2003 BELTWIDE COTTON CONFERENCES, NASHVILLE, TN – JANUARY 6-10

# RESPONSE TO TEMPERATURE OF *IN-VITRO* POLLEN GERMINATION AND POLLEN TUBE GROWTH OF COTTON GENOTYPES

**V.G. Kakani, K. Raja Reddy, Ted Wallace, Duli Zhao, and Sailaja Koti**
**Mississippi State University**
**Mississippi State, MS**
**P.V. Vara Prasad**
**University of Florida**
**Gainsville, FL**

## Abstract

Temperatures greater than 30ºC occur frequently in many cotton growing areas in the US and are known to reduce boll retention in cotton. Temperature extremes are likely to increase in frequency under future projected climates. The reproductive period in cotton is about 100 d during the crop season. The reproductive stages of squaring, determination of ovule number, pollen grain formation, pollen tube growth and cell division of zygote are sensitive to high temperature. Failure of successful fertilization causes boll abscission resulting in yield reduction. The objectives of this study were to (1) develop a growth media for germinating cotton pollen with varied genetic background, (2) identify temperature response function for pollen germination and pollen tube growth, (3) determine cardinal temperatures for pollen germination and pollen tube growth and (4) identify genotypes with pollen tolerant to high temperature.

Cotton genotypes were grown in the fields of North Farm of Mississippi State, MS. Thirteen cotton cultivars with varying genetic background and tolerance to abiotic and biotic stresses were selected for the study. The genotypes used for the study were Acala 1517-99, BXN 49B, DP 458B/RR, DP 5415RR, FM 832, FM 832B, NuCOTN 33B, NuCOTN 35B, Pima S6, ST 457, ST 4793R, ST 4892BR, STV 825. Four in-vitro pollen germination media, Brewbaker and Kwack media, Barrows PMDA media, Taylor's germination media and a modified Taylor's germination media were tested for their ability to support pollen germination and pollen tube growth. At 10 d after first flower, five flowers were collected from the plants between 0800 and 0900 h. Pollen was dusted evenly on to the germinating media placed in petri dishes by tapping the flowers. The pollen of each genotype was exposed to temperatures between 10 and 45ºC at 5ºC intervals in growth cabinets. Percent pollen germination and maximum length of pollen tube were recorded after 24 h. Quadratic, cubic, higher order polynomials, beta function and modified bi-linear model were tested for pollen response to temperature. A day after collecting pollen, leaf membrane thermostability, expressed as relative injury (RI%), was determined for all the genotypes. Leaf photosynthesis, conductance and fluorescence were also collected using LICOR-6400.

Of the four pollen growth media tested, modified Taylor's media provided maximum germination and pollen tube growth of the genotypes tested. The modified bi-linear model, with maximum $R^2$ and minimum root mean squared deviation gave the best fit to both pollen germination and pollen tube growth response to temperature of the 13 genotypes. Mean cardinal temperatures (Tmin, Topt and Tmax) for 13 genotypes were 15.0, 31.6 and 43.3ºC for percentage pollen germination and 11.9, 28.6, 42.9ºC for maximum pollen tube length. Pollen of genotypes DP 458B/RR, Acala 1517-99 and Pima S6 had high optimum and maximum temperatures compared to other genotypes and can be classified as tolerant to high temperature.

Genotypes showed variability for RI and physiological variables measured. For the 13 genotypes tested, the RI ranged between 35 and 77%, leaf photosynthesis was between 35.8 and 41.5 µmol $CO_2$ $m^{-2}$ $s^{-1}$, while stomatal conductance ranged between 0.428 and 0.512 mol $m^{-2}$ $s^{-1}$. No significant correlation was detected between pollen and physiological variables tested. Hence, selecting genotypes for high temperature tolerance based on these physiological variables may not be always successful. Further screening of large number of cotton genotypes can be carried out using the *in-vitro* method to identify high temperature tolerance in cotton genotypes. Research is required to identify the relationship between percent pollen germination, pollen tube length and percent boll retention.