CROP INSIGHTS

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Management of Foliar Diseases in Corn with Fungicides

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Summary

- A survey was conducted of fungicide field efficacy data from Pioneer side-by-side field trials and university research trials conducted in 1999 to 2007 to improve understanding of the value of foliar fungicide use in corn.
- Corn yield increased an average of 7.9 bu/acre across 345 trials in response to a foliar fungicide application.
- Yield response to fungicide application was similar between 2006 and 2007 with average yield increases of 8.1 bu/acre and 6.9 bu/acre, respectively.
- The average yield benefit of foliar fungicide application was 6.6 bu/acre in the northwestern Corn Belt, but was greater than 12 bu/acre in the southeastern states.
- The yield advantage with a foliar fungicide application was the greatest for hybrids highly susceptible to gray leaf spot and at sites with significant disease pressure.
- The average yield response to foliar fungicide application was greater with practices that favor high levels of residue such as corn-following-corn, and no-till or strip-till.
- In rare cases, crop injury was associated with fungicide treatment prior to tasseling or use of non-ionic surfactants.

Introduction

Foliar fungicide application to corn has been one of the most prevalent topics of interest among growers, agronomists and researchers over the past few years. Although testimonials abound, growers could benefit from a more thorough analysis of the value of fungicide applications. Therefore, Pioneer researchers have compiled fungicide efficacy data from Pioneer side-by-side field trials and 3rd-party efficacy trials conducted by university researchers. The results are reported below.

Objectives

The primary objective of this survey study was to determine the value of foliar fungicide use in corn by:

1) Evaluating corn yield response and economic benefit associated with foliar fungicide use at a large number of sites under a wide range of growing conditions.

The yield advantage for foliar fungicide application was much greater at sites with significant disease pressure and for hybrids highly susceptible to gray leaf spot.

2) Identifying agronomic factors likely to influence the probability of a positive economic response from fungicide application.

Methods

The key information collected in the study was the grain yield response of corn to the application(s) of any foliar fungicide. The break-even yield response needed to pay for fungicide application was estimated at 5.2 bu/acre, assuming a corn price of $4.25/acre and fungicide plus application cost of $22/acre. University trials frequently employed multiple fungicide treatments, in which case the average yield response for all fungicide treatments was calculated. Only treatments where fungicide was applied between tasseling and brown silk were included. Very few sites included comparisons among multiple fungicides; therefore it was not possible to effectively rank the efficacy of commonly used fungicides. Fungicide trials conducted from 1999 to 2007 were included, however the majority of data collected was from 2006 and 2007. Fungicides included in the trials were Headline® (230 trials), Stratego® (31 trials), Quilt® (23 trials), and Quadris® (7 trials). Multiple fungicides were used in 48 trials.

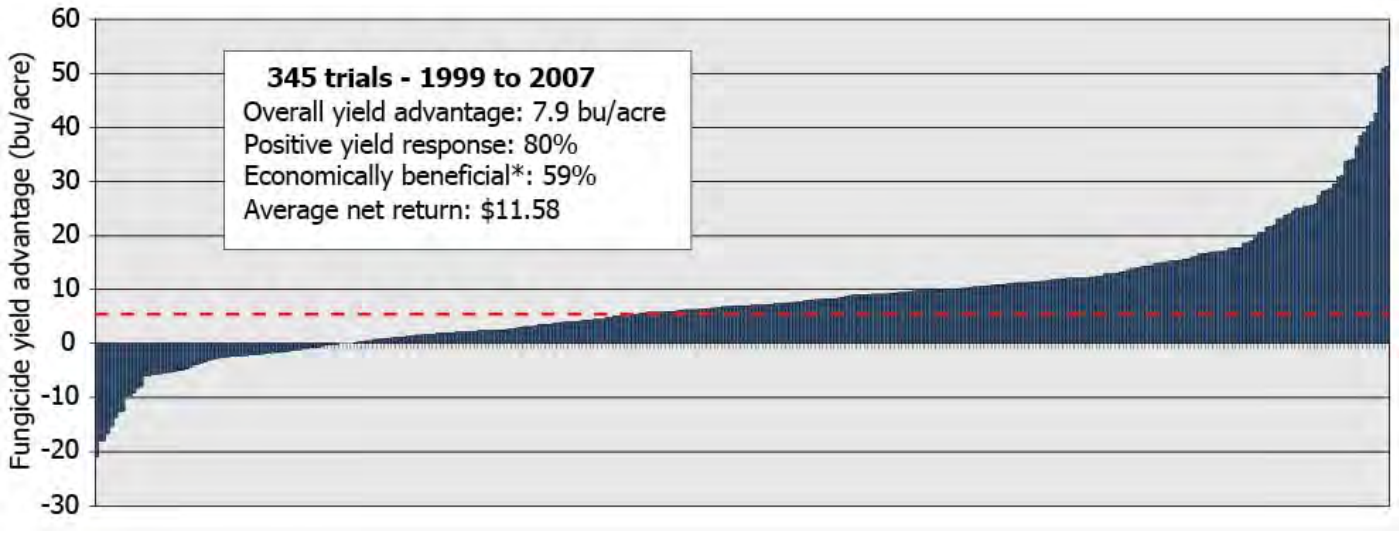

Figure 1. Corn yield response to foliar fungicide application in 74 university and 271 on-farm trials.

* Assumes a corn price of $4.25/bu and fungicide cost of $22/acre. Break-even yield response = 5.2 bu/acre.

Results

The average yield response across 74 university trials and 271 on-farm trials to the application of a fungicide spray was an increase of 7.9 bu/acre (Figure 1). A positive yield response to fungicide application occurred in 80% of the trials. Assuming a break-even yield response of 5.2 bu/acre, fungicide application was economically beneficial in 59% of the trials, with an average net return of $11.58/acre.

Table 1. Summary of foliar fungicide survey results from trials conducted in 2006 and 2007.

Summary Data	2006	2007
Number of trials	85	224
Overall yield advantage	8.1 bu/acre	6.9 bu/acre
Positive yield response	82%	79%
Economically beneficial	65%	55%
Average net return	$12.43	$7.33

The data showed similar results between 2006 and 2007 (Table 1). The average yield response across 85 trials in 2006 was an increase of 8.1 bu/acre, with a positive yield response in 82% of the trials. In 2007, the average yield response across 224 trials was an increase of 6.9 bu/acre, with a positive yield response in 79% of the trials. Fungicide application was economically beneficial in 65% of the trials in 2006 and 55% of the trials in 2007. Average net returns with fungicide application were $12.43/acre in 2006 and $7.33/acre in 2007.

Factors Influencing Yield Response

Disease Pressure. Thirty-six of the university trials included an evaluation of foliar disease severity. The presence of significant disease pressure resulted in an average yield response to foliar fungicide treatment that was over four-fold greater than at sites with low severity (Figure 2). These results strongly suggest that the principle benefit of foliar fungicide sprays on corn is disease control. In the nine trials that had low disease pressure, the average yield response would not pay for the fungicide application.

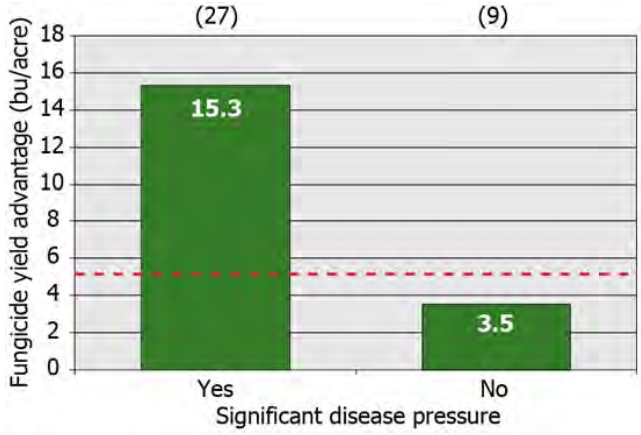

Figure 2. Yield response to foliar fungicide with and with-out significant foliar disease pressure.

Number of trials indicated in parentheses. Break-even yield response = 5.2 bu/acre.

Location. Foliar diseases can occur anywhere corn is grown in North America, but are more common in the warmer, more humid growing areas of the South and East. The more consistently favorable conditions for disease development in these regions increase the likelihood that a fungicide application will be profitable.

The survey results showed that, in general, the yield benefits of foliar fungicide sprays were greater in southern regions, although yield responses at individual sites varied widely within all four regions (Figure 3).

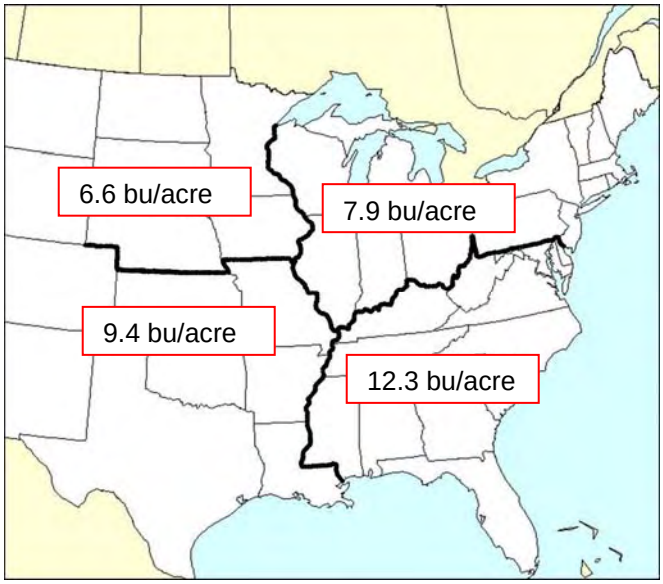

Figure 3. Average corn yield response to foliar fungicides by region.

Number of trials: NW = 152, NE = 116, SW = 43, SE = 33

The average yield advantage with fungicides was 9.4 bu/acre for southern locations west of the Mississippi River, and 12.3 bu/acre for southeastern trials. In the northeastern section of the Corn Belt, yield increased an average of 7.9 bu/acre with fungicide application. The lowest average yield response was 6.6 bu/acre in the northwestern Corn Belt.

Hybrid Disease Susceptibility. The probability of using a fungicide profitably is directly related to the susceptibility of a hybrid to the predominant leaf diseases. Pioneer has typically not recommended fungicide use on hybrids rating 6 or higher (on the Pioneer 1 to 9 rating system) for the disease in question (Munkvold, 2006). Many of the trials included in the survey were conducted using Pioneer hybrids. This allowed the determination of whether the yield response to fungicide application was affected by the disease rating of the hybrid. The principle foliar disease in the study area is gray leaf spot. As expected, the yield response to the application of a foliar fungicide was the highest for the more susceptible hybrids (Figure 4). For resistant hybrids, the average yield increase was only about four bu/acre, which was less than the response needed to cover the typical costs of a foliar fungicide application.

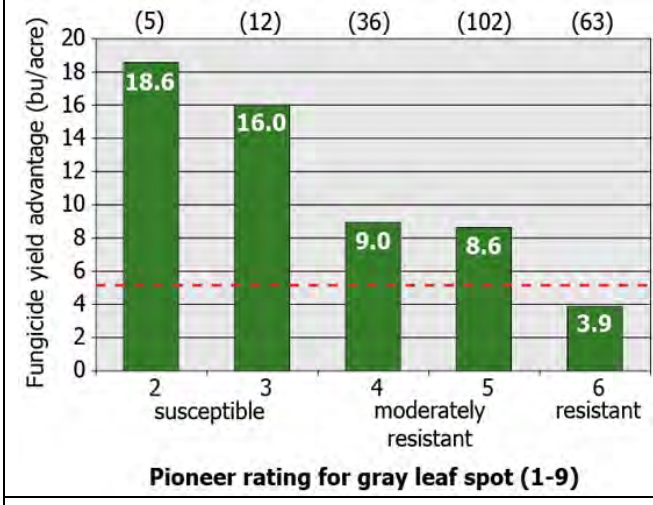

Figure 4. Average yield response of Pioneer hybrids to foliar fungicide application according to gray leaf spot disease rating.

Number of trials indicated in parentheses. Break-even yield response = 5.2 bu/acre.

Previous Crop and Tillage. Corn-following-corn fields are at a higher risk and more likely to benefit from a fungicide application than corn-following-soybean fields. Survival of diseases in corn residue leads to earlier and more extensive disease infection and higher disease incidence in this production system. Many common diseases including gray leaf spot, northern leaf blight, southern leaf blight, eyespot and northern leaf spot overwinter in corn residue, providing a source of inoculum to infect corn planted the following season.

Tillage can influence disease pressure and potential benefit of fungicide application in much the same way as cropping sequence. By leaving more crop residue on the soil surface, conservation tillage and no-till can greatly increase the disease inoculum load.

Survey results from 139 on-farm trials where previous crop and tillage practices were reported showed an inverse relationship between tillage intensity and yield response to foliar fungicide application in both corn following corn and corn following soybean (Figure 5). In corn following corn the average yield advantage with fungicide application exceeded the break-even yield response in all three tillage categories. Fungicide yield response was 13.3 bu/acre in no-till or strip-till, 10.7 bu/acre in conservation tillage, and 5.7 bu/acre in conventional tillage.

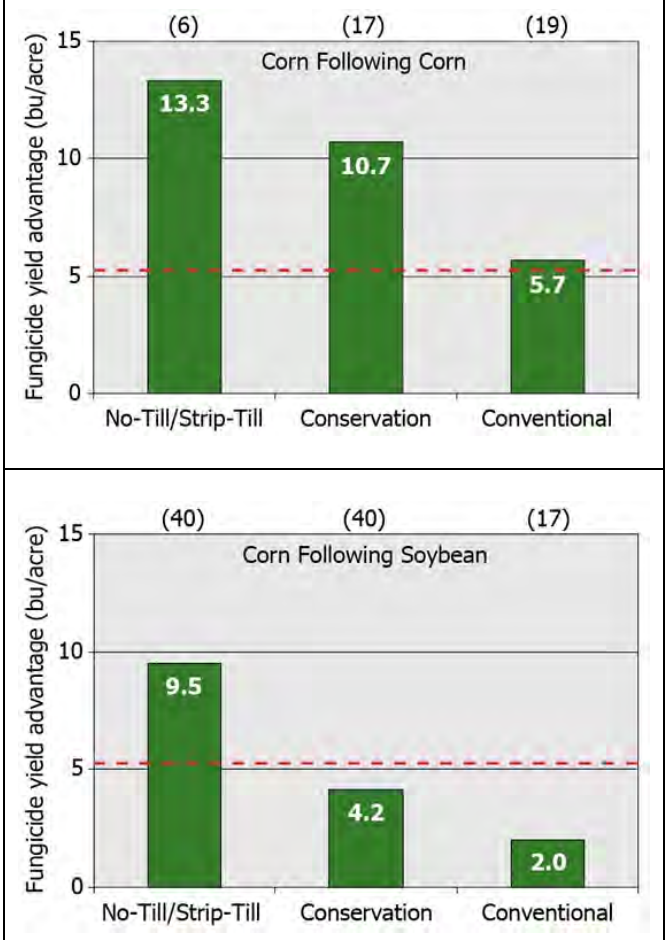

Figure 5. Average yield response to foliar fungicide application as influenced by tillage in corn following corn (top) and corn following soybean (bottom).

Number of trials indicated in parentheses. Break-even yield response = 5.2 bu/acre.

In corn following soybean, the yield advantage with fungicide in no-till or strip-till was 9.5 bu/acre, which exceeded the break-even yield response. The average fungicide yield response in conservation and conventional tillage did not exceed the break-even response, with average yield responses of 4.2 bu/acre and 2 bu/acre in the two tillage systems, respectively. Rotation away from corn to a different crop, such as soybean, is often recommended as a way to manage corn diseases by reducing inoculum levels. However, these results suggest that under a high-residue system, such as no-till or strip till, disease pressure in corn following soybean may still be sufficient to justify a fungicide treatment.

Risk of Crop Injury

The occurrence of crop injury associated with fungicide application was reported in a limited number of cases (less than 1% of treated fields, according to fungicide manufacturers) in 2007. The most frequent damage was partial to completely arrested cob development (Figure 6).

Figure 6. Arrested ear development in a field treated with fungicide in 2007. Application was made prior to tasseling.

Damage was often associated with fields that were treated prior to tasseling or treatments that included non-ionic surfactants. Crop injury tended to be more frequent with ground applications, but this is likely because ground applications were done at an earlier crop growth stage than aerial applications. In order to reduce the risk of injury, read and follow the label instructions carefully.

Reference

Munkvold, G. 2006. Foliar fungicide use in corn. Crop Insights, Vol. 16, no. 7. Pioneer Hi-Bred Int'l, Inc. Johnston, IA.
https://www.pioneer.com/growingpoint/agronomy/library_corn/diseases/foliar_fungicides.jsp

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