# SPAR RESEARCH HEIGHLIGHTS

2005 - Differences in vitro Pollen Germination and Pollen Tube Growth of Cotton Cultivars in Response to High Temperature.

**Reference**

V. G. Kakani, K. R. Reddy, S. Koti, T. P Wallace, P.V.V. Prasad, V. R. Reddy and D. Zhao. 2005. Differences in In Vitro Pollen Germination and Pollen Tube Growth of Cotton Cultivars in Response to High Temperature. Annals of Botany 96: 59-67.

**What was done?**

High-temperature environments with >30 °C reduce boll retention and yield in cotton. Therefore, identification of cotton with high-temperature tolerance would be beneficial in both current and future climates. Response to temperature (10-45 °C at 5 °C intervals) of pollen germination and tube growth was quantified. And their relationship to cell membrane thermostability was studied in 12 cultivars. A principal component analysis was carried out to classify genotypes for temperature tolerance.

**What was learned?**

Pollen germination and pollen tube length of the cultivars ranged from 20 to 60 % and 411 to 903 µm, respectively. A modified bilinear model best described the response to temperature of pollen germination and pollen tube length. Cultivar variation existed for cardinal temperatures (Tmin, Topt and Tmax) of pollen germination percentage and pollen tube length. Mean cardinal temperature calculated from the bilinear model for the 12 cultivars were 15.0, 31.8 and 43.3 °C for pollen germination and 11.9, 28.6 and 42.9 °C for pollen tube lengths. No significant correlations were found between pollen parameters and cell membrane thermostability. Cultivars were classified into four groups based on principle component analysis.

**What it means?**

Based on the principal component analysis, it is concluded that higher pollen germination percentages and longer pollen tube lengths under optimum conditions and with optimum temperatures above 32 °C for pollen germination would indicate tolerance to high temperatures. The above parameters can be used for screening cultivars to high-temperature tolerance.

2005 - Crop Responses to Elevated Carbon Dioxide and Interactions with Temperature.

**Reference**

K. R. Reddy, P.V.V. Prasad, V. G. Kakani. 2005. Crop Responses to Elevated Carbon Dioxide and Interactions with Temperature. Journal of Crop Improvement 13: 157-191.

**What was done?**

Several experiments were conducted in sunlit controlled environment facility known as Soil-Plant-Atmosphere (SPAR) to investigate the effects of carbon dioxide concentration ([CO2]) and temperature.

**What was learned?**

Increases in [CO2] above present levels will improve productivity of cotton because of improved carbon exchange rates, vegetative growth, and number of reproductive organs (bolls). In contrast, an increase in temperature above optimum will decrease cotton yield due to increased boll abscission and smaller boll size. Doubling of [CO2] did not ameliorate the adverse effects of high temperature on reproductive growth (boll abscission or boll size) or fiber quality.

**What it means?**

From the results, we conclude that in future climates, if increases in [CO2] are associated with higher temperatures, cotton yield and quality will decrease, particularly in regions where present temperatures are near optimum.

2004 - Growth, yield and fiber quality responses of cotton to elevated $CO_2$ and N nutrition

**Reference**

K. Raja Reddy, Sailaja Koti, Gayle H Davidonis, and V.R. Reddy 2004. Interactive effects of Carbon Dioxide and Nitrogen Nutrition on Cotton Growth, Development, Yield and Fiber Quality. Agronomy Journal 96: 96: 1139-1147.

**What was done?**

To determine the consequences of elevated carbon dioxide concentrations ([$CO_2$]) and nitrogen (N) nutrition on cotton growth, yield and fiber quality, plants were grown in sunlit Soil-Plant-Atmosphere-Research chambers under favorable water and temperature conditions at three levels of [$CO_2$] (180 (subambient), 360 (ambient) and 720 (elevated) μmol mol-1) and two levels of N nutrition [Continuous N throughout the growth period (N+) and N is withheld from flowering (N-)].

**What was learned?**

Leaf N concentrations decreased with increasing [$CO_2$] under both N+ and N- conditions. These low leaf N concentrations did not decrease the effect of elevated [$CO_2$] in producing higher lint yields at both the N treatments, the response being highest for plants grown under elevated [$CO_2$] and N+ conditions. Fiber quality was not significantly affected by [$CO_2$], while the leaf N concentrations which varied with [$CO_2$] had either a positive or a negative influence on most of the fiber quality parameters. Leaf N during boll maturation period had significant positive correlations with fiber length, fine fiber fraction and immature fiber fraction and significant negative correlations with fiber diameter, short fiber content, cross-sectional area, circularity and micronafis.

**What it means?**

A positive impact of elevated [$CO_2$] was observed on cotton yield, but the magnitude of the response was dependent on N availability. The existing critical N values, which were established when [$CO_2$] was considerably lower (330 μmol mol-1) than the current levels, require reconsideration as atmospheric [$CO_2$] is increasing continuously. Careful consideration of N fertilization will be necessary to take full advantage of any future increases in atmospheric [$CO_2$]. Fiber quality seems to be unaltered by atmospheric $CO_2$, but showed significant changes when N was insufficient for growth under both ambient and elevated $CO_2$ conditions.