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EFFECT OF NIGHT TEMPERATURES ON PLANT GROWTH, BOLL DEVELOPMENT AND YIELD

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Abstract

Although cotton (*Gossypium hirsutum* L.) originates from tropical environments, it is sensitive to high temperatures during different stages of its development. Preliminary work has indicated a strong correlation between high temperatures during boll development and low yields in the Mid-South. Both high day temperatures as well as high night temperatures can influence cotton growth and yield. Although extensive research has been made to demonstrate the effect of high day temperatures on yield, information on the night temperature effect is lacking. A study was conducted in 2003 to analyze the effect of night temperature on boll growth and development under field conditions. The hypothesis stated that prolonged periods of elevated night temperatures affect the plant carbohydrate production as a consequence of increased respiration at night; thereby reducing photo assimilates available to meet the increasing sink demand. The objective was to quantify the effect of elevated night temperature on boll development and fiber yield. Treatments consisted of elevated, decreased and normal or ambient temperatures. Shelters were constructed of PVC pipe to hold a plastic covering over the top and sides of the middle two rows of each plot to maintain the imposed temperature treatments. At flowering, 50 white flowers were tagged weekly for three weeks in order to asses the effect of temperature treatments on bolls of different stages of development. In order to elevate or decrease the temperatures, factory heaters or air conditioners were placed between the middle two rows at night to blow hot or cool air respectively. The temperature treatments were imposed during the third week of flowering for two weeks using the PVC shelters with plastic drawn over the top and sides of the plots at night for four hours, 8:00 P.M. until midnight, and removed the following day. Temperature sensors were placed in each plot to monitor the imposed treatments. Photosynthesis and respiration were measured along with sampling of leaves for determination of dry matter, cuticular leaf wax content, specific leaf weight, carbohydrates, chlorophyll, and antioxidant enzymes during and after temperatures imposition. Results showed that rates of night respiration were significantly increased ($P \leq 0.05$) in the elevated night temperature treatment and the photosynthetic activity was decreased in the same treatment when measured the following day. There was no significant ($P \leq 0.05$) effect of elevated or lowered night temperatures on final boll weight or fiber yield. However, there was a numerical trend for elevated night temperature to decrease the percentage of fiber and the fiber yield per seed. The decrease in fiber per seed would presumably be related to a shortage of carbohydrates for boll growth as was indicated by the increased respiration and decreased photosynthesis. The two week period of imposed temperatures was insufficient for a lasting effect, and apparently allowed time for boll compensation and recovery from the temperature stress. Furthermore, weather conditions played a major role, as was observed in our study with mild day and night temperatures during the second week of treatment. Other variables evaluated were not significantly different ($P \leq 0.05$), and carbohydrates are currently being analyzed. This study will be continued under more controlled conditions of temperature in the growth chamber, with measurements focusing on boll compensation after different intervals of temperatures imposition.