EXOGENOUS APPLICATION OF PUTRESCINE ON COTTON OVARIES UNDER TWO TEMPERATURE REGIMES

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Abstract

Polyamines are organic polycations that have been associated with a large number of plant growth and developmental processes, such as pollination and fruit set. However, evidence is limited on the effect of exogenous polyamines on polyamines content of cotton ovaries. Therefore a growth chamber study was conducted to investigate the effect of exogenous application of putrescine on cotton candles on the polyamines content of ovaries and the seed set of cotton, under two temperature regimes. The results showed that exogenous putrescine application significantly increased the putrescine content of cotton ovaries at both temperature regimes, but not the Spermidine and spermine concentration. Also subjecting the plants to 38^{o}C significantly decreased spermidine and spermine levels, but not putrescine. High temperature significantly decreased seed set, while exogenous putrescine application significantly increased seed set.

Introduction

Past experience and recent research has indicated that high temperature is one of the major factor adversely affecting cotton yields (Bibi, 2004; Oosterhuis, 2002). The ideal temperature range in cotton has been reported to be 30/20^{o}C (Reddy et. al. 1991), although cotton physiological growth is not significantly affected up to 35^{o}C (Bibi et.al., 2004). The influence of temperature on the number of ovules per flower has not been determined directly, although there is an indication that extreme high temperatures can result in a lower number of ovules per locule (Hughes, 1966).

Plant growth substances play a controlling role in the process of reproduction. Polyamines (PAs) are substances which are naturally present in plants and act as promoters of growth. They play an important role at the time of flowering, pollination and early fruit development (Costa et al., 1984). In addition, polyamines have been associated with plant response to abiotic stress (Kumar et al., 1997).To our knowledge no evidence exists on the effect of exogenous PAs on polyamines content of cotton ovaries. Also no information exist on how PAs affect seed set of cotton in high and normal temperatures. Therefore the objective of this study was to investigate the effect of exogenous putrsecine application on seed set of cotton under two temperature regimes

Material and Methods

A growth chamber study was conducted in December 2006 in the Altheimer Laboratory, Fayetteville, AR. Cotton (*Gossypium hirsutum* L.) cultivar DP444BR was planted in 80 2L pots filled with Sunshine growing media. Two growth chambers were used, one was used as a control with a day/night temperature regime of 30/20^{o}C, while the second chamber was the high temperature treatment with day/night temperature at 38/20^{o}C. The plants were maintained at control temperature until they reached the flowering stage (5 weeks after planting). Following that 40 pots were placed in each growth chamber. The 40 pots in each chamber were split in two sets, half were used as control and half were used for the exogenous application of putrescine. Putrescine at 10mM plus 0.5% Tween 20 was applied 2 days after the plants were in the temperature treatment. Putrescine was applied to 20 tagged "candles" of the same main stem node. In addition, 20 more candles were tagged from the control plants in each growth chamber. At anthesis (24 hours later) 4 treated white flowers and 4 "untreated control" white flowers were collected for analysis of polyamines using a modified Smith and Davies (1985) protocol. This procedure was repeated for 3 days. After 3 weeks the remaining bolls were collected in order to determine the number of seeds. The treatment design was a two-factor factorial design with the main-factor temperature and the sub-factor Putrescine application. For the statistical analysis, JMP 6 software was used (SAS Institute Inc., Cary, NC).

Results and Discussion

The statistical analysis of the data revealed that there was no significant temperature x Exog Put application interaction. Because of the lack of interaction we focused on the main effects of the exogenous Put application and the main effect of temperature. The results showed that the exogenous Put application significantly increased the putrescine content of cotton ovaries in both temperature regimes (Fig.1). However, spermidine and spermine concentration in cotton ovaries was not significantly affected.

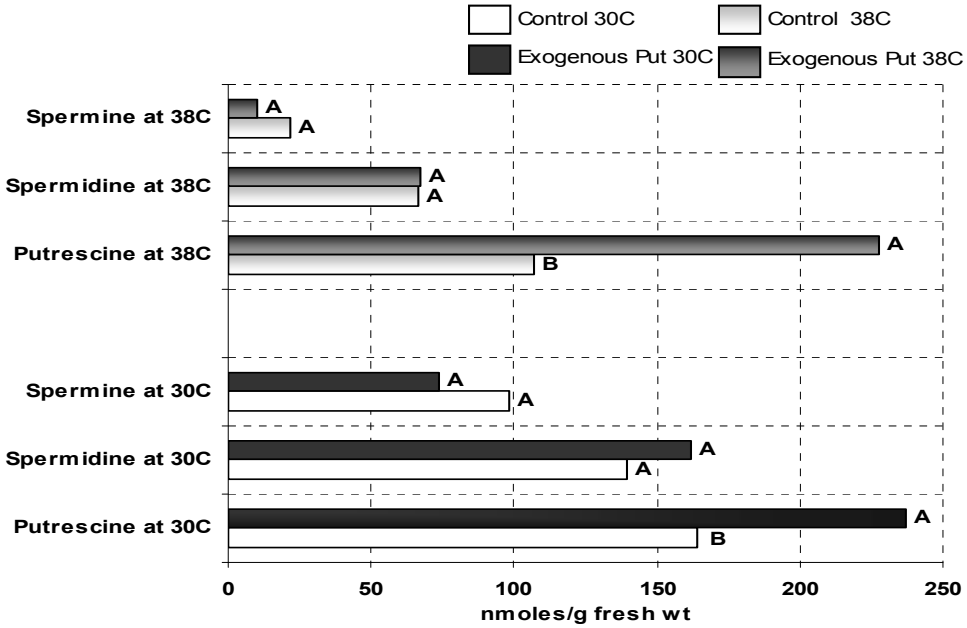

Figure 1. Effect of exogenous Putrescine application on putrescine, spermidine, and spermine content of cotton ovaries at 30 and 38°C. Pairs of columns with the same letter are not significantly different (P=0.05).

Subjecting the plants to temperatures above the 35°C physiological optimum (Bibi, et.al., 2005) significantly decreased the spermidine and spermine levels, but not the putrescine probably due to the exogenous application (Fig.2).

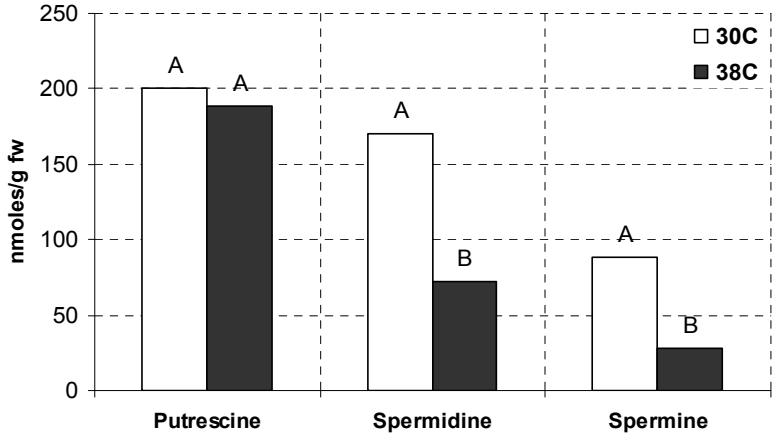

Figure 2. Effect of high temperature on putrescine, spermidine, and spermine content of cotton ovaries. Pairs of columns with the same letter are not significantly different (P=0.05).

The seed set measurements showed again that there was no significant temperature x Exog Put application interaction. Analyzing the main effects on seed set of cotton was significantly decreased from the high temperature (Fig.3). In addition seed set was significantly increased by exogenous Put application (Fg.4).

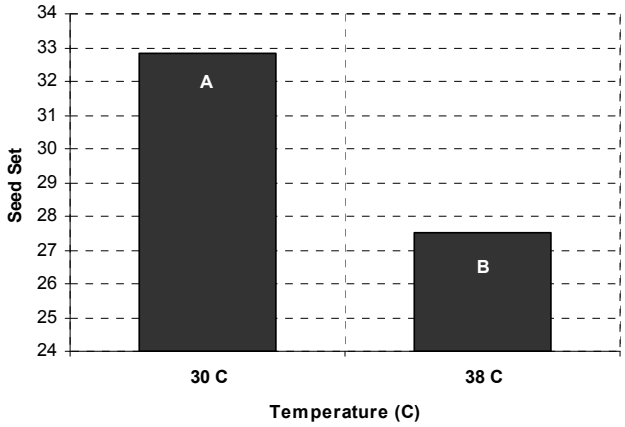

Figure 3. Effect of temperature on seed set of cotton. Columns with the same letter are not significantly different (P=0.05).

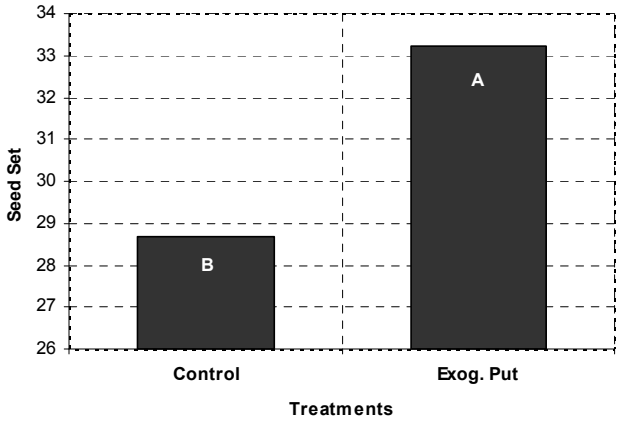

Figure 4. Effect of exogenous Putrescine application on seed set of cotton. Columns with the same letter are not significantly different (P=0.05).

Conclusion

Polyamines play an important role in flowers and seed induction and have been shown to decrease under high temperature stress. Exogenous application of Putrescine increased the level of Putrescine in flowers and this was associated with increased seed set. Therefore the possibility exists of ameliorating high temperature stress in cotton flowers through exogenous application of Putrescine.

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