

**IMPROVED CROP SAFETY ON ROUNDUP READY® FLEX COTTON: EVALUATING  
ROUNDUP® BRANDS WITH CROPSHIELD™ FORMULAS**

**Jonathan Siebert  
Shea W. Murdock  
Monsanto Company  
St. Louis, MO**

**Abstract**

Prior to the commercialization of Roundup Ready® *Flex* cotton, while conducting field trials evaluating tolerances and weed control systems Monsanto researchers discovered the potential for leaf injury to occur with over-the-top topical glyphosate applications beyond the four leaf stage of development. Many components of a herbicide formulation can cause a crop response. Surfactant type, concentration, other additives, and the manufacturing process itself are the most critical, these components in combination with environmental conditions and crop stage all factor into the potential and severity of leaf injury. Greenhouse and field trials determined that the injury was independent of glyphosate salt type, isopropyl amine versus potassium, and was likely due to other components in the glyphosate formulation. Exhaustive research led to the development of the products, now referred to as Roundup Original MAX™ and Roundup WeatherMAX® with CROPSHIELD™ Formulas for expanded use on Roundup Ready *Flex* cotton, in addition to all Roundup Ready® crops, which optimizes both weed control and crop safety. In 2005 Roundup brands with CROPSHIELD Formulas, were shown to greatly reduce the potential for leaf injury throughout the cotton belt in more than 1600 side-by-side comparisons.

In 2006 field trials were performed at 25 locations to confirm the outstanding results obtained in 2005 greenhouse and field trials, to insure that Roundup brands with CROPSHIELD Formulas are delivering excellent crop safety, as well as attempt to better understand the combination of parameters that must be present for injury to occur. Trials were conducted using small plot research techniques and evaluated crop safety of Roundup WeatherMAX with CROPSHIELD Formula, Roundup Original MAX with CROPSHIELD Formula, and two additional glyphosate formulations (referred to as GLYA and GLYB) which are representative of products currently on the market. Applications of 1.125 and 2.25 lb ae/A were made at the 6-8 leaf stage of development, early bloom, and mid-bloom. Weather data were recorded at the time of application and visual necrosis ratings made five days after each application. Seedcotton yields were obtained where possible and all data were subjected to statistical analysis.

Percent necrosis (based on a 0 – 100 scale) never exceeded 6.25% with applications of Roundup brands with CROPSHIELD Formulas (Roundup Original MAX or Roundup WeatherMAX) at the labeled use rate of 1.125 lb ae/A. A high level of crop safety was maintained even at the 2X rate (2.25 lb ae/A) with injury exceeding 10% in only five percent of the applications. In contrast, with GLYB at 1.125 lb ae/A injury was recorded 60, 64, and 68 percent of the time at the 6-8 leaf, early bloom, and mid-bloom application timings, respectively; with necrosis ratings exceeding 10% in 17% of applications. Applications of GLYB at 2.25 lb ae/A caused injury in 71% of applications, averaging 18.5% necrosis and reaching levels as high as 46.5% in some cases. Seedcotton yields (treatment means averaged across 18 locations) ranged from 3482 lbs/A to 3644 lbs/A but were not significantly different from the weed free check at 3609 lbs/A. Although not statistically significant, seedcotton yields of Roundup Ready *Flex* cotton receiving a season long total of 6.75 lb ae/A (3 – 2.25 lb applications) of Roundup Original MAX or Roundup WeatherMAX with CROPSHIELD Formulas yielded 9 and 16 lbs/A more than the weed free check, respectively. Analysis of weather data revealed a weak (0.39013 correlation coefficient), but statistically significant ( $P > 0.0013$ ) correlation between level of observed necrosis and relative humidity at the time of application. However, a significant correlation between air temperature at application and observed leaf necrosis could not be identified and additional research is needed to identify the environmental conditions conducive for a foliar response.

These studies across the cotton belt again demonstrated the excellent crop safety observed with CROPSHIELD Formulas. Eight out of ten growers surveyed agree that it is safer to use Roundup® brands versus competing

herbicides. Therefore the development of CROPSHIELD Formulas contributed to the successful introduction of Roundup Ready *Flex* cotton on over 2.1 million acres in the United States during the 2006 growing season.