2011

Demonstration Reports

Technology Development by MONSANTO

THE LEARNING CENTER at Monmouth, IL

I would like to thank you once again for visiting the Monmouth Learning Center this past year! We had a very successful summer with visitors from all over the US, as well as the world, coming to Monmouth for tours and training. For 2012, we plan to continue showcasing our current as well as pipeline technologies, and continue to look at new ways to improve our agronomic systems trials in order to enhance your experience here at the Learning Center.

As always, our mission is to provide valuable agronomic and technical information that will help keep you on the forefront of yield, efficiency, and profitability. With this in mind, we have once again compiled summary results from some of our key 2011 trials and demonstrations on corn and soybean production, as well as weed management.

I hope you find the information contained in the reports to be valuable to your farming operation, and we look forward to hosting you again at the Learning Center in 2012!

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Sincerely,

Troy Coziahr, Manager

Monsanto Learning Center – Monmouth, IL

To book a tour at the
Monsanto Learning Center
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2011 Demonstration Reports

Equidistant Plant Spacing in Corn

In recent years, trends have shown an increase in corn planting populations. If not managed properly, this increase can lead to competition between plants for resources and compromise yield potential. This study was conducted to determine if an alternative row spacing could offer higher yields when compared to commonly used row spacings.

Study Guidelines

In 2011, a study was conducted at the Monmouth Learning Center to evaluate the effect of true equidistant row spacing on corn production. Plants were arranged either in a row or staggered pattern (Figure 1), which allowed each plant one square foot of area for growth and was equal to a plant density of 43,560 plants per acre. Total plot size in this study was 1,500 sq. ft. with 375 sq. ft. allocated to each hybrid by row configuration (Figure 2). 375 seeds were planted in each individual block. Plots were hand planted from May 18-21 and harvested on September 19.

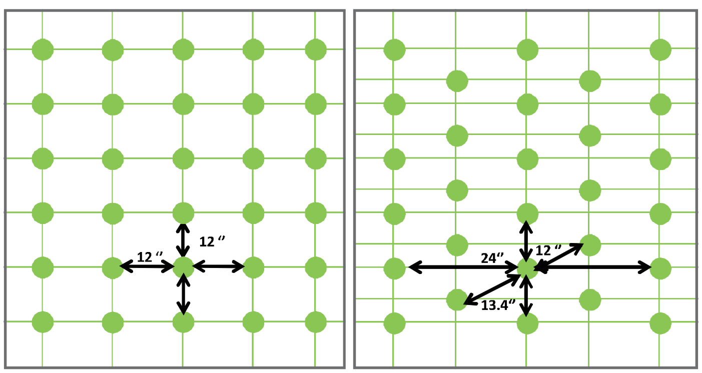

Figure 1. Equidistant plant spacing in a row configuration (left) and a staggered configuration (right).

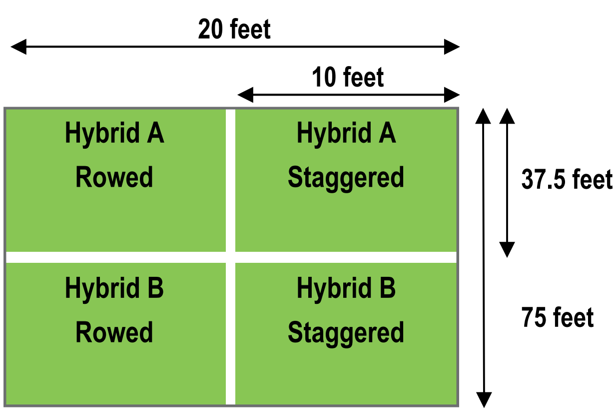

Figure 2. Plot size and square footage for each hybrid and hybrid by row configuration.

The experiment was replicated using two different 112 relative maturity hybrids. The previous crop was corn and no soil insecticide was used in the study. Hybrid A was a Genuity® VT Triple PRO® product; Hybrid B was a YieldGard VT Triple® product. Plots received an application of a stress reducing agent at V6 as well as fungicide applications at V6 and VT. Fertility (on a per acre basis) included 180 lbs of 32% N pre-plant incorporated, 50 lbs of 12-40-0-10S-1Z fertilizer broadcasted at planting, 50 lbs of polycoated urea broadcasted at V6, and 20 lbs of urea broadcasted at V18.

In addition to yield data, information was collected to help identify factors that may affect corn production in equidistant row spacing. Air temperatures were taken within the crop canopy three times throughout the growing season and data was recorded on light penetrating the crop canopy from V8 to R4 in the row configuration of Hybrid B.

Results

Several factors worked to limit yield potential during this study. Cutworm damage reduced plant stands 20-30% in Hybrid A, resulting in stunted plants that did not contribute to yield (Figure 3). Plants were exposed to extreme summer heat during pollination and moisture stress from early July to mid-August. Heavy aphid infestation was a problem late in the growing season at R4-R5 and further reduced yields. Additionally, a hail storm caused severe defoliation at R5.

Hybrids A and B differed in their yield response (Figure 4). Hybrid A did not perform well in the heat and plants were physiologically mature by late August. Plants were also subject to severe stalk lodging. Hybrid B handled stress well and had exceptional late season plant health (Figure 5). Final yield of Hybrid B averaged across both row configurations was 310 bu/acre, close to 100 bu/acre greater than the average yield of Hybrid A at 211 bu/acre. The average yield across both hybrids in the row configuration was slightly higher than in the staggered configuration with average yields being 265 bu/acre and 256 bu/acre, respectively.

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Equidistant Plant Spacing in Corn (cont.)

Summary Comments

Plants must intercept large amounts of sunlight in order to maximize yield potential. Corn planted in equidistant row spacing had early and thick canopy closure (Figure 6), which led to increased sunlight capture and helped provide the plant the energy needed to produce higher yields. Canopy closure was achieved at V4 and from V14 to R3, 95% of the light was captured by the canopy. This increased to 98% light capture at reproduction (Figure 7).

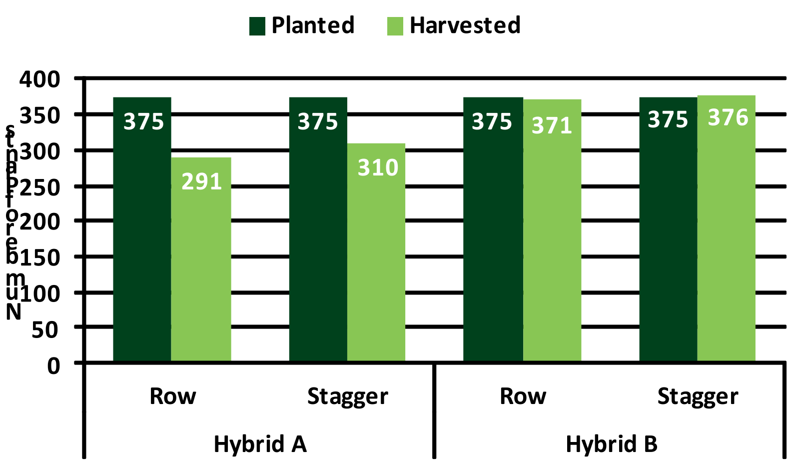

Figure 3. The number of kernels planted and ears harvested per treatment and per hybrid.

Figure 5. Hybrid B had good late season plant health and good yield.

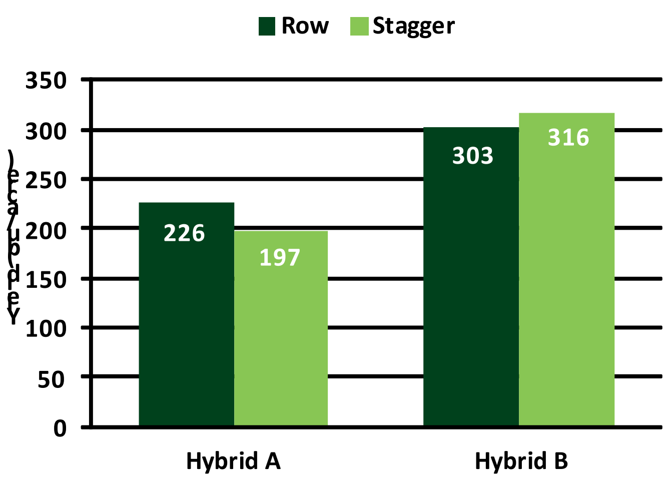

Figure 4. The effects of hybrid and equidistant row spacing configurations on corn yield.

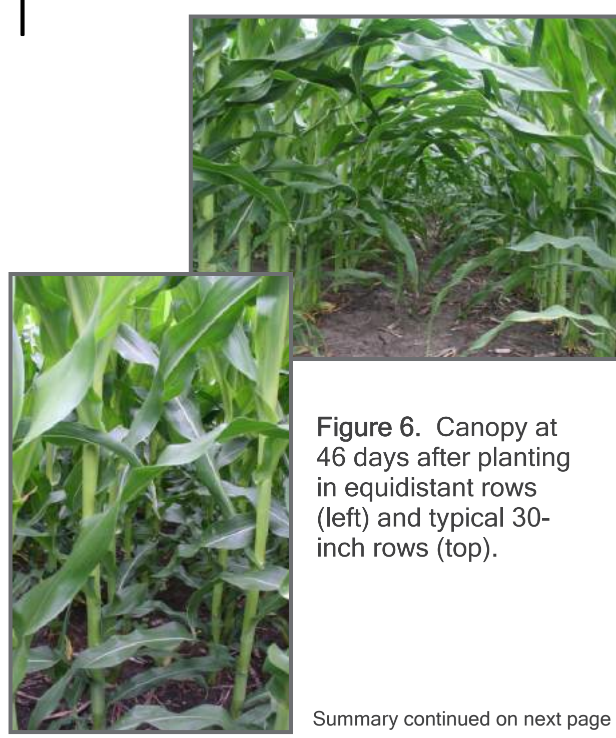

Figure 6. Canopy at 46 days after planting in equidistant rows (left) and typical 30-inch rows (top).

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Equidistant Plant Spacing in Corn (cont.)

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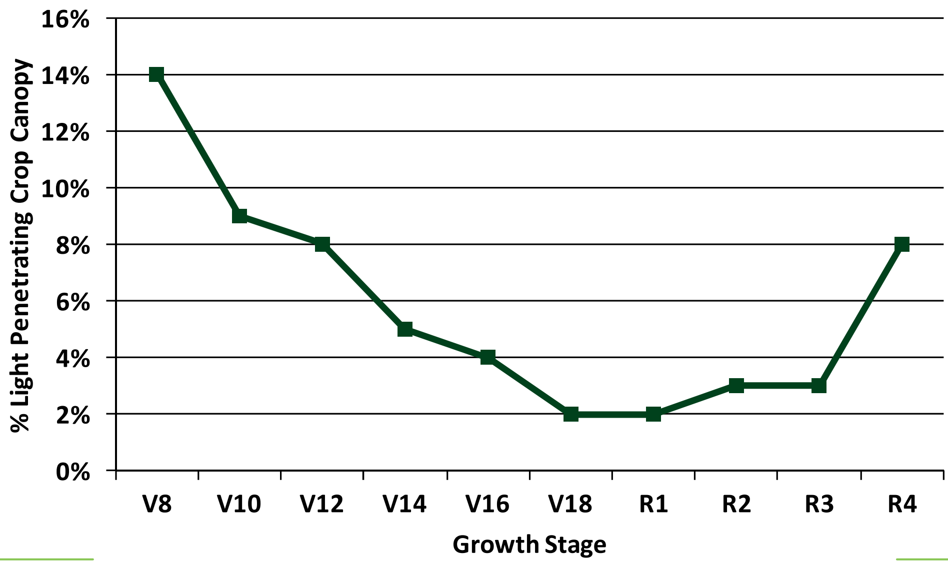

Figure 7. Percent light penetrating crop canopy during different growth stages of Hybrid B in the row configuration.

Equidistant row configurations may also create a microclimate within the canopy that helps to speed plant growth by maintaining plant respiration. Although temperatures were only recorded three times during the growing season, temperatures inside the canopy ranged from 12° to 21° F warmer than temperatures outside the canopy.

The yields of Hybrid A and Hybrid B in equidistant row configurations are in stark contrast to the yield of Hybrid C, which was used in the plot border rows. Border rows were planted at 44,000 plants per acre in 30-inch rows and received the same treatments as Hybrids A and B. The resulting yield was 124 bu/acre. While it must be noted that this hybrid is different from the two used in the experiment, the results still shed light on the effects of overplanting in 30-inch rows.

While large-scale equidistant plant spacing may not be possible with current technology, these results suggest there is untapped yield potential that can be realized by altering row configurations.

The information discussed in this report is from a single site, non-replicated, one-year 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.

Evaluation of a Nitrogen Rate Calculator

Historically, nitrogen (N) corn fertilizer rate recommendations have been determined on a yield-based approach. However, the poor relationship between the yield-based rate recommendation and the maximum return to N (MRTN) rate has led to the establishment of a Corn Nitrogen Rate Calculator that can be utilized on a regional basis across the Corn Belt. The Corn Nitrogen Rate Calculator is a tool to determine the most profitable fertilizer N rate for corn by calculating the return to N application and finding the MRTN at selected prices of N and corn in individual states.[1,2]

Study Guidelines

A replicated trial was conducted in 2011 at the Monsanto Learning Center in Monmouth, IL to evaluate the Corn Nitrogen Rate Calculator as a decision tool for determining corn N fertilizer rates. Corn was planted on May 5, 2011 with different corn rootworm (CRW) protection as follows: 1) 105 day relative maturity (RM) products of Genuity® SmartStax® and Roundup Ready® Corn 2 plus soil applied insecticide (Force® 3G); 2) 111 RM products of Genuity SmartStax and Roundup Ready Corn 2 plus soil applied insecticide; and 3) 113 RM products of YieldGard VT Triple® and Genuity® VT Double PRO™ plus soil applied insecticide. The N treatments evaluated in the trial were as follows:

1. 0 lb N/acre
2. 90 lb N/acre
3. 180 lb N/acre
4. 270 lb N/acre

The N source was 32% urea ammonium nitrate (UAN) solution, and all N treatments were applied preplant and incorporated into the soil. Planting was in a continuous corn system using conventional tillage (chisel plow in the fall, soil finisher in the spring). Weed control consisted of a preemergence treatment of Harness® Xtra 5.6L at 2 quarts per acre followed by a postemergence treatment of Roundup WeatherMAX® at 22 ounces per acre. Corn was harvested on September 21, 2011.

Results And Discussion

Overall, CRW protection technologies had no effect on yield within N treatments, suggesting low rootworm pressure at this site (Figure 1). Therefore, the nitrogen response curve (NRC) was calculated by averaging all corn product yields within the N rate (Figure 2). The NRC was used to calculate the N rate that maximizes yield. A maximum yield of 220 bu/acre was obtained with a N rate of 239 lb N/acre. The MRTN rate of 195 lb N/acre

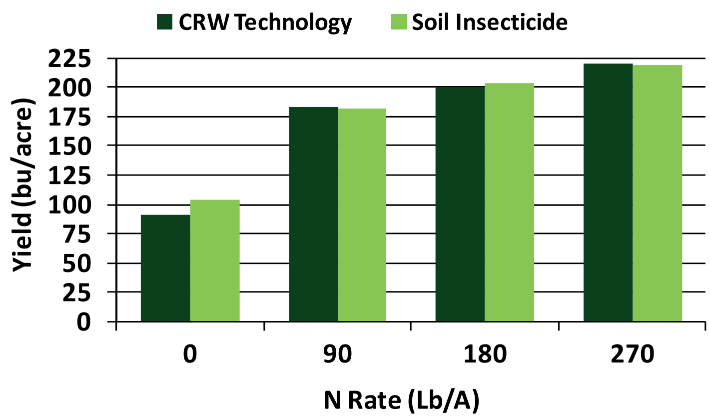

Figure 1. Average corn yield across corn rootworm (CRW) protection technologies and products at different nitrogen (N) rates.

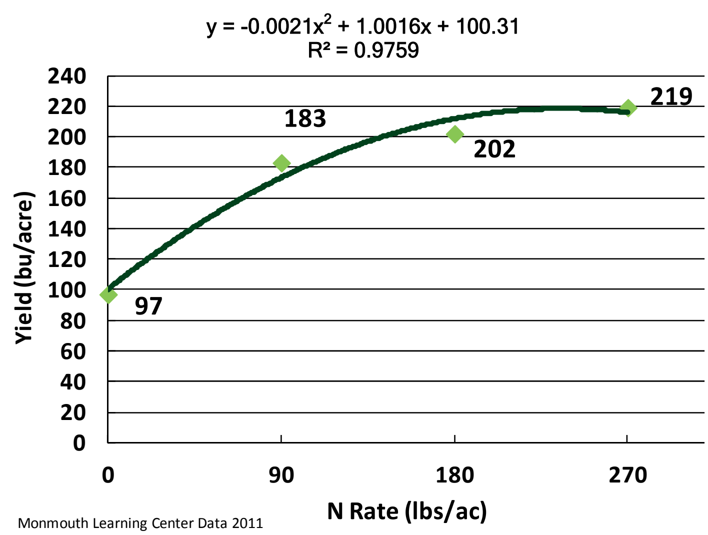

Figure 2. Nitrogen response curve (NRC) using average yields across all corn products.

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Evaluation of a Nitrogen Rate Calculator (cont.)

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was obtained by using the Corn Nitrogen Rate Calculator Web tool, choosing central Illinois, corn following corn, and setting a corn price of $6.15 per bushel with the set price for 32% UAN fertilizer (Figure 3).[2] Guidelines provided for a profitable N rate was in the range of 182 to 207 lb N/acre. The MRTN rate of 195 lb N/acre resulted in a calculated yield of 216 bu/acre, and a yield range of 213 to 218 bu/acre was for the profitable N rate range. The applicability of the Nitrogen Rate Calculator for this area was evaluated by comparing the N rate obtained from the NRC with the MRTN rate guidelines (Figure 4). When considering projected yield, corn price and fertilizer cost, a more profitable net return would be possible by choosing a N rate within the guidelines of the Corn Nitrogen Rate Calculator.

This testing showed that the Corn Nitrogen Rate Calculator can be effectively used to determine corn N recommendations for this area under the described conditions.

References

[1] *Sawyer, J. et al. 2006. Concepts and rationale for regional nitrogen rate guidelines for corn. Iowa State University extension publication PM 2015, April 2006.*

[2] *Corn Nitrogen Rate Calculator. Iowa State University. http://extension .agron.iastate.edu (verified 11/4/2011).*

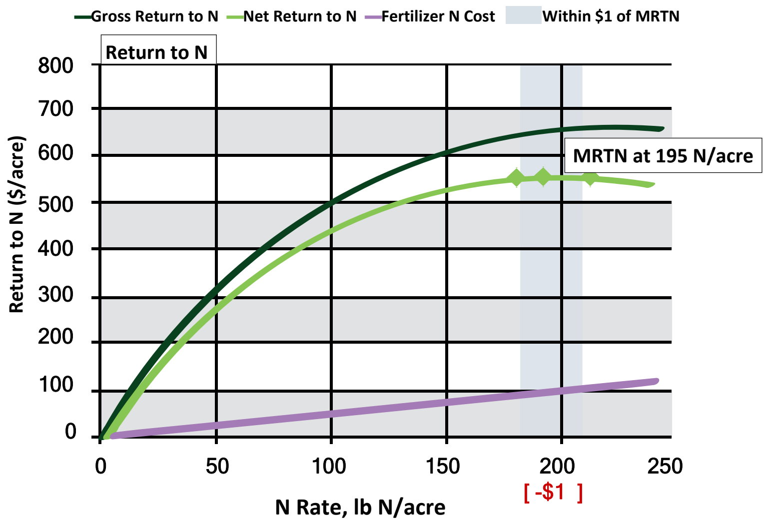

Figure 3. Maximum return to nitrogen (MRTN) rate developed by using the Corn Nitrogen Rate Calculator Web tool.[2]

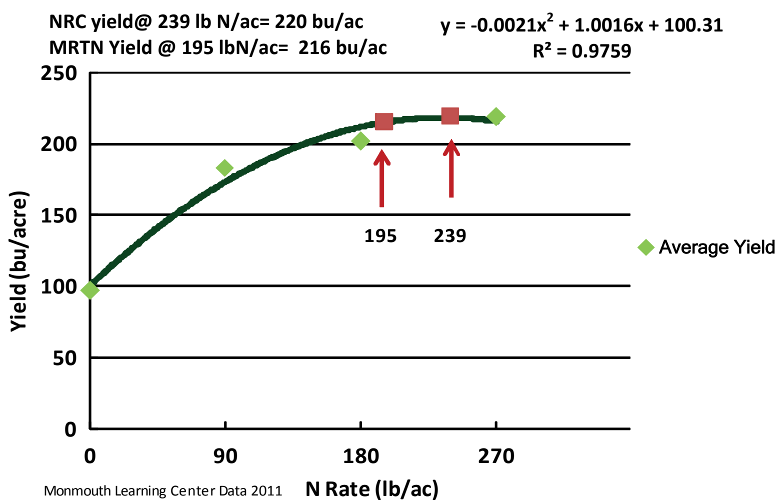

Figure 4. Yield comparison at N rates developed by the NRC and the MRTN methods.

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No-Till Corn Response to Rotation and Nitrogen Levels

While no-till corn has numerous benefits, achieving optimum yields requires knowledge about the effects of rotation and soil fertility. Plant residue can create management issues, especially in continuous corn production. A research study was conducted at the Monmouth Learning Center to determine the yield response of corn in a no-till system with step-down N rates in both continuous corn and a corn-soybean rotation.

Demonstration Testing

A demonstration was conducted at the Monmouth Learning Center to assess corn response to nitrogen (N) in a no-till system with continuous corn production and corn production in a corn-soybean rotation.

A 111 relative maturity (RM) corn hybrid with Genuity® SmartStax® trait package was selected for the demonstration. The site location has been in no-till since the 1980s, and the crop rotation schedule utilized in the trial has been in place for the past five years. The field was divided into four blocks: two blocks with alternating corn-soybean rotation and two blocks in continuous corn and continuous soybean production. All products were planted at a population of 36,000 seeds/acre on May 13, 2011 and harvested on October 4, 2011. Weeds were controlled with a preemergence herbicide application of Harness® Xtra at 2 qts/acre and a post-emergence application of Roundup PowerMAX® at 22 fl oz/acre with AMS at 17 lbs/100 gal.

Different amounts of N were applied to the demonstration plots. N was applied preplant using 32% UAN solution. The plots received an N rate based on the previous crop planted. For demonstrations in continuous corn production, the 100% N application was 220 lbs N/acre, and for demonstrations in the corn-soybean rotation, the 100% N application was 180 lbs N/acre. N rates were applied at 100%, 75%, 50% and 25% in both continuous corn and corn-soybean rotation scenarios.

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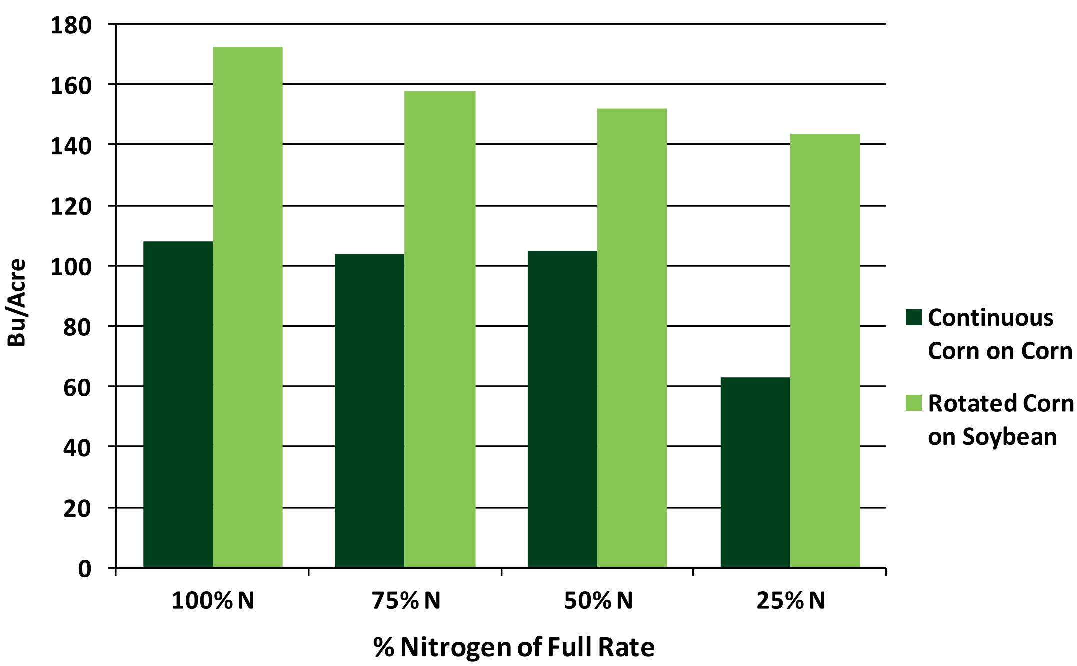

Figure 1. No-till corn response to nitrogen (N) rates for fields in continuous corn and corn-soybean rotation. 100% N rates: Continuous corn = 220 lbs N/acre; Rotated corn on soybean = 180 lbs N/acre.

No-Till Corn Response to Rotation and Nitrogen Levels (cont.)

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Summary Comments

Yields were highest (172 bu/acre) when the 100% N rate (180 lbs N/acre) was applied to corn in a corn-soybean rotation. Even when only 25% of the full N rate (45 lbs N/acre) was applied to the corn in a corn-soybean rotation, yield results were higher than all continuous corn yields reported.

This trial demonstrates the accumulated yield penalty in continuous corn systems. Rotated corn and soybean systems demonstrated moderate yield gains with increasing units of N.

Commodity pricing, coupled with advancements in corn production, may have many producers looking to change their crop rotation to continuous corn production. However, a corn-soybean rotation, especially in no-till systems, can be beneficial to corn yield potential. In a literature review of published data comparing continuous corn to a corn-soybean rotation, corn in a rotation reported higher yield results than corn in continuous corn systems in all but two of the studies[1]. One potential yield reducing factor in continuous corn can be residue management, which can be especially problematic in a no-till system. Microbial decomposition of previous season's residue can utilize the bulk of N applied to the continuous corn system[2]. University research indicates a 25 bu/acre yield reduction with continuous corn and the yield reduction may increase over time[2]. Other factors that may contribute to a yield drag in continuous corn systems include greater levels of disease inoculum, residue interference with planting, a longer period for soils to warm in the spring, and a decreased efficacy of soil-applied herbicides. Farmers must use a systems approach to residue management which involves the integration of planting, nutrient management and special harvesting.

References

[1]*Erickson, B. 2008. Corn/soybean rotation literature summary. Purdue University. http://www.agecon.purdue.edu/ (verified 11/8/11).*

[2]*Below, F. Seven wonders of corn. Monmouth Learning Center. Growers Day. Monmouth, IL. 3 August 2011.*

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Response of Foliar Application Timing by Corn Hybrid

Multiple stresses can negatively affect corn plants throughout the growing season, which can reduce yield potential. Taking preventative steps to mitigate or lessen stress may help maintain or increase yield potential. A research study was conducted at the Monmouth Learning Center near Monmouth, IL to evaluate the use of a foliar fungicide applications and timing to mitigate stress caused by foliar diseases in corn.

Demonstration Testing

A demonstration trial was conducted at the Monmouth Learning Center to assess corn yield response to foliar application of a strobilurin fungicide. The fungicide was applied to corn hybrids with various trait packages to evaluate different application timings.

Twelve corn hybrids ranging from 111 -113 day relative maturity (RM) were selected for the trial. Of the 12 corn hybrids selected, two were Genuity® SmartStax®, five were Genuity® VT Triple PRO® and five were Genuity® VT Double PRO®. All products were planted at a population of 36,000 plants/acre on May 3, 2011. Each individual plot was 1,100 square feet. Each corn hybrid received an application of the strobilurin fungicide at either V6, tassel (VT) or at both V6 + VT growth stages. An untreated check of each corn product was established for comparison.

Late-season plant health notes were taken by examining plants for staygreen, plant intactness, stalk lodging, and anthracnose infestation. Yield comparisons of the corn hybrids treated with a fungicide compared to the untreated hybrids are shown in Figure 1. Corn hybrids reported various responses to the different fungicide applications and timings.

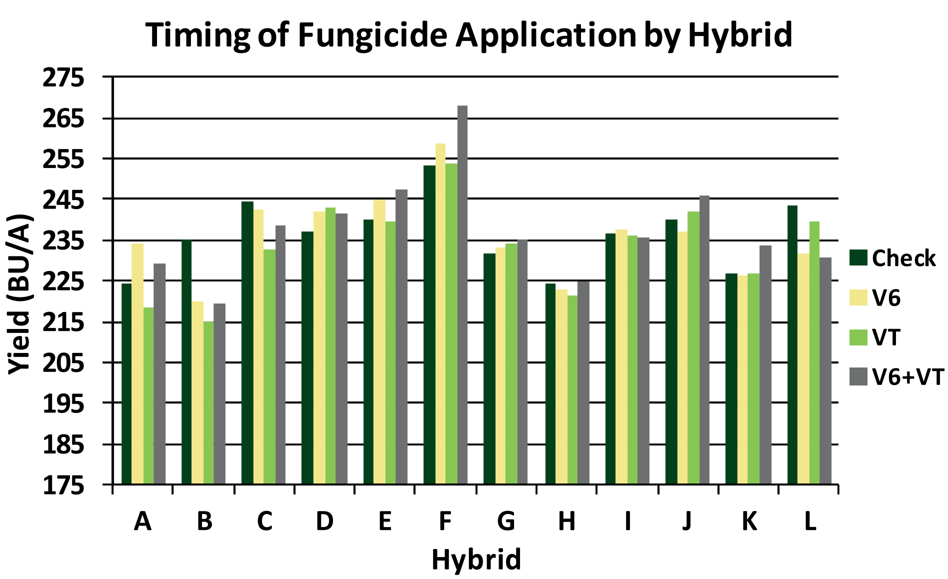

Figure 1. Corn hybrid yield response to different strobilurin fungicide application timings.

Summary Comments

Foliar fungal disease pressure on corn was low in 2011, and overall corn hybrids were largely unresponsive to fungicide applications. Selected hybrids all responded differently to fungicide applications and different application timings. For example, hybrid A and I reported their highest yield when a fungicide was applied at V6 timing, hybrid D reported its highest yield when fungicide was applied at VT timing and hybrid E, F, G, J, and K reported their highest yield when fungicide was applied at V6 and VT timings (Figure 1).

When averaged across all hybrids, the foliar fungicide applications did not affect yield. However, the combined application of fungicide at V6 and VT growth stage provided the highest overall yield, but did not appear to be additive (Figure 2). When comparing the single fungicide application timings, yield results from the V6 application were higher by approximately 2.5 bu/acre when compared to the VT application timing (Figure 2).

It was also determined that plant health was not notably affected by the fungicide applications. The individual hybrids reported different staygreen ratings parameters with relation to the fungicide application timing (Figure 3). Certain hybrids reported an increase in plant health with the fungicide

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Response of Foliar Application Timing by Corn Hybrid (cont.)

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application as determined by staygreen evaluation, while other hybrids appeared to be unaffected by the fungicide application.

These results reinforce the importance of talking with local seed sales representatives about hybrid characteristics and fungicide products to determine the best fit for each individual field scenario.

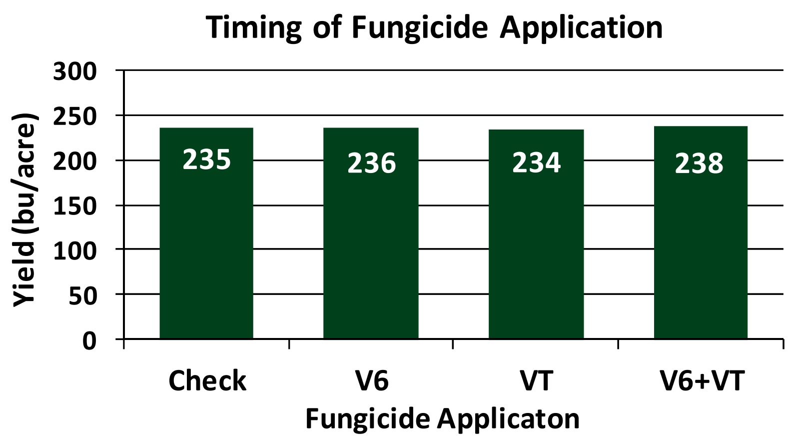

Figure 2. Yield response to strobilurin fungicide application timing across selected hybrids. Data represents average of 12 hybrids and two replications.

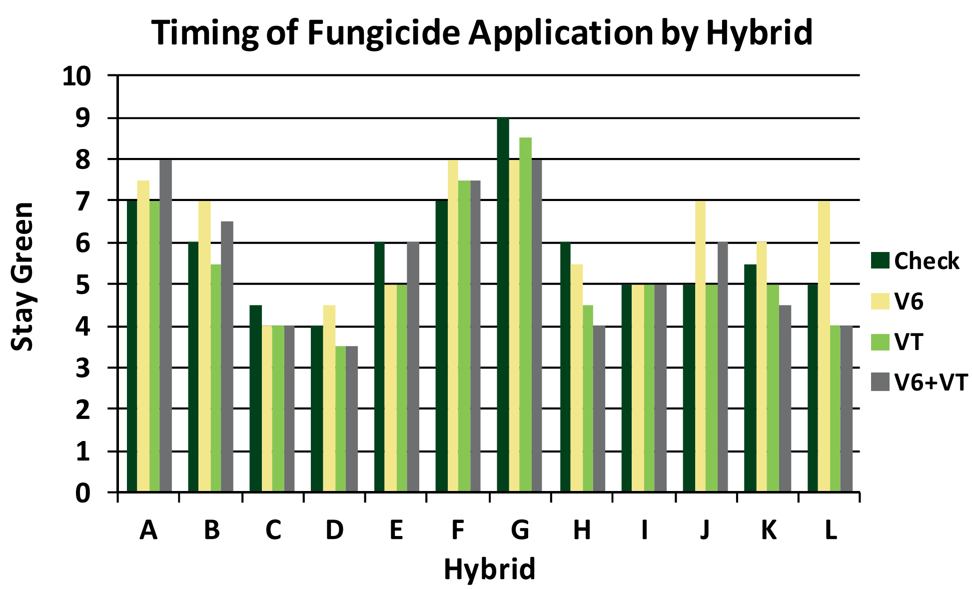

Figure 3. Staygreen response to strobilurin fungicide by hybrid and application timing. Data represents average of 12 hybrids and two replications.

The information discussed in this report is from a single site, non-replicated, one-year 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.

The Effect of Volunteer Roundup Ready® Corn on Corn Yield

Volunteer corn resulting from the previous year's crop due to harvest problems, poor stalk quality, or storm damage can be a challenge. Understanding the competitive effects of volunteers on corn yield can help in making control decisions. Correctly implemented management practices can also decrease the risk of volunteer corn problems.

Study Guidelines

Testing was conducted in 2011 at the Monsanto Learning Center in Monmouth, IL to evaluate the effects of volunteer Roundup Ready® corn on corn yield. One test was conducted where volunteer corn was applied using whole ears to mimic clumps from dropped ears at harvest. Another test was conducted where the whole ears were shelled and kernels were broadcast over the plot to mimic header loss from the combine at harvest. The volunteer corn came from a corn product with only the Roundup Ready herbicide tolerance trait. The seed was broadcast in the spring prior to planting and incorporated into the soil with two passes of a field cultivator. All plots were 1,000 square feet in size. The treatments consisted of 0 (no volunteer corn), 2, 5, and 10 ears applied to a particular plot either as whole ears or as shelled kernels from the ears.

A 111 day relative maturity corn product with the Roundup Ready® Corn 2, LibertyLink®, and Herculex® XTRA traits was planted to all plots on May 4, 2011 at a target population of 36,000 plants per acre. When the planted corn reached the V4 growth stage, herbicide treatments of Ignite® (intended to remove all volunteer corn from the plot) and Roundup PowerMAX® (intended not to control the volunteer corn) were applied. Each herbicide treatment was paired with a volunteer corn treatment. Plots were harvested on September 22, 2011.

Results And Discussion

The shelled ear test produced 199 bu/acre with no volunteer corn in the plots. Corn yield was reduced by 1.4 to 2.5% (3 to 5 bu/acre) with 2 to 5 shelled volunteer corn ears in the plots. With 10 shelled volunteer corn ears, corn yield was reduced by 4.1% (8 bu/acre) when comparing the Ignite and Roundup PowerMAX herbicide treatments (Figure 1). Corn yields, where volunteer corn was controlled with Ignite in the 2 and 5 shelled volunteer corn ear plots, were similar to the control (no volunteer corn). However, corn yield was reduced by 4% in the Ignite treated plots with 10 shelled volunteer corn ears. This was attributed to early season competition from the volunteer corn plants prior to treatment with Ignite.

Corn yielded about 215 bu/acre in the whole ear (clump) test with no volunteer corn in the plots. Corn yield was reduced by 4.6 to 7.6% (10 to 15 bu/acre) with 2 to 5 whole ear clumps in the plots. With 10 whole ear volunteer corn clumps, corn yield was reduced by 8.4% (16 bu/acre) when comparing the Ignite and Roundup PowerMAX herbicide treatments (Figure 2). Comparing the Ignite treated plots, corn yield was reduced by about 4, 5, and 12% with 2, 5, and 10 whole ear volunteer corn clumps, respectively. This was attributed to the lack of effectiveness in herbicide application, as uniform spray coverage can be more difficult to obtain on volunteer corn clumps.

University testing has shown that corn yields can be reduced when volunteer corn populations are high. Low volunteer corn populations can initially look bad, but generally do not impact corn yield. Predictions from University testing indicated that a volunteer population of around 1,000 plants per acre would result in less than a 1% loss in corn yield (average of 1 bu/acre in the multiple University site testing conducted in 2007). High volunteer populations of 5,000 to 10,000 plants per acre (about 100 to 200 plants per 1,000 square feet) had a predicted yield loss of 3 to 6%, and a very high population of 20,000 plants per acre (about 400 plants per 1,000 square feet) had a predicted yield loss of 12%.[1] Volunteer corn populations were not recorded in this testing, but the results appear to be in line with those of the University predicted yield losses.

Greater corn yield loss was observed with the clumped volunteer corn (whole ear) than with the shelled corn in this testing. This could be attributed to better control of the shelled corn volunteers than whole ear volunteers with Ignite herbicide. Good spray coverage can be difficult to obtain on corn volunteer clumps. However, testing has shown that volunteer corn plants in ear clumps

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The Effect of Volunteer Roundup Ready® Corn on Corn Yield (cont.)

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can be less competitive with the corn crop than the same number of evenly dispersed volunteers.[2] The distribution and density of volunteer corn plants can be highly variable in a corn field. In both of these tests, treatments with 10 ears showed a large yield decrease from the other treatments. The 10 ear treatments resulted in high volunteer corn populations that provided early season competition with the corn crop.

Management practices can help to minimize the losses from volunteer corn competition in corn.[3] Selecting corn products with insect protection traits, good standability, stalk strength, and ear retention characteristics can help to keep volunteer corn from becoming a problem in field corn. A timely corn harvest with proper combine settings and adjustments helps to reduce corn ear and kernel losses in the field. Finally, herbicide options are available to control volunteer corn if it becomes a problem.

References

[1]*Agronomic Spotlight. 2010. Volunteer corn in corn fields. Monsanto Technology Development.*

[2]*Stahl, L. et al. 2007. Effect of glyphosate-resistant volunteer corn on glyphosate-resistant corn. University of Minnesota, North Central Weed Science Society Proceedings 62:48.*

[3]*Agronomic Spotlight. 2010. Volunteer corn control: Pre-plant, replant and in-crop. Monsanto Technology Development.*

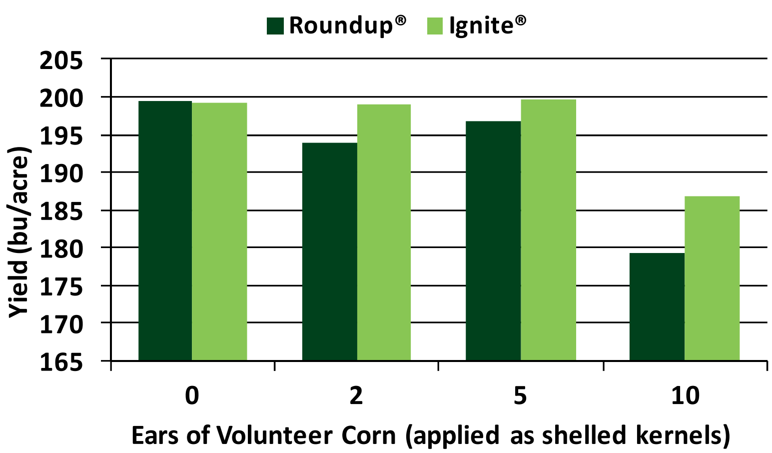

Figure 1. Effect of Roundup Ready® volunteer corn (shelled) on corn yield - 2011 Monmouth, IL.

No Volunteer Corn

2 Ears Shelled

5 Ears Shelled

10 Ears Shelled

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The Effect of Volunteer Roundup Ready® Corn on Corn Yield (cont.)

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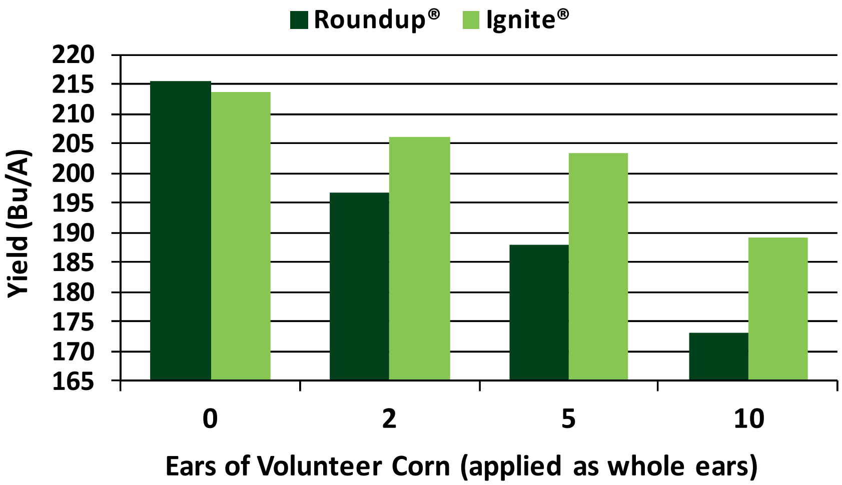

No Volunteer Corn

Figure 2. Effect of Roundup Ready® volunteer corn (in clumps) on corn yield - 2011 Monmouth, IL.

2 Ear Clumps

5 Ear Clumps

10 Ear Clumps

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Tillage Practices Under Different Rotation Systems for Corn Production

Tillage practices may be chosen based on residue management, disease management, or soil condition. Growers also have options when it comes to rotation systems, seeding rate, fungicide application, and even planting date in some years. In 2011, the Learning Center near Monmouth evaluated several of these management practices under conventional and strip tillage in corn production.

Study Guidelines

Five trials were conducted in 2011 at the Monmouth Learning Center near Monmouth, IL to evaluate the yield impact of multiple management practices on corn production under conventional tillage and strip tillage. All trials were studied in a conventional tillage (CT) system, which included chisel plow in the fall and soil finisher in the spring; and strip tillage (ST). Weed management for all trials consisted of PRE: Harness® Xtra 5.6L at 2 qt/acre and POST: Roundup PowerMAX® at 22 oz/acre.

The following management practices were examined:

Trial	Details
Tillage x Planting Date	• One 105 RM and two 111 RM hybrids planted in continuous corn (CC) at 36,000 seeds/acre • Planting dates: Early (4/12/2011); Mid (5/6/2011); Late (5/23/2011) • Harvested from Mid-September to early October
Tillage x Seeding Rate	• Two 111 RM hybrids planted 5/5/2011 in a continuous corn and a corn-soybean (CS) rotation system, harvested in late September to early October • Seeding rate: 28,000; 35,000; and 42,000 seeds/acre
Tillage x Fungicide	• Two 111 RM hybrids planted 5/5/2011 in a continuous corn and a corn-soybean rotation system at 36,000 seeds/acre, harvested in late September to early October. • Fungicide application: Headline® at growth stage R2 at 9 oz/acre + Crop Oil Concentrate at 1% volume COC/volume mix

Table 1. Treatment details for the tillage practices study at Monmouth Learning Center, 2011.

Results

This report summarizes three separate trials, with the overall objective to investigate the yield impact of planting date, seeding rate, and foliar fungicide under strip and conventional tillage systems.

Yields were similar for the corn planted at early and mid planting dates (Figure 1). Only the late planted corn showed a decrease in yield of 7.5 bu/acre compared to the early and mid planted corn. These results support previous studies by Monsanto and universities which state that corn yield potential can decrease with delayed planting because of a shorter growing season, insect and disease pressure, and moisture stress during pollination. However, little difference between tillage systems was observed within any planting date (Figure 1).

Regardless of the rotation system, yield was similar for corn planted at 35,000 and 42,000 seeds/acre (Figures 2 and 3). In general, there was a substantial decrease in yield of 15 bu/acre when seeding rate was lowered to 28,000 seeds/acre. The yield response to tillage

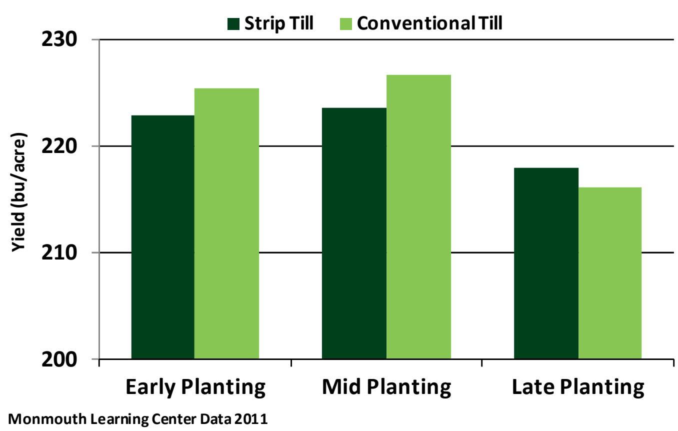

Figure 1. Effect of planting date on yield in continuous corn averaged across hybrids under strip and conventional tillage.

Summary continued on next page

Tillage Practices Under Different Rotation Systems for Corn Production (cont.)

Continued from page 13

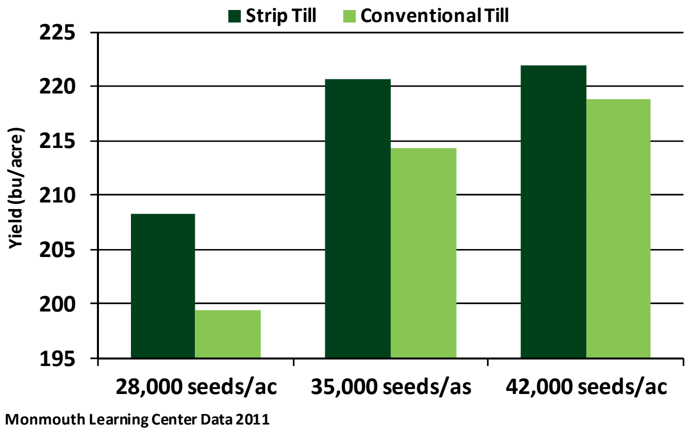

Figure 2. Effect of seeding rate on yield in continuous corn under strip and conventional tillage.

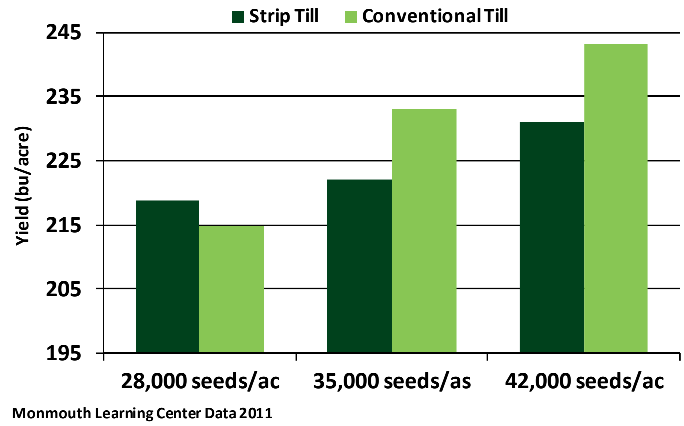

Figure 3. Effect of seeding rate on yield in a corn-soybean rotation under strip and conventional tillage.

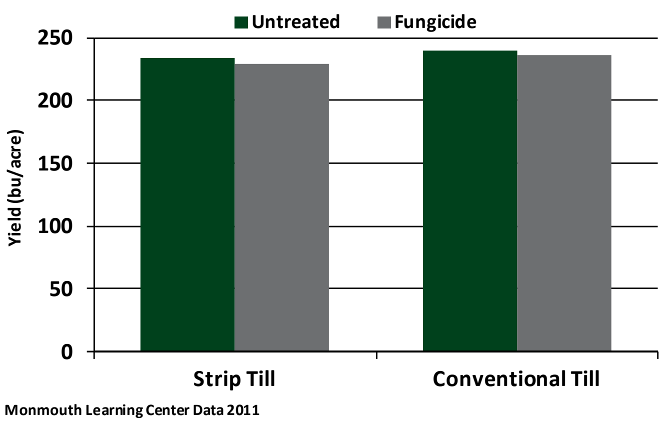

Figure 4. Effect of fungicide application on yield in continuous corn under strip and conventional tillage.

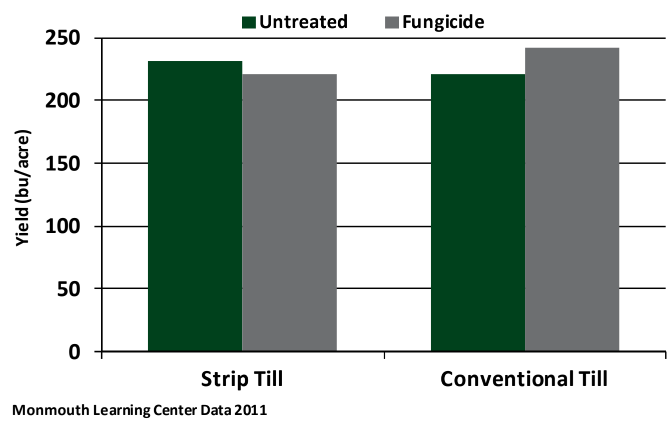

Figure 5. Effect of fungicide application on yield in a corn- soybean rotation under strip and conventional tillage.

practices varied depending on the rotation system. Overall, strip tillage resulted in relatively greater yields across all seeding rates compared to conventional tillage under CC, while conventional tillage was the yield leader under the CS rotation at 35,000 and 42,000 seeds/acre (Figures 2 and 3). However, a greater yield response to tillage practices was observed in the CS rotation compared to the CC system. This effect could be due to the boost in yield usually seen in CS rotation systems.

Foliar fungicide and tillage practices had little effect on yield in either rotation system suggesting that foliar fungal disease pressure was low this year in this particular site (Figures 4 and 5).

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Tillage Practices Under Different Rotation Systems for Corn Production (cont.)

Continued from page 14

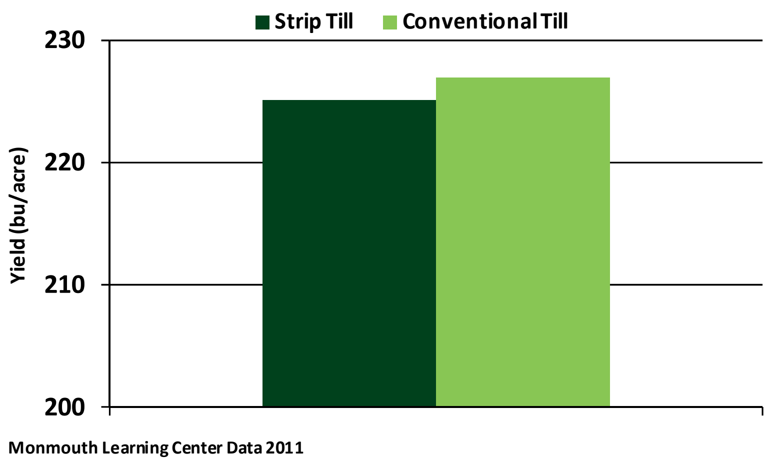

Figure 6. Overall effect of tillage practices averaged across all trials and rotation systems.

Overall, tillage practices across all trials and rotation systems had very little effect on yield (Figure 6). It is worthwhile to mention that nutrient placement was not done in the strip tilled plots, which is one of the main advantages of this tillage system. Therefore, the results found in this study may not translate to other field situations. Similar demonstrations are planned for next season at the Monmouth Learning Center to include nutrient placement for strip till. Please consult with your agronomist to identify the management practices that are most suitable for the hybrids planted in your area.

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Figure 7. Representative examples from each of the rotation systems and tillage practices.

Uneven Establishment in Corn

Each spring, growers strive for uniform corn plant spacing and emergence to maximize yield potential. Uneven emergence produces plants of differing growth stages and typically result in lower yields because the smaller, late-emerging plants cannot capture enough sunlight to produce a normal ear. They often contribute little to yield, and in fact act as a “weedy competitor” for moisture, nutrients, and space. Non-uniform plant spacing can result in skips or doubles in the seed row and lower yields by reducing ear consistency or the amount of harvestable ears. Demonstrations were conducted at the Monmouth Learning Center to quantify the effects of uneven stand establishment in corn.

Study Guidelines

Two demos were conducted at the Monmouth Learning Center to evaluate the importance of uniform stand establishment in corn. One demo evaluated erratic planting, and the second evaluated erratic emergence. Plots were planted 5/12/2011 and harvested 10/3/2011. The same 113 RM hybrid was used for each experiment. Each plot was 1000 ft^2 in size.

Treatments were the following:

Demo 1—Erratic Emergence

- **Target population of 36,000**
- **Target population of 44,000**
- **Target population of 36,000 with 25% of the plants planted at VE**
- **Target population of 36,000 with 25% of the plants planted at V1**
- **Target population of 44,000 with 25% of the plants planted at VE**
- **Target population of 44,000 with 25% of the plants planted at V1**

Demo 2—Erratic Planting

- **Target population of 36,000**
- **Target population of 44,000**
- **Target population of 36,000 (45,000 planting pop – 25% non-glyphosate tolerant seed)**
- **Target population of 44,000 (56,250 planting pop – 25% non-glyphosate tolerant seed)**

In the erratic emergence study, plots were planted at 75% of target population and the remaining 25% was hand planted at VE or V1. In the erratic planting study, Roundup® brand agricultural herbicide application was made at V1 to kill all non-glyphosate tolerant (conventional) plants; thus, simulating poor seed spacing.

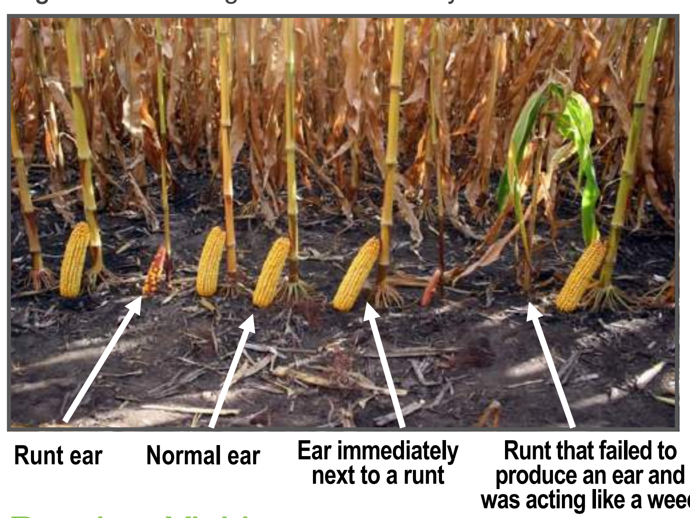
Results

In order to provide data on how treatments were affecting yield at the individual plant level, ears from each treatment were collected from 1/1000th of an acre (17.5 ft). Ears were counted and separated into three categories (Figure 1):

1. Normal
2. Harvestable Runts- determined as ears less than 1/3 the size of a normal ear
3. Ears immediately next to a runt(s)

Ears were mechanically shelled and kernels were counted for each category.

Figure 1. Ear categories used in analysis.



Results - Yield:

Erratic Emergence. Overall, 44,000 plants per acre produced higher yields than 36,000 plants per acre (Figure 2). Partial delayed emergence at VE and V1 decreased yields by 13% and 12.5%, respectively, compared to the uniform stand of 36,000 plants per acre. At 44,000 plants per acre, yields declined similarly due to delayed emergence, with 11% and 13.5% decreases at VE and V1.

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Uneven Establishment in Corn (cont.)

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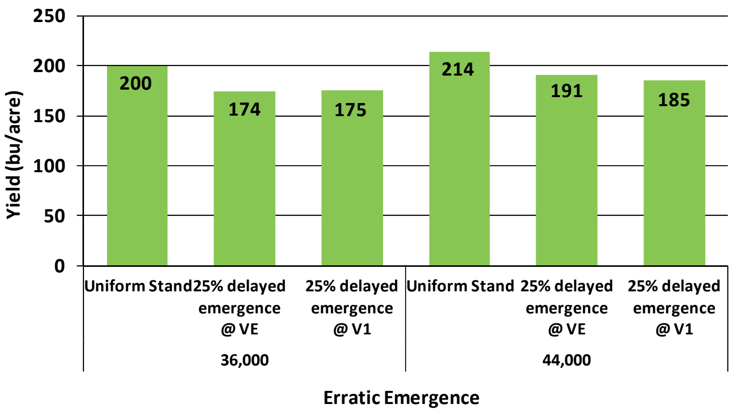

Figure 2. Effect of erratic emergence on corn production. Data Source: 2011 Monmouth Learning Center

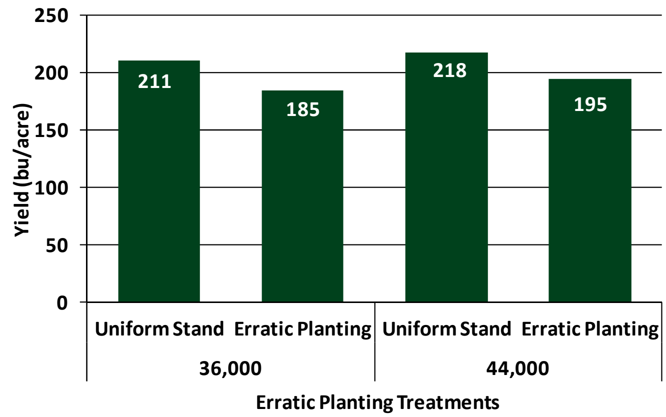

Figure 3. Effect of erratic planting on corn production. Data Source: 2011 Monmouth Learning Center

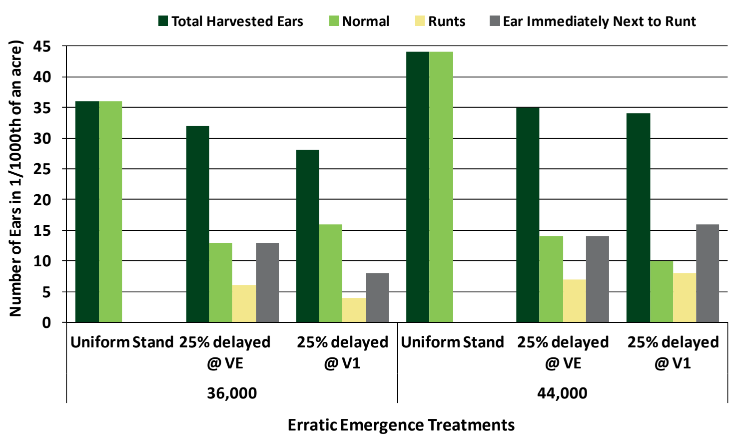

Figure 4. Effect of erratic emergence on corn ear counts. Data Source: 2011 Monmouth Learning Center

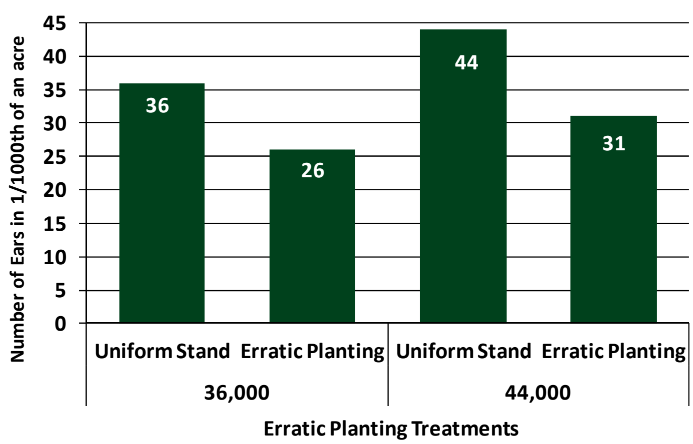

Figure 5. Effect of erratic planting on corn ear counts. Data Source: 2011 Monmouth Learning Center

Erratic Planting. When conventional plants were chemically killed to simulate erratic planting, yields were decreased by 12% and 11% for 36,000 and 44,000 plants per acre, respectively (Figure 3). These demos show how yield decreases were similar regardless of delayed emergence or skips.

Results - Corn Kernel and Ear Counts:

Erratic Emergence. Total harvested ears equates to the number of "normal" ears in the untreated 36,000 and 44,000 plant populations (Figure 4). This is because the baseline for what a normal ear looks like is established from the uniform stands of 36,000 and 44,000. The total harvested ears decreased as emergence was delayed. Harvested ears at 36,000 plants per acre decreased 11% and 22% at VE and V1 delayed emergence, and declined 20% and 23% at VE and V1 with 44,000 plants per acre. Additionally, the number of runts and ears immediately next to runts increased as emergence was delayed. The percentage of runts in the total number of harvested ears ranged from 14 to 24% in the delayed emergence demos. These results illustrate how erratic emergence can impact corn ear counts.

Numerous times runts failed to produce an ear and acted like a weed; therefore, they were not included in either the overall ear count or counted as a runt. On the graphs, this explains the difference between harvested ears on the target populations of 36,000 and 44,000 plants per acre and their treatments.

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Uneven Establishment in Corn (cont.)

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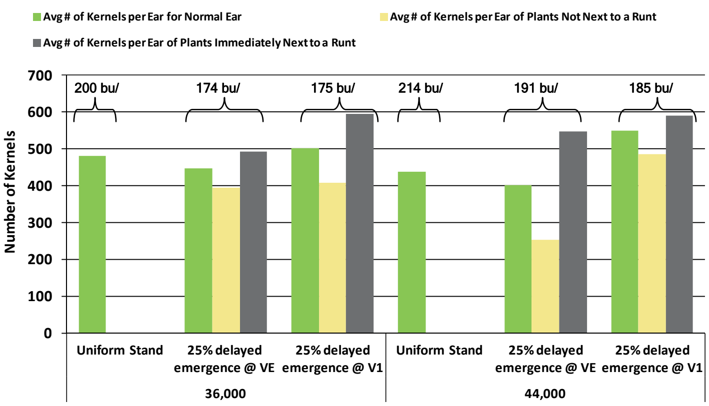

Figure 6. Effect of erratic emergence on corn yield and kernel counts. Data Source: 2011 Monmouth Learning Center

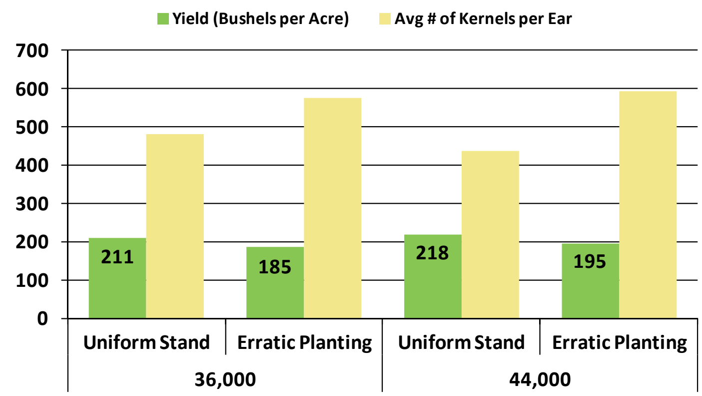

Figure 7. Effect of erratic planting on corn yield and kernel counts. Data Source: 2011 Monmouth Learning Center

Erratic Planting. In the erratic planting demo, poor seed spacing resulted in 28% and 30% fewer ears for 36,000 and 44,000 plants per acre, respectively (Figure 5).

The effect of uneven emergence and planting on kernel counts was also examined. In the uneven emergence trial, there were more kernels per ear for plants immediately next to a runt than for plants not next to a runt (Figure 6). The results from both erratic emergence and erratic planting demos showed there is no relationship between kernel number per ear and an increase in yield in these demos (Figures 6 and 7). The number of kernels per ear did not compensate for a lack of ears per acre, and the importance of uniform stand establishment is supported.

Summary Comments

- Data herein supports the importance of uniform plant spacing and emergence.
  - Uniform stands provided the highest overall yields for both the erratic emergence and erratic planting demonstrations.
- For uneven emergence:
  - Most of the delayed plants resulted in a runt ear which reduced yields by 12-14%.
    - Roughly 15-25% of final ear counts were runts in each treatment.
  - Yields were nearly identical between delayed plants at VE and V1.
    - This finding is similar to Carter et al., 1989 who found 10% yield reductions when 25% of the plants were delayed at planting.
  - Ears immediately next to a runt were larger and had the greatest number of kernels per ear, but ears were not large enough to make up for runt plants and overall yield was reduced.
    - This finding is similar to Nafziger, 1996.
- For erratic planting:
  - Skips in the seedbed reduced yields by the same 12-14% as noted above.
  - Ears next to a skip were larger then a normal ear, but not large enough to make up for missing ears.
  - Together these findings agree with those above and with Carter et al., 1989 and Nafziger, 1996.
- Corn yield depends on the number of ears per acre, number of kernels per ear, and average weight per kernel.
- Numerous sources have described negative yield effects associated with uneven emergence and within row plant spacing variation[1,2,3]
- Uniform emergence and stand establishment can be increased by:
  - Planting into soil with adequate and uniform

Uneven Establishment in Corn (cont.)

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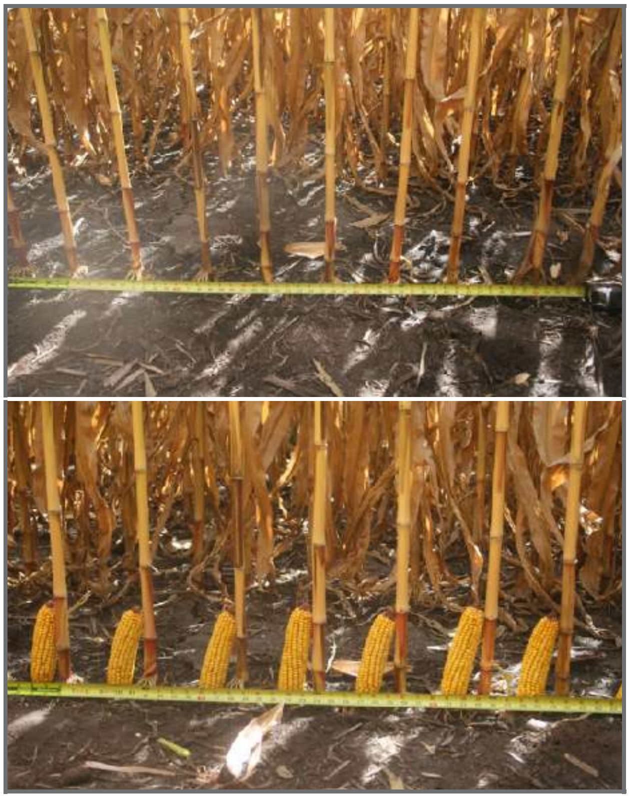

Figure 8. Erratic emergence demo - Uniform Stand. 36,000 plants per acre. 2011 Monmouth Learning Center

Figure 9. Erratic emergence demo - 25% seeds delayed at VE. 36,000 plants per acre. 2011 Monmouth Learning Center

moisture in the seed zone.

- Planting into soils with temperatures greater than 50°F.
- Maintaining good soil to seed contact while planting.
- Clearing the seed furrow of residue.
- Preparing a proper seedbed free of soil clods, compaction, and soil crusting.
- Planting at proper speeds.
- Using products to minimize early season insect damage:
    - Seed treatments
    - Biotechnology traits
    - Insecticides

Sources:

[1]Carter, P.R., E.D. Nafziger, and J.G. Lauer. 1989. Uneven emergence in corn. North Central Regional Extension Pub. No. 344.

[2]Nafziger, E.D. 1996. Effects of missing and two-plant hills on corn grain yield. Journal of Production Agriculture 9:238-240.

[3]Nielsen, R.L. 2001. Stand establishment variability in corn. AGRY-91-01, Department of Agronomy, Purdue Univ., W. Lafayette, IN.

Additional reference used in the development of this publication: Nielsen, R.L. 2010. Requirements for uniform germination and emergence of corn. Corny News Network, Purdue Univ. [On line]. Available at http://www.agry.purdue.edu [URL accessed November 2011].

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Benefits of Early Planted Soybeans

Historically, soybean planting dates have been delayed relative to corn and were considered non-critical in regards to yield. However, research has shown that early planting can be critical to producing high soybean yields. With soybean commodity prices increasing, planting dates need to be evaluated as a factor to help increase potential yield and profitability.

Study Guidelines

A demonstration with four replications was conducted in 2011 at the Monsanto Learning Center in Monmouth, IL to evaluate the effects of planting date on soybean yield. Genuity® Roundup Ready 2 Yield® soybean varieties, with relative maturities (RM) of 2.8 and 3.4, were both planted early on May 2, 2011 and three weeks later on May 23, 2011. Soybeans were planted in 15 inch rows at a population of 130,000 seeds per acre. Plots were 500 square feet in size. The field plot was conventionally tilled (chisel plow in the fall and soil finisher in the spring) and has been in a corn and soybean rotation system. The herbicide program consisted of a preemergence treatment of Valor® XLT at 3 ounces per acre (oz/A) followed by a postemergence treatment of Roundup PowerMAX® at 22 oz/A. Soybeans were harvested on October 10, 2011.

Results and Conclusions

The 2.8 and 3.4 RM soybean varieties yielded 14.4 and 8.2 bushels per acre (bu/acre) more, respectively, when planted earlier (Figure 1). The average increase in yield between the early and late planting date was 11.2 bu/acre when averaged across both varieties. The 2.8 RM variety demonstrated more yield loss from the later planting than the 3.4 RM variety. The results clearly show that higher yields can be obtained from an earlier planting in this situation.

University of Illinois multi-year testing at Dekalb (northern IL) and Monmouth (west central IL) showed an incremental yield loss for soybean planting dates beyond May 1.[1] Multi-year testing conducted at the University of Wisconsin showed soybean seed number and pod number to be greater with early May (3-6) vs. late May (23-27) planting

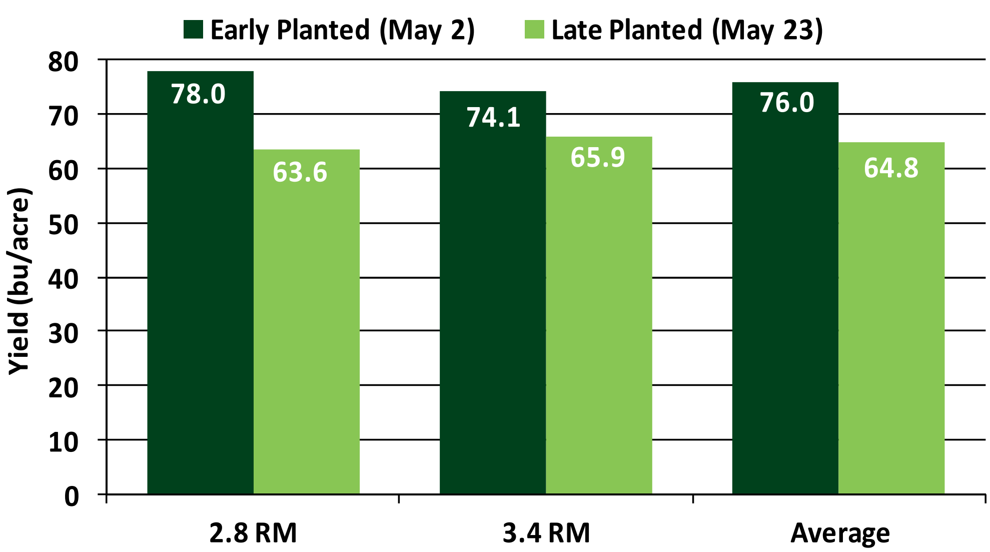

Figure 1. Effect of planting date on the yield of 2.8 and 3.4 relative maturity (RM) Genuity® Roundup Ready 2 Yield® soybean varieties – 2011 Monmouth Learning Center.

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Benefits of Early Planted Soybeans (cont.)

Continued from page 20

dates. Early planting provides the potential for producing a larger crop canopy earlier in the growing season, which can better utilize solar radiation for photosynthesis and available soil moisture during the growing season. Soybeans can be more able to establish a good root system before potentially harsher conditions of summer. Weed competition can be reduced with earlier establishment of a full soybean canopy before later emerging weeds become a problem. The extended vegetative growth of soybeans from early planting can lead to more nodes on the main stem increasing the potential for more pods per plant. Early planting can lead to earlier flowering of soybeans and a longer period of reproductive growth for more seed fill.[2] An additional benefit of early planting would include a longer planting window for maximizing soybean yields.[3]

When good soil and seedbed conditions exist, planting soybeans early can lead to increased yields. This can be especially true on the more productive soils and higher yielding environments.

References:

[1]*Agronomic Spotlight. 2011. Benefits of early planting in soybeans - IL. Monsanto Technology Development.*

[2]*Bastidas, A.M. et al. 2008. Soybean sowing date: The vegetative, reproductive, and agronomic impacts. Crop Science 48: 727-739.*

[3]*Staton, M. 2011. Planting soybeans early offers many benefits. Michigan State University extension crop advisory team alerts, March 18, 2011 13:48. http://ipmnews.msu.edu (verified 11/11/2011).*

The information discussed in this report is from a single site, one-year 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.

Foliar Feeding Strategies for Soybean Production

The benefits of foliar feeding in soybean production are unclear. Theoretically, foliar nutrient application is more effective than soil applications because nutrients can be immediately available to the plant. However, some researchers have suggested that foliar feeding only increases yield potential if an existing nutrient deficiency, such as boron or manganese, is present. Consultants and growers have reported yield increases ranging from 3-9 bu/acre due to foliar nutrient applications[1].

Study Guidelines

Three demonstration trials were conducted at the Monsanto Learning Center at Monmouth, IL in 2011 to evaluate various foliar feeding strategies on soybean production.

Foliar products differed between experiments and each was summarized separately. Genuity® Roundup Ready 2 Yield® soybeans (relative maturity 3.1) were planted on May 18, 2011 and harvested on October 8, 2011 with two replications for each experiment. All experiments received the same weed control program which consisted of a pre-emergence application of Valor® XLT at a rate of 3 oz/acre and a post-emergence application of Roundup WeatherMAX® herbicide at a rate of 22 oz/acre.

Demonstration Trial #1

In Trial # 1 the previous crop was corn. Conventional tillage, consisting of fall chisel plowing and one pass with a soil finisher in the spring, was used on all plots. The inputs included liquid controlled-release nitrogen (LCRN) at 8 qt/acre and granulated sugar at 2 lb/acre. The treatments were based on the two inputs and the plant growth stage at the time of application (Table 1; Figure 1).

Table 1. The ten treatments used in demonstration trial # 1.

Treatment	Input	Growth Stage of Application
1	Untreated Check	-
2	LCRN	V6
3	Sugar	V6
4	LCRN + Sugar	V6
5	LCRN	R1
6	Sugar	R1
7	LCRN + Sugar	R1
8	LCRN	V6 and R1
9	Sugar	V6 and R1
10	LCRN + Sugar	V6 and R1

LCRN = liquid controlled-release nitrogen **Sugar** = granulated sugar

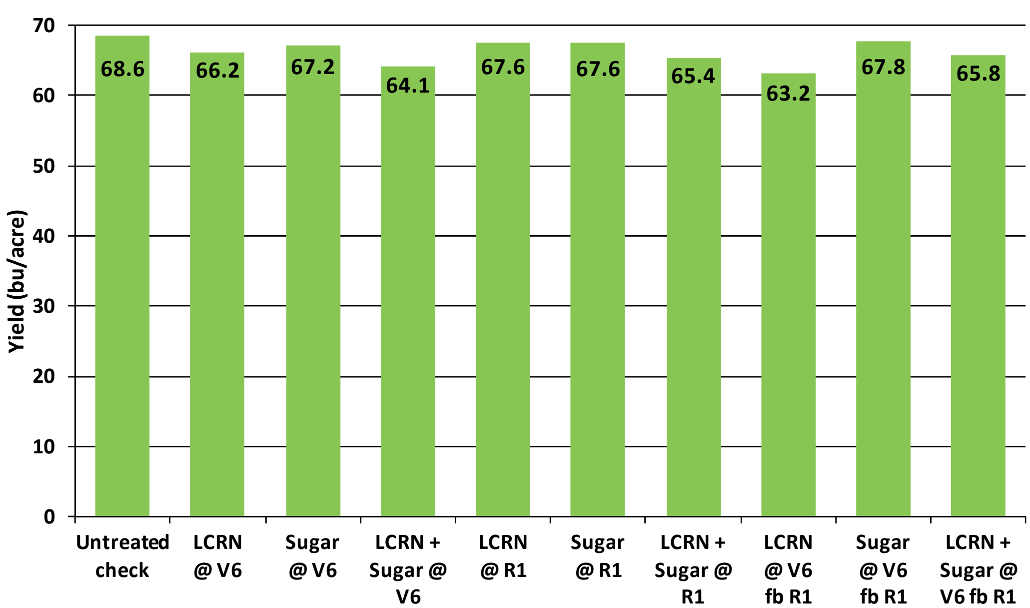

Figure 1. Soybean yield of different foliar treatments in trial # 1.

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Foliar Feeding Strategies for Soybean Production (cont.)

Continued from page 22

Demonstration Trial #2

In Trial # 2 the previous crop was corn. Conventional tillage, consisting of fall chisel plowing and one pass with a soil finisher in the spring, was used on all plots. Inputs included a strobilurin foliar fungicide at 0.3 qt/acre, stress inhibitor (ethylene) at 0.5 qt/acre, foliar feed 1 at 1.0 qt/acre, and foliar feed 2 at 2.0 qt/acre. Treatments were based on input and plant growth stage at the time of application (Table 2; Figure 2).

Demonstration Trial #3

Trial # 3 was conducted in a continuous no-tillage regime and data was pooled across all crop rotation systems (corn-soybean and continuous soybean systems). Inputs included a strobilurin foliar fungicide at 0.3 qt/acre, stress inhibitor (ethylene) at 0.5 qt/acre, foliar feed 1 at 1.0 qt/acre, and foliar feed 2 at 2.0 qt/acre. The treatments were based on input and plant growth stage at the time of application (Table 3; Figure 3).

Results and Conclusions

Table 2. The eight treatments used in demonstration trial # 2.

Treatment	Input	Growth Stage of Application
1	Untreated Check	-
2	Fungicide	R3
3	Stress Inhibitor	V6
4	Stress Inhibitor	R4
5	Fungicide + Stress Inhibitor	R4
6	Foliar Feed 1	V6
7	Foliar Feed 2	V6
8	Foliar Feed 2 + Stress Inhibitor	V6

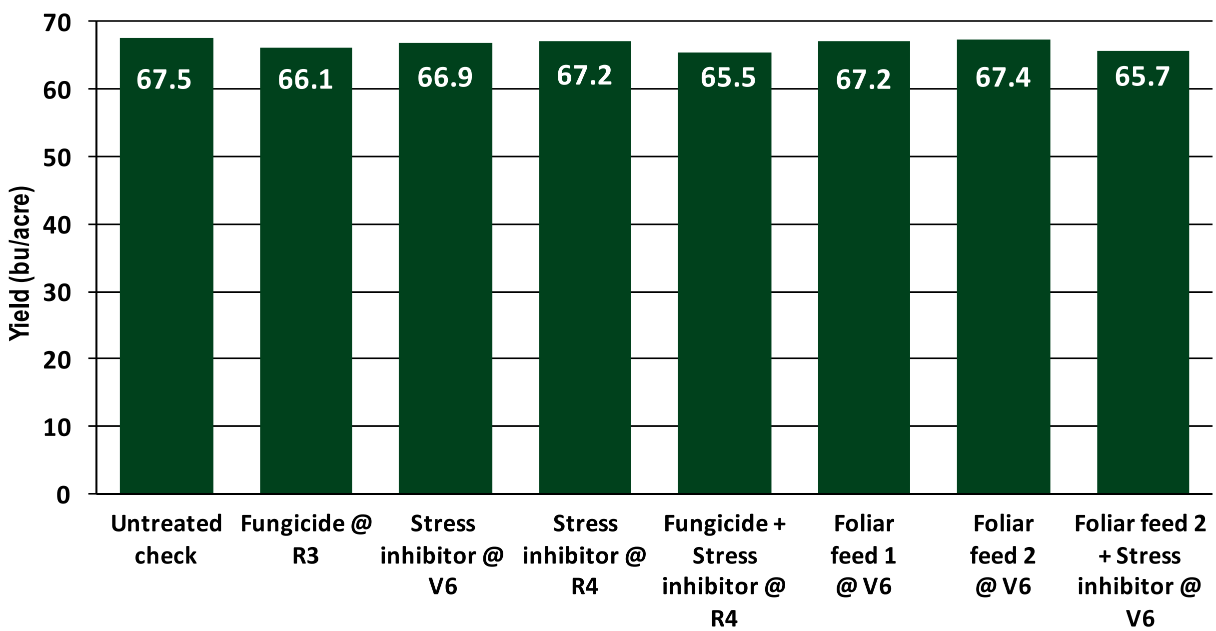

Figure 2. Soybean yield of different foliar treatments in trial # 2.

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Foliar Feeding Strategies for Soybean Production (cont.)

Continued from page 23

These three trials investigated the effect of different foliar feeding strategies on yield potential in soybean. In these particular studies, none of the investigated foliar feedings had an effect on yield compared to the untreated check. These results are consistent with past data collected at the Monmouth Learning Center. This trend is likely due to the highly fertile and productive soils at this location. These results may not translate to other soils and growing situations. Please check with your local agronomist to find research results applicable to your specific area and soil conditions.

Sources:

[1]*D. Eilers. April 1, 2004. Foliar Feeding. Corn and Soybean Digest.*

Cooperative Extension System. November 3, 2008. Does foliar feeding pay for soybeans? Available on-line: www.extension.org. Verified: 11/04/11.

Table 3. The five treatments used in demonstration trial # 3.

Treatment	Input	Growth Stage of Application
1	Untreated Check	-
2	Fungicide	R3
3	Stress Inhibitor	R4
4	Foliar Feed 1	V6
5	Foliar Feed 2	V6

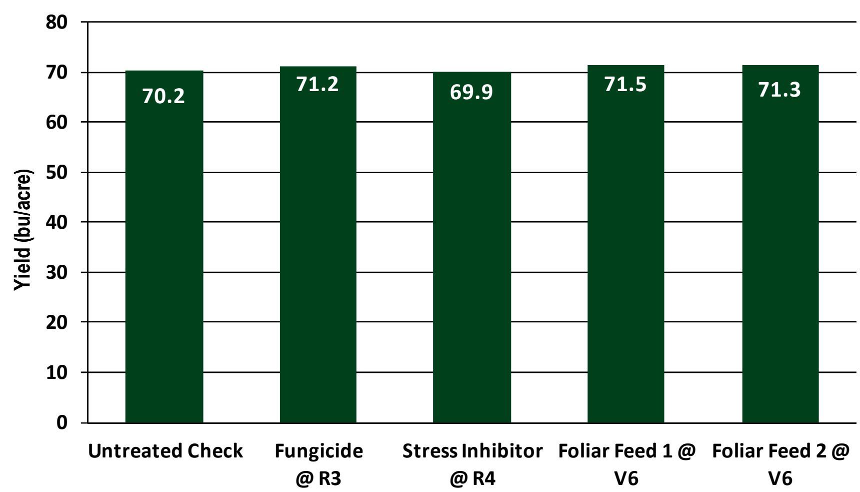

Figure 3. Soybean yield of different foliar treatments in trial # 3.

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Use of Residual Herbicides in a Genuity® Roundup Ready 2 Yield® Soybean System

Residual herbicides in the Genuity® Roundup Ready 2 Yield® soybean system can offer multiple benefits including reducing the risk for herbicide resistance, managing resistant weeds, and protecting yield potential. This demonstration was designed to evaluate the effect of residual herbicides, applied preemergence (PRE) and/or postemergence (POST), on soybean yield.

Study Guidelines

A demonstration trial was conducted at the Monmouth Learning Center to assess soybean yield response to the use of residual herbicides in the Genuity® Roundup Ready 2 Yield® Soybean system. The plot was chisel plowed in the fall of 2010 and a soil finisher was used in the spring of 2011 to prepare the seed bed for planting, thus removing the need for burndown herbicide treatments. A 3.1 relative maturity Genuity® Roundup Ready 2 Yield® soybean was planted on May 10, 2011. Two replications of these treatments were established.

Treatments were:

1. A single postemergence (POST) application of Roundup WeatherMAX® herbicide (22 oz/acre) on 4 to 6 inch weeds.
2. A preemergence (PRE) application of Valor® XLT (3 oz./acre) followed by (fb) a POST application of Roundup WeatherMAX®.
3. A preemergence (PRE) application of Valor® XLT (3 oz./acre) followed by (fb) a POST application of Roundup WeatherMAX® (22 oz/acre) + Warrant® Herbicide (1.5 qt/acre).

Results

A residual herbicide PRE controlled many weeds, but due to extremely heavy weed pressure, there was still considerable weed pressure at the POST application timing (Figure 1). A POST application of Roundup WeatherMAX® and Warrant® Herbicide following a PRE application of Valor® XLT resulted in excellent weed control (Figure 2).

A residual herbicide PRE resulted in a 4.7 bu/acre yield advantage over the treatment with no residual PRE (Figure 3). The use of a residual POST resulted in an additional 8 bu/acre (Figure 3). The use of

Figure 1. Weed control in a plot that received Valor® XLT (3 oz/acre) PRE.

Figure 2. Weed control in a plot that received Valor® XLT (3 oz/acre) PRE followed by Roundup WeatherMAX® (22 oz/acre) + Warrant® Herbicide (1.5 qt/acre).

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Use of Residual Herbicides in a Genuity® Roundup Ready 2 Yield® Soybean System (cont.)

Continued from page 25

residual herbicides both PRE and POST resulted in an additional 12.7 bu/acre over the PRE only treatment (Figure 3).

Summary

The addition of residual herbicides in the Genuity® Roundup Ready 2 Yield® soybean system improved yield in this demonstration. Additionally, residual herbicides can help reduce the selection pressure for glyphosate-resistance. Using residual herbicides and multiple modes of action are two tools to help minimize the risk for weed resistance and help protect the sustainability of the Roundup Ready® system.

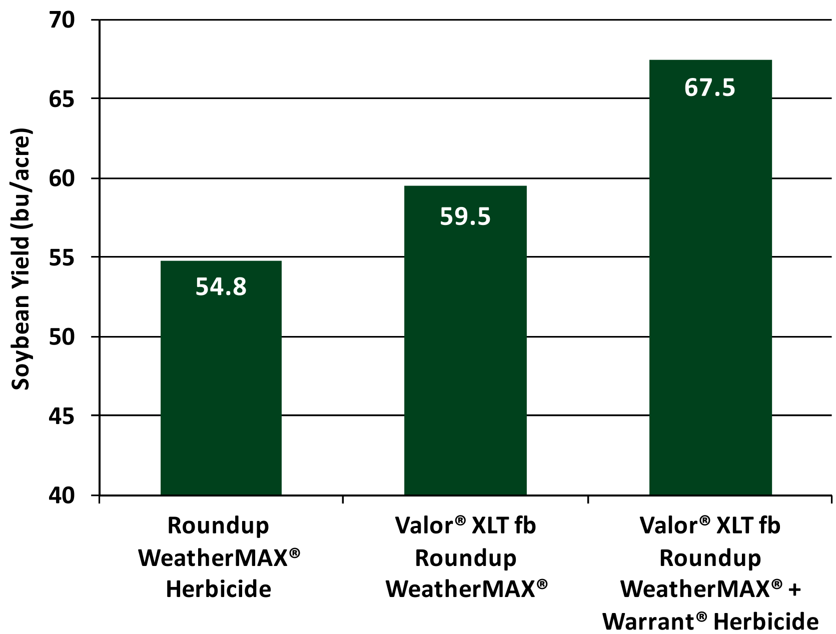

Figure 3. Effect of residual herbicides applied PRE and/or POST on soybean yields.

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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. Harness® and Warrant® Herbicide are not registered in all states. Harness® and Warrant® Herbicide may be subject to use restrictions in some states. The distribution, sale, or use of an unregistered pesticide is a violation of federal and/or state law and is strictly prohibited. Check with your local Monsanto dealer or representative for the product registration status in your state. Genuity and Design®, Genuity Icons, Genuity®, Harness®, Roundup PowerMAX®, Roundup Ready 2 Technology and Design®, Roundup Ready 2 Yield®, Roundup Ready®, Roundup Technology®, Roundup WeatherMAX®, Roundup®, SmartStax®, Technology Development by Monsanto and Design®, VT Double PRO®, VT Triple PRO®, and Warrant® are trademarks of Monsanto Technology LLC. Ignite® and LibertyLink® and the Water Droplet Design® are registered trademarks of Bayer. Herculex® is a registered trademark of Dow AgroSciences LLC. Headline® is a registered trademark of BASF Corporation. Valor® is a registered trademark of Valent U.S.A. Corporation. 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.