CHANGES IN THE COTTON BOLL WALL WITH AGE IN RELATION TO BOLL WORM AND BOLL WEEVIL FEEDING HABITS

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Abstract

It has been demonstrated that bollworm and boll weevil damage to developing cotton (Gossypium hirsutum L.) bolls declines dramatically at approximately 350 heat units after flower fertilization. Use is made of this phenomenon for timing the cessation of insecticide application to the cotton crop. This study was designed to explain this phenomenon by investigating physical, anatomical and biochemical changes in the capsule wall in relation to boll age and insect feeding. The effect of plant growth regulators, PIX and PGR-IV, on the development of the boll wall was also investigated. The largest change in resistance to penetration occurred at 350 heat units after anthesis. Light and electron microscopy showed massive lignification of the endocarp cells of the boll wall at about 350 heat units which may be related to resistance to insect feeding. This study should explain the decline in attractiveness of the cotton boll with age to bollworm and boll weevils, and provide additional confidence utilizing this phenomenon to terminate insecticides.

Introduction

Recent research in Arkansas has shown that bollworm and boll weevil damage to a cotton boll declines dramatically at approximately 350 heat units after pollination of the flower that produced the boll (Bagwell, 1995). This fact is used in the COTMAN cotton monitoring program for timing the termination of insecticide applications (Cochran et.al., 1995). Use of the "350 heat units after cutout decision rule" could potentially reduce input costs and save up to $50 an acre in southeast Arkansas (Cochran et.al., 1994). However, the concern is that if insecticide applications are terminated too early, there could be a decrease in yield.

Materials and Methods

Experiments were conducted at the Arkansas Agricultural Research and Extension Center in Fayetteville, and the Southeast Branch Station in Rohwer, AR in 1996 and 1997. In 1996, there were three treatments (control, PIX, and PGR-IV applied), three replications, and one cultivar (DPL 90). In 1997, there were two cultivars (DPL 90 and DPL 20) and three replications. Two taggings (first flower and NAWF=5) of 30 white flowers per plot were made and 9 bolls were sampled per plot from each tagging at weekly intervals. Physical, anatomical, and biochemical measurements were made to record changes in the boll wall development with age. Records of daily accumulated heat units were made.

Results and Discussion

The decline in attractiveness of the cotton boll with age to bollworms and boll weevils may be due to several physical and anatomical changes in the boll wall. Boll size and boll wall thickness reached a maximum about three weeks after anthesis. Resistance to penetration of the boll wall increased sharply at about 350 heat units. Plant growth regulators did not have any noticeable effect on the developmental trends of the boll wall. There was no clear trend in the pattern of glucose, sucrose, fructose, or tannins during the sample period. Anatomical and physical measurements indicated that the parenchymous capsule wall increased in thickness, resistance to penetration and endocarp thickness with age. Electron microscopy showed an increase in lignification of endocarp cells at the time of 350 heat units, and this may indicate a significant resistance to insect feeding.

References

Bagwell, R.D. 1995. Monitoring the cotton plant for insecticide effects and late season insecticide use termination. Ph.D. Dissertation, University of Arkansas, Fayetteville, Arkansas.

Cochran, M.J., Tugwell, N.P., Bourland, F.M., Oosterhuis, D.M., Holman, M.E., and R. Bagwell. 1995. COTMAN's user's guide version 2.1. University of Arkansas, Fayetteville, Agri. Exp. Sta. Miscel. Publ.

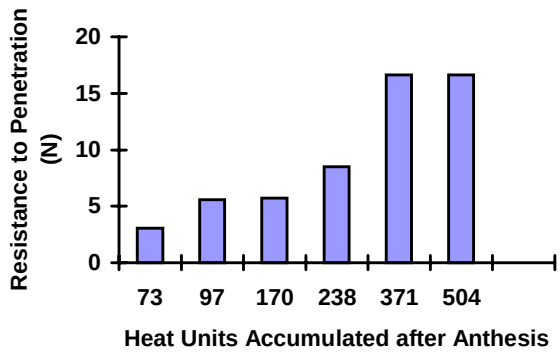

Figure 1. Changes in resistance to penetration of boll wall with age.

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