

TITLE

Magnitude of Glyphosate Residues in Corn
Raw Agricultural Commodities Following Applications of a
Glyphosate-Based Formulation to MON 87427

DATA GUIDELINES

U. S. Environmental Protection Agency's Residue Chemistry
Test Guidelines, OPPTS 860.1500, Crop Field Trials

AUTHOR

Michael G. Mueth

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SPONSOR

Monsanto Company
Environmental Sciences Technology Center
800 North Lindbergh Blvd.
St. Louis, Missouri 63167

FIELD RESEARCH MANAGEMENT CONTRACTOR

Richard D. Carringer
The Carringers, Inc.
1003 Palace Ct.
Apex, NC 27502

ANALYTICAL LABORATORY

Monsanto Company
Environmental Sciences Technology Center
800 North Lindbergh Blvd.
St. Louis, Missouri 63167

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CERTIFICATION OF AUTHENTICITY

This summary report is an accurate account of work conducted in this study.

Author and
Study Director:



Michael G. Mueth
Monsanto Company
800 North Lindbergh Blvd.
St. Louis, Missouri 63167
(314) 694-6468

Date: 8-30-2010

INTRODUCTION

A glyphosate residue study was conducted in typical corn-growing regions of the U.S. in 2008, in plots planted with hybrid seed produced with the Roundup Hybridizing System (RHS™) and containing the Roundup Ready 2 Technology. The plots were treated with the glyphosate herbicide MON 79770, which is sold under the trade name of Roundup WeatherMAX®.

The purpose of this study was to determine glyphosate and aminomethylphosphonic acid (AMPA) residue levels in corn raw agricultural commodities grown from hybrids that contain the Roundup Ready 2 Technology and were produced using the Roundup Hybridizing System (RHS™), including MON 87427, following applications of glyphosate-based formulations. This summary report contains data from the study demonstrating that residues of glyphosate in MON 87427 grain will be within existing Maximum Residue Limits (MRL) or tolerances, when applications of glyphosate-based herbicides such as Roundup WeatherMAX are made at rates currently approved by the U.S. EPA for weed control in corn hybrids with Roundup Ready 2 Technology.

The current maximum allowable rates and growth stages for glyphosate-containing herbicides applied to corn containing the Roundup Ready 2 Technology are summarized below for Roundup WeatherMAX herbicide. Any combination of application rates and timings may be used within the allowed limits for individual rates and timings as specified on the label.

Table 1: Maximum Allowable Combined Application Amounts of Roundup WeatherMAX Per Season to Corn

Application Timing	Rate as Roundup WeatherMAX	Equivalent rate as Glyphosate Acid
Combined total per year for all applications	12.4 l/ha or 5.3 quarts/acre	6.72 kg/ha or 6.0 lb/acre
Preplant, at-planting and preemergence applications	7.7 l/ha or 3.3 quarts/acre	4.14 kg/ha or 3.7 lb/acre
Total in-crop applications from emergence through 48-inch corn	4.7 l/ha or 2 quarts/acre	2.52 kg/ha or 2.25 lb/acre
Maximum single in-crop applications from emergence through 48-inch corn	2.3 l/ha or 1 quart/acre	1.27 kg/ha or 1.13 lb/acre
Maximum preharvest application after maximum kernel fill is complete and the crop is physiologically mature (black layer formation) until 7 days before harvest	1.6 l/ha or 0.69 quarts/acre	0.86 kg/ha or 0.77 lb/acre
Total applications from emergence through harvest	4.7 l/ha or 2 quarts/acre	2.52 kg/ha or 2.25 lb/acre

® Roundup WeatherMAX is a registered trademark of Monsanto Technology LLC.

According to the U.S. label instructions, this product may be applied alone or in a tank-mix over the top of corn hybrids with Roundup Ready 2 Technology from emergence through the V8 stage (8 leaves with collars), or until the corn height reaches 30 inches (75 cm, free standing), whichever comes first. Drop nozzle application is recommended for applications up to 48 inches in height (through approximately the V12 stage).

As part of this study, Roundup WeatherMAX was applied to corn hybrids containing both MON 87427 and Roundup Ready 2 Technology at rates and growth stages derived from the current approved U.S. labeling, and the mature grain was analyzed for glyphosate residues.

SUMMARY

Data were obtained on the residue levels of glyphosate and its major metabolite, aminomethylphosphonic acid (AMPA), in corn grain grown from corn hybrids containing both MON 87427 and Roundup Ready 2 Technology following applications of the glyphosate-based herbicide, Roundup WeatherMAX[®]. Roundup WeatherMAX herbicide is registered in the U.S. under EPA Registration No. 524-537 and contains 540 grams per liter or 4.5 lbs per U.S. gallon of glyphosate acid.

The field portion of the study was conducted in the United States in 2008 at one site in each of six states: Illinois, Indiana, Iowa, Minnesota, Wisconsin, and Nebraska. These sites represent major corn growing areas in the U.S. All sites contained two treated plots with corn hybrids containing MON 87427, and one untreated plot. Each treated plot was planted with a single hybrid (MON 87427 × Roundup Ready 2 corn). The two hybrids were derived from two different Roundup Ready events containing Roundup Ready 2 Technology (NK603 and MON 88017). The untreated plot was planted with hybrid cross LH198+LH287. At all sites, the untreated and treated plots measured a minimum of 50 and 100 square metres, respectively. The untreated plot was a minimum distance of 30 metres from the treated plots.

Under the current U.S. Roundup WeatherMAX herbicide label, application rates and timings may be combined in various ways within the allowable limits. The target application rates and timings selected for this study are summarized in the following table. The combination of applications represent the maximum pre-emergence and in-crop applications allowed on corn hybrids containing Roundup Ready 2 Technology, and the total combined in-season rate of 6.9 kg glyphosate acid per hectare is consistent with the current U.S. label.

Table 2: Applications of Roundup WeatherMAX Herbicide to Hybrids Containing Both MON 87427 and Roundup Ready 2 Technology

Test System Description		Application Rate kg glyphosate acid/ha (volume Roundup WeatherMAX/ha)		
Corn Hybrid	Control/Test	Preemergence Application	V3-V4 Application	V8 Application
LH198+LH287 conventional	Control	0	0	0
MON 87427 × NK603	Test	4.35 kg/ha (7.9 l/ha)	1.27 kg/ha (2.3 l/ha)	1.27 kg/ha (2.3 l/ha)
MON 87427 × MON 88017	Test	4.35 kg/ha (7.9 l/ha)	1.27 kg/ha (2.3 l/ha)	1.27 kg/ha (2.3 l/ha)

The first application was a preemergence broadcast application applied to the soil after planting, but prior to crop emergence. The second and third applications were postemergence over-the-top broadcast applications at the V3-V4 and V8 corn growth stages, respectively. The V3-V4 stage is an early vegetative stage, and V8 is the beginning of rapid nitrogen uptake by the plant. Spray solutions for the in-crop over-the-top applications also contained a nonionic surfactant at a target concentration of 0.5 litres per 100 litres of spray solution (0.5% v/v) and ammonium sulfate at a target concentration of 2 kg per 100 litre of spray solution. All applications were within 5% of target application rates. All nonionic surfactant and ammonium sulfate concentrations were within 5% of target concentrations.

Corn grain samples were collected at normal harvest at all sites. Samples were composited from at least twelve separate representative subsamples collected from different locations in the plot, or composited from at least twelve separate subsamples from the harvester as it advanced through the plot. A single composited sample was collected from each untreated plot, and two independently composited samples were collected from each treated plot. The untreated plot was sampled first followed by the treated plots. Samples were taken from the interior of the plots.

Glyphosate and AMPA residue levels were determined by LC/MS/MS according to an established method [1]. Untreated control samples, and untreated control samples fortified with solutions containing known amounts of glyphosate and AMPA, were included in each sample set along with the treated samples. Control samples were fortified at levels ranging from 0.05 to 2.5 ppm for both analytes in corn grain. Four fortified samples were analyzed along with the treated samples from three sites in a sample set. All residue levels in the untreated grain samples were at or below the 0.05 ppm lower limit of method validation. The average background-corrected recoveries across all fortification levels for glyphosate and AMPA are shown in the following table.

Table 3: Percent Recovery of Glyphosate and AMPA from Fortified Corn Grain Samples

			Background Corrected Recovery Average (Range) %	
	Number of Samples	Fortification Level (ppm)	Glyphosate	AMPA
Corn Grain	8	0.05 – 2.5	94.1 (92.4 – 96.6)	93.8 (89.8 – 98.0)

The results summarized for treated samples in the following table show that resulting glyphosate residue levels in corn grain grown from hybrids containing both MON 87427 and Roundup Ready 2 Technology are below the tolerance or MRL established for glyphosate in corn grain by numerous regulatory authorities. These MRLs include 5 ppm established by the United States EPA [2] and CODEX [3], and 1 ppm established by Japan's MHLW [4]. These results confirm that glyphosate residues in MON 87427 will be within the existing tolerance when applications are made according to the current approved labeling used commercially in the U.S. for Roundup Ready corn.

Table 4: Glyphosate and AMPA Residues in Corn Grain Grown From Hybrids Containing Both MON 87427 and Roundup Ready 2 Technology

Hybrid	PHI Range (days) ²	Glyphosate (ppm) ¹		AMPA (ppm) ¹	
		Median	Range	Median	Range
MON 87427 × NK603	88-121	0.04	0.01-0.13	0.01	0.01-0.03
MON 87427 × MON 88017	88-121	0.06	0.01-0.20	0.02	0.01-0.04

¹The median and range of individual residue values across all six sites.

²PHI - Preharvest interval = Interval between the last application and sampling.

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