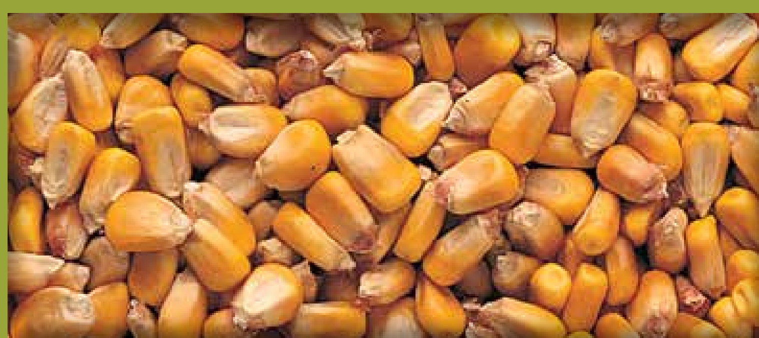
Monsanto Learning Center at Monmouth, IL
2013 Demonstration Reports



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Thank you for visiting the Monsanto Learning Center at Monmouth, IL this past summer! These past few years have seen phenomenal advancements in crop production science and technology, and that trend will continue at an ever-increasing pace. As always, our goal here at the Monsanto Learning Center is to help you keep up with those changes and provide you with up-to-date, relevant agronomic information that will benefit you and your operation. With that goal in mind, this booklet contains summaries from a number of our key trials and demonstrations around corn and soybean management systems.

For 2014, we will continue to strive to meet that goal with new trials and demonstrations around cover crops, insect and weed resistance management, high yield management systems approaches, and many other aspects of crop production research. We also plan to continue showcasing our current and future technologies, such as Integrated Farming Systems and Roundup Ready® Xtend Crop System, pending regulatory approvals . We hope you find the information within these pages, as well as the rest of our field trials and demonstrations to be valuable to you and your operation. Please contact us if you have any questions about these summaries, or any of the other projects here at the Monsanto Learning Center.

Additionally, you can download the electronic versions of the reports contained in this booklet by visiting the Monsanto Learning Center at Monmouth, IL website. The address is listed on the opposite page as well as a QR code that you can scan to be taken there directly. You can also follow us on Facebook and Twitter for seasonal agronomic and tour updates all year long.

Thank you once again, and we look forward to hosting you again in 2014!

Sincerely,

Troy Coziahr, Manager

Monsanto Learning Center - Monmouth

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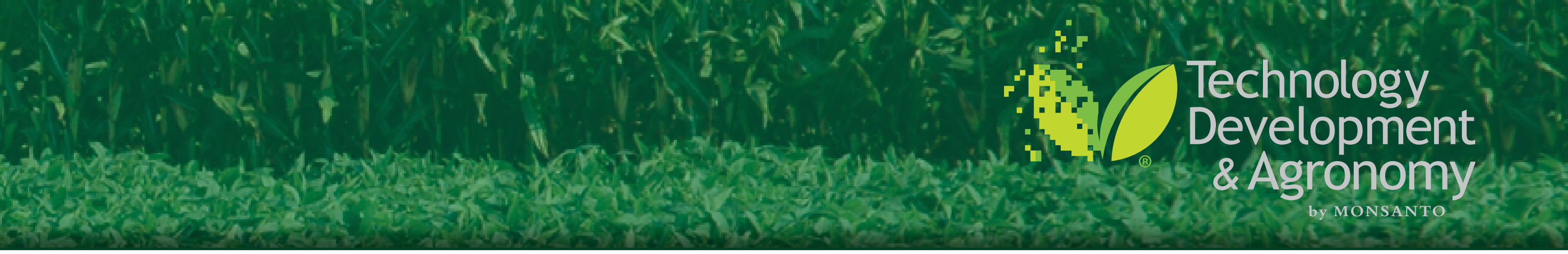


Effects of Twin Row Configuration on Corn Yield

Background

Corn seeding rates have been increasing steadily by 300 to 425 plants/acre per year, over the past 25 years. This increase has been made possible due to genetic improvements in plant stress tolerance and agronomic practices. Population increases have been directly correlated to corn yield increases on a per year basis. Since row spacing interacts with population to determine interplant competition, potential yield performance can be maximized when optimum plant population is matched with the best row spacing configuration.

This trial was based on the knowledge that corn planted in twin rows, positioned eight inches apart on 30" centers (Figure 1), can potentially provide higher yields than the standard 30" single row. In 2009, Monsanto trials in 20 locations across the U.S. showed that twin row spacing outyielded the standard 30" single row 80% of the time[2]. Corn that is planted in twin rows has more equidistant plant spacing. Therefore, it has potentially greater access to water and nutrients, improved light interception, and enhanced ability to cope with stressful conditions. However, within the twin row system, it is not known if seed placement (Figure 2) can further increase yield potential and what will be the response of different corn products at different plant populations.

Study Guidelines

Three corn products, Genuity® SmartStax® RIB Complete® corn blend (112 RM), Genuity® VT Double PRO® RIB Complete® corn blend (111 RM), and Genuity® VT Triple PRO® RIB Complete® corn blend (112 RM), were planted on 5/1/2013. Treatments included synchronized and unsynchronized seed placement configurations in twin rows with 30K, 35K, 40K, and 45K seeds/acre plant populations.

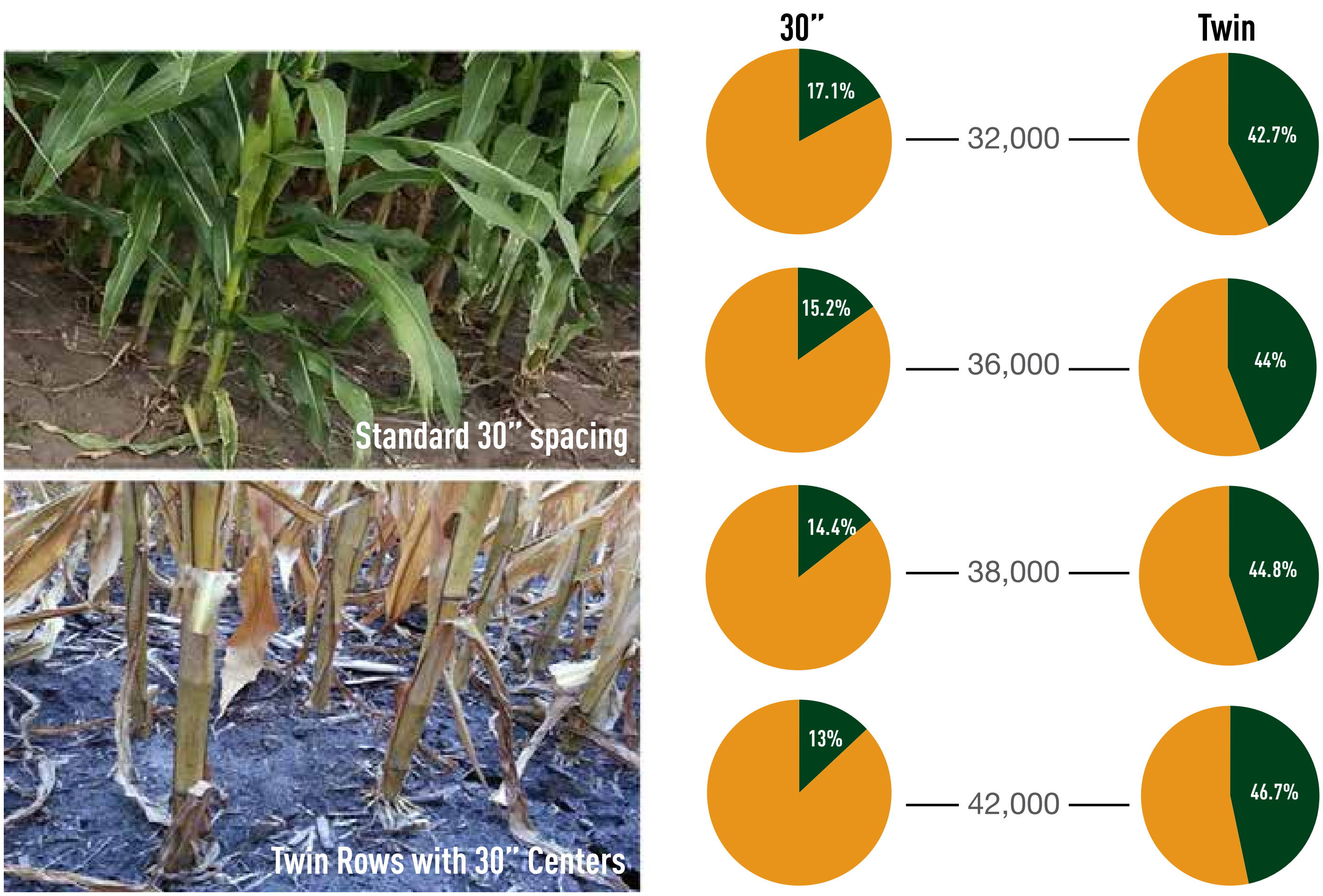


Figure 1. Interplant spacing between standard 30" rows and twin rows with 30" centers and the percent of an acre that is utilized in twin rows versus 30-inch rows. The green part on the pie chart represents the rooting area available in each system.

Effects of Twin Row Configuration on Corn Yield

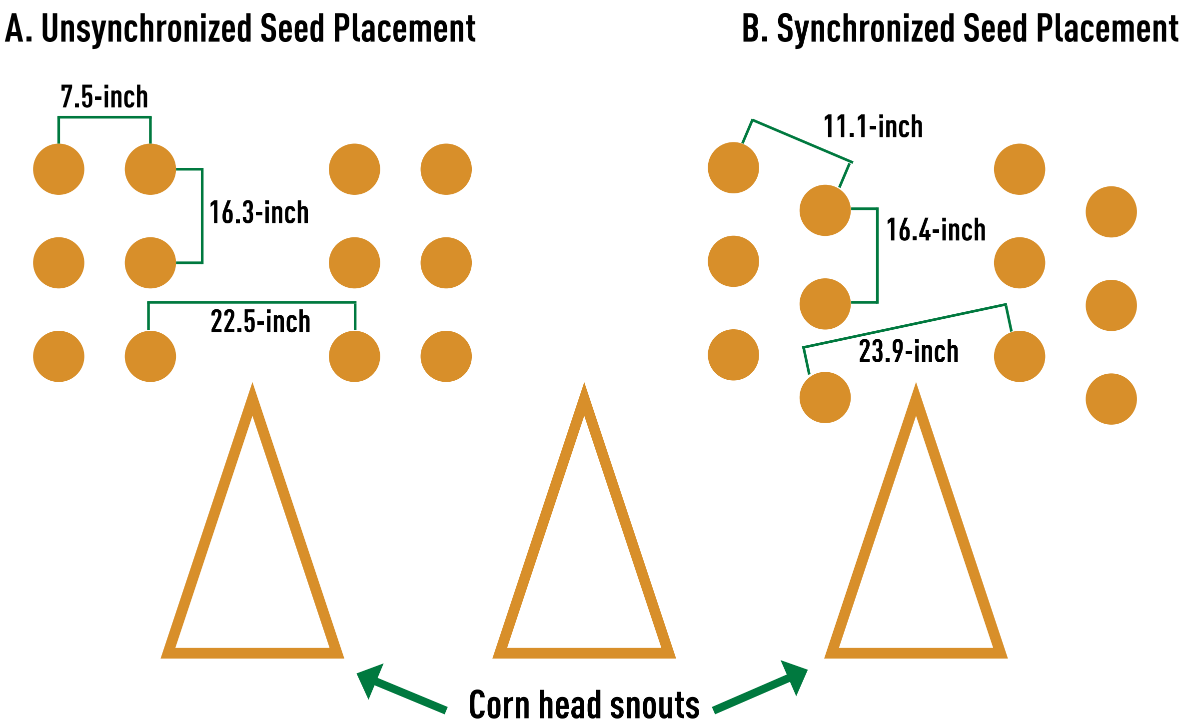


Figure 2. Unsynchronized (A) and synchronized (B) twin row corn plant (orange circles) arrangement distances for 25K* seeds/acre plant population. (*K = 1000).

Plot size was 20' x 100' (0.045914 acres) planted in a continuous corn field. Conventional tillage consisted of chisel plowing in the fall followed by a soil finisher in the spring. Weeds were managed with PRE application of Harness® Xtra 5.6L herbicide at 2 qts/acre on 5/2/2013 and POST application of Roundup PowerMAX® herbicide at 22 fl oz/acre + AMS at 17 lb/100 gal on 6/19/2013. Plots were harvest on 9/27/2013 and yield was adjusted to 15% moisture content.

Results and Observations

Unsynchronized seed placement at 30K and 45K seeds/acre provided higher yields than the synchronized treatment (Figure 3). Unsynchronized seed placement provided lower and similar yields at 35K seeds/acre and 40K seeds/acre, respectively, compared to the synchronized seed placement.

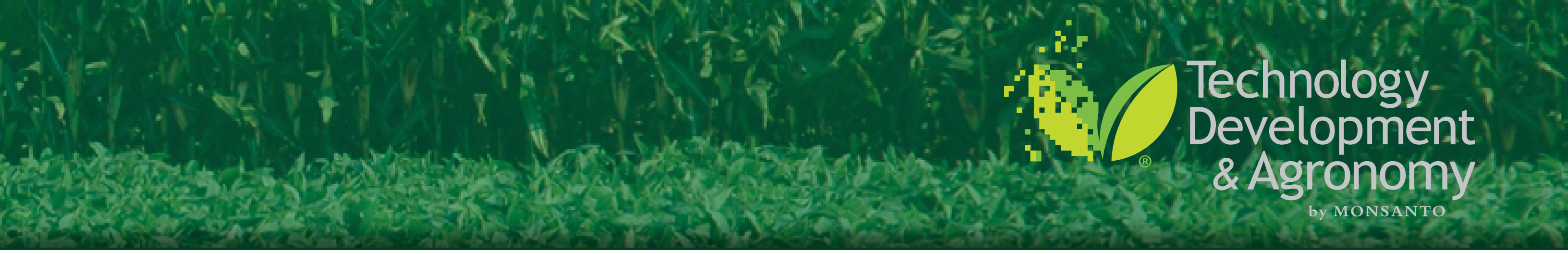
The yield response of corn products to seed placement was highly inconsistent and provided no specific trend across all populations.

In 2012, a similar trial conducted at the same location showed that synchronized seed placement produced a yield advantage of 8 bu/acre over the unsynchronized placement at low (30K seeds/acre) and medium (35K seeds/acre) plant populations. The unsynchronized seed placement configuration produced a 3 bu/acre advantage over the synchronized placement at high (40-45K seeds/acre) plant population.

Compiled data from 2012 and 2013 indicated that synchronized seed placement slightly outyielded (≈ 3.4 bu/acre) the unsynchronized placement at both low and medium populations (Figure 4). Such yield response is highly inconsistent across years, products, and probably other factors and should be cautiously adapted for management decisions.

Key Messages

- In 2013, yield response to seed placement was highly inconsistent and provided no specific trend across all populations.
- Yield difference at all populations was not high enough to warrant preference of one configuration over the other. Similar results reported by Nelson and Smoot[1] that a non-significant yield difference was observed between the two twin row seed placement configurations.



Effects of Twin Row Configuration on Corn Yield

- Yield for both seed placement configurations was lower at 40K and 45K seeds/acre, compared to 30K and 35K populations, which indicates that at high population severe interplant competition can present potential yield limitations irrespective of the twin row configuration.
- Two-year results indicate that yield response to seed placement, if any, varies from year to year, thus there is no advantage to synchronized seed placement in twin rows.

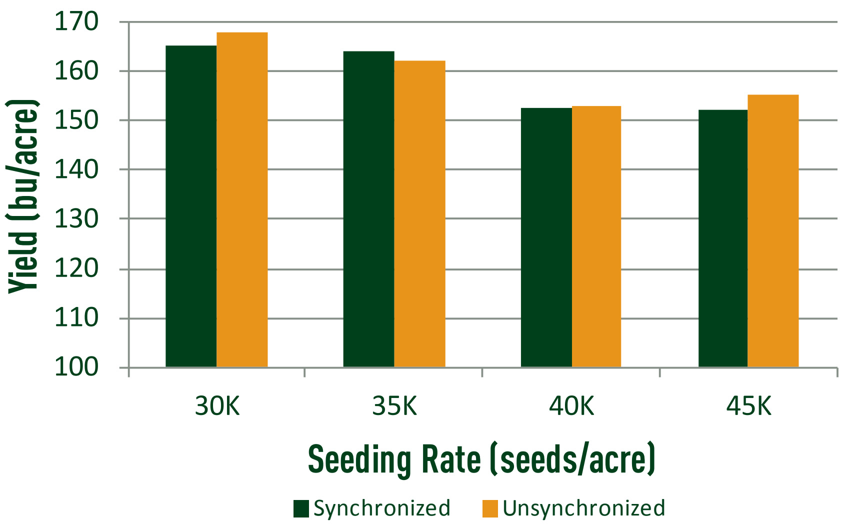


Figure 3. Effects of seed placement in twin rows and plant population on average yield of three corn products in 2013.

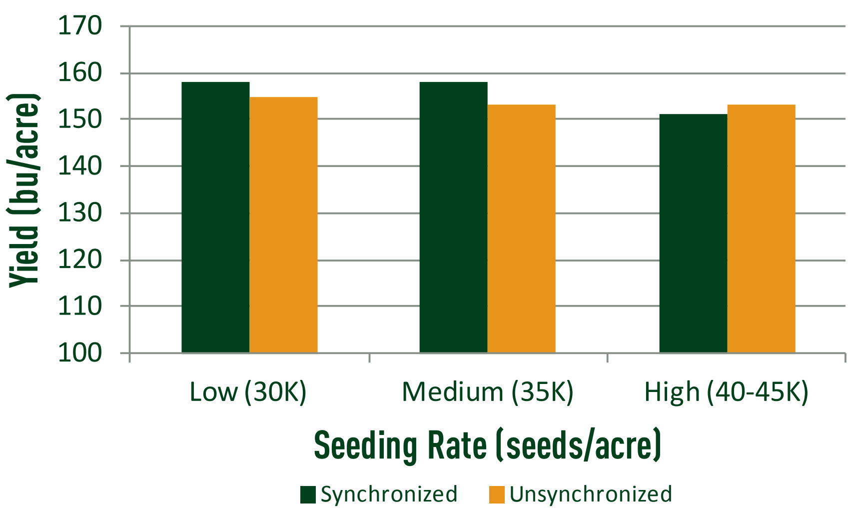


Figure 4. Effects of seed placement in twin rows and plant population on two-year yield average of three corn products.

Sources and Legals

[1] Nelson, K. A., and R. L. Smoot. 2009. Twin- and single-row corn production in northeast Mis. Crop Management, University of Missouri. [2] Evaluation of Twin Rows in Corn. 2009. National Research Summary. Monsanto Company. Importance of proper spacing for plants in twin row configuration. 2012. Monmouth Learning Center 2012, Demonstration Report. Monsanto Company. Populations and variable rate seeding for corn. 2013. agKnowledge Spotlight for DEKALB® Brand. Monsanto Company.

The information discussed in this report is from a single site, non-replicated demonstration. This informational piece is designed to report the results of this demonstration and is not intended to infer any confirmed trends. Please use this information accordingly.

Effect of Corn Rootworm Control and Nitrogen Rate on Corn Yield

Background

- Nitrogen is one of the highest input costs for growers. Availability of Nitrogen and water are the two most important factors in determining potential corn yield.
- The damage caused by corn rootworm (CRW) larvae can severely impact the ability of a corn plant to capture water and nitrogen.
- With this in mind, a demonstration trial was conducted at the Monsanto Learning Center in Monmouth, IL to illustrate the value of CRW protection in high-pressure environments.

Materials and Methods

- Conventional tillage: Fall chisel plow. Corn on corn rotation.
- UAN applied and incorporated in the spring. The seed bed established using a soil finisher
- Roundup Ready® Corn 2, Roundup Ready® Corn 2+ Soil Applied Insecticide (SAI), Genuity® VT Triple PRO® RIB Complete® corn blend, and Genuity® SmartStax® RIB Complete® corn blend were planted with 105 and 111 day RM respectively.
- Planting was on May 13, 2013 at 38,000 seeds per acre in thirty inch rows.
- Three primary treatments
  - – 32% UAN applied at 60 lbs per acre
  - – 32% UAN applied at 120 lbs per acre
  - – 32% UAN applied at 240 lbs per acre
- Corn was harvested September 25, 2013.

Nitrogen Rate x Corn Rootworm Control

- Using multiple modes of CRW protection (Genuity® SmartStax® RIB Complete® corn blend) had shown the best protection against CRW feeding and an increase in yield at all Nitrogen rates in this trial.
- Genuity® SmartStax® RIB Complete® corn blend had shown a 75% increase in Nitrogen Use Efficiency compared to the refuge.
- Bt products exhibited improved Nitrogen and water uptake, which leads to better grain yield, compared with the non-Bt counterparts.

NIS Root Score

- Products with CRW protection had shown greater root mass for optimal nitrogen uptake resulting in higher yield.
- Using a single MOA to protect against CRW offered some yield advantage and reduced CRW feeding when compared to a refuge corn product.

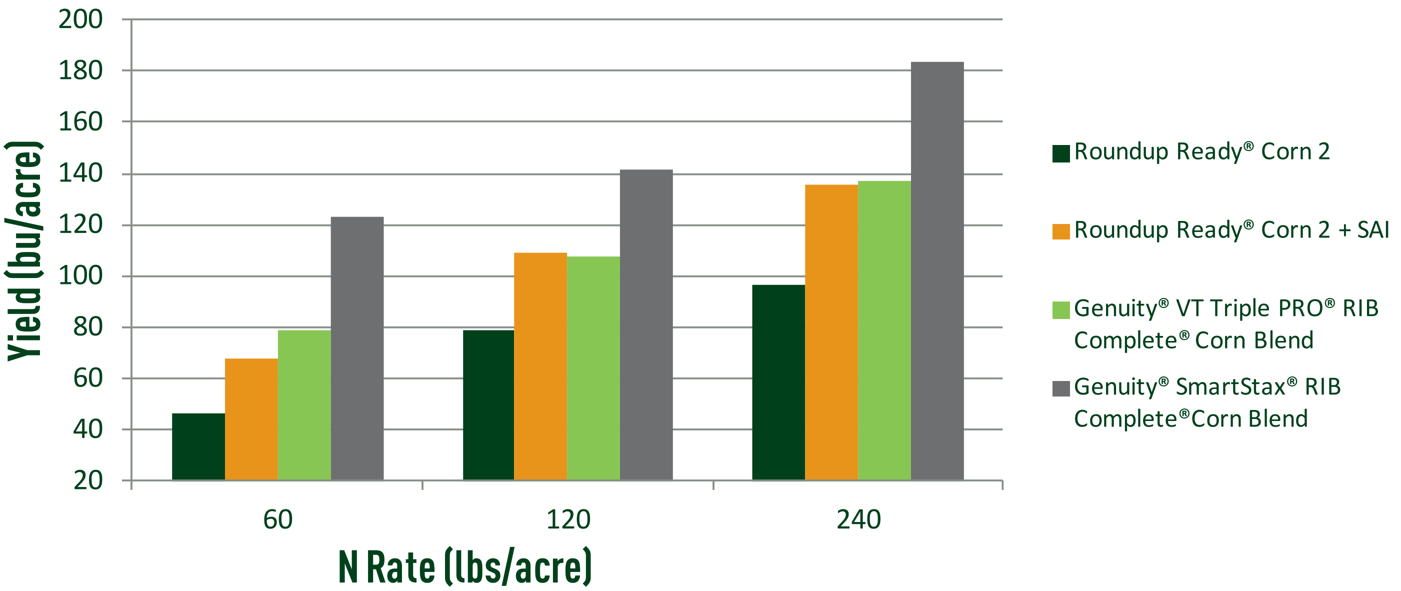


Figure 1. Nitrogen Rate x Corn Rootworm Control

Effect of Corn Rootworm Control and Nitrogen Rate on Corn Yield

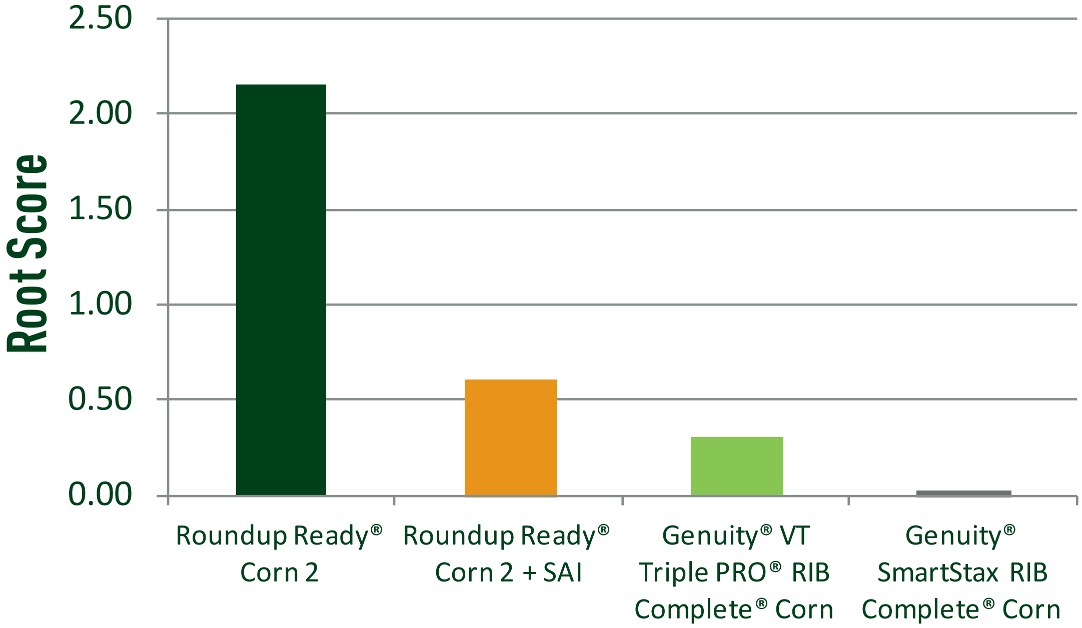


Figure 2. NIS Root Score.

Key Messages

- Protecting root systems from CRW damage results in improved water uptake and more efficient utilization of nitrogen, leading to higher yields.
- In a high-pressure CRW environment, the Genuity® SmartStax® RIB Complete® corn blend trait package had the lowest root node injury rating – well under the economic threshold value of .25, as well as the highest yield compared to all other treatments.
- Utilizing CRW best management practices such as crop rotation and adult beetle scouting, in conjunction with the multiple MOA Genuity® SmartStax® RIB Complete® corn blend package, not only optimizes productivity, but can increase the durability of Bt traits.

Source and Legals

[1] Below, F. E, et al. 2013. South Dakota Corn Grower' Annual Meeting. The quest for 300 bushel corn. Sioux Falls, SD.

[2] Jason. W, et al. Transgenic corn rootworm protection increases grain yield and nitrogen use of maize. Crop Science, 2013; 53 (2): 585

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B.t. products may not yet be registered in all states. Check with your Monsanto representative for the registration status in your state.

IMPORTANT IRM INFORMATION: Genuity® RIB Complete® corn blend products do not require the planting of a structured refuge except in the Cotton-Growing Area where corn earworm is a significant pest. Genuity® SmartStax® RIB Complete® and Genuity® VT Triple PRO® RIB Complete® corn are blended seed corn products. See the IRM/Grower Guide for additional information. Always read and follow IRM requirements.

Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible.

ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. Roundup Ready® crops contain genes that confer tolerance to glyphosate, the active ingredient in Roundup® brand agricultural herbicides. Roundup® brand agricultural herbicides will kill crops that are not tolerant to glyphosate. Genuity®, RIB Complete®, Roundup Ready 2 Technology and Design®, Roundup Ready®, Roundup®, SmartStax® and VT Triple PRO® are trademarks of Monsanto Technology LLC. Leaf Design® is a registered trademark of Monsanto Company. LibertyLink and the Water Droplet Design® is a registered trademark of Bayer. Herculex® is a registered trademark of Dow AgroSciences LLC. Respect the Refuge and Corn Design® and Respect the Refuge® are registered trademarks of National Corn Growers Association. All other trademarks are the property of their respective owners.

Insect Resistance Management — Planting Refuges, Preserving Technology

Before opening a bag of seed, be sure to read, understand and accept the stewardship requirements, **including applicable refuge requirements for insect resistance management,** for the biotechnology traits expressed in the seed as set forth in the Monsanto Technology/Stewardship Agreement that you sign. By opening and using a bag of seed, you are reaffirming your obligation to comply with the most recent stewardship requirements.

Effect of Corn Rootworm Control and Nitrogen Rate on Corn Yield

Figure 3. Roundup Ready® Corn 2

Figure 4. Genuity® VT Triple PRO® RIB Complete® corn blend

Figure 5. Roundup Ready® Corn 2 plus SAI

Figure 6. Genuity® SmartStax® RIB Complete® Corn Blend

Corn Rootworm Management Under High Pressure

Background

Best management practices to help control corn rootworm (CRW) include[1]:

- Crop rotation to soybeans or other non-host crops.
- Planting a corn product with multiple modes of action for CRW.
- Planting a corn product with a single mode of action (MOA) for CRW in conjunction with soil-applied insecticide (SAI) at planting.
- Scouting for adult beetles and applying a foliar insecticide if they reach threshold to help minimize egg lay and subsequent pressure the following year.

Selection of a *B.t.* trait technology is the main platform on which all other management strategies should be built.

A trial was conducted at the Monsanto Learning Center at Monmouth, IL to assess the efficacy of trait packages offering single and dual modes of action in conjunction with SAI in the management of CRW under high pressure.

Study Guidelines

The trial was planted in a continuous corn rotation on May 13, 2013. The soil was prepared under conventional tillage with a chisel plow in the fall followed by a soil finisher to establish the seed bed in the spring. A pre-emergent herbicide application of Harness® Xtra 5.6L at 2.75 qt/acre was applied on May 14, 2013. A post-emergent herbicide application of Roundup PowerMAX® at 22 fl oz/a + AMS at 17 lb/100 gal was applied on June 21, 2013.

Corn technology used included:

- Dual MOA Genuity® SmartStax® RIB Complete® corn blend (112 RM)
- Single MOA Genuity® VT Triple PRO® RIB Complete® corn blend (112 RM)
- Roundup Ready® Corn 2 (111 RM)
- Single MOA competitor product (112 RM)

Treatments included:

- An application of Force® 3G, a SAI (applied at planting)
- Not treated with soil-applied insecticide

Plots measured 10' x 100' (0.023 acres)/treatment. The trial was planted at 36,000 seeds/acre in 30" single rows with 4 rows per treatment. Yield data was adjusted to 15% moisture content.

Results

CRW larvae feed on corn roots, which can decrease yield potential and increase the risk of root lodging. Figure 1 shows the amount of root damage from CRW larvae as influenced by SAI and the different technologies used in this study.

Without SAI, Roundup Ready® Corn 2 had the highest node-injury scale (NIS) of 2.9, followed by the single MOA competitor product, and Genuity® VT Triple PRO® RIB Complete® corn blend. Genuity® SmartStax® RIB Complete® corn blend had the lowest NIS of 0.02 (Figure 2). Application of SAI substantially reduced root damage by as much as 87% in the Roundup Ready® Corn 2, 95% in the single MOA competitor product, and 92% in Genuity® VT Triple PRO® RIB Complete® corn blend. SAI did not provide any additional value to the dual MOA Genuity® SmartStax® RIB Complete® corn blend product in terms of larval feeding. Economic damage is more likely to occur with NIS ratings of 0.75 or greater[2]; therefore, without SAI, the single MOA competitor product will be more likely to suffer economic damages with its 1.1 NIS score than the Genuity® VT Triple PRO® RIB Complete® corn blend with its 0.64 NIS score.

The two single MOA products had nearly the same average yield of approximately 144 bu/acre. Even though this is 33% higher than Roundup Ready® Corn 2, which yielded an average of 95.8 bu/acre, the dual MOA Genuity® SmartStax® RIB Complete® corn blend had the highest average yield of 204 bu/acre (Figure 3), 53% and 30% yield increases over Roundup Ready® Corn 2 and the two single MOA products, respectively.

The addition of SAI increased yield across all products, with 41, 18, 12 and 7% yield increases in Roundup Ready® Corn 2, the single MOA competitor product, Genuity® VT Triple PRO® RIB Complete® corn blend, and Genuity® SmartStax® RIB Complete® corn blend respectively. SAI may also be controlling secondary insects that the trait technologies do not protect against. SAI alone can be inconsistent from year-to-year because of environment, planting dates, and other factors. As a result, it may not always provide adequate protection when used alone.

Key Messages

The study indicates that *B.t.* technology provides an effective management strategy for CRW.

- The trait package to be used should be selected by the prevailing insect pressure.

  – Under low-moderate pressure, a single MOA product could be used with (or without, in some cases) SAI for effective management.

Corn Rootworm Management Under High Pressure

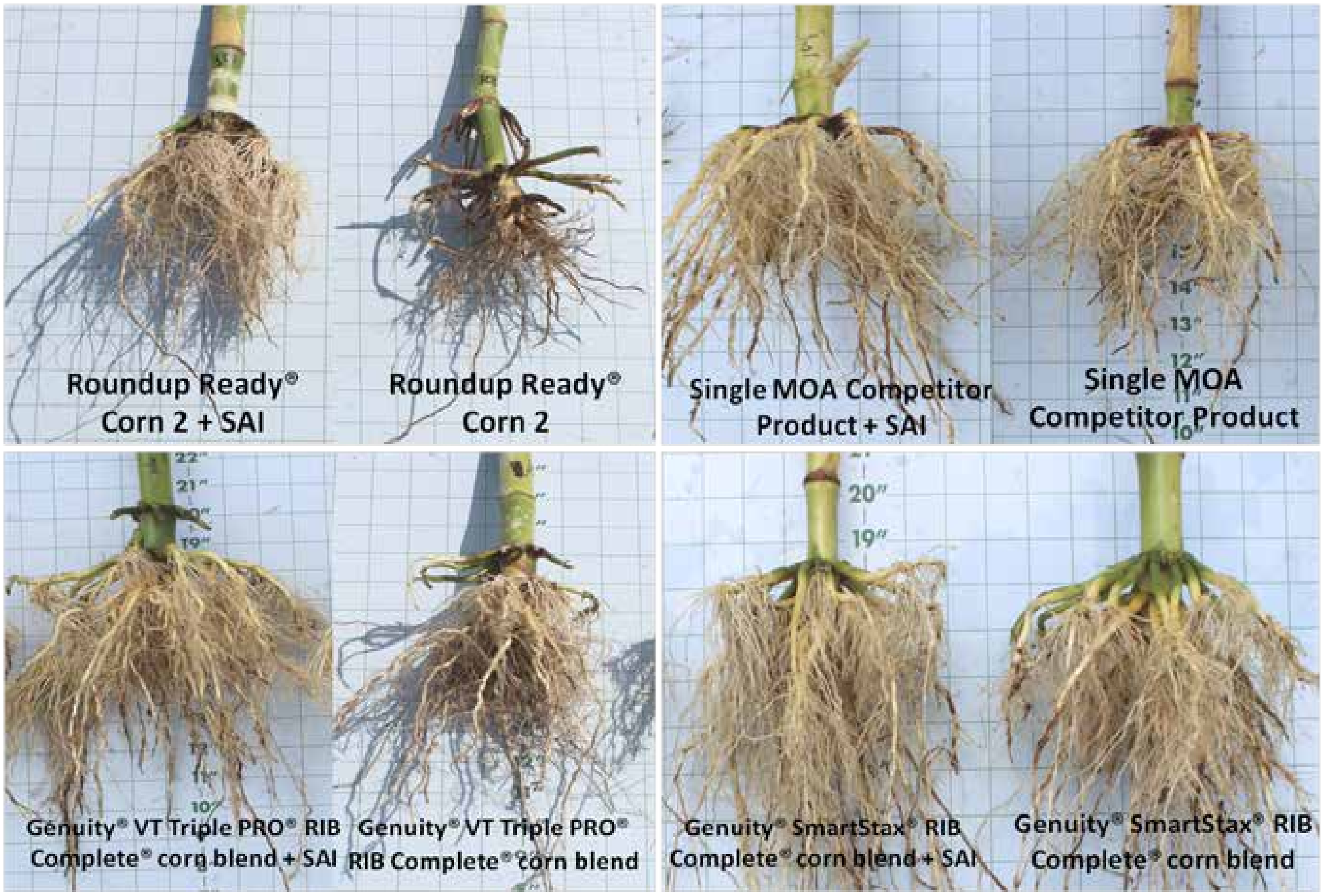

Figure 1. Examples of corn rootworm larval damage as influenced by SAI and corn *B.t.* technology.

– Under all corn rootworm pressure environments, a dual MOA product provides the best control.

- The use of the appropriate *B.t.* technology for a field is highly recommended.

  – Protects the sustainability of the grower's production as well as the durability of *B.t.* technology.

- Growers are encouraged to scout fields to determine pest pressure and employ various management tactics during the existing crop season (such as foliar insecticide applications), which can reduce egg laying and subsequent CRW population the following year.

  – Knowing current season's beetle density provides a valuable decision tool for next year's management, including crop rotation and the trait package to use.

- For continued success and profitability in CRW management, growers should look to an integrated pest management strategy and employ best management practices as part of their whole farm solution to pest management.

Sources and Legals

[1] Genuity. 2013. Best management practices for heavy corn rootworm pressure. Monsanto Technology Development & Agronomy. [2] Genuity. 2012. Corn rootworm management guide 2012. Monsanto Technology Development & Agronomy.

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Corn Rootworm Management Under High Pressure

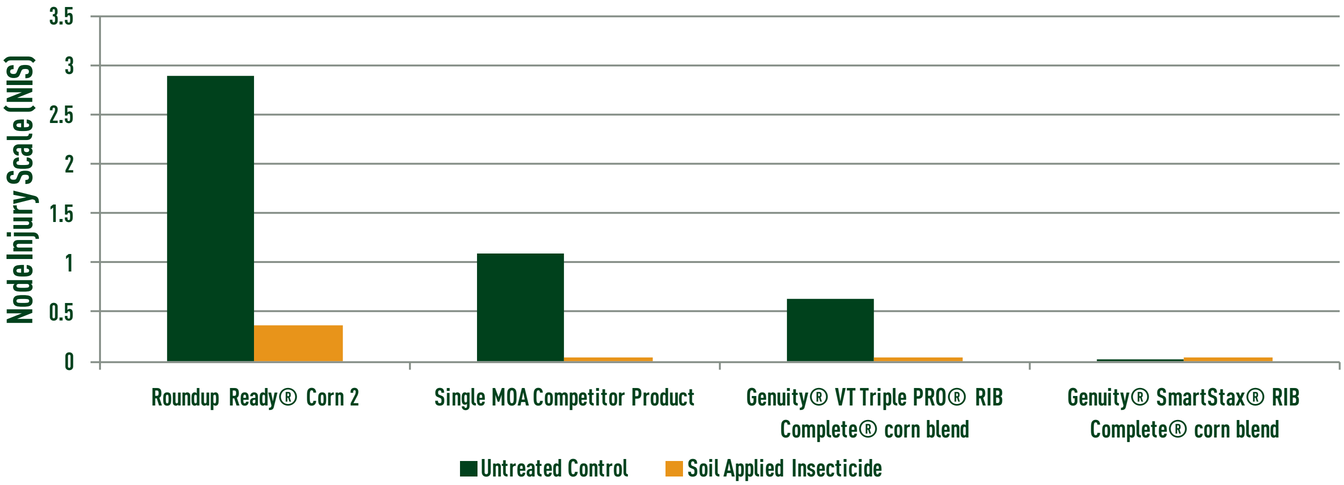

Figure 2. Effects of SAI on CRW root damage of corn products on a high pressure field at Monmouth, IL as measured by the Iowa State University Node-Injury Scale (NIS).

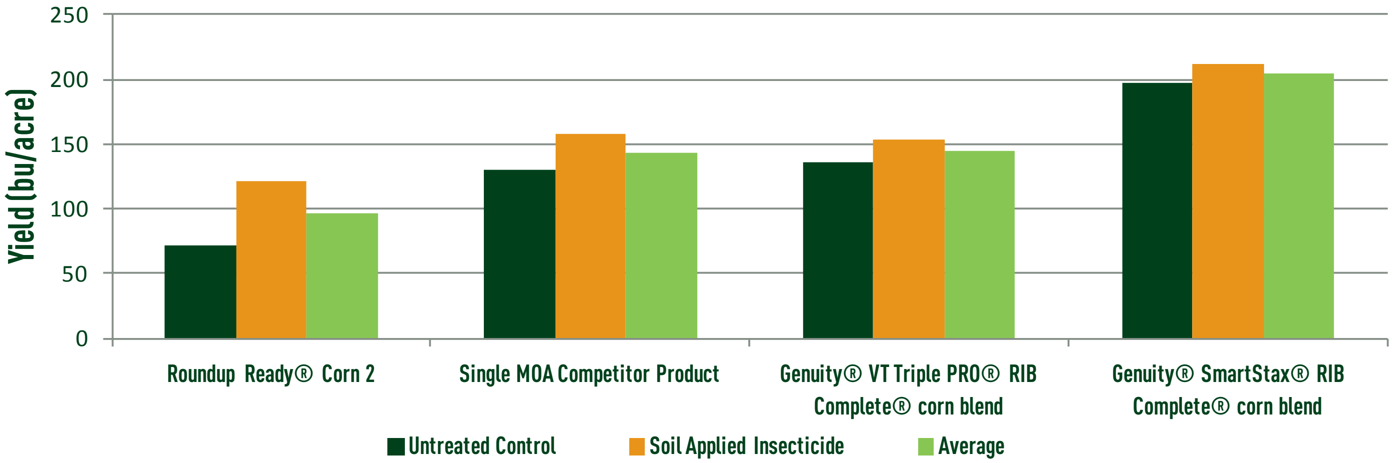

Figure 3. Yield performances of *B.t.* traited corn products as affected by SAI on a high CRW pressure field at Monmouth, IL. Average = average yield of untreated control and SAI.

Timing Of Weed Removal On Corn And Soybean Yields

Background

Weeds compete with the crop for light, water, and nutrients. Controlling weeds before they reach a critical size is essential to protect yields and maximize profits. A demonstration trial was conducted at the Monsanto Learning Center at Monmouth, IL to illustrate the effects of proper timing of weed removal on corn and soybean yields.

Study Guidelines

Soybean:

- Genuity® Roundup Ready 2 Yield® (2.9 RM)
- Planted: 5/4/2013; harvested: 9/27/2013
- Conventional tillage: Chisel plow in the fall and soil finisher in the spring

Corn:

- Genuity® SmartStax® RIB Complete® corn blend (112 RM)
- Planted: 5/4/2013; harvested 10/1/2013
- Conventional tillage: Chisel plow in the fall and soil finisher in the spring

Results and Observations

Highest yield was produced when weeds were controlled at or before reaching 4 inches height; however, substantial yield drops occurred as weed height increased (Figure 1).

Figure 3 shows the general trends of yield reduction with delayed weed control were similar in corn. Weed heights of greater than 4 inches, at the time of control, resulted in yield reduction.

Key Messages

- Weeds in corn and soybean should be controlled while they are small.

Herbicide Application	Soybean	Corn
PRE	Valor® XLT herbicide @ 3 oz/acre	Harness® Xtra @ 2 qt/acre
POST*	Roundup PowerMAX® @ 22 fl oz/acre on 4" weeds	
	Roundup PowerMAX® @ 32 fl oz/acre on 8" weeds	
	Roundup PowerMAX® @ 32 fl oz/acre on 12" weeds	
	Roundup PowerMAX® @ 22 fl oz/acre on 16" weeds	

*Ammonium sulfate (AMS) was added to all POST treatments at a rate of 17 lbs/100 gal as a water conditioner.

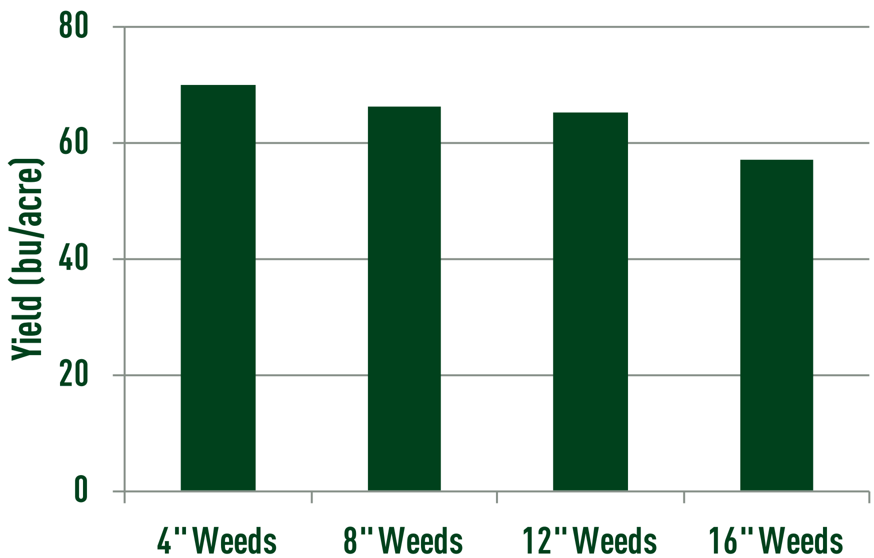

Figure 1. Soybean yield response to timely weed control.

- The larger weeds become (Figure 2 B-D), the more difficult they are to control, therefore it is critical to control weeds before they reach 4 inches height.
- A study suggests that allowing weeds to grow beyond 4 inches can cost soybean growers as much as $3.71/acre/day (assuming $13/bu soybean price).

  Source: Kamienski, C. 2003. Master thesis. Effect of postemergence glyphosate application timing on weed control and grain yield in glyphosate-resistant soybean. University of Illinois.
- Residual herbicide provides early season weed control, more flexibility for POST applications, and additional modes of action (MOA) chemicals for managing weed resistance.
- Roundup Ready PLUS® Weed Management Solutions provides excellent weed control and can help optimize productivity in corn and soybean systems.

Timing Of Weed Removal On Corn And Soybean Yields

A. Weeds at or < 4 inches.

B. Weeds about 8 inches.

C. Weeds about 12 inches.

D. Weeds about 16 inches.

Figure 2. Soybean fields treated when weeds were 4-16 inches tall.

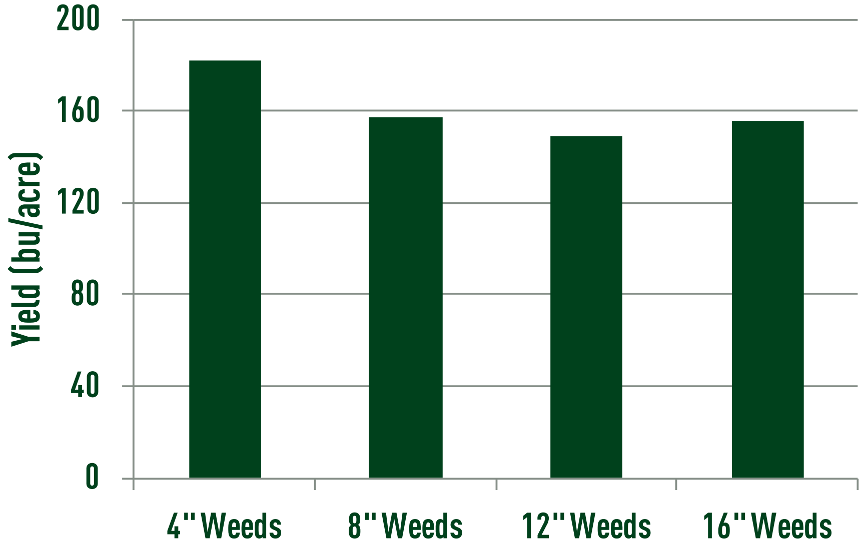

Figure 3. Corn yield response to timely weed control.

Source and Legals

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Corn Populations by Stress Mitigation

Background

A corn demonstration study was conducted at the Monsanto Learning Center at Monmouth, Illinois to determine the highest plant population that can be supported before a decrease in potential yield is observed from heat and drought stress associated with a plant population that is too high. The study was designed to show the effects of biotech rootworm protection and how it can help relieve crop stress at different plant populations. Plant population dynamics are important because populations have been increasing over the years due to advancements in corn breeding and better agronomics.

Study Guidelines

- Planted into prior year corn ground.
- Field was conventionally fall tilled with chisel plow.
- Spring seed bed established with soil finisher.
- Seeds planted into 30-inch rows at rates of 28, 32, 36, 40, 44, and 48,000 seeds/acre.
- A 112 RM product with rootworm protection and a 105 RM product without rootworm protection were utilized.
- Nitrogen applied in spring as 32% UAN.

Results

Root systems can be significantly injured by corn rootworm feeding, which can inhibit nutrient and water uptake leading to reductions in potential yield (Figure 1). Biotech protected root systems through increased root mass can help reduce crop stress induced by heat and drought (Figure 2).

Figure 1. Corn Rootworm Injury to Unprotected Root System

Figure 2. Root mass of Corn Rootworm Protected Product.

Corn Populations by Stress Mitigation

Yield increases occurred for both products as population increased; however, there was a substantial drop in yield at the seeding rate of 48,000 seeds/acre for the unprotected product (Table 1 and Figure 3). At all population levels except the 28,000 seeding rate, the product with rootworm protection performed better than the unprotected product (Table 1 and Figure 3).

Summary

- Planting corn at higher seeding rates can result in a larger investment in seed, but selecting the right seed and the right seeding rate can result in potentially higher yields and profits for growers.
- The yield of the rootworm protected product increased because crop stress associated with corn rootworm feeding was reduced compared to the non-protected product.
- The rootworm protected product showed a better response to higher populations under high corn rootworm pressure.
- Traits that protect the plant from corn rootworm damage can help relieve crop stress, which can allow for higher planting populations, higher potential yields, and increased potential profits over products without trait protection.

Legal

Table 1. Corn Yield for Seed Products With and Without Corn Rootworm Protection as Population Increases.

Population seeds/acre	Product Without Corn Rootworm Protection (bu/acre)	Product With Corn Rootworm Protection (bu/acre)
28,000	209.1	209.1
32,000	227.8	234.2
36,000	237.6	251.3
40,000	239.5	256.9
44,000	250.5	261.0
48,000	233.1	263.4

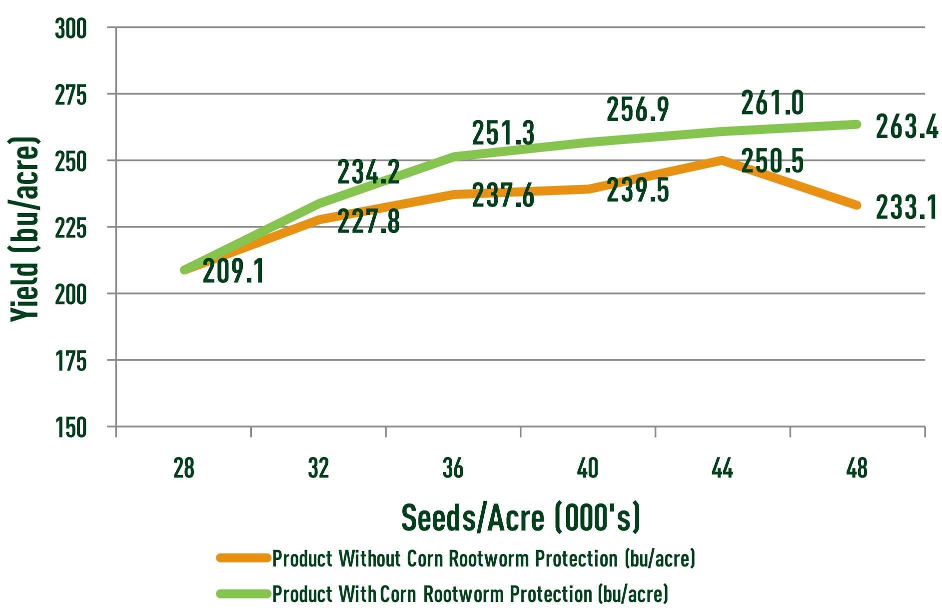
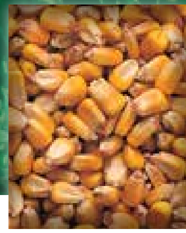


Figure 3. Corn yield for seed products with and without corn rootworm protection as population increases.



Comparison of Tillage Systems in Continuous Corn

Background

Crop residues can increase efficiency of irrigation, conserve soil moisture, and reduce soil and water erosion. However, excessive crop residue at planting can interfere with good seed-to-soil contact, leading to poor emergence and vigor. If not properly managed, residues can harbor diseases, insects, and immobilize nitrogen which may lead to potential yield loss. Corn is a high residue crop with a high root carbon to nitrogen (C/N) ratio of 48:1. Thus, corn residues decompose less quickly than legume crops like soybeans and alfalfa that have lower C/N ratios. Residue management, especially in continuous corn cropping systems, can be challenging.

Depending on the environment and field conditions, no-till may not be an option when planting corn after corn. Tillage may contribute to the success of continuous corn acres by helping to reduce soil compaction, incorporate fertilizer, and break up residue from the previous season. Conventional and strip tillage are two of the tillage options available to continuous corn growers.

Two separate experiments under continuous corn production systems were established during the 2013 growing season at the Monsanto Learning Center near Monmouth, IL to determine:

1. Effects of tillage and fungicide on corn yield.
2. Effects of tillage and population on corn yield.

Study Guidelines

Both experiments were conducted in a conventional tillage system, which included chisel plow in the fall and soil finisher in the spring; and strip tillage in the fall with row cleaners used at planting (Figure 1). Standard weed management practices were used to maintain a weed-free environment. Table 1 lists the management practices that were followed in each experiment.

Results

Fungicide application greatly improved yield, with a 10 bu/acre advantage in strip tillage, and a 12 bu/acre advantage in conventional tillage. Across fungicide treatments, conventional tillage out-yielded strip tillage by as much as 20 bu/acre, with yields of 170 and 150 bu/acre, respectively (Figure 2).

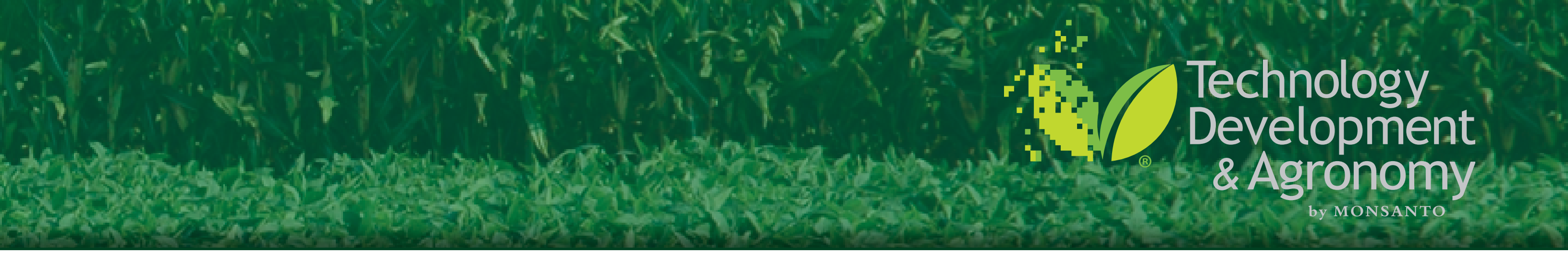
The highest yields were achieved with 35,000 seeds/acre under both tillage systems. Under both tillage systems, 28,000 seeds/acre slightly out-yielded 42,000 seeds/acre. Across populations, conventional tillage out-yielded strip tillage, with yields of 181 and 146 bu/acre, respectively (Figure 3).

In both experiments, conventional tillage out-yielded strip tillage, by an average of 27.6 bu/acre. These results were similar to results from 2012 in which conventional tillage out-yielded strip tillage by 21.4 bu/acre. Crop residue can affect the growing environment in many different ways. Some of these effects can be positive, but others can lead to increased plant stress, thus proper residue management is critical. Even though conventional tillage out-yielded strip tillage, many factors influence tillage decisions and growers should consider economic and agronomic components to make the best tillage choices for their fields. Corn product selection should match the agronomic needs of the field and farming operation.

Legal

Experiment	Details
Tillage x Seeding Rate	•Two Genuity® SmartStax® RIB Complete® corn blends (105 and 112 RM) planted 5/2/2013 in a continuous corn rotation system in 30-inch rows. •Seeding rate: 28,000; 35,000; and 42,000 seeds/acre.
Tillage x Fungicide	•Genuity® SmartStax® RIB Complete® corn blend (112 RM) and Roundup Ready® Corn 2 (111 RM) with soil insecticide at planting. •Planted 5/1/2013 in a continuous corn rotation system in 30-inch rows. •Fungicide application: Headline® fungicide at growth stage R2 at 0.145 fl oz/acre + Crop Oil Concentrate at 1% volume COC/volume mix.

Table 1. Treatments for the tillage practices study at Monmouth Learning Center, 2013.



Comparison of Tillage Systems in Continuous Corn

Figure 1. Conventional tillage (left) and strip tillage (right) fields under continuous corn systems at Monmouth, IL.

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Before opening a bag of seed, be sure to read, understand and accept the stewardship requirements, **including applicable refuge requirements for insect resistance management,** for the biotechnology traits expressed in the seed as set forth in the Monsanto Technology/Stewardship Agreement that you sign. By opening and using a bag of seed, you are reaffirming your obligation to comply with the most recent stewardship requirements.

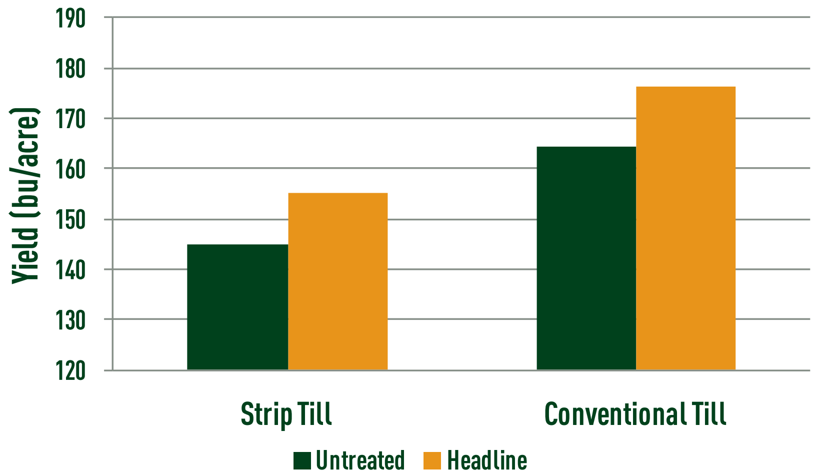

Figure 2. Effect of tillage and fungicide treatment on corn yield under continuous corn systems averaged across corn products at Monmouth, IL.

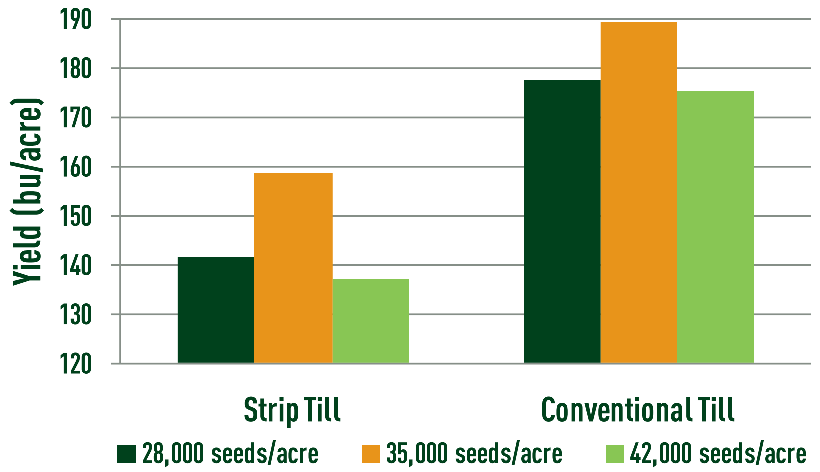

Figure 3. Effect of tillage and plant population on corn yield under continuous corn systems averaged across corn products at Monmouth, IL.

Drought and Nitrogen Timing Effects in Corn

Background

Efficient use of nitrogen (N) fertilizer for corn production is important for maximizing economic return and yield potential. The availability of N can be highly variable and is influenced by many factors, one of the biggest factors being weather. This can be further exacerbated in drought conditions when roots may not grow well and nutrient movement in the soil is limited. Strong root systems are important in drought conditions and under high corn rootworm pressure situations like continuous corn. A trial conducted at the Monsanto Learning Center at Monmouth, IL was designed to investigate the effects of N rate and timing on corn yield when grown in drought conditions.

Study Guidelines

Four corn products were planted with relative maturities ranging from 105 to 112. Treatments were applied to a continuous corn field using a conventional tillage system (Table 1). All N was applied as a 32% urea ammonium-nitrate (UAN) solution. Standard weed control was used to maintain a weed-free environment. Side-dress applications were made on June 21, 2013.

Results

In order for plants to take up adequate amounts of N to support optimum growth, N must move with water to the root through the process of mass flow. Dry conditions later in the growing season likely restricted N availability, which may account for the lack of response to side-dress N applications in 2013 (Figure 1). Previous years' data from the Monsanto Learning Center at Monmouth, IL show a five bushel per acre response to side-dress applications at the full rate (Figure 2).

Legals

The information discussed in this report is from a single site, 2 replicate demonstration. This informational piece is designed to report the results of this demonstration and is not intended to infer any confirmed trends. Please use this information accordingly.

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Table 1. Nitrogen Rate and Timing Treatments

Rate 1	Half Rate Pre-Plant
	120 lbs N/acre
Rate 2	Full Rate Pre-Plant
	240 lbs N/acre
Rate 3	Half Rate - Split Application
	60 lbs N/acre pre-plant followed by 60 lbs N/acre at V4 stage
Rate 4	Full Rate - Split Application
	180 lbs N/acre pre-plant followed by 60 lbs N/acre at V4 stage

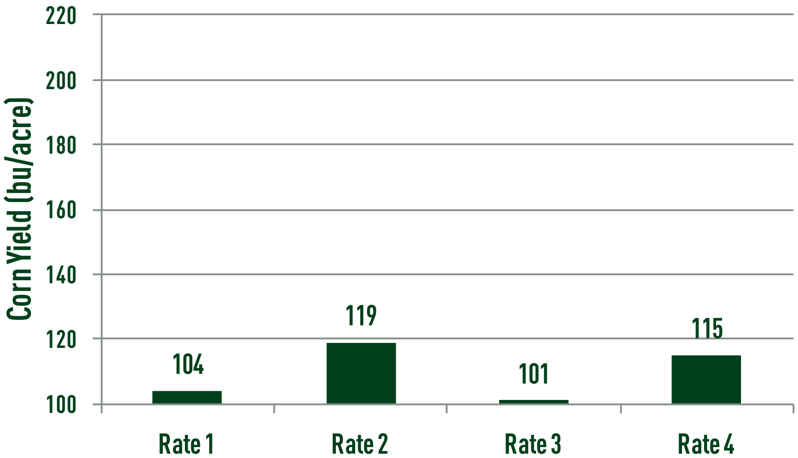

Figure 1. Effect of nitrogen rate and timing on corn yield in 2013.

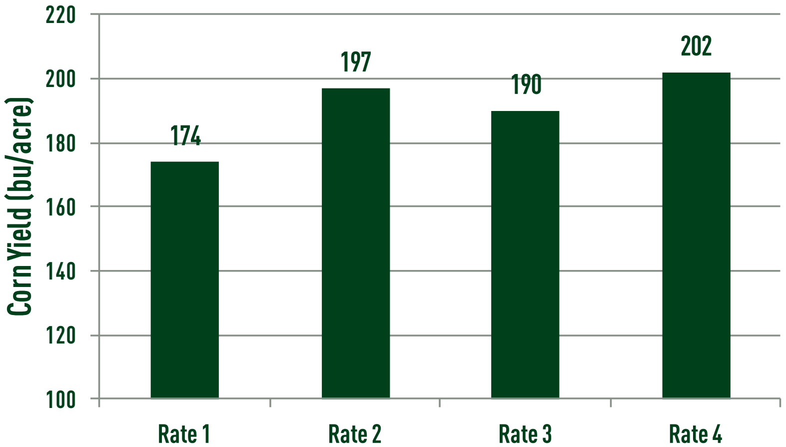

Figure 2. Four-year average of effect of nitrogen rate and timing on corn yield from 2009 to 2012.

Higher Yielding Corn Strategies

Background

Corn grain yield is the final result of several factors that influence the development and performance of the plant throughout a growing season. Yield has steadily increased in the past 150 years (Figure 1) due to advancements in breeding, cultural practices, and biotechnology. In order to meet grain demands in a world with steadily decreasing farmable land, the behavior of yield-influencing factors must be understood.

Multi-year and multi-location university research has indicated that there are 7 categorical management factors that influence corn yield. These factors are weather, nitrogen, product selection (including biotech traits), previous crop, plant population, tillage practices, and growth regulators (e.g. 'plant performance' or greening effect of strobilurin fungicides). Nutrient availability is also an important factor in plant growth. The MESZ (12-40-0-10S-1Zn) product, which provides a single source to promote balanced crop nutrition via fused granules containing 4 essential nutrients, plus 0-0-60 (potash) was used in this study to display the effects of nutrients at low and high management rates.

Understanding the interactions of these factors is critical to maximize corn yield potential. Differentiating these factors into a standard system versus high management system in an omission plot layout can help gain insight on how each factor contributes to final yield. A replicated corn demonstration trial was conducted at the Monsanto Learning Center at Monmouth, IL to investigate the interaction and management levels of several factors that can impact corn yield.

Study Guidelines

Roundup Ready® Corn 2 (105 RM), Genuity® SmartStax® RIB Complete® corn blend (105 RM), and Genuity® VT Triple PRO® RIB Complete® corn blend (112 RM) were planted on 5/14/2013 using various combinations of plant populations, nutrients levels, and Headline® fungicide applied at R1 growth stage (Table 1). Treatments were applied to a corn-soybean rotation field with strip tillage done in the fall.

Plot size was 10 feet x 100 feet (0.023 acre) with a 30-inch single row. There were 4 rows per treatment. Weeds were managed with PRE application of Harness® Xtra 5.6L herbicide at 2.5 qt/acre on 5/2/2013 and POST application of Roundup PowerMAX® herbicide at 22 fl oz/acre + ammonium sulfate (AMS) at 17 lbs/100 gal on 6/19/2013. Plots were harvested on 9/7/2013 and yield was adjusted to 15% moisture content.

Figure 1.Historical U.S. Corn Grain Yields 1866 to Date

Higher Yielding Corn Strategies

Table 1. Seeding rates, fertilizer levels and Headline® fungicide rate used for 2013 demonstration trial.

Seeding Rate* (seeds/acre)	MESZ + 0-0-60** (lbs/acre)	Headline® Fungicide*** (fl oz/acre)
35K*	50	9
42K	100	

*K = 1,000
**MicroEssentials® SZ™ (12% N- 40% P- 0% K- 10% S- 1% Zn) + 0-0-60 (N-P-K) placed in till zone in the fall
***applied on 7/22/2013 at the R1 stage

Results

When averaged across corn products, Headline® fungicide application, and plant populations, the 100 lbs of added nutrients (MESZ + Potash) outyielded the 50 lbs MESZ + Potash treatment. Highest yield of 270 bu/acre was obtained in 42,000 seeds/acre plant population compared to 259 bu/acre for the 35,000 seeds/acre population (Figure 2).

Across corn products, yield of the 42,000 seeds/acre plant population was slightly higher compared to the lower population (35,000 seeds/acre) with the addition of 100 lbs of nutrients (Figure 3).

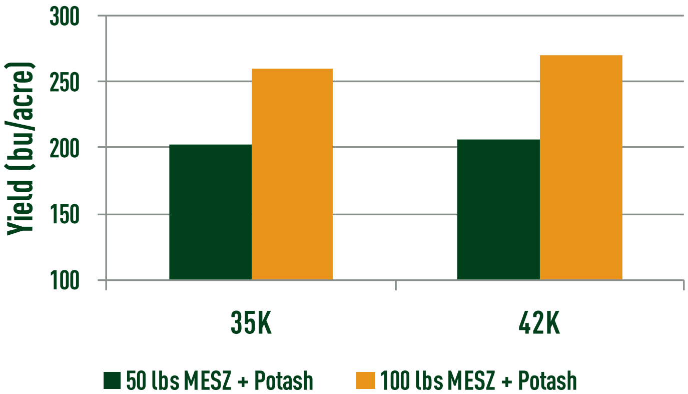

Figure 2. Effect of nutrient addition and plant population on average yield of three corn products in 2013.

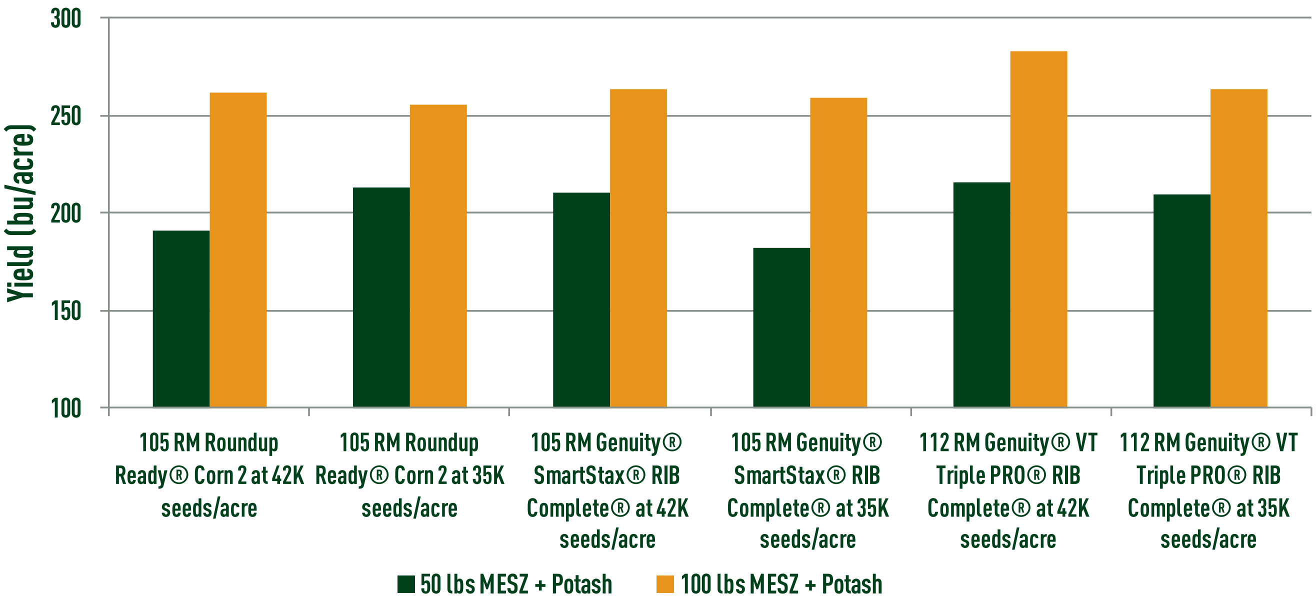

Figure 3. Effect of nutrient addition, plant population, and corn trait package on yield of three corn products in 2013.

Higher Yielding Corn Strategies

The effect of Headline® fungicide application at R1 stage on yield across different planting populations and corn products was slightly higher (Figure 4); however, this was not consistent as the untreated check yielded the same or higher than the treated plot in some cases (data not shown).

Key Messages

- Regardless of the trait, fertilizer, plant population, and fungicide application none of the corn products produced 300 bu/acre due to:

  – Very wet conditions shortly after planting causing poor stand establishment and disadvantaged roots.

  – High temperatures and drought conditions during pollination late in the season, which may have caused kernel abortion.
- Ideally, a combination of fertilizers, genetics, traits, strobilurin fungicides and other crop protection products, good growing conditions, and strategically placed plant population can all help achieve higher yield[2].

Sources and Legal

[1] USDA-NASS. Historical corn yield data 1866-2013, http://quickstats.nass.usda.gov (verified 11/20/13). [2] Below, F.E. et al. 2011. A report of crop physiology laboratory omission plot studies in 2011. University of Illinois, http://cropphysiology.cropsci.illinois.edu (verified 11/20/13).MicroEssentials SZ Product Portfolio. http://www.microessentials.com (verified 12/3/2013).

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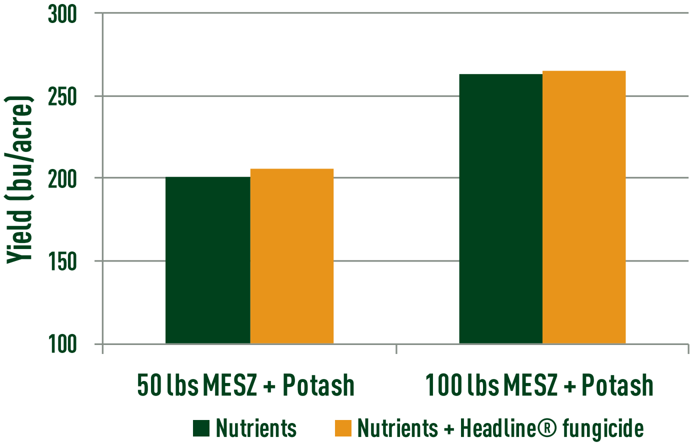

Figure 4. Effect of Headline® fungicide and nutrient applications on average yield of three corn products in 2013.

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Soybean Populations by Stress Mitigation

Study Guidelines

A trial was conducted at the Monsanto Learning Center at Monmouth, IL to investigate how different treatments for minimizing stress on soybean affected yield potential at different plant populations. The trial also examined the most profitable plant populations for the given trial location. The trial was planted with Genuity® Roundup Ready 2 Yield® soybean products on June 7, 2013. The soil was prepared under conventional tillage with a chisel plow in the fall followed by a soil finisher to establish the seed bed in the spring. Pre-emergence herbicide was applied June 7, 2013 and the trial was harvested October 11, 2013. Plant populations included: 75K, 100K, 130K, 170K, and 200K seeds per acre planted in 30-inch rows.

Each population had treatments applied at different growth stages:

- Untreated control (UTC)
- Foliar fungicide at R3 (FF)
- Foliar insecticide at R3 (FI)
- Foliar fungicide + insecticide at R3 (FF + FI)
- Foliar fungicide + insecticide at R3 and R5 (FF + FI 2X)
- Sugar at R1

The application schedule included:

- R1 applications applied July 23, 2013
- R3 applications applied August 1, 2013
- R5 applications applied August 19, 2013

Results

When population levels were averaged across stress mitigation treatment, there was an upward trend in yield with increasing plant populations (Figure 1).

Of the five stress mitigation treatments, foliar fungicide plus foliar insecticide applied at R3 and R5 showed the highest yield (Figure 2). The 2013 results do not agree with long term data as there has not typically been a yield response with foliar fungicide and insecticide applications at R3 and R5 at this location. This may have been due to heavy Japanese beetle (*Popillia japonica*) pressure in 2013. Although the 200K population provided the highest average yield and highest gross income, it was not the most profitable (considering gross income and seed cost). The 130K population provided the most profitable scenario in this trial as shown in Figure 4 with an $8.47 advantage over the 200K population.

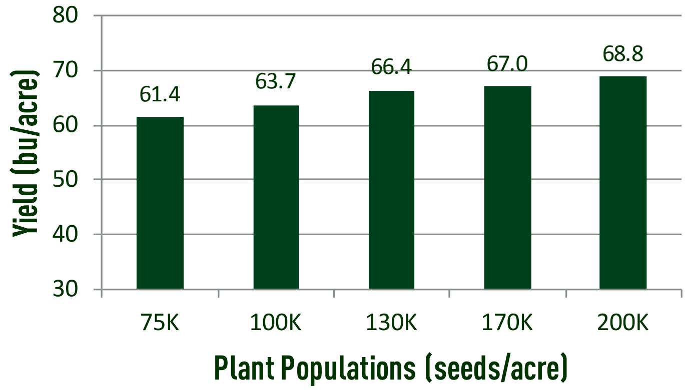

Figure 1. Yield Affected by Plant Population

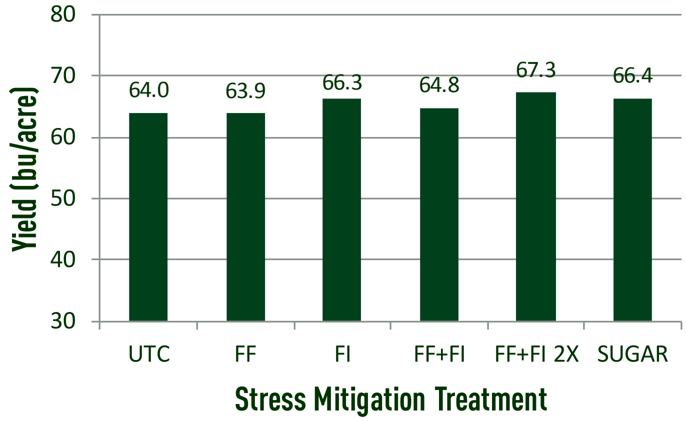

Figure 2. Yield Affected by Stress Mitigation Treatment

Key Messages

Overall, this trial provided the following findings:

- A greater response to stress mitigation was demonstrated at higher plant populations (Figure 3).
  - Higher plant populations create more stress on the plant, therefore reducing outside stress can result in increased yield.
- While increased yields were observed at higher planting populations, those increases did not result in optimum profitability.
- Good agronomic practices such as proper planting date and population can help reduce environmental stresses.

It was noted that some of the treatments may not have caused a response due to the late planting date and drought. The Monsanto Learning Center at Monmouth will continue to investigate the yield effects of stress mitigation in soybean in the future.

Soybean Populations by Stress Mitigation

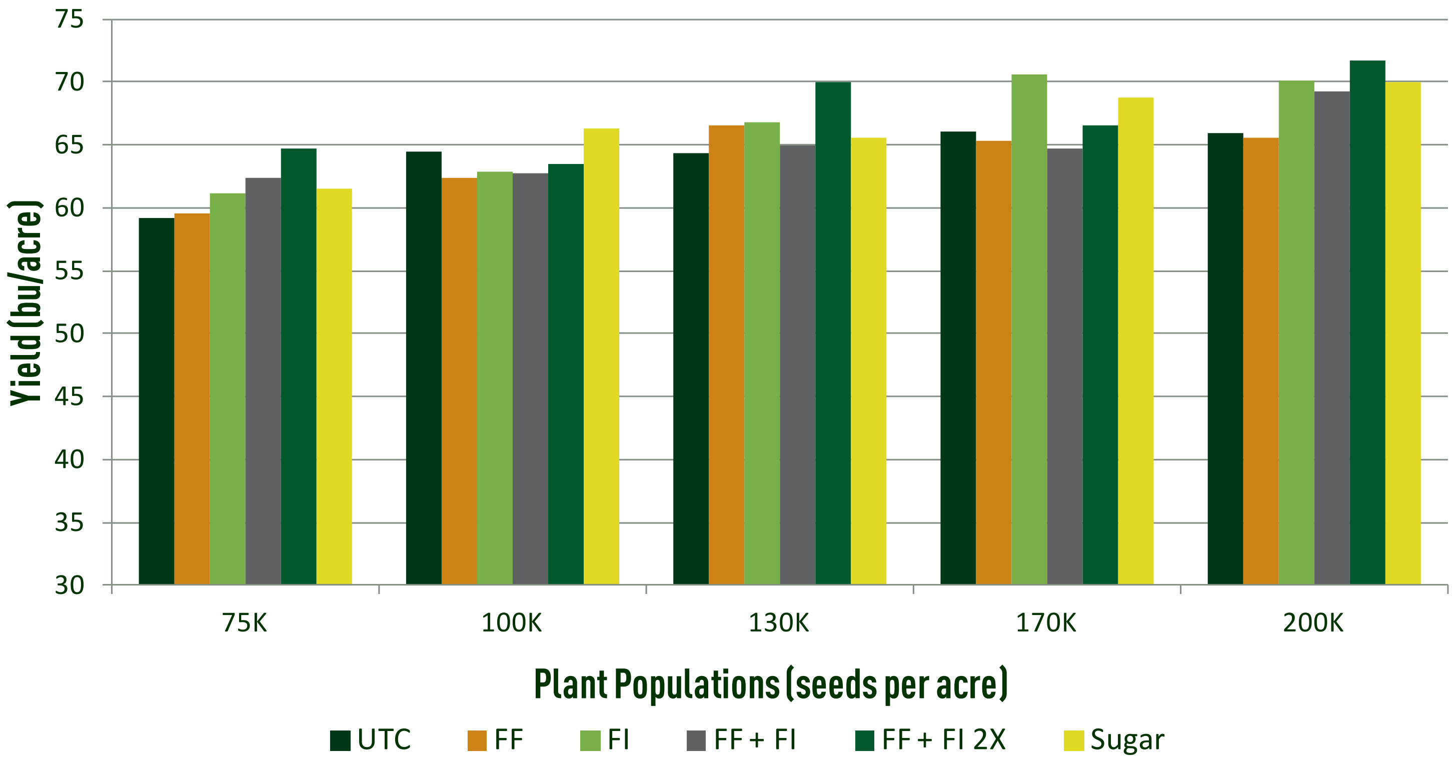

Figure 3. Yield Affected by Population and Stress Mitigation Treatment

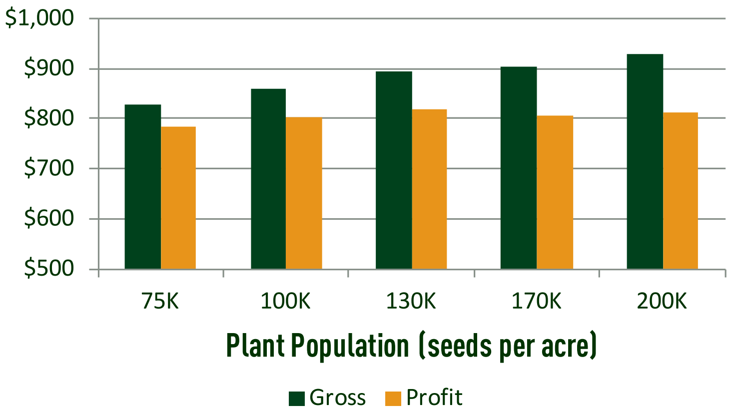

Figure 4. Profitability Affected by Plant Population

Legals

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