STUDY TITLE

Phenotypic Evaluation and Ecological Interactions of the Combined Trait Corn Product MON 89034 × TC1507 × MON 88017 × DAS-59122-7 Grown During 2006

This report reflects data developed and reported in Monsanto Study 07-01-52-05

AUTHOR

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SPONSOR AND TESTING FACILITY

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REPORT NUMBER

MSL0021061

The text below applies only to use of the data by the United States Environmental Protection Agency (U.S. EPA) in connection with the provisions of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).

STATEMENT OF NO DATA CONFIDENTIALITY CLAIM

No claim of data confidentiality is made for any information contained in this study on the basis of its falling within the scope of FIFRA § 10(d)(1)(A), (B), or (C).

We submit this material to the U.S. EPA specifically under the requirements set forth in FIFRA as amended, and consent to the use and disclosure of this material by the EPA strictly in accordance with FIFRA. By submitting this material to the EPA in accordance with the method and format requirements contained in PR Notice 86-5, we reserve and do not waive any rights involving this material that are or can be claimed by the company notwithstanding this submission to the EPA.

Company: Monsanto Company

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Signature: _____ Date: _____

This document describes the phenotypic and ecological characterization of the combined trait corn product MON 89034 × TC1507 × MON 88017 × DAS-59122-7 generated under Study 07-01-52-05.

The Statement of Compliance from Study 07-01-52-05 is provided below.

STATEMENT OF COMPLIANCE

This study does not meet the U.S. EPA Good Laboratory Practice requirements as specified in 40 CFR Part 160. Measures taken to ensure study quality have been included in the Quality Measures section of the report.

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QUALITY CONTROL STATEMENT

This report was reviewed to assure that it accurately reflects the portion of the work conducted in Monsanto Study 07-01-52-05.

Reviewed by:

DeAnn Holder

Monsanto Company
Monsanto Regulatory – Quality Assurance
Unit

2/28/08

Date

REPORT CERTIFICATION

This report is an accurate and complete representation of a portion of the work conducted in study #07-01-52-05.

Signatures of Approval:

Study Director and
Report Author:

Eric W. Rosenbaum — Date 2/28/08

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STUDY INFORMATION PAGE

Report Title:	Phenotypic Evaluation and Ecological Interactions of the Combined Trait Corn Product MON 89034 × TC1507 × MON 88017 × DAS-59122-7 Grown During 2006
Study Number:	07-01-52-05
Sponsor and Testing Facility:	Monsanto Company 800 N. Lindbergh Blvd. St. Louis, Missouri 63167
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ABBREVIATIONS

FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
USDA-APHIS	United States Department of Agriculture – Animal and Plant Health Inspection Service
U.S. EPA	United States Environmental Protection Agency

1.0 SUMMARY

Monsanto Company and Agrigenetics (Dow AgroSciences) have used conventional breeding techniques to develop the combined trait corn product MON 89034 × TC1507 × MON 88017 × DAS-59122-7 that confers insect resistance and herbicide tolerance. Comparative phenotypic and ecological assessment data are used to characterize the plant and to assess pest potential, and ultimately the ecological risk of the biotechnology-derived crop compared to conventional hybrids.

In Spring 2006, field trials were established at four sites in a randomized complete block design with three replications. The test substance was MON 89034 × TC1507 × MON 88017 × DAS-59122-7. The control substance was the conventional corn hybrid, XE6001, which has background genetics similar to the test substance. In addition, commercially available corn hybrids were used as reference substances. Early stand count, seedling vigor, days to 50% pollen shed, days to 50% silking, ear height, plant height, staygreen, dropped ears, final stand count, stalk lodging, root lodging, grain moisture, test weight, yield, insect stressor, disease stressor, and abiotic stressor data were collected throughout the growing season.

In the combined-site analyses, no differences were detected between MON 89034 × TC1507 × MON 88017 × DAS-59122-7 and the control for any of the 14 phenotypic characteristics.

No differences were observed between MON 89034 × TC1507 × MON 88017 × DAS-59122-7 and the control for 33 of the 34 assessed ecological stressor symptoms (11 insect, 15 disease, and 8 abiotic). One difference was observed between MON 89034 × TC1507 × MON 88017 × DAS-59122-7 and the control for northern corn leaf blight at the IA-1 site during the third observation (slight vs. moderate, respectively). The observed difference in the incidence of northern corn leaf blight was not observed at other sites or observations. Therefore, the difference in northern corn leaf blight susceptibility is unlikely to be of biological concern.

This portion of the study evaluated the phenotypic characteristics and ecological interactions of MON 89034 × TC1507 × MON 88017 × DAS-59122-7 compared to a conventional corn control. The characteristics measured provide crop biology and ecological interactions data useful in characterizing the plant in an assessment of ecological risk. The results support a conclusion that the combination of the insect protection traits and herbicide tolerance traits through conventional breeding did not unexpectedly alter the assessed phenotypic characteristics or ecological interactions of MON 89034 × TC1507 × MON 88017 × DAS-59122-7 compared to conventional corn. Thus, the results support a conclusion of no increased pest potential or adverse environmental impact for the combined trait product.

2.0 INTRODUCTION

Monsanto Company and Agrigenetics (Dow AgroSciences) have used conventional breeding techniques to develop the combined trait corn product MON 89034 × TC1507 × MON 88017 × DAS-59122-7 that confers insect resistance and herbicide tolerance. Each biotechnology-derived trait contributes specific benefits to the final combined product as follows:

MON 89034 produces two insecticidal proteins that protect against feeding damage caused by European corn borer (*Ostrinia nubilalis*) and other lepidopteran insect pests. MON 89034 produces two *Bacillus thuringiensis* proteins, Cry2Ab2 (subsp. *kurstaki*) protein and Cry1A.105, a modified Cry1A *Bt* protein. The combination of the two insecticidal proteins provides enhanced insect control and offers an additional insect-resistance management tool.

TC1507 produces the *Bacillus thuringiensis* var *aizawai* Cry1F protein to selectively control larvae of the European corn borer (*Ostrinia nubilalis*) and other lepidopteran insect pests. In addition, TC1507 produces the phosphinothricin acetyl transferase (PAT) protein from *Streptomyces viridochromogenes*, to confer tolerance to glufosinate-ammonium, the active ingredient in Liberty® herbicide.

MON 88017 produces a modified *Bacillus thuringiensis* (subsp. *Kumamotoensis*) Cry3Bb1 protein to protect against corn rootworm (CRW) larval feeding. In addition, MON 88017 is a Roundup Ready® corn that produces 5-enolpyruvylshikimate-3-phosphate synthase protein from *Agrobacterium sp.* strain CP4 (CP4 EPSPS), which confers tolerance to glyphosate, the active ingredient in Roundup® agricultural herbicides.

DAS-59122-7 produces the *Bacillus thuringiensis* strain PS149B1 Cry34Ab1 and Cry35Ab1 proteins to protect against coleopteran pests such as corn rootworm. In addition, DAS-59122-7 produces the phosphinothricin acetyl transferase protein from *Streptomyces viridochromogenes* (PAT), and confers tolerance to glufosinate-ammonium, the active ingredient in Liberty herbicide.

The combined trait corn product MON 89034 × TC1507 × MON 88017 × DAS-59122-7 provides insect protection against lepidopteran and coleopteran insect pests and tolerance to the glyphosate and glufosinate herbicide families in a single product generated through conventional breeding techniques.

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Separate evaluations of MON 89034 (Kendrick and Clark, 2006a; Kendrick and Clark, 2006b; Kendrick et al, 2005), MON 88017 (Pester and Woodrum, 2003; Rosenbaum et al, 2003), TC1507 (Bing, 2005), and DAS-59122-7 (Bing, 2004) were conducted and revealed no differences with respect to pest potential when compared to conventional corn. Although no changes in pest potential or ecological risk would be expected when these traits are combined through conventional breeding, it was recognized that there may be a need for confirmatory data.

The purpose of this study was to assess the phenotypic characteristics and ecological interactions of the combined trait corn products MON 89034 × TC1507 × NK603 and MON 89034 × TC1507 × MON 88017 × DAS-59122-7 compared to a conventional corn control. The purpose of this report was to report the results of the assessment of MON 89034 × TC1507 × MON 88017 × DAS-59122-7 compared to a conventional corn control.

3.0 MATERIALS AND METHODS

3.1 Study Sites

In Spring 2006, phenotypic and ecological data were collected at the four sites listed below under Monsanto Production Plan 06-01-52-04. These sites provided a range of environmental and agronomic conditions representative of major U.S. corn growing regions. The Principal Investigator at each site was familiar with the growth, production, and evaluation of corn characteristics required by the production.

Site Code	County, State
IA-1	Jefferson Co., IA
IA-2	Greene Co., IA
IL-1	Stark Co., IL
NE	York Co., NE

3.2 Test, Control, and Reference Substances

Test, control, and reference starting seed information is summarized in Table 1. The test and control starting seed were produced in the U.S. in 2005 by Monsanto Trait Integration. The reference starting seed were obtained from commercial sources.

3.2.1 Test Substance

The test substance was MON 89034 × TC1507 × MON 88017 × DAS-59122-7 (Table 1).

3.2.2 Control Substance

The control substance was the conventional corn hybrid, XE6001, which has background genetics similar to the test substances (Table 1).

3.2.3 Reference Substances

The reference substances were commercially available conventional corn hybrids. Three different reference hybrids were planted at each site (Table 1).

For the test and control starting seed, the presence or absence of MON 89034, TC1507, MON 88017, and DAS-59122-7 was verified by event-specific polymerase chain reaction analyses. The results of these analyses were as expected for the test and control substance. The methods of verification were documented by the Monsanto Product Characterization Technology Center and the results and raw data are retained in the Monsanto Regulatory archive. Copies of the Certificates of Analysis are included in the study file. To confirm identities of the reference substances, the Principal Investigator visually compared the chain-of-custody documentation with the label on the seed packages.

3.3 USDA-APHIS Compliance

The shipment and environmental release of the regulated starting seed used in this study was conducted in accordance with United States Department of Agriculture-Animal and Plant Health Inspection Service (USDA-APHIS) regulations under notification number 06-073-02n.

3.4 Experimental Methods

The experiment was established at each of the sites in a randomized complete block design with three replications. Each plot consisted of six rows spaced approximately 30 inches apart and approximately 20 feet in length (Table 2). The plots were separated by two rows of conventional corn along their length and by an alley approximately five feet wide along their width. The entire plot area was surrounded by a border of conventional corn approximately 10 feet (four rows) in width. Phenotypic and ecological data were collected from rows four and five. The remaining rows were used for other purposes under Production Plan 06-01-52-04.

Planting information is listed in Table 2. Agronomic practices used to prepare and maintain each study site were characteristic of those used in each respective geographic region.

Phenotypic Evaluation
The phenotypic characteristics evaluated are listed and described in Table 3.

Ecological Interactions
Ecological interactions on a biotechnology-derived trait are used to characterize the plant by assessing altered susceptibility to diseases and insect pests, and plant response to abiotic stressors. Ecological interactions were evaluated at four growth stage intervals [V2 – V4 (Observation 1), V10 – V15 (Observation 2), VT – R3 (Observation 3), and R6 (Observation 4)]. Evaluations were made on the 4th and 5th rows of each plot for differential plant response to three non-target pests, three diseases, and three abiotic stressors using the following scale:

0	=	none (no symptoms observed)
1 – 3	=	slight (symptoms not damaging to plant development)
4 – 6	=	moderate (intermediate between slight and severe)
7 – 9	=	severe (symptoms damaging to plant development)

Ecological stressor data on corn earworm, European corn borer, and herbicide injury were not reported. Since the test substance in this study provided protection against or tolerance to these stressors, the data collected on them did not fall within the scope of an ecological interaction assessment for this study. Furthermore, animal damage was not reported due to the non-uniform nature of animal damage in field trials.

3.5 Data Assessment

During the process of data summarization and analysis, experienced scientists familiar with each experimental design and evaluation criteria were involved in all steps. This oversight ensured that the data were consistent with expectations based on experience with the crop. In addition, the overall dataset was evaluated for evidence of biologically relevant changes, and for possible evidence of an unexpected plant response. If cooperating scientists indicated any unexpected observations or issues in the course of the study, they are noted in this report. Data were then submitted to statistical analysis.

3.6 Statistical Analysis

An analysis of variance (ANOVA) was conducted according to a randomized complete block design using SAS® (SAS Version 9.1.3, SAS Institute, Inc. 2002-2003). The level of significance was α=0.05. For each analyzed characteristic, the test substance was compared to the control substance pooled across all sites (combined-site analysis) and at each site (individual site analysis). Characteristics analyzed were:

- Early stand count
- Seedling vigor
- Days to 50% pollen shed
- Days to 50% silking
- Ear height
- Plant height
- Staygreen
- Dropped ears
- Final stand count
- Stalk lodging
- Root lodging
- Grain moisture
- Test weight
- Yield

No statistical comparisons were made between the test and reference substances. For the reference substances, the minimum and maximum mean values were calculated for each characteristic.

To help satisfy the assumptions of the analysis, a square root transformation was utilized in the analysis of early stand, dropped ears, root lodging, stalk lodging.

Due to a lack of variability for all substances, individual site comparisons for the characteristics dropped ears (at sites IA-1 and IA-2), plant vigor (plant = seedling) (at sites IA-1 and IL-1), and root lodging (at sites IA-1 and IL-1) could not be done.

Combined-site Analysis

A combined-site analysis was performed for each plant phenotypic characteristic separately. A model of the following form was fit each characteristic:

$$y_{ijk} = \mu + s_i + r_{j(i)} + l_k + (sl)_{ik} + \varepsilon_{ijk} \quad (2)$$

where, y_{ijk} = Measurement for the kth substance in the jth replicate of the ith site; μ = The overall mean; s_i = Random Effect of the ith site; $r_{j(i)}$ = Random effect of the jth replicate in the ith site; l_k = Effect of the kth

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substance; $(sl)_{ik}$ = Random effect of the interaction between the i^{th} site and the k^{th} substance; ε_{ijk} = Residual effect.

PROC MIXED in SAS (V9.1.3) was used to fit model (2) separately for each phenotypic characteristic. The model was first used to provide overall F-tests. Because there were multiple test substances, comparisons were only performed where the overall F test was significant at the 5% significance level to protect against type I errors. Where the overall F tests were significant comparisons were made between the test substances and the control substance at the 5% significance level.

Individual Site Analysis
A model of the following form was fit for each characteristic at each site:

$$y_{ij} = \mu + r_i + t_j + \varepsilon_{ij} \quad (1)$$

where, y_{ij} = Measurement for the j^{th} substance in the i^{th} replicate; μ = The overall mean; r_i = Random effect of the i^{th} replicate; t_j = Effect of the j^{th} substance; ε_{ij} = Residual effect.

PROC MIXED in SAS (V9.1.3) was used to fit model (1) separately for each phenotypic characteristic at each site. The model was first used to provide overall F-tests. Because there were multiple test substances, comparisons were only performed where the overall F test was significant at the 5% significance level to protect against inflated type I error rates. Where the overall F tests were significant comparisons were made between the test substances and the control substance at the 5% significance level.

3.7 Quality Measures

Compliance with U.S. EPA FIFRA Good Laboratory Practice Standards as specified in 40 Code of Federal Regulations Part 160, including Quality Assurance oversight, was not required for study 07-01-52-05. However, the following quality control measures were employed to ensure the integrity of the study:

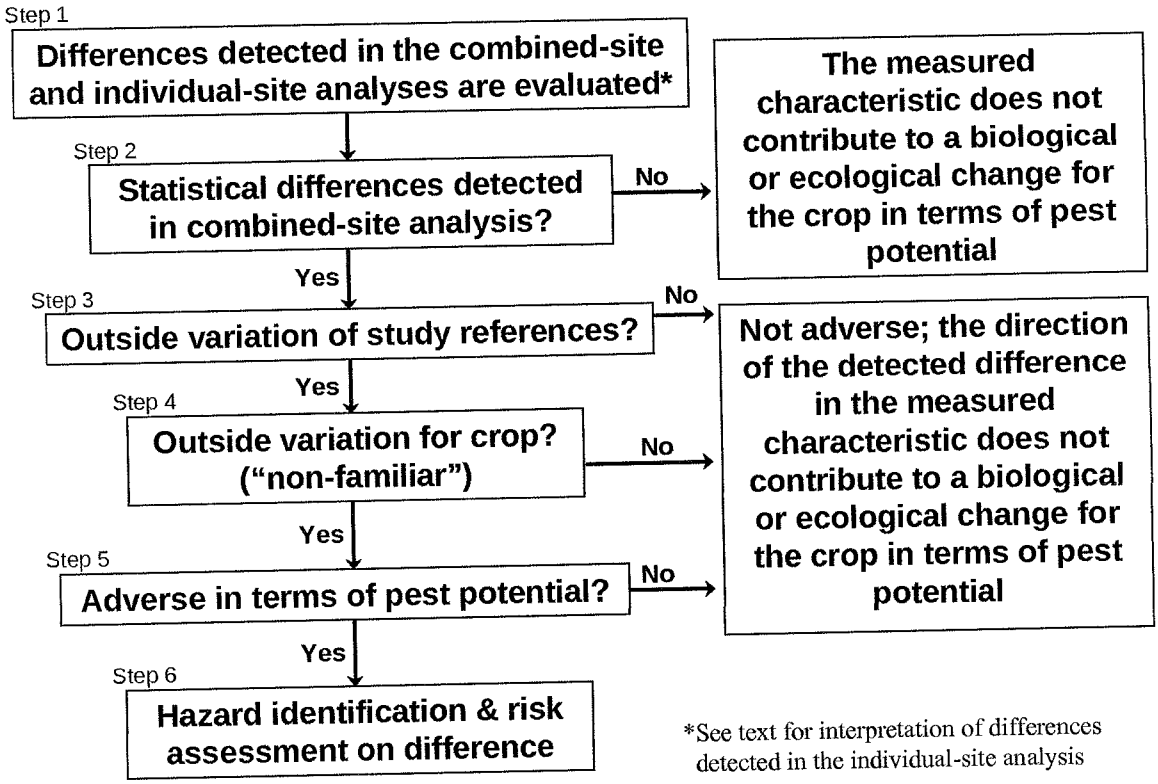
- Study 07-01-52-05 was conducted according to a peer-reviewed protocol.
- The statistical analysis documentation and statistical analysis report were peer-reviewed.
- The statistician reviewed the report.

- The Monsanto Quality Assurance Unit audited the statistical analysis results and report.
- The study file was retained in the Monsanto Regulatory archive.

3.8 Data Interpretation Methods

Comparative plant characterization data between a biotechnology-derived crop and the control are considered in the context of contributions to increased pest/weed potential. Characteristics for which no differences are detected support a conclusion of no increased pest potential of the biotechnology-derived crop compared to the conventional crop. Characteristics for which differences are detected are considered in the step-wise method described below. Any detected difference for a characteristic is considered in the context of whether or not the difference increased pest/weed potential of the biotechnology-derived crop. Ultimately, a weight of evidence approach considering all characteristics and studies is used for the final risk assessment of differences and their significance in terms of increased pest potential.

Methods for interpretation of detected differences



Note: *A "no" answer at any step indicates that the characteristic does not contribute to a biological or ecological change for the crop in terms of pest/weed potential and subsequent steps are not considered.*

- Steps 1 & 2. Combined-site and individual-site statistical analyses are conducted and evaluated on each measured characteristic. Differences detected in the individual-site analysis must be observed in the combined-site analysis to be considered further for potential adverse effects in terms of pest/weed potential. Any difference detected in the combined-site analysis is further assessed.
- Step 3. If a difference is detected in the combined-site analysis across multiple environments, then the test substance mean value is assessed relative to the reference substances.
- Step 4. If the test substance mean is outside the variation of the reference substances (e.g., reference range), the test substance mean is considered in the context of known values common for the crop.
- Step 5. If the test substance mean is outside the range of values common for the crop, the test substance is considered "non-familiar" for that characteristic. The detected difference is then assessed for whether or not it is adverse in terms of pest/weed potential.
- Step 6. If an adverse effect (hazard) is identified, risk assessment on the difference is conducted. The risk assessment considers contributions to enhanced pest potential of the crop itself, the impact of differences detected in other measured characteristics, and potential for, and effects of trait transfer to feral populations of the crop or a sexually compatible species.

4.0 RESULTS AND DISCUSSION

4.1 Phenotypic Evaluation

In the combined-site analyses, no differences were detected between MON 89034 × TC1507 × MON 88017 × DAS-59122-7 and the control for any of the 14 phenotypic characteristics (Table 4).

In the individual site analyses, no differences between MON 89034 × TC1507 × MON 88017 × DAS-59122-7 and the control were detected for early stand count, seedling vigor, staygreen, dropped ears, stalk lodging, root lodging, test weight, or yield (Table 5). A total of six out of 56 site by characteristic comparisons were significantly different between MON 89034 × TC1507 × MON 88017 × DAS-59122-7 and the control. Days to 50% pollen shed were greater for MON 89034 × TC1507 × MON 88017 × DAS-59122-7 compared to the control at the NE site (57.3 vs. 56.0 days, respectively). Days to 50% silking were also greater for MON 89034 × TC1507 × MON 88017 × DAS-59122-7 compared to the control at the NE site (57.7 vs. 55.3 days, respectively). Ear height was

greater for MON 89034 × TC1507 × MON 88017 × DAS-59122-7 compared to the control at the IL-1 site (50.1 vs. 46.3 inches, respectively). Plant height was greater for MON 89034 × TC1507 × MON 88017 × DAS-59122-7 compared to the control at the IL-1 site (105.5 vs. 101.2 inches, respectively). Final stand count was greater for MON 89034 × TC1507 × MON 88017 × DAS-59122-7 compared to the control at the IA-1 site (68.7 vs. 63.0 plants per two rows, respectively). Grain moisture was greater for MON 89034 × TC1507 × MON 88017 × DAS-59122-7 compared to the control at the IA-1 site (25.8 vs. 22.7 %, respectively).

Since no differences were detected in the combined-site analysis, the differences detected in the individual site analysis were not indicative of a consistent trend in the data and are unlikely to be biologically meaningful in terms of increased weed potential of MON 89034 × TC1507 × MON 88017 × DAS-59122-7 compared to the conventional corn control (Section 3.8 schematic diagram, step 2).

4.2 Ecological Interactions

Ecological interaction evaluations are conducted as part of a plant characterization study, and are considered during an ecological risk assessment. Ecological interaction evaluations included the collection of data on insect damage, diseases, and abiotic stressors. These data are then used to assess for altered environmental impact of the biotechnology-derived combined trait product.

Plots were rated for specific biotic (i.e., insect damage, diseases) and abiotic (e.g., drought) stressors commonly occurring at each site to evaluate any differences in stressor symptoms between MON 89034 × TC1507 × MON 88017 × DAS-59122-7 and the control. The reported incidence for a specific observation in Tables 6, 7, and 8 represents the range of values observed in the field among the 3 replications per site. These data were not subjected to statistical analysis. MON 89034 × TC1507 × MON 88017 × DAS-59122-7 and the control were considered different in their susceptibility or tolerance to a specific stressor if the incidence range across all three replications of MON 89034 × TC1507 × MON 88017 × DAS-59122-7 did not overlap with the incidence range across all three replications of the control (e.g., none vs. moderate – severe).

No differences were observed between MON 89034 × TC1507 × MON 88017 × DAS-59122-7 and the control for 33 of the 34 assessed ecological stressor symptoms (11 insect, 15 disease, and 8 abiotic; Tables 6, 7, 8). One difference was observed between MON 89034 × TC1507 × MON 88017 × DAS-59122-7 and the control for northern corn leaf blight

at the IA-1 site during the third observation (slight vs. moderate; Table 7). The observed difference in the incidence of northern corn leaf blight was not observed at other sites or observations. Therefore, the difference in northern corn leaf blight susceptibility is unlikely to be of biological concern.

The results of the insect damage, plant-disease interactions, and plant response to abiotic stressors support the conclusion that the combined trait corn product MON 89034 × TC1507 × MON 88017 × DAS-59122-7 was not unexpectedly altered compared to conventional corn based on the assessed ecological interactions.

5.0 CONCLUSIONS

This portion of the study evaluated the phenotypic characteristics and ecological interactions of MON 89034 × TC1507 × MON 88017 × DAS-59122-7 compared to a conventional corn control. The characteristics measured provide crop biology and ecological interactions data useful in characterizing the plant in an assessment of ecological risk. The results support a conclusion that the combination of the insect protection traits and herbicide tolerance traits through conventional breeding did not unexpectedly alter the assessed phenotypic characteristics or ecological interactions of MON 89034 × TC1507 × MON 88017 × DAS-59122-7 compared to conventional corn. Thus, the results support a conclusion of no increased pest potential or adverse environmental impact for the combined trait product.

6.0 ACKNOWLEDGEMENTS

The author acknowledges Tim Perez, Monsanto Company, for his assistance with the statistical analysis of the data.

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Table 1. Test, Control, and Reference Substances

Substance	Substance Type	Phenotype[1]	Monsanto Lot	Sites
MON 89034 × TC1507 × MON 88017 × DAS-59122-7	Test	RR/LL/IP	GLP-0604-17108-S	All
XE6001	Control	Conventional	GLP-0604-17109-S	All
Garst 8424	Reference	Conventional	GLP-0604-17089-S	NE
NC+4822	Reference	Conventional	GLP-0604-17090-S	NE
Pioneer 34N43	Reference	Conventional	GLP-0604-17091-S	NE
Moews 3744	Reference	Conventional	GLP-0604-17077-S	IL-1
Moews 3765	Reference	Conventional	GLP-0604-17078-S	IL-1
Pioneer 33K39	Reference	Conventional	GLP-0604-17076-S	IL-1
DKC 61-50	Reference	Conventional	GLP-0603-16999-S	IA-1
Golden Harvest H8920	Reference	Conventional	GLP-0604-17069-S	IA-1
Golden Harvest H8991	Reference	Conventional	GLP-0603-16996-S	IA-1
DKC 61-42	Reference	Conventional	GLP-0603-16998-S	IA-2
DKC 63-78	Reference	Conventional	GLP-0604-17073-S	IA-2
Pioneer 33N29	Reference	Conventional	GLP-0604-17088-S	IA-2

[1]Phenotype descriptors are as follows: RR=glyphosate herbicide tolerant, LL= glufosinate-ammonium herbicide tolerant, IP=insect protected

Table 2. Study Site Planting Information, Soil Description, and Cropping History

Site	Planting Date	Planting Depth	Plot Size (ft)[1]	Soil Series, Organic Matter, pH	2005 Crop
IA-1	06/03/2006	1.5 in	20 × 15	Taintor silty clay loam; 4.0%; 6.8	Soybean
IA-2	06/01/2006	2.0 in	20 × 15	Coland; 5-7%; 6.1-7.3	Soybean
IL-1	05/31/2006	1.5 in	20 × 15	Plano silt loam; 3.2%; 6.3	Soybean
NE	05/31/2006	1.5 in	20 × 15	Silt loam; 3.2%; 6.2	Soybean

[1] Plots consisted of six rows spaced 30 inches apart.

Table 3. Phenotypic Characteristics Evaluated

Characteristic	Description
Early stand count	Number of emerged plants at the V2-V4 growth stage
Seedling vigor	Rated on a 0-9 scale at V2-V4, where 0 = dead, 1-3 = below average vigor, 4-6 = average vigor, and 7-9 = above average vigor
Days to 50% pollen shed	Calculated from date of 50% shed
Days to 50% silking	Calculated from date of 50% silk
Ear height	Distance from the soil surface to the node where the ear attaches to the stalk measured after flowering but before harvest
Plant height	Distance from the soil surface to the uppermost leaf collar measured after flowering but before harvest
Staygreen	Rated on a 0-9 scale at R6, where 0 = all leaves are dried up and brown on plants, 5 = leaves above the ear are green and leaves below the ear are dried up and brown, and 9 = all leaves of the plant are green
Dropped ears	Number of ears that have dropped to the ground counted within four days prior to harvest
Final stand count	Number of plants, excluding tillers, counted within four days prior to harvest
Stalk lodging	Number of plants that are broken below the ear, counted within four days prior to harvest
Root lodging	Number of plants leaning greater than approximately 30° from vertical, counted within four days prior to harvest
Grain moisture	Percent moisture of shelled grain at harvest or after drying
Test weight	Weight of shelled grain per unit volume at harvest or after drying
Yield	Calculated from grain weight, moisture, and test weight

Table 4. Phenotypic Characteristics of MON 89034 × TC1507 × MON 88017 × DAS-59122-7, the Control, and the References Across All Sites

			Reference Range[1]	
Phenotypic Characteristic (units)	**Test**	**Control**	**Minimum**	**Maximum**
Early Stand (Plants/2 Rows)	86.9	86.7	72.0	85.0
Seedling Vigor (0-9 scale)	7.9	8.0	7.0	8.0
Days to 50% Pollen Shed	56.6	56.2	55.0	60.3
Days to 50% Silking	55.7	55.1	54.3	59.0
Ear Height (in)	42.5	42.1	36.2	52.2
Plant Height (in)	105.0	106.7	93.8	113.3
Staygreen (0-9)	6.4	5.8	4.0	7.3
Dropped Ears (Number/2 Rows)	1.4	0.6	0.0	1.0
Final Stand Count (Plants/2 Rows)	70.9	69.1	62.7	72.7
Stalk Lodging (Plants/2 Rows)	3.8	6.5	1.3	20.0
Root Lodging (Plants/2 Rows)	0.8	0.4	0.0	29.0
Grain Moisture (%)	24.2	23.0	19.9	28.0
Test Weight (lb/bu)	54.3	53.2	51.5	59.1
Yield (bu/a)	152.9	161.0	83.2	219.1

* Indicates a statistically significant difference between the test and control at $p \leq 0.05$ (none detected).
[1] Reference range = minimum and maximum mean values observed among the references.

Table 5. Phenotypic Characteristics of MON 89034 × TC1507 × MON 88017 × DAS-59122-7 and the Control at Each Site

	Phenotypic Characteristic (units)									
	Early Stand (Plants/2 Rows)		Seedling Vigor (0-9 scale)		Days to 50% Pollen Shed		Days to 50% Silking		Ear Height (in)	
Site	Test	Control	Test	Control	Test	Control	Test	Control	Test	Control
IA-1	88.0	88.0	8.0	8.0	54.3	54.3	53.7	53.7	36.1	34.8
IA-2	86.3	85.3	8.0	8.0	55.7	55.3	54.7	54.0	38.5	39.3
IL-1	86.7	86.0	8.0	8.0	59.0	59.0	56.7	57.3	50.1*	46.3
NE	86.7	87.3	7.7	8.0	57.3*	56.0	57.7*	55.3	45.3	48.1

	Phenotypic Characteristic (units)									
	Plant Height (in)		Staygreen (0-9)		Dropped Ears (Number/2 Rows)		Final Stand Count (Plants/2 Rows)		Stalk Lodging (Plants/2 Rows)	
Site	Test	Control	Test	Control	Test	Control	Test	Control	Test	Control
IA-1	108.8	111.9	7.0	5.7	0.0	0.0	68.7*	63.0	0.0	3.7
IA-2	112.5	114.3	7.3	7.0	0.0	0.0	69.3	68.7	3.7	8.3
IL-1	105.5*	101.2	6.3	5.3	5.7	2.3	73.0	73.3	9.7	12.3
NE	93.2	99.5	5.0	5.3	0.0	0.0	72.7	71.3	2.0	1.7

	Phenotypic Characteristic (units)							
	Root Lodging (Plants/2 Rows)		Grain Moisture (%)		Test Weight (lb/bu)		Yield (bu/a)	
Site	Test	Control	Test	Control	Test	Control	Test	Control
IA-1	0.0	0.0	25.8*	22.7	50.6	50.7	172.7	180.2
IA-2	3.0	0.7	23.8	23.6	59.1	54.7	137.6	149.8
IL-1	0.0	0.0	25.6	24.7	53.9	54.2	131.0	135.6
NE	0.3	1.0	21.6	20.8	53.5	53.0	170.5	178.5

* Indicates a statistically significant difference between the test and control at $p \leq 0.05$.

Table 6. Insect Stressor Symptom Severity of MON 89034 × TC1507 × MON 88017 × DAS-59122-7, the Control, and the References

		Obs 1			Obs 2			Obs 3			Obs 4		
Name	**Site(s)**	**Test**	**Ctrl**	**Refs**	**Test**	**Ctrl**	**Refs**	**Test**	**Ctrl**	**Refs**	**Test**	**Ctrl**	**Refs**
Aphids	IA-1	—	—	—	sl	sl	sl	—	—	—	—	—	—
	IA-2	—	—	—	—	—	—	no	no	no	no	no	no
	IL-1	—	—	—	no	no	no	—	—	—	—	—	—
	NE	—	—	—	—	—	—	no	no	no	—	—	—
Billbug	IA-2	no	no-sl	no-sl	—	—	—	—	—	—	—	—	—
Corn rootworm beetles	IA-1, IL-1	—	—	—	no	no	no	sl	sl	sl	—	—	—
	IA-2	—	—	—	no	no	no	—	—	—	—	—	—
	NE	—	—	—	no	no-sl	no-sl	sl	sl	sl	—	—	—
Cutworm	IA-1, IL-1, NE	no	no	no	—	—	—	—	—	—	—	—	—
	IA-2	—	—	—	—	—	—	sl	sl	sl	sl	sl	sl
Fall armyworm	IA-1	—	—	—	—	—	—	—	—	—	no	no	no
Flea beetle	IA-1	sl	sl	sl	—	—	—	—	—	—	—	—	—
	IL-1	no	no	no	—	—	—	—	—	—	—	—	—
Grasshoppers	IA-2	—	—	—	no-sl	no-sl	no-sl	no	no	no-sl	sl	sl	sl
	IL-1	—	—	—	—	—	—	—	—	—	sl	sl	sl
	NE	—	—	—	no-sl	no-sl	no-sl	no	no	no	no	no	no
Leafhopper	IA-1	no	no	no	—	—	—	—	—	—	—	—	—
Stalk borer	IA-2	no-sl	no-sl	no-sl	—	—	—	—	—	—	—	—	—
White grub	IA-2	no	no	no-sl	—	—	—	—	—	—	—	—	—
	IL-1, NE	no	no	no	—	—	—	—	—	—	—	—	—
Wireworm	NE	no	no	no	—	—	—	—	—	—	—	—	—

Definitions: Obs = observation, Ctrl = control, Refs = references, no = none, sl = slight, mo = moderate, se = severe
— Stressor not evaluated at this observation and site

Table 7. Disease Stressor Symptom Severity of MON 89034 × TC1507 × MON 88017 × DAS-59122-7, the Control, and the References

		Obs 1			Obs 2			Obs 3			Obs 4		
Name	**Site(s)**	**Test**	**Ctrl**	**Refs**	**Test**	**Ctrl**	**Refs**	**Test**	**Ctrl**	**Refs**	**Test**	**Ctrl**	**Refs**
Anthracnose	IA-1	—	—	—	—	—	—	—	—	—	no	no	no
	IA-2	—	—	—	—	—	—	no	no	no	no	no	no-sl
	IL-1	—	—	—	no	no	no	sl	sl	sl	sl	sl	sl
Ear rot	IA-1	—	—	—	—	—	—	—	—	—	sl	sl-mo	sl
Eyespot	IA-2	—	—	—	no	no	no	sl	sl	sl	sl	sl	sl
Fusarium	IA-1, NE	no	no	no	—	—	—	—	—	—	—	—	—
Grey leaf spot	IA-1	—	—	—	no	no	no	—	—	—	—	—	—
	IA-2	—	—	—	no	no	no	sl	sl	sl	sl	sl	sl
	IL-1	—	—	—	—	—	—	sl	sl	sl	sl	sl	sl
	NE	—	—	—	no	no	no	sl	sl	sl	no	no	no
Leaf blight	IA-1	no	no	no	—	—	—	—	—	—	—	—	—
Northern corn leaf blight	IA-1	—	—	—	no	no	no	sl*	mo	sl	—	—	—
	IA-2	—	—	—	no	no	no	—	—	—	—	—	—
Northern leaf spot	IA-2	no	no	no	—	—	—	—	—	—	—	—	—
	IL-1	—	—	—	no	no	no	—	—	—	—	—	—
Pythium	IA-1, IL-1	no	no	no	—	—	—	—	—	—	—	—	—
Rust	IA-1, IL-1	—	—	—	—	—	—	no	no	no	—	—	—
	NE	—	—	—	no-sl	no-sl	no-sl	sl	sl	sl	no	no	no
Seedling blight	IA-2, IL-1, NE	no	no	no	—	—	—	—	—	—	—	—	—
Smut	IA-1	—	—	—	no	no	no	no	no-sl	no	—	—	—
	IL-1	—	—	—	—	—	—	—	—	—	no	no	no
	NE	—	—	—	—	—	—	no	no	no-sl	no	no	no

Table 7 (continued). Disease Stressor Symptom Severity of MON 89034 × TC1507 × MON 88017 × DAS-59122-7, the Control, and the References

		Obs 1			Obs 2			Obs 3			Obs 4		
Name	**Site(s)**	**Test**	**Ctrl**	**Refs**	**Test**	**Ctrl**	**Refs**	**Test**	**Ctrl**	**Refs**	**Test**	**Ctrl**	**Refs**
Stalk rot	IA-1	—	—	—	—	—	—	—	—	—	no	no	no-sl
Stewarts wilt	IL-1, NE	no	no	no	no	no	no	—	—	—	—	—	—
White leaf spot	IA-2	no	no	no	—	—	—	—	—	—	—	—	—

Definitions: Obs = observation, Ctrl = control, Refs = references, no = none, sl = slight, mo = moderate, se = severe
— Stressor not evaluated at this observation and site
* Qualitative difference between test and control

Table 8. Abiotic Stressor Symptom Severity of MON 89034 × TC1507 × MON 88017 × DAS-59122-7, the Control, and the References

		Obs 1			Obs 2			Obs 3			Obs 4		
Name	**Site(s)**	**Test**	**Ctrl**	**Refs**	**Test**	**Ctrl**	**Refs**	**Test**	**Ctrl**	**Refs**	**Test**	**Ctrl**	**Refs**
Compaction	IA-1, NE	no	no	no	—	—	—	—	—	—	—	—	—
	IA-2	—	—	—	no	no	no	no	no	no	no	no	no
Drought	IA-1	—	—	—	—	—	—	—	—	—	no	no	no
	IL-1	no	no	no	no	no	no	—	—	—	—	—	—
Flood	IA-2	—	—	—	—	—	—	—	—	—	no	no	no
Frost	IL-1	no	no	no	—	—	—	—	—	—	—	—	—
Hail	IL-1	no	no	no	—	—	—	—	—	—	—	—	—
	NE	no	no	no	no	no	no	—	—	—	sl	sl	sl
Heat	IA-1	no	no	no	—	—	—	no	no	no	no	no	no
	IA-2	no	no	no	no	no	no	no	no	no	—	—	—
	IL-1	—	—	—	—	—	—	mo	mo	mo	—	—	—
	NE	—	—	—	no	no	no	no	no	no	—	—	—
Nutrient deficiency	IA-1	—	—	—	no	no	no	no	no	no	—	—	—
	IL-1	—	—	—	no	no	no	—	—	—	no	no	no
Wind	IA-1	sl	sl	sl	mo	mo	sl-mo	no	no	no	no	no	no
	IA-2	no-sl	no	no-sl	no	no	no	no	no	no	no-sl	no-mo	no-se
	IL-1	—	—	—	—	—	—	no-sl	no-sl	no-sl	no-sl	no-se	no-sl
	NE	—	—	—	no	no	no	no	no	no	sl	sl	sl

Definitions: Obs = observation, Ctrl = control, Refs = references, no = none, sl = slight, mo = moderate, se = severe
— Stressor not evaluated at this observation and site