Technology Development by MONSANTO℠

# 2010 Demonstration REPORTS

# The Learning Center

at Monmouth, Illinois

# Dear Reader

Our mission at the Learning Center is to provide valuable agronomic and technical information that will help keep you on the forefront of yield, efficiency, and profitability. To enhance your experience at the Learning Center, we plan to continue showcasing new technologies in our product pipeline and provide summaries of important research conducted onsite. With this in mind, summarized here are the results from several trials we conducted at the Learning Center in 2010. I hope you find the information contained in these summaries to be valuable to your farming operation, and I look forward to hosting you at the Learning Center again in 2011!

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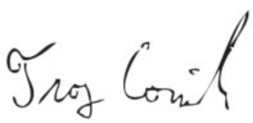
Sincerely,



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Monsanto Learning Center – Monmouth, IL

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## 2010 Demonstration Reports

# Impact of Residue Removal in Continuous Corn

Corn residue in continuous corn should be managed to avoid potential problems during the growing season. Excessive residue at planting can interfere with good seed to soil contact, leading to poor emergence and vigor. In addition, corn diseases can overwinter in corn residue. Finally, if most of the residue decomposition is occurring during the growing season, the nitrogen (N) required for decomposition can limit the N available for corn growth.

## Study Guidelines

A long term demonstration trial has been conducted at the Monsanto Learning Center near Monmouth, IL to assess the effects of removing crop residue from a continuous corn system. The third year of yield data was collected in 2010. Four different percentages of residue are removed annually from the trial; 0% removal, 50% removal, 75% removal, and 100% removal (Figure 1). Stalk residue was shredded and baled in the fall to remove the different percentages of residue. Conventional tillage was used in-season. A chisel plow and a soil finisher were run in the fall and spring, respectively. Soil samples were analyzed to quantify phosphorus (P), potassium (K), soil pH, and percent organic matter in 2008 and 2010. These soil parameters will be monitored throughout the span of this long term trial.

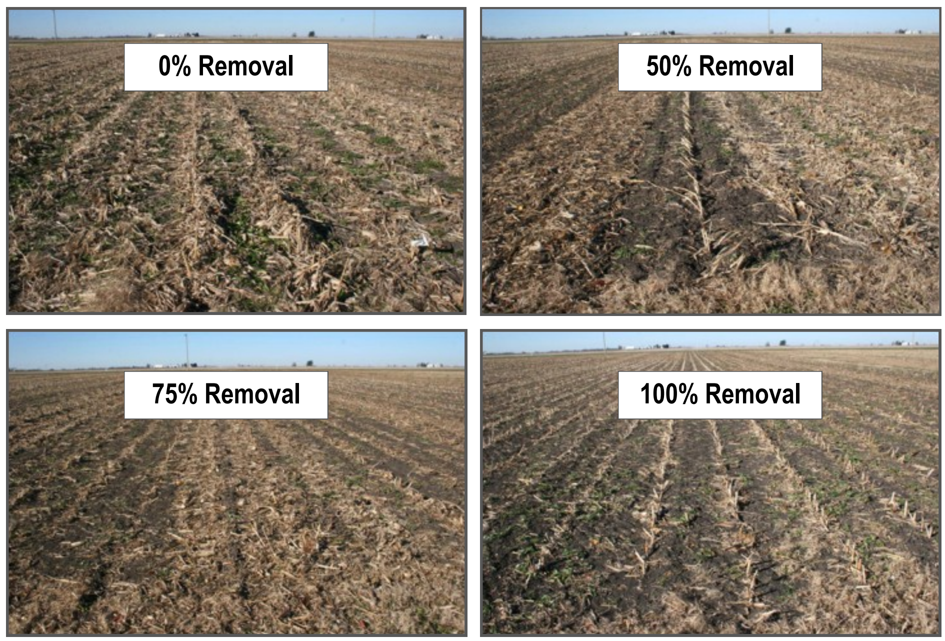


**Figure 1.** Percentage of residue removed for each treatment at the Monsanto Learning Center near Monmouth, IL in 2010.

## Results

In 2008 corn yields were similar across each of the corn residue removal rates (Figure 2). In 2009 corn yields were also similar across the different corn residue removal rates, even though the yields were consistently lower in 2009 compared to 2008.

In 2010, major differences in corn yields were observed across the different crop residue rates. The plots with 100% of the residue removed had the highest yields. Corn yields decreased as the amount of residue left in the field increased. As a result the lowest corn yields were found in the plot where 0% residue had been removed.

Soil test results from 2010 showed no discernible differences between treatments when compared to 2008 test results. With the exception of April, the spring of 2010 was extremely wet and colder than normal. Twenty-six inches of rain fell from April 28th to June 28th. The excess water led to severe N deficiency (Figure 3). The combination of cold and wet conditions in 2010 likely resulted in little to no decomposition of the previous year's residue until temperatures warmed up in July. The onset of warmer temperatures likely resulted in rapid decomposition of remaining residue, which may have limited the amount of N available to the crop even further during key developmental growth stages.

When microbes break down residues that are high in carbon (C), such as corn, they can compete with growing corn for available N in order to maintain their ideal C/N ratio of 10:1. This immobilization of available N can result in N deficiency symptoms until the majority of the decomposition is complete and microbes die and release the N back into the soil in the process termed mineralization.

In conclusion, the 2008 and 2009 trials showed little differences in yield across the four different rates of corn residue removal. In 2010 a major difference in yield was observed, most likely due to weather conditions that occurred during the season. The 2010 yield results mirror the lower than average yields seen in 2010 on much of the continuous corn in Northern Illinois.

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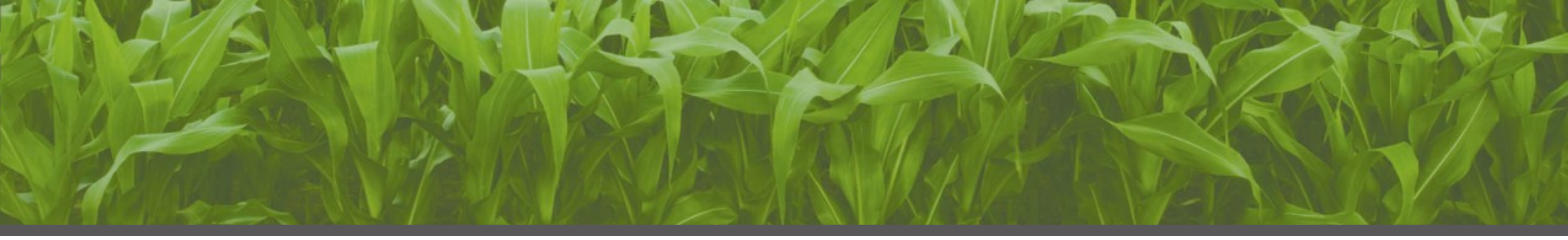
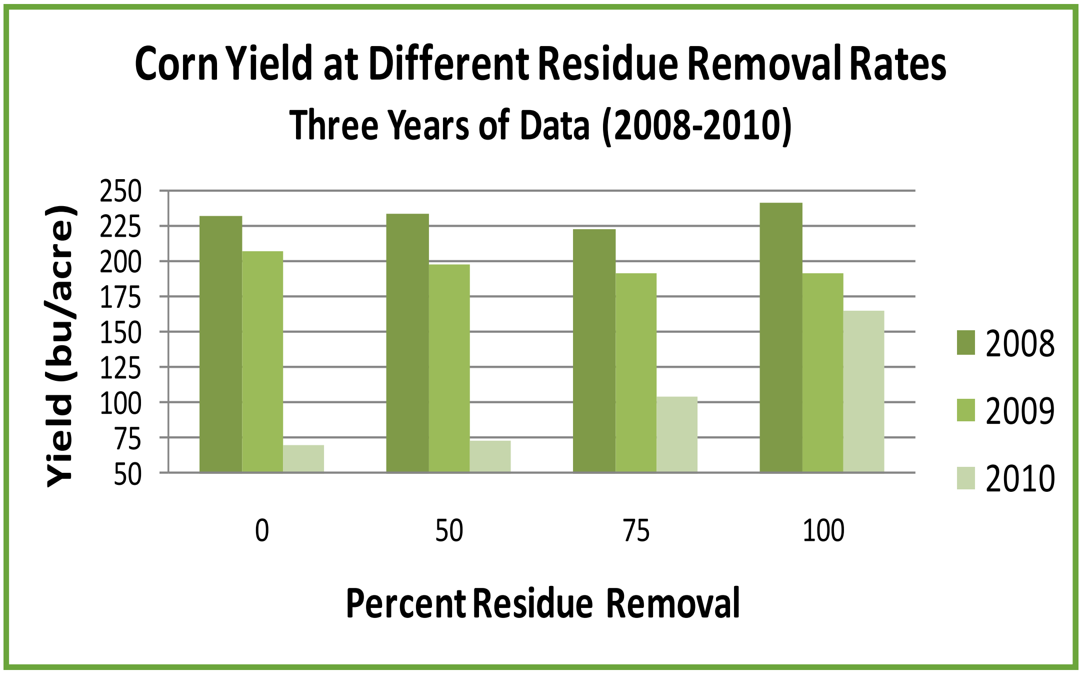


# Impact of Residue Removal in Continuous Corn *(cont.)*




◄ **Figure 2.** Corn yield at 0%, 50%, 75%, and 100% residue removed at the Monsanto Learning Center near Monmouth, IL in 2008, 2009, and 2010.

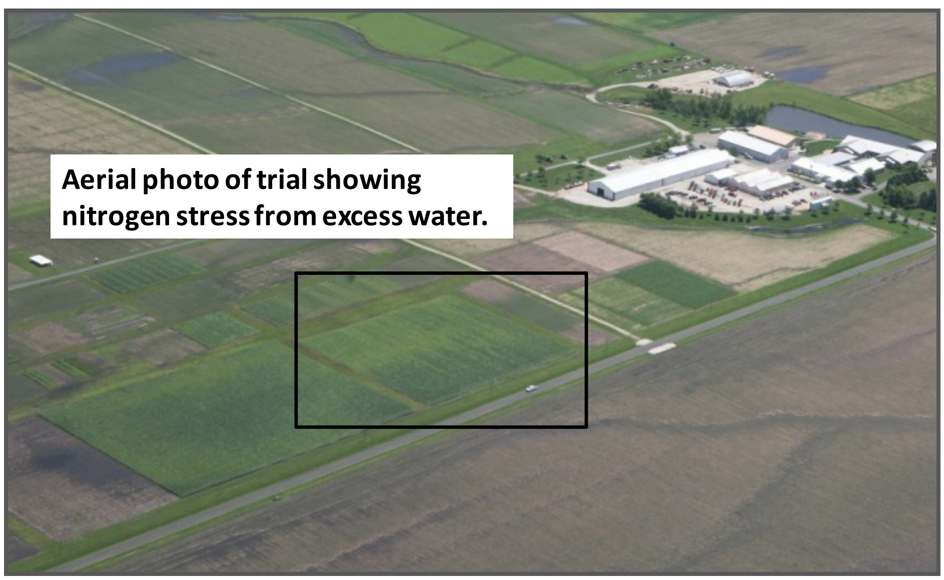



**Figure 3.** ► The light green color outlined by the black rectangle shows where excess water caused nitrogen stress at the Monsanto Learning Center near Monmouth, IL in 2010.

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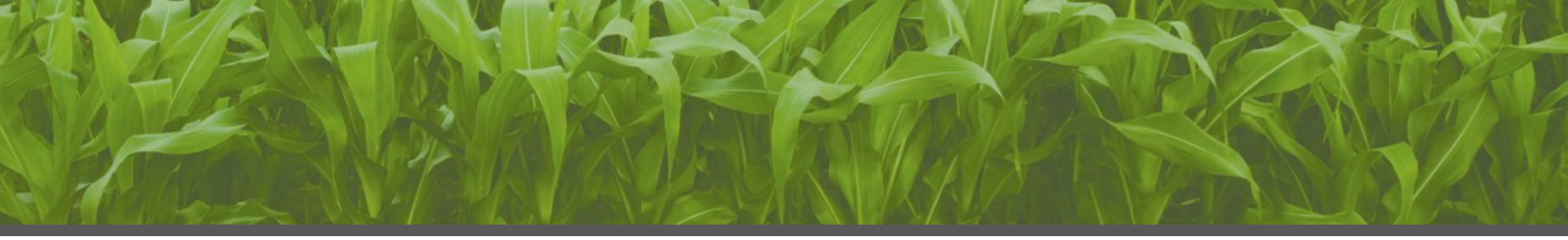

# Effect of Planting Date and Corn Rootworm Protection on Corn Yield

Advancements in corn hybrid genetics, weed control practices and corn trait technology are allowing producers additional flexibility in their planting date while still maintaining optimal yields. As production practices evolve, it is important to understand how insect protection technologies can effect the optimal planting date. Seed treatments or soil applied insecticides can help protect corn plants from insect pests for several weeks, but will lose efficacy with time. As the efficacy of an insecticide decreases over time, early planted corn may have less protection from soil insect pests, such as rootworms. These insects may cause more damage to early planted corn roots in May or early June when soils warm up. Corn rootworm feeding pressure typically decreases on late planted or replanted corn; however, late planting can also reduce yield potential. Comparing early versus late corn planting scenarios using hybrids with and without rootworm protection can help producers with their planting and insect management decisions.

## Study Guidelines

Testing was conducted at the Monsanto Learning Center near Monmouth, IL in 2010 to evaluate the impact of different rootworm protection technologies in combination with planting dates on corn yield potential. Germplasm families of two different relative maturity (RM) groups (107 and 111RM) were selected for this trial. Each germplasm family consisted of 3 different products that individually contained Genuity® SmartStax® (GENSS) which provides two modes action for rootworm protection, Yieldgard VT Triple® (VT3) offering one mode of action for rootworm protection, and one product Roundup Ready® Corn 2 with a soil applied insecticide (RR2+SI). Force® 3G insecticide was applied to the Roundup Ready® Corn 2 product at planting. Corn was planted on April 12 and May 25. The trial was conducted in a field that has been in continuous corn for five years using a conventional tillage system.

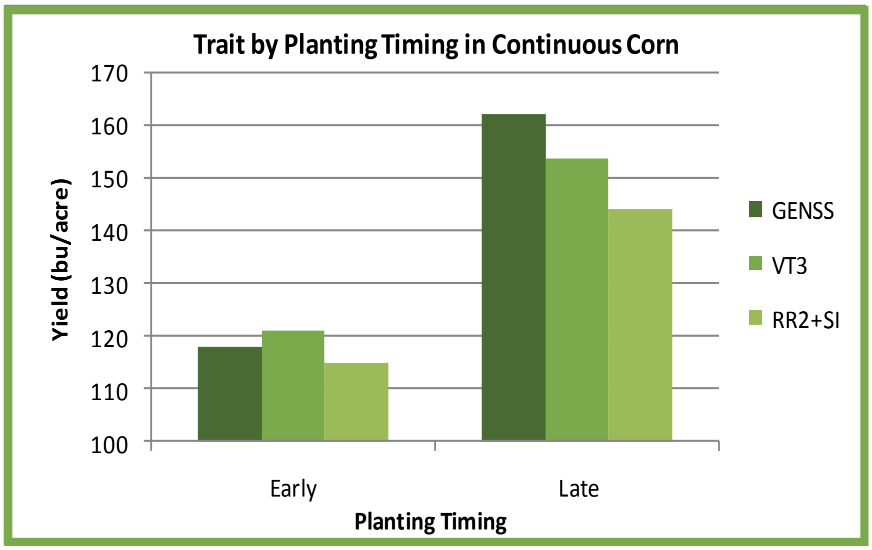


**Figure 1.** Effect of corn insect protection technologies and planting date on yield.

## Results and Discussion

Cool early-season temperatures coupled with above average rainfall (24"+ from May 1-June 23) may have lead to lower yields and greater variability for the early planted (April) corn compared to the later planted (May) corn (Figure 1). Rootworm pressure was below average at the Monsanto Learning Center near Monmouth this year. Wet conditions early in the season may have decreased rootworm pressure as well as the value of the soil applied insecticide.

The data shows increased yields for products with advanced corn rootworm protection (Genuity® SmartStax® and Yieldgard VT Triple®) in the late planted corn, as well as, the average of the two planting dates (Figure 2). In the late planted scenario, when averaging the 107 and 111 RM corn products, the Genuity® SmartStax® corn products increased corn yield by 8.5 bu/acre when compared to the Yieldgard VT Triple®, and 18 bu/acre when compared to the Roundup Ready® Corn 2 with soil applied insecticide, respectively (Figure 1). Averaging both the early and late corn plantings, Genuity® SmartStax® corn products increased corn yield by 2.7 bu/acre compared to Yieldgard VT Triple®, and 10.5 bu/acre when compared to the Roundup Ready® Corn 2 with soil applied insecticide. The trial data shows that increased corn yields were obtained with increased insect protection when averaging planting dates and taking into account sporadic early season environmental conditions

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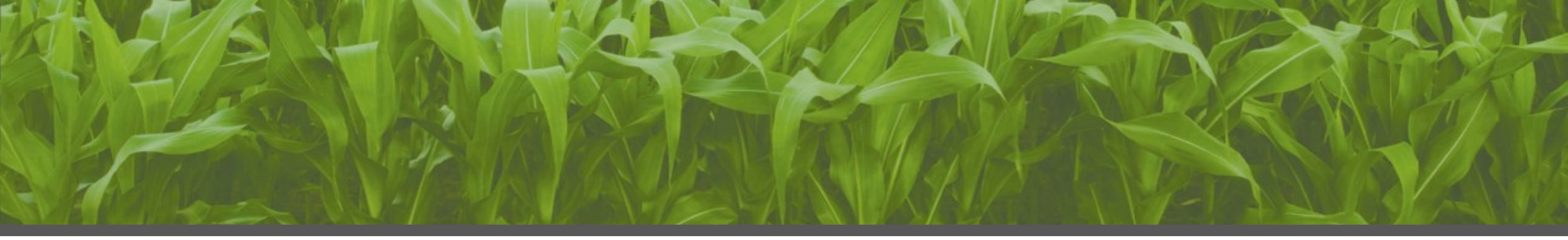

# Effect of Planting Date and Corn Rootworm Protection on Corn Yield *(cont.)*

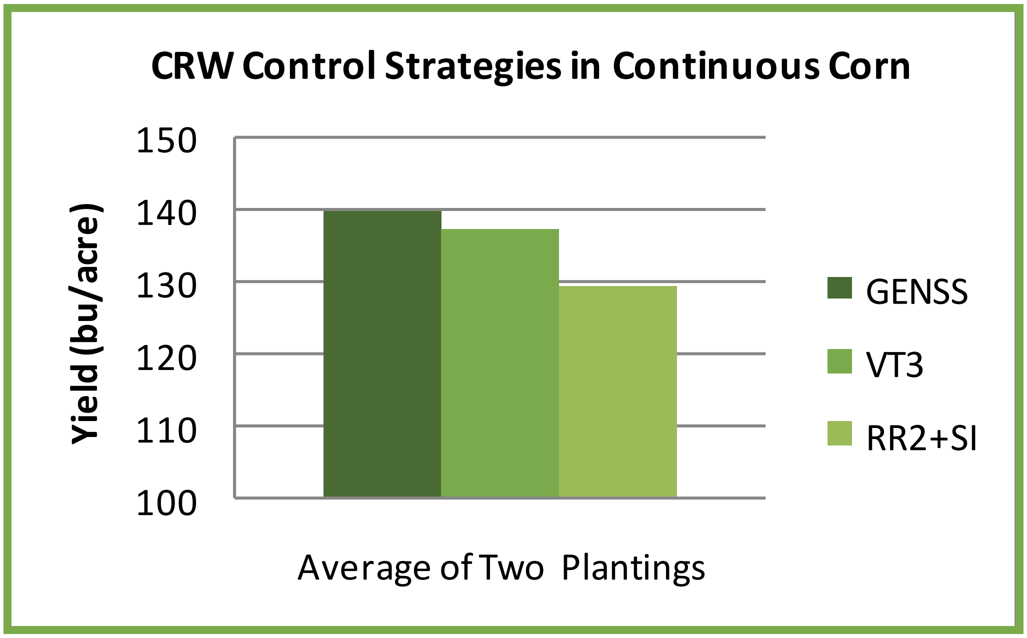


**Figure 2.** Effect of corn insect protection technologies on yield when averaged across early and late planting dates in 2010.

The 2010 growing season did not represent normal environmental conditions for Illinois as early planted corn will typically yield greater than late planted corn. The results from the 2010 data suggests that corn containing traits with rootworm protection can provide enhanced protection from rootworms and other insect damage in continuous corn and high rootworm pressure situations. While the objective of this trial was to focus on rootworm technologies it is also important to note that Genuity® SmartStax® also provides protection from corn earworm, and some of the yield increase observed in these data may be due to additional protection from this important corn pest.

***Source:***

*Bledsoe, L. W. and J. L. Obermeyer. 2010. Managing corn rootworms. Purdue Extension. E-49-W http://www.purdue.edu (verified 10/20/10).*

*Cummins, G. and D. Rueber. 2007. Influence of date of planting on corn hybrids with/without Bt corn rootworm protection. Iowa State University. ISRF08-22. www.iastate.edu (verified 10/19/10).*

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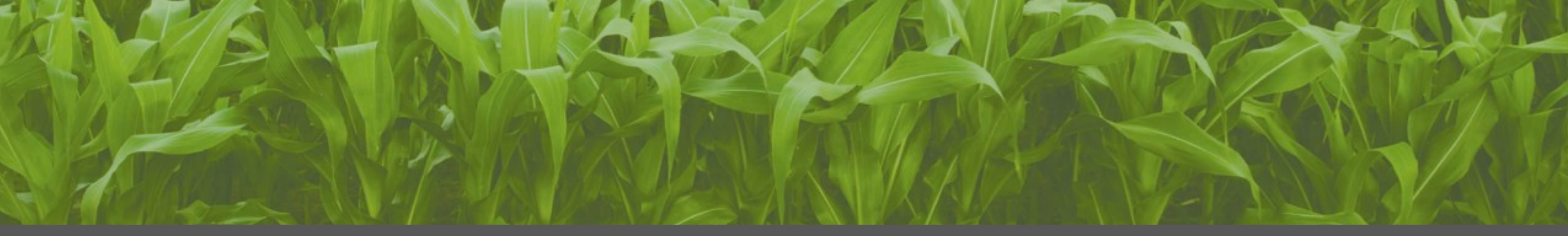

# Nitrogen Rate and Timing of Application in Corn

One of the most costly and important inputs in corn production is nitrogen fertilizer. Research was conducted at the Monmouth Learning Center to evaluate the yield response of corn to application timing and nitrogen use rates.

## Study Guidelines

Data was collected in 2008, 2009, and 2010 from non-replicated trials at the Monsanto Learning Center near Monmouth, Illinois to evaluate the effect of nitrogen rate and timing of application in corn. The same four hybrids were used in 2008 and 2009. New hybrids were used in 2010. Nitrogen rates were established using the Illinois Agronomy Handbook recommendations.

Weed control for the trial consisted of 2 qt/Acre Harness® Xtra preemergence followed by 22 oz/Acre Roundup PowerMAX® when weeds were 4 inches tall or less. The preplant nitrogen was applied with a ground application rig and incorporated. Side-dress nitrogen was applied with a hand boom at the V6 growth stage. All nitrogen was applied as 32% urea ammonium-nitrate (UAN) solution. In 2008, the crop rotation was corn following soybean and in 2009 and 2010 corn followed corn.

An extremely wet spring and summer led to nitrogen leaching and lower yields in 2010. 2009 was also an extremely wet year. High organic matter soils with excellent nitrogen mineralization make it difficult in some years to control the availability of nitrogen to the plant.

**Five Rate of Nitrogen Used**

| | | |
|---|---|---|
| **Rate 1** | **Full rate preplant** | |
| | 2008 | 200 lbs N/Acre |
| | 2009-2010 | 240 lbs N/Acre |
| **Rate 2** | **Half rate preplant** | |
| | 2008 | 100 lbs N/Acre |
| | 2009-2010 | 120 lbs N/Acre |
| **Rate 3** | **Half rate Preplant followed by side-dress** | |
| | 2008 | 50 lbs N/Acre followed by 50 lbs N/Acre at V6 stage |
| | 2009-2010 | 60 lbs N/Acre followed by 60 lbs N/Acre at V6 stage |
| **Rate 4** | **Full rate Preplant followed by side-dress** | |
| | 2008 | 167 lbs N/Acre followed by 33 lbs N/Acre at V6 stage |
| | 2009-2010 | 180 lbs N/Acre followed by 60 lbs N/Acre at V6 stage |
| **Rate 5** | **Untreated Check** | |
| | 2008 | 0 lbs N/Acre |
| | 2009-2010 | 0 lbs N/Acre |

## Results and Conclusions

Overall response to the timing of nitrogen application in 2008 and 2009 was limited. Yields from 2009 showed a slight positive response to the split application of nitrogen. Yields from 2010 showed a greater response to nitrogen rate and timing compared to results from 2008 and 2009.

Splitting nitrogen applications can have significant benefits if environmental conditions lead to poor nitrogen availability later in the growing season. Soil type and rainfall can have a major effect on the availability of nitrogen at key periods during the growing season. High organic matter soils are able to mineralize large amounts of nitrogen quickly and make it available to the plant if needed. However, this process is not sustainable over time.

Later maturing hybrids showed a more positive response to split applications of nitrogen compared to the earlier hybrids in 2008 and 2009. However, in 2010, the earlier hybrids showed a better response. This was likely due to differences in genetics and their response to the overall variability in the growing seasons.

Figure 1 shows a summary of all five treatment rates averaged over four hybrids for three years.

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# Nitrogen Rate and Timing of Application in Corn *(cont.)*

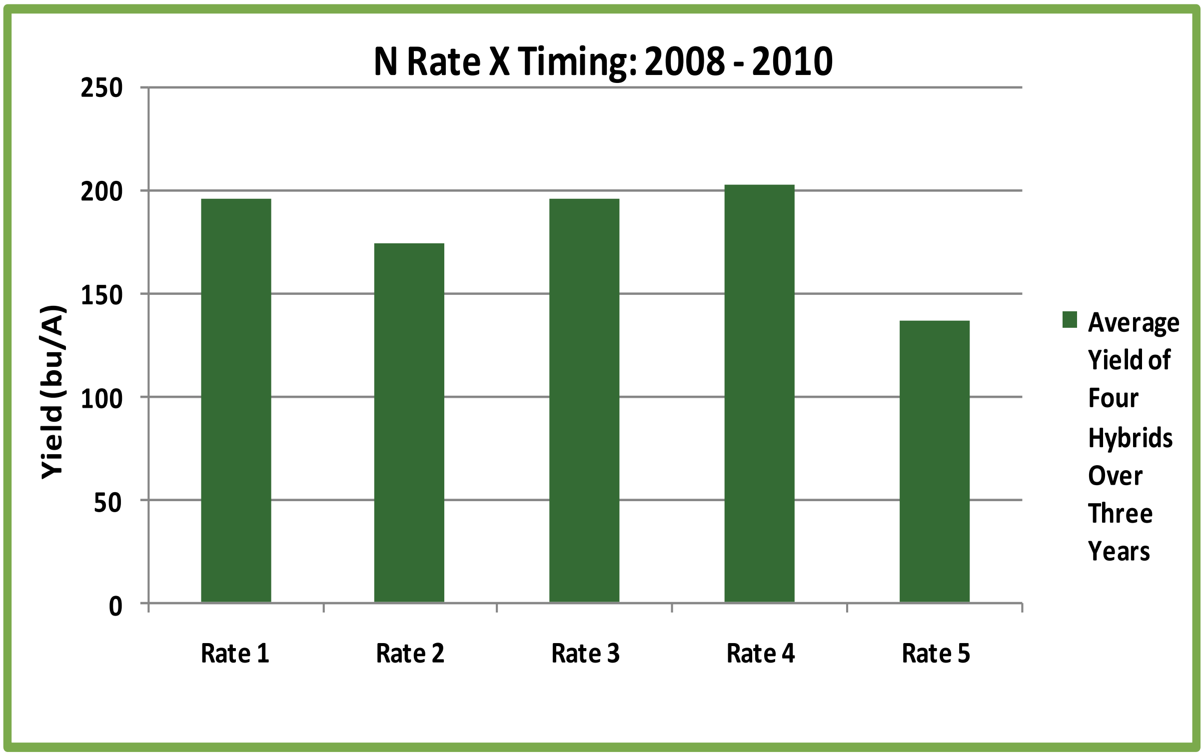


**Figure 1. Average corn yields across nitrogen rates and application timing.**

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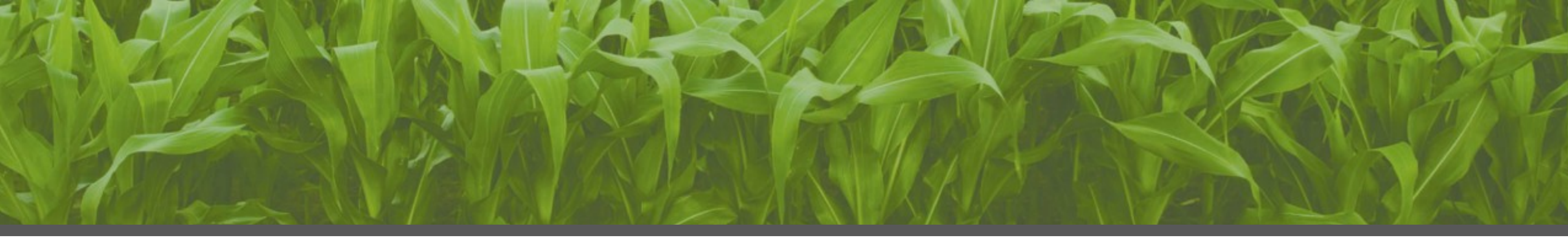


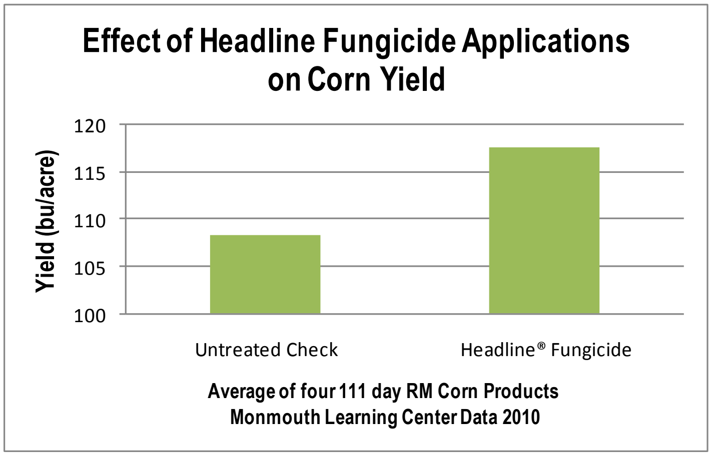
# Stress Mitigation from use of Fungicide and Corn Rootworm Traits in Corn

Corn plants face multiple stresses throughout the growing season which can reduce yield potential. Taking preventative steps to mitigate, or lessen, stress can help maintain or increase yield potential. A research study was conducted at the Monmouth Learning Center to evaluate the use of foliar fungicide and corn rootworm traits as a means to mitigate stress caused by foliar diseases and corn rootworm feeding in corn.

## Study Guidelines

A demonstration trial was conducted at the Monsanto Learning Center near Monmouth, IL to assess corn yield response to Headline fungicide. As another form of stress mitigation, corn yield response to corn rootworm protection with and without Headline fungicide treatment was also evaluated.

Four corn products with 111 day RM and the same base genetics were selected for the trial. All products were planted at a population of 36,000 plants/ acre on April 14, 2010. Corn products included in the trial were: Genuity® SmartStax® corn, YieldGard VT Triple® corn, Roundup Ready® Corn 2 treated with Force® 3G soil insecticide and Roundup Ready Corn 2. The previous year's crop was corn and conventional tillage, consisting of fall chisel plowing and a spring soil finisher, was used.




A foliar application of Headline fungicide was applied at the R2 growth stage at a rate of 9 oz/A with crop oil concentrate (COC) of 1% volume of COC/volume mix. Both pre- and post-emergence herbicides were used for consistent weed control in this study. Harness® Xtra 5.6L herbicide product was the pre-emergence weed control applied at a rate of 2.5 quarts/acre. Roundup PowerMAX® herbicide product was the post-emergence weed control applied at a rate of 22 oz/acre.

Yield comparisons of the corn products treated with Headline fungicide compared to the untreated check (UTC) are shown in Figure 1. Figure 2 shows the effect of Headline fungicide and corn rootworm protection on corn yield.

## Results and Conclusions

- Foliar fungal disease pressure on corn was low in 2010, however one application of foliar fungicide protected yield significantly.
- The corn products without corn rootworm protection yielded lower than corn products with rootworm protection.
- One application of Headline fungicide greatly increased yield in the corn products without corn rootworm protection possibly by mitigating stress due to low levels of foliar diseases on plants already stressed due to a lack of corn rootworm protection.
- Yield was not increased significantly by an application of Headline fungicide to the corn products with corn rootworm control, possibly due to the low disease pressure this year and the lack of stress from corn root worm.
- On the Monmouth Learning Center farm in 2010, stalk quality was consistently better in plots that received the Headline fungicide application, as seen in Figures 3-6. However, this did not always correlate positively with yield.

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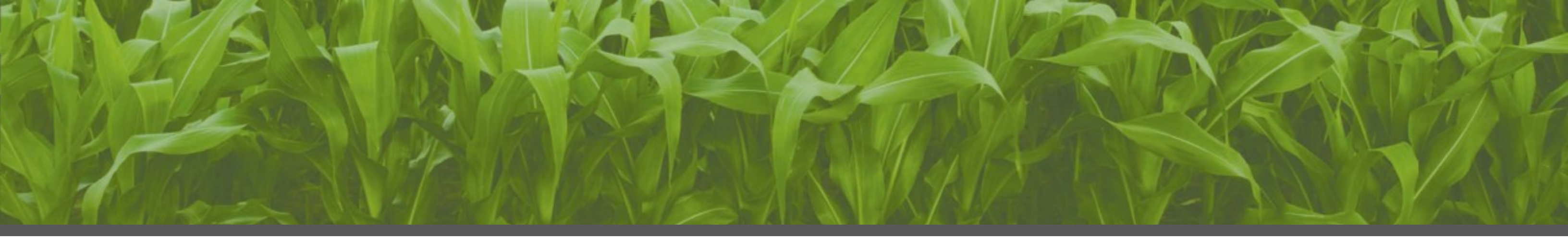
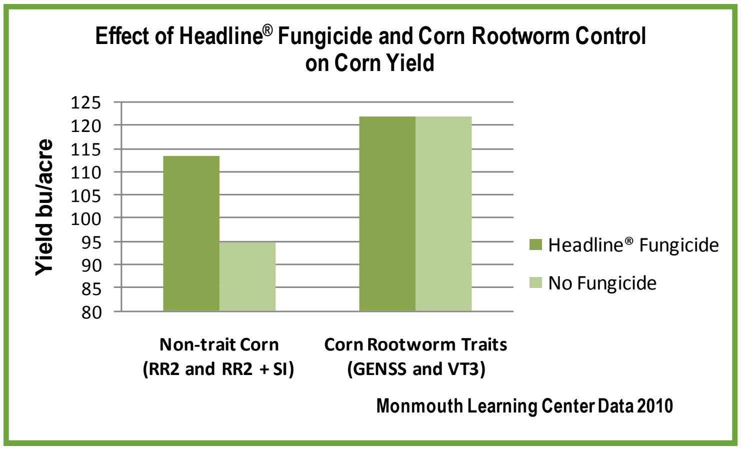


# Stress Mitigation from use of Fungicide and Corn Rootworm Traits in Corn *(cont.)*




◄**Figure 2.** Effect of Headline® fungicide and corn rootworm protection on corn yield. The non-trait corn products were Roundup Ready® Corn 2 (RR2) and Roundup Ready® Corn 2 treated with Force® 3G soil insecticide (RR2 + SI). These were compared to the corn rootworm traits: Genuity® SmartStax® corn (GENSS) and YieldGard VT Triple® corn (VT3). Monsanto Learning Center near Monmouth, IL in 2010.

**Figure 3.** ► Genuity® SmartStax® corn treated with Headline® fungicide. Monsanto Learning Center near Monmouth, IL in 2010.

◄**Figure 4.** Genuity® SmartStax® corn with NO Headline® fungicide treatment. Monsanto Learning Center near Monmouth, IL in 2010.

**Figure 5.** ► YieldGard VT Triple® corn treated with Headline® fungicide. Monsanto Learning Center near Monmouth, IL in 2010

◄**Figure 6.** YieldGard VT Triple® corn with NO Headline® fungicide treatment. Monsanto Learning Center near Monmouth, IL in 2010.

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# Managing Soybeans for High Yield Potential

While soybean maximum yield potential is genetically determined, actual yield potential depends on environmental conditions and management practices. Growers are considering additional inputs and management practices to more fully exploit the genetic potential of soybean. Studies have shown that stress mitigation practices such as maximizing nutrient availability and reducing competition from weed, disease, and insect pressure can increase soybean yield potential. Rhizobium inoculant, foliar fungicide, foliar insecticide, and sugar application are several inputs being examined for their effect on soybean yield potential.

## Study Guidelines

A demonstration trial was conducted at the Monsanto Learning Center near Monmouth, IL in 2010 to evaluate the addition of single and multiple inputs on soybean yield. Both 3.0 and 3.5 maturity soybeans with Genuity® Roundup Ready 2 Yield® technology were planted. Row spacings of 15-inch and 30-inch were examined. Soybeans were planted on April 20 and harvested on October 7. Testing was conducted in a conventional tillage scenario using a chisel plow in the fall and soil finisher in the spring. The treatments were as follows:

| |
|---|
| **Untreated check** |
| **Rhizobium inoculant (RI)** |
| **Foliar Fungicide @ R3 (FF)** |
| **Foliar Insecticide @ R3 (FI)** |
| **RI + FF** |
| **RI + FI** |
| **FF + FI** |
| **RI + FF + FI** |
| **2 lbs Sugar/acre @ R1 + FF + FI** |
| **RI + Sugar + FF + FI** |

## Results and Discussions

2010 soybean yields were higher than average for the Monmouth Learning Center and surrounding areas. With the exception of one data anomaly, 15-inch rows showed an advantage of 2 bu/a over 30-inch row spacing in this trial (Figure 1). Across all Learning Center trials in 2010, 15-inch rows showed a 3 bu/a advantage over 30-inch rows (data not shown). This is consistent with both university and Monmouth Learning Center Data collected over the past several years.

Little to no yield response was seen in the individual fungicide and insecticide treatments (Figure 2). In addition, little difference was noted between the 3.0 and 3.5 maturity soybeans; therefore, these data were combined. However, when fungicide and insecticide applications were combined, an increase of approximately 4 bushels was observed (Figure 2). This positive yield response was in spite of the fact that insect and disease pressures were observed to be lower than normal. This could mean that responses to fungicide and insecticide applications would be even greater in a year with higher pressures. It is important to note that this trial represents only one data point and no definitive conclusions can be drawn from these results. More study is needed, and we will continue to look at these strategies more thoroughly in the coming seasons.

The addition of foliar applied sugar is a practice of interest to many area soybean farmers. However, this treatment showed no benefit in this trial.

The combination of inoculant, fungicide, and insecticide in this trial yielded 4.6 bu/a more than the untreated check and represented an input cost of approximately $26 per acre (excluding application cost). Therefore, break-even price for soybeans would be approximately $5.65 per bushel. At the time of harvest, the cash soybean market was approximately $10 per bushel, resulting in a $20 per acre profit for the combination of inoculant, fungicide, and insecticide.

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# Managing Soybeans for High Yield Potential *(cont.)*

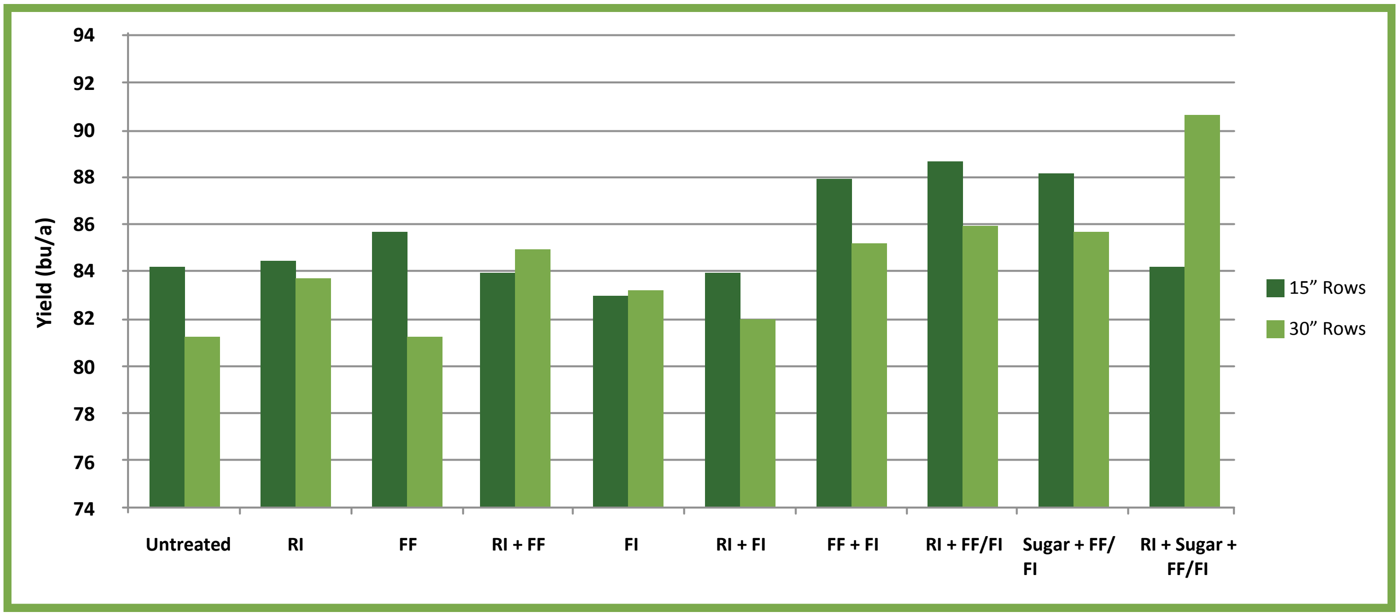


**Figure 1.** Effect of additional inputs and row spacing on soybean yield. Results averaged across two maturities in 2010.

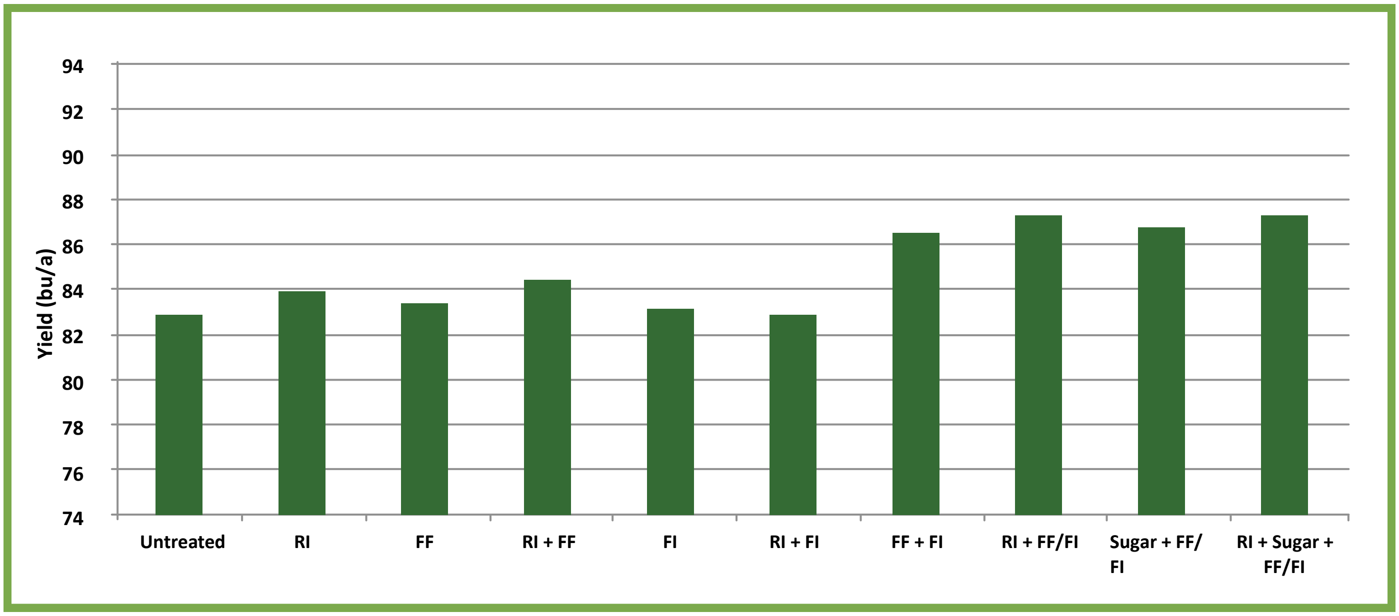


**Figure 2.** Effect of additional inputs on soybean yield. Results averaged across two maturities and two row spacings in 2010.

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# Effect of Foliar Fungicide Use on Soybean Yield

Soybean yields can be affected by many factors throughout the growing season including management decisions and disease. Headline® fungicide has been shown to be effective against several common foliar diseases of soybean, with treatment resulting in increased soybean yield. Research was conducted at the Monmouth Learning Center to assess the soybean yield response to the use of Headline fungicide and the impact that management decisions such as planting date and tillage may have on yield.

## Study Guidelines

Two trials were conducted in 2010 at the Monmouth Learning Center near Monmouth, IL to evaluate the yield impact of foliar fungicide use, planting date, and tillage. Two soybean varieties were used in both trials: a maturity group 3.0 Genuity® Roundup Ready 2 Yield® variety and a maturity group 3.5 Genuity® Roundup Ready 2 Yield® variety. Trials were treated with a pre-emergence application of Valor® XLT at 3 oz/acre and post-emergence Roundup PowerMAX® at 22 oz/acre. Headline® fungicide was applied in both studies at the R3 growth stage at 9 oz/acre plus non -ionic surfactant at 0.25% volume NIS/volume mix.

The first trial was planted in a corn-soybean rotation on May 5. A conventional tillage system (Fall: chisel plow; Spring: soil finisher) and strip tillage were used.

The second trial was planted in a corn-soybean rotation with conventional tillage (Fall: chisel plow; Spring: soil finisher). Soybeans were planted at an early planting date (April 19) and a late planting date (May 28).

## Results and Conclusions

Foliar fungal disease pressure was low this year with sudden death syndrome (SDS) being the predominant disease late in the season. Incidence and severity of SDS is not mitigated by the application of foliar fungicides such as Headline.

In the first trial, a greater yield response to the application of Headline fungicide was observed in the strip tillage system compared to the conventional tillage system (Figure 1). This may be because more plant residue and disease inoculum is left on the soil surface with strip tillage. Therefore, disease pressure may have been greater in the strip tillage plots compared to the conventional tillage plots. Across both tillage practices, soybeans treated with Headline had a yield advantage over untreated soybeans (Figure 2).

In the second trial, early planted soybeans yielded better than late planted soybeans regardless of whether or not Headline was applied (Figures 3 and 4). This supports previous studies by

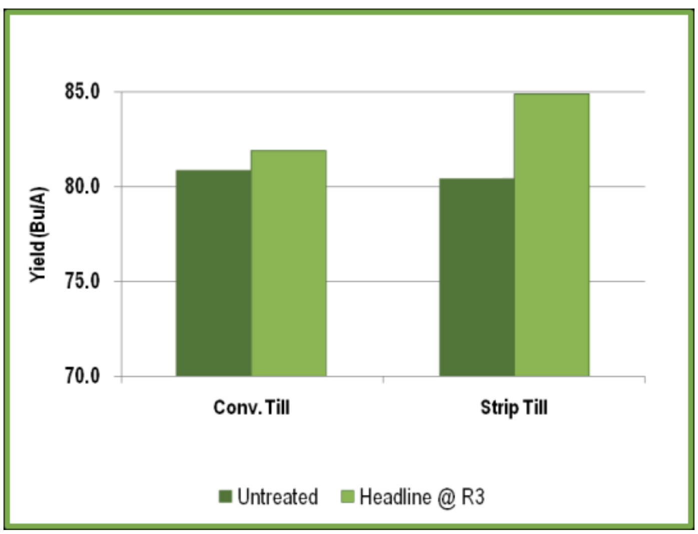


**Figure 1.** Effect of tillage and foliar fungicide use on yield. Average yield across two soybean varieties in conventional tillage and strip tillage systems.

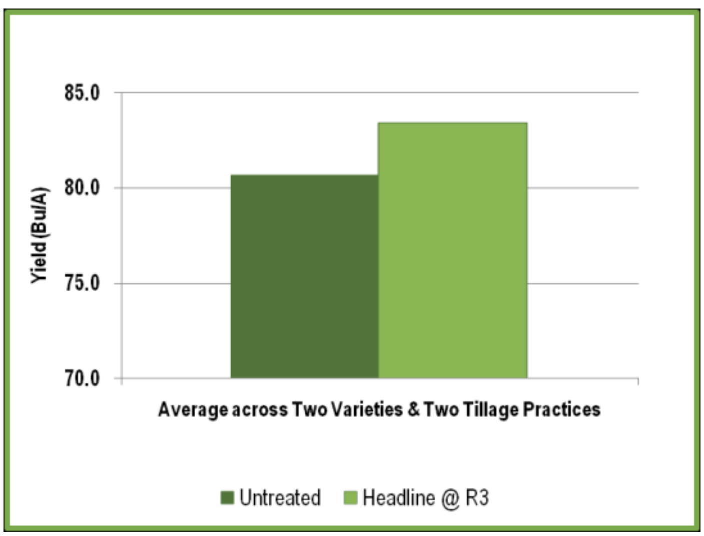


**Figure 2.** Effect of foliar fungicide use on yield. Average yield across two soybean varieties and two tillage systems.

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# Effect of Foliar Fungicide Use on Soybean Yield *(cont.)*

Monsanto and universities promoting early planting of soybeans to help maximize yield potential. Across both maturity groups, early planted soybeans with a Headline® fungicide application at R3 had a yield advantage of 9.6 bu/a over late planted soybeans with a fungicide application (Figure 5). When no fungicide was applied, early planted soybeans had a yield advantage of 5.7 bu/a over late planted soybeans. Early planted soybeans had a greater yield response to foliar fungicide than late planted soybeans. This is consistent with data collected in previous years at the Monmouth Learning Center. This could be due in part to disease pressure differences related to planting date. Fungal disease present on early planted soybeans have more time to produce secondary inoculum and complete secondary disease cycles, thus increasing the disease pressure experienced by plants throughout the season.

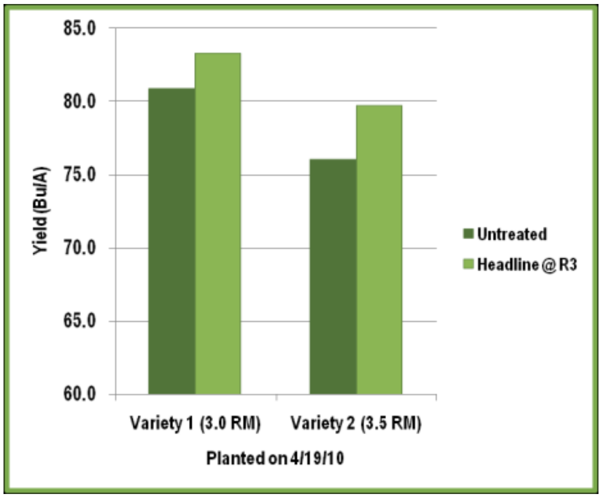


**Figure 3.** Effect of foliar fungicide use on yield in early planted soybeans.

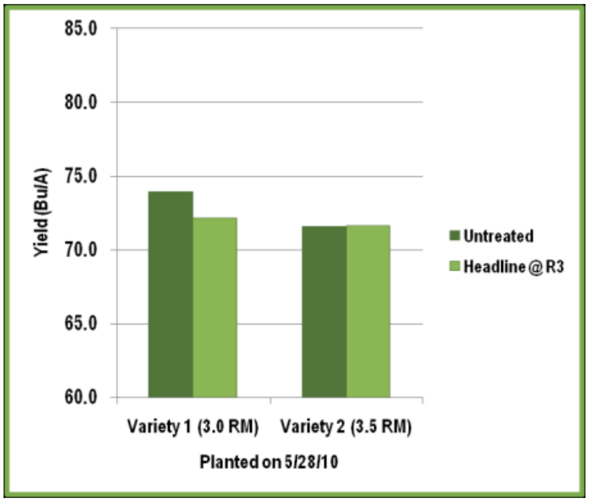


**Figure 4.** Effect of foliar fungicide use on yield in late planted soybean.

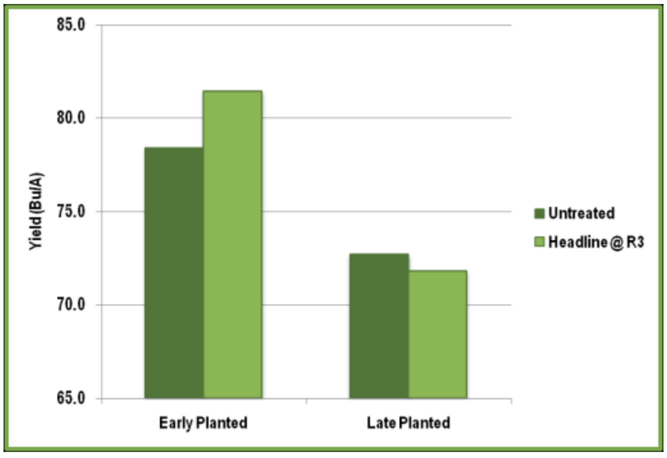


**Figure 5.** Effect of planting date and fungicide use on yield. Average yield across two soybean maturity groups.

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.

# Nitrogen Management in Soybean

It is generally accepted that in most situations, preplant nitrogen (N) applications often result in reduced root nodulation and insignificant increases in soybean yield potential. Soybean plants work with rhizobium bacteria in the soil to nodulate and fix most of their required N. However, available N often becomes depleted in the later R growth stages due to increased demand from the plant when nodule efficiency tends to decrease. It is thought that supplying N in these later stages may help boost production, especially in high-yield environments.

## Study Guidelines

A replicated trial was conducted at the Monsanto Learning Center near Monmouth, Illinois in 2010 to evaluate the effects of various rates of soil applied N on the nodulation and yield potential of soybeans compared to an untreated check. A maturity group 3.0 Genuity® Roundup Ready 2 Yield® soybean was planted in 30-inch rows. The trial was planted on May 5 at 150,000 seeds/acre. The herbicide program was Valor® XLT herbicide at 3 oz./acre pre-emergence, followed by Roundup PowerMAX® herbicide at 22 oz./acre postemergence on 4-inch weeds. It was harvested on October 5, with an average yield of 86.2 bu./acre. In 2009, the field was planted to corn and chisel plowed in the fall. To level the seed bed, a soil finisher was used in the spring of 2010.

The N treatments were applied using 32% urea ammonium-nitrate (UAN). Two application timings evaluated were preplant incorporated (PPI) and R1. The treatments at R1 were applied with a hand boom using drop nozzles. Agrotain®, a urease inhibitor, was added to the treatments at R1 to help stabilize and prevent loss of the N. At each timing, N rates of 0, 25, 75, 100, and 200 lbs./acre were evaluated.

## Results

While the N treatments visually resulted in greener, taller soybean plants they also reduced root nodulation compared to the untreated check. (Figure 1). Higher yields were obtained with N applications at both timings. However, yield increases seen in the N applied plots were not economically feasible (Figure 2). The increased yields were not high enough to cover the cost of the added N, which ranged from \$12.50 to \$20 for each additional bushel produced, not including application costs.

## Conclusions

- PPI applications of N resulted in taller greener plants, with fewer nodules.
- The yield increases from any of the treatments was not sufficient to cover the cost of the N and application.
- Adding soil-applied N was not economically feasible in either timing at any rate.

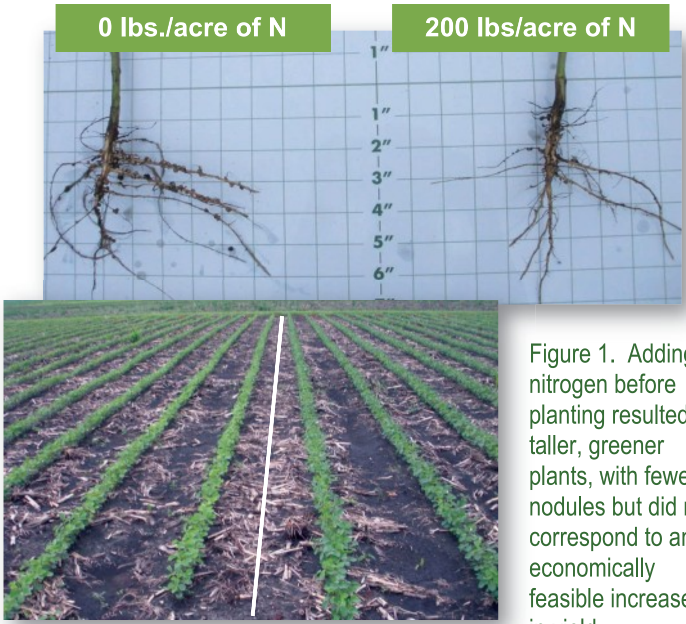


Figure 1. Adding nitrogen before planting resulted in taller, greener plants, with fewer nodules but did not correspond to an economically feasible increase in yield.

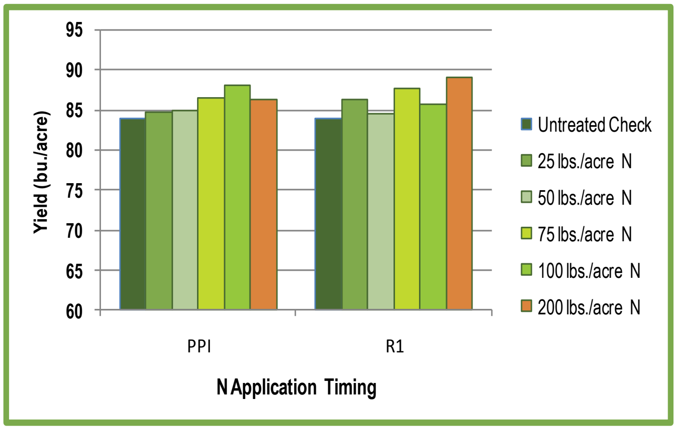


Figure 2. Yield increases from various rates of N (lbs./acre) at two timings, as compared to the untreated check.

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