL20, Bishopville, SC.