

**GLYPHOSATE INHIBITS POLLEN AND ANTHER DEVELOPMENT  
IN GLYPHOSATE RESISTANT COTTON**

**Wendy A. Pline, Ryan Viator, Keith L. Edmisten,  
John W. Wilcut, Judith Thomas and Randy Wells  
North Carolina State University  
Raleigh, NC**

**Abstract**

Roundup (glyphosate) treatments to Roundup-Ready (RR) cotton have been associated with poor pollination and increased boll abortion. Anatomical studies were conducted to characterize the effect of Roundup treatments on the development of male and female reproductive organs of cotton flowers at anthesis. In comparison to non-treated plants, Roundup applied at both the 4-leaf stage postemergence (POST) and at the 8-leaf stage postemergence-directed (PDIR) inhibited the elongation of the anther column and filament, which increased the distance from the anthers to the receptive stigma tip 4.9 to 5.7 mm during the first week of flowering. The increased distance from anthers to stigma resulted in 42% less pollen deposited on stigmas of Roundup-treated plants than non-treated plants. Moreover, pollen from Roundup-treated plants showed numerous morphological abnormalities. Transmission electron microscopy showed the presence of large vacuoles, numerous starch grains, and less organized pockets of endoplasmic reticulum (ER) containing fewer ribosomes in pollen from Roundup-treated than non-treated plants. Pollen development in Roundup-treated plants is likely inhibited or aborted at the vacuolate microspore and vacuolate microgamete stages of microgametogenesis resulting in immature pollen at anthesis. Although stigmas from Roundup-treated plants were 1.2-1.4 mm longer than those from non-treated plants, no other anatomical differences in stigmas were visibly evident. The presence of the Roundup resistant CP4-EPSPS enzyme was quantified in reproductive and vegetative tissues using ELISA. Content of CP4-EPSPS in the stigma, anther, pre-anthesis floral bud (square), and flower petals was significantly less than in vegetative leaf tissue. Roundup effects on male reproductive development resulting in poor pollen deposition on the stigma, as well as production of aborted pollen with reduced viability provide a likely explanation for reports of increased boll abortion and pollination problems in Roundup-treated RR cotton.