**Benchmark Study**

Glyphosate Resistance Management

2009 – Report #1

MISSISSIPPI STATE UNIVERSITY

PURDUE UNIVERSITY

Southern Illinois University Carbondale

IOWA STATE UNIVERSITY

NC STATE UNIVERSITY

University of Nebraska Lincoln

# Long-Term Research Study Initiated to Improve the Sustainability of the Roundup Ready® Technology

The introduction of herbicide-resistant crops, and more specifically the introduction of the Roundup Ready technology, is considered to be one of the most dramatic changes in weed management in the history of crop production. The impact of this technology in crop production has been well documented. Roundup Ready soybean, the first biotechnology-derived herbicide-resistant crop, was introduced in 1996. The adoption of the Roundup Ready system in soybean, cotton, corn, canola and sugar beets has been rapid and wide spread because it enables broad-spectrum weed control, outstanding crop safety and flexibility and simplicity in weed management.

However, university weed scientists are concerned that the growers' current herbicide programs will affect the sustainability and effectiveness of weed control in Roundup Ready cropping systems. Weed populations may shift to species that are more tolerant to glyphosate. Without proper management, the potential for weeds to become glyphosate resistant could adversely impact the utility and life cycle of glyphosate herbicide products. In 2005, weed scientists from six universities, with the support of the Monsanto Company, initiated a long-term research study to assess the sustainability of the Roundup Ready technology as the weed management foundation for U.S. cropping systems. The information gathered from this research study will provide university scientists with valuable data to develop and tailor effective strategies and outreach programs to improve sustained weed control in the Roundup Ready technology.

**Study Objectives**

- Determine growers' current tillage practices and herbicide use patterns and their perceptions of changes in weed pressures and problematic weeds after adopting Roundup Ready cropping systems.
- Evaluate the sustainability and profitability of grower herbicide programs compared to university based herbicide programs for Roundup Ready cropping systems.
- Assess the risks of Roundup Ready cropping systems for the development of weed community shifts and glyphosate-resistant weed populations.
- Develop recommendations that can improve the sustainability of Roundup Ready cropping systems.

This long-term research study consists of two parts: a grower survey study and long-term field studies.

**Part 1 – Grower Survey Study**

Approximately 1200 growers from six states (approximately 200 growers each in Illinois, Indiana, Iowa, Mississippi, Nebraska, and North Carolina) were surveyed by telephone between November, 2005 and January, 2006. The growers from

these states represent the major Roundup Ready crop growing regions of the United States and provide diversity in environments, cropping systems, and weed populations. Survey respondents were actively involved in farming, responsible for the decisions concerning the seeds, traits, and herbicides purchased for their operation, and farmed a minimum of 250 acres of corn, soybean, or cotton in 2005. Only growers using the Roundup Ready trait or trait combinations for a minimum or three years were included in the survey. University scientists developed the survey questions which were composed of questions in four sections: 1) crops grown currently and in the past six years, 2) weed pressure and tillage practices on a specific, representative field, 3) current and past herbicide programs, and 4) awareness and perceptions of glyphosate-resistant weeds.

**Part 2 – Long-Term Field Studies**

Growers were randomly selected from among the survey respondents in Part 1 of this study to participate in a long-term field study (minimum of four years). Approximately 150 growers in Illinois, Indiana, Iowa, Mississippi, Nebraska, and North Carolina (25 to 30 per state) were asked to provide a representative field of about 25 acres for the duration of the study. Each field was split into two equal halves. On one half of the field the grower continued using the current weed management program. On the other half, the grower would use herbicide recommendations provided by the university weed specialist in the state. The crop rotation and other production practices remained the same for both halves of the field. Researchers expect the university herbicide program to reduce the selection pressure of glyphosate and lower the potential risk of weeds developing resistance to glyphosate herbicide.

**Field Comparison**

| **Grower Managed Side** | **University Managed Side** |
|---|---|
| • Current herbicide program | • Herbicide program to reduce potential for weeds to develop resistance to glyphosate<br>• Change herbicide program as needed to manage weed problem |

Field data and soil samples would be collected each year by university scientists to determine the impact of the two weed management programs on weed populations, weed species diversity, weed seedbank, crop yields, and economic returns. The results of this long-term study will provide valuable data to determine the sustainability and profitability of current grower weed management programs compared to more diversified weed management programs designed to lower the potential risk of selecting for weeds resistant to glyphosate.

---

David R. Shaw, Wade A. Givens, Luke A. Farno, and Patrick D. Gerald – Mississippi State University; David Jordan – North Carolina State University; William G. Johnson and Stephen C. Weller - Purdue University; Bryan G. Young – Southern Illinois University; Robert G. Wilson – University of Nebraska; and Micheal D.K. Owen – Iowa State University. Using a Grower Survey to Assess the Benefits and Challenges of Glyphosate-Resistant Cropping Systems for Weed Management in U.S. Corn, Cotton, and Soybean. Weed Technology 23:134-149.