CROP INSIGHTS

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Foliar Fungicide and Insecticide Use in Soybeans

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Summary

- Pioneer conducted extensive on-farm and small-plot trials to better understand the potential value of foliar fungicides in soybeans, both alone and combined with an insecticide.
- Across 148 on-farm trials conducted between 2007 and 2011, the average yield response to a foliar fungicide application was 2.5 bu/acre. In trials where an insecticide was included, the average gain was 5.3 bu/acre.
- Pioneer small-plot research trials were also conducted from 2004 to 2008. Fungicides, when used alone or in combination with insecticides, increased soybean yields by 2.9 to 5.5 bu/acre on average.
- Despite considerable variation in growing conditions across years and locations, the trials demonstrated a consistent positive yield response to treatments that included strobilurin fungicides (Headline® and Quadris®).
- The economic viability of a fungicide or fungicide+insecticide application can vary greatly according to the price of soybeans and cost of the treatment and application.

Introduction

The increased grain price of soybeans has made crop inputs with potential to increase yields more attractive to growers. This includes foliar fungicides, which have proven effective in helping to manage several common foliar diseases. In addition, the possibility of physiological benefits to the plant from strobilurin fungicides has generated interest in these products. As a result, foliar fungicide use has increased in most soybean-producing areas.

Fungicides for Disease Control in Soybeans

Before using a foliar fungicide, it is important to scout and determine the type of disease(s) present, as only fungal pathogens can be controlled with these products. Fungal diseases that can be managed with foliar fungicides include anthracnose, Septoria brown spot, Cercospora leaf blight, frogeye leaf spot, pod and stem blight, and soybean rust. Bacterial diseases such as bacterial blight or bacterial pustule, and viral diseases such as soybean vein necrosis virus are not controlled by fungicides.

Several fungal diseases are also not well-controlled by foliar fungicides, due to time of infection or where it occurs in the plant. For example, stem canker can cause severe yield losses in soybeans, but results of fungicide applications have often been inconsistent. This is likely because infection occurs during early vegetative growth and fungicides are often not applied in time to prevent it. Charcoal rot and sudden death syndrome also can cause severe yield losses, but because infection occurs in the roots, they are not controlled by foliar fungicides.

Still other diseases may be controlled by fungicides, but because yield is rarely reduced by these pathogens, treatment is generally not recommended. Alternaria and Phyllosticta leafspot and downy mildew are examples of such diseases.

Figure 1. Septoria brown spot (left) and frogeye leaf spot (right) are two diseases capable of reducing yield in soybeans that can be managed with foliar fungicides.

White mold is another disease that requires precise timing for fungicide control. Several foliar fungicides may be useful against white mold when applications are targeted at early flowering (R1) and there is sufficient penetration of spray to the lower soybean canopy. DuPont has applied to regulatory

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authorities in the U.S. for registration of a broad-spectrum fungicide that offers preventative and curative disease control in several crops, including control of white mold in soybeans. Early test results with DuPont™ Aproach™ fungicide have been very positive when compared to existing fungicide choices such as Domark® and Topsin®. DuPont anticipates launching Aproach in the U.S. in summer 2012, and plans to develop additional products based on the fungicide's active ingredient, picoxystrobin.

Other Physiological Effects

Although leaf diseases are frequently present in soybean fields at some level, they are often thought to have minimal, non-economic impacts on yield. This leads to the possibility that physiological benefits apart from disease protection often claimed for these fungicides may indeed play a role in increasing soybean yields. These benefits may include reduced ethylene production, improved CO_2 assimilation, increased water use efficiency, increased stress tolerance during flowering and pod fill and delayed plant senescence.

Foliar Fungicide and Insecticide Applications

Insecticide applications to soybeans have also increased in recent years due to soybean aphid proliferation throughout most of North America. However, unlike claims for fungicide products, insecticide benefit in the absence of pests has not been heavily promoted. Nevertheless, more growers are exploring the benefits of insecticide use, particularly by including an insecticide in the tank when making a fungicide application. Although this practice is efficient from an application standpoint, growers should be aware that precise timing is usually required for optimum effectiveness of one or both spray components.

Pioneer Soybean Fungicide Research

To better understand the value of foliar fungicides in soybeans, both alone and in combination with an insecticide, Pioneer researchers conducted extensive on-farm and small-plot trials:

- **On-farm fungicide trial survey:** Survey of on-farm foliar fungicide and fungicide + insecticide side-by-side trials conducted between 2007 and 2011.
- **Pioneer small-plot research:** Experiments conducted from 2004 to 2008 to determine soybean yield response to foliar fungicide and fungicide + insecticide applications across several Midwestern sites.

Fungicide treatments in these trials were generally applied at around R3, which was proven to be the most effective stage for controlling diseases in several research studies.

On-Farm Fungicide Trials

Between 2007 and 2011, Pioneer researchers conducted a total of 148 trials comparing yield of untreated soybeans to soybeans treated with a foliar fungicide, as well as 52 trials that included an insecticide in the treatment. Trials were located in 11 states and two Canadian provinces. Across all of these trials, the average yield response to a foliar fungicide application was 2.5 bu/acre, with a positive yield response in 82% of the trials (Figure 2). When an insecticide was included, the average response increased to 5.3 bu/acre and a positive yield response was observed in 94% of the trials.

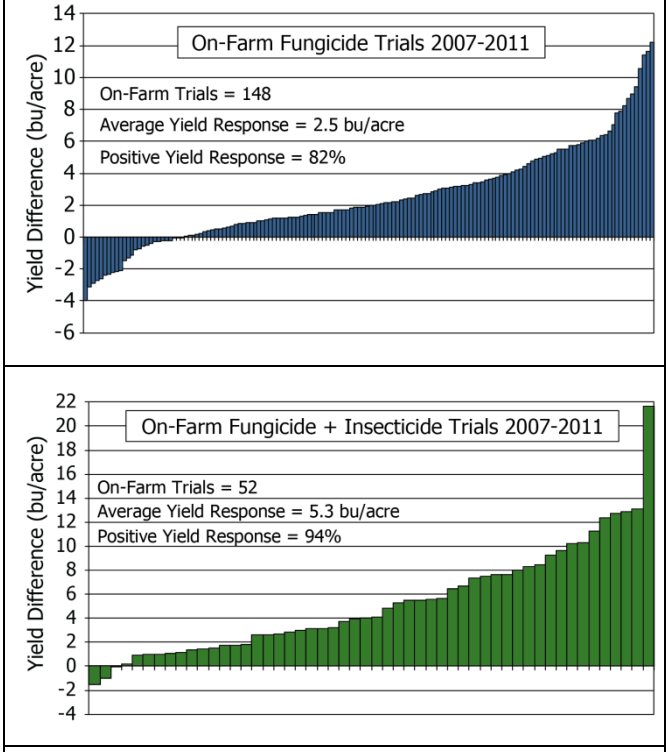

Figure 2. Average soybean yield response to foliar fungicide (top) and fungicide + insecticide (above) across Pioneer on-farm trials conducted from 2007 to 2011.[3]

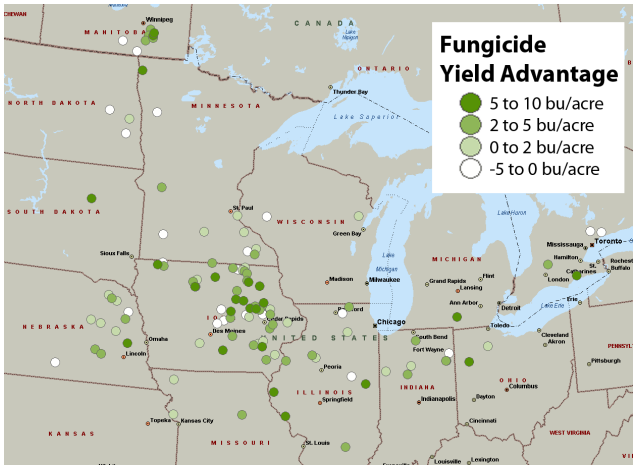

Figure 3. Average soybean yield response to foliar fungicide treatment across 148 Pioneer on-farm trials conducted from 2007 to 2011.[3]

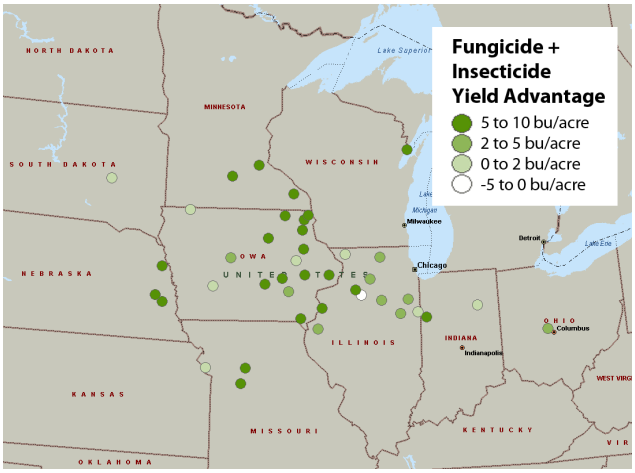

Figure 4. Average soybean yield response to foliar fungicide + insecticide treatment (above) across 52 Pioneer on-farm trials conducted from 2007 to 2011.[3]

Pioneer Small-Plot Research Trials

Pioneer small-plot research trials were conducted from 2004 to 2008 to evaluate the effect of the strobilurin fungicides Headline and Quadris and fungicide/insecticide combinations applied at soybean growth stage R3 to R4 (pod stages) on soybean yield. Trials were conducted at 4 to 10 locations per year at sites in Illinois, Indiana, Iowa, Minnesota, and Nebraska. Trials were planted in 30-inch rows at 160,000 seeds/acre. Fungicides and insecticides were applied at labeled rates in a total volume of 15 to 20 gallons/acre.

Table 1. Treatments and rates used in fungicide/insecticide small-plot study.

Treatment	Growth Stage	Rate/Acre
Headline®	R3 to R4	6 oz
Quadris®	R3 to R4	6.2 oz
Headline + DuPont™ Asana®	R3 to R4	6 & 6.4 oz
Quadris+ Warrior®	R3 to R4	6.2 & 2.56 oz

Research results showed that applying a strobilurin fungicide with or without an insecticide at growth stage R3 to R4 frequently results in a significant yield response.

- Headline applied at the R3 stage resulted in an average yield response of 3.7 bu/acre. A positive yield response was observed 78% of the time (Figure 5).
- Quadris applied at the R3 stage resulted in an average yield response of 2.9 bu/acre. Although the average yield response was lower than Headline, the number of positive yield responses was very similar (Figure 6).
- Headline/Asana® applied at the R3 stage resulted in an average yield response of 5.5 bu/acre. A positive yield response was observed 90% of the time (Figure 7). This treatment was only evaluated in 2007 and 2008.
- Quadris/Warrior applied at the R3 stage resulted in an average yield response of 4.1 bu/acre. A positive yield response was observed 77% of the time (Figure 8).

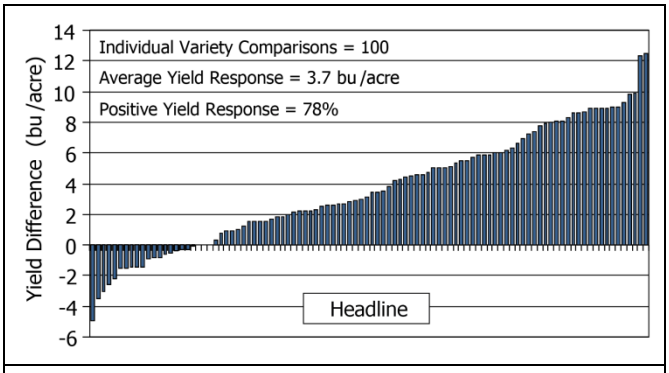

Figure 5. Soybean yield response to Headline in Pioneer small-plot research trials (2004 to 2008).[3]

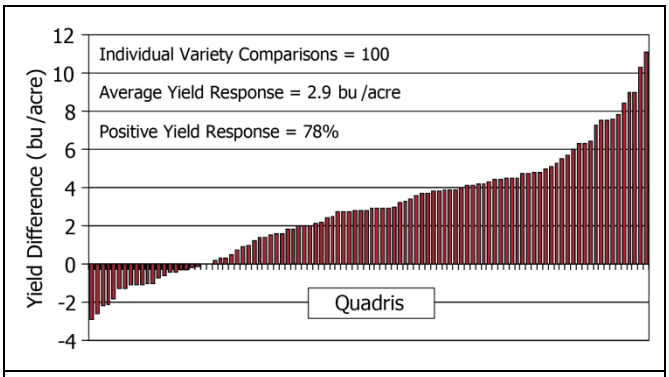

Figure 6. Soybean yield response to Quadris in Pioneer small-plot research trials (2004 to 2008).[3]

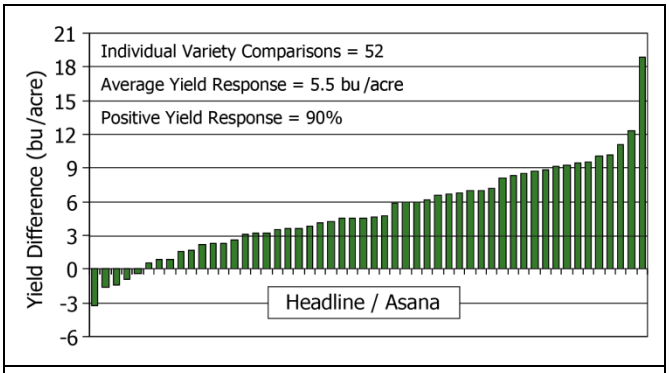

Figure 7. Soybean yield response to Headline + Asana® in Pioneer small-plot research trials (2007 to 2008).[3]

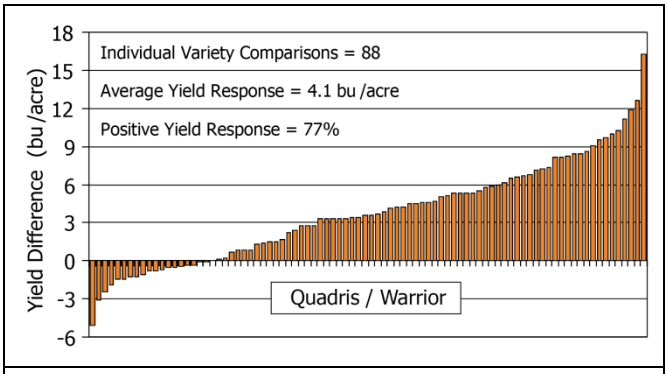

Figure 8. Soybean yield response to Quadris® + Warrior® in Pioneer small-plot research trials (2005 to 2008).[3]

In the 2008 research trials, all four strobilurin fungicide and strobilurin fungicide / insecticide applications significantly improved yield over the untreated check across locations in Illinois, Indiana and Nebraska. At one location in Minnesota, treatments including an insecticide greatly improved yield due to high soybean aphid pressure at the site. Asana® applied alone increased yield by 20.5 bu/acre, Headline® + Asana® by 24 bu/acre, and Quadris + Warrior by 18.2 bu/acre.

Other Considerations

Economic Benefit

The economic viability of a fungicide application or fungicide + insecticide application can vary greatly according to the price of soybeans and cost of the treatment and application. Higher soybean prices and lower treatment costs both reduce the break-even yield response; lower soybean prices and higher costs increase it (Table 2).

Table 2. Yield response necessary to cover the cost of fungicide and application over a range of costs and soybean prices.

Trmt Cost /Acre	Soybean Price / bu						
	$9	$10	$11	$12	$13	$14	$15
	---------- bu/acre ----------						
$15.00	1.7	1.5	1.4	1.3	1.2	1.1	1.0
$17.50	1.9	1.8	1.6	1.5	1.3	1.3	1.2
$20.00	2.2	2.0	1.8	1.7	1.5	1.4	1.3
$22.50	2.5	2.3	2.0	1.9	1.7	1.6	1.5
$25.00	2.8	2.5	2.3	2.1	1.9	1.8	1.7
$27.50	3.1	2.8	2.5	2.3	2.1	2.0	1.8
$30.00	3.3	3.0	2.7	2.5	2.3	2.1	2.0
$32.50	3.6	3.3	3.0	2.7	2.5	2.3	2.2
$35.00	3.9	3.5	3.2	2.9	2.7	2.5	2.3

Factors that Influence Disease Risk

The response to a foliar fungicide treatment will vary depending upon conditions that favor disease development. The higher the disease pressure, the more likely there will be an economic response to treatment.

- **Soybean variety and planting date** – Soybean varieties with genetic susceptibility to a disease present in the field will be at greater risk for infection. Early maturity varieties and early planting can also increase risk, depending on the disease.
- **Weather conditions** – Humid and wet weather conditions are the most favorable conditions for disease development. However, anytime soybean leaves are wet over an extended period of time, the plant is more vulnerable to a disease. Irrigation can also increase disease risk.
- **Disease pressure** – Continuous soybeans (especially with no-till practices) are conducive environments for diseases to develop. Many pathogens have the ability to survive in soybean stubble over the winter. The more stubble present, the greater the chance for a foliar disease. Be aware of diseases present the previous year and manage accordingly.

Resistance Prevention

Fungicide resistance prevention should also be considered in treatment decisions. The strobilurin class of fungicides, although very effective at controlling many corn diseases, is considered high risk for resistance development in fungal species. Strobilurin resistance has already been documented in disease species in other crops, and has recently been discovered in frogeye leaf spot in soybeans. Widespread indiscriminant use of fungicides increases the selection pressure on fungal pathogens, which can accelerate resistance development.

[3] Product responses are variable and subject to a variety of environmental, disease, and pest pressures. Individual results may vary.

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