

Foliar Fungicide Effect on Soybean Yield

by Jim Trybom and Mark Jeschke

Summary

- Trials were conducted at 10 locations in 2007 to evaluate the effects of foliar fungicide and fungicide/insecticide applications on soybean yield.
- Despite highly variable growing conditions in 2007, nine out of ten testing locations showed a positive yield response to fungicide treatments.
- Headline® combined with Asana® provided the greatest average yield benefit of 5.9 bu/acre.
- Headline provided a greater yield benefit when applied at the R3/4 growth stage than at the R1/2 stage.
- Fungicide and fungicide/insecticide treatments provided an economic yield response 65% of the time or more when applied at the R3 growth stage.

Introduction

High soybean commodity prices have reduced the relative cost of a number of potentially yield-enhancing inputs including foliar fungicides. These current economic conditions and new claims of “plant health” effects have expanded fungicide use well across the Midwest from the historical use areas in the southern United States. These plant health claims are associated with the strobilurin fungicides Headline and Quadris®. Several effects have been reported, including longer green leaf retention or delayed plant senescence, improved CO₂ assimilation, increased water use efficiency, and increased stress tolerance during flowering and pod fill.

Some combination of these plant health effects and/or an ability to control previously ignored foliar diseases provide an opportunity to increase soybean yields. The objective of this study was to evaluate the yield effects of the strobilurin fungicides Headline and Quadris, and strobilurin/insecticide combinations applied at the R3/4 (pod development) stage.

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Numerous comparisons over the past four years have demonstrated a consistent positive soybean yield response to foliar fungicide and insecticide treatments.

Study Description

Replicated small plot trials were conducted by Pioneer Agronomy Sciences researchers at 10 locations in 2007: Mankato, MN; Dysart and Dallas Center, IA; Windfall and Tipton, IN; York, NE; and Princeton, Champaign, Carrollton, and Eldorado, IL. Four Pioneer® brand varieties with the Roundup Ready® gene were included in the study at each location. Trials were planted in 30 inch rows at 160,000 seeds/acre.

Six treatments were evaluated (Table 1) at different soybean growth stages. Growth stage R1 is the early flowering stage and R3 is the early pod development stage (Table 2). An application of Headline at the flowering (R1/2) stage was included to evaluate the effect of an earlier fungicide application on yield. Previous research evaluated later season applications at the R5 growth stage although the yield benefit was not as great as with applications at the R3 growth stage. Fungicides and insecticides were applied at labeled rates in a total volume of 15-20 gallons/acre. Soybean yield and seed quality traits were recorded. Data were analyzed using an ANOVA for a split-plot design.

Table 1. Soybean fungicide treatments and yields in 2007.

Treatment Code	Fungicide	Growth Stage	Rate/Acre	Yield (bu/acre)
HR1	Headline	R1/2	6 oz	59.1
HR3	Headline	R3/4	6 oz	60.3
QR3	Quadris	R3/4	6.2 oz	59.7
H/ASR3	Headline+Asana	R3/4	6.0 & 6.4 oz	62.7
Q/WR3	Quadris+Warrior®	R3/4	6.2 & 2.56 oz	61.0
CHK	Untreated			56.8

Table 2. Soybean reproductive growth stages.

Growth Stage	Description
R1	Beginning flower
R2	Full flower
R3	Beginning pod
R4	Full pod
R5	Beginning seed

Results

Did strobilurin fungicide applications improve soybean yield under Midwest conditions in 2007?

Yes. The 2007 soybean growing season was diverse across the Midwest. There was drought in some growing areas and excessive rainfall in others, moderate insect pressure to no insects, and moderate to little disease pressure depending on location. In spite of this diversity, nine of ten testing locations (all except Princeton, IL) showed a yield response to the fungicide treatments. All fungicide applications improved yield over the untreated check when data were averaged across locations and varieties (Table 1). Data from all locations could not be combined and statistically analyzed because the same variety set was not included at all locations. The Headline/Asana treatment at growth stage R3 showed the greatest yield response, 5.9 bushels/acre.

Early Group II (Mankato, MN) - Varieties in the Mankato study were Pioneer® brand 92M01, 92M21, 92M32, and 92M33 (all RR). All fungicides treatments were significantly higher yielding than the untreated check when data were averaged over the four varieties. The Headline/Asana treatment improved yield 12.5 bu/acre (Figure 1, green bars).

Mid-Late Group II (Dysart, IA and Princeton, IL) - Varieties in this set were Pioneer® brand 92M54, 92M61, 92M75, and 92M91 (all RR). Headline at R3 and Headline/Asana at R3 were significantly higher yielding than the untreated check (Figure 1, red bars).

Group III (Windfall & Tipton, IN; York, NE; Dallas Center, IA; and Champaign, IL) - The varieties at these locations were Pioneer® brand 93M11, 93M13, 93M42, and 93M61 (all RR). All treatments were significantly higher yielding than the untreated check. The Headline/Asana application at R3 showed the greatest yield response, 6.1 bu/acre (Figure 1, yellow bars).

Group IV (Carrollton and Eldorado, IL) - The varieties at these locations were Pioneer® brand 94M30, 94B73, 94M71, and 94M80 (all RR). Both of these southern Illinois locations experienced drought stress in 2007. Yield levels at these locations were in the 35 to 45 bu/acre range. Despite the dry conditions and lack of significant disease and insect pressure, both of the fungicide/insecticide combination treatments were significantly higher yielding than the untreated check (Figure 1, blue bars).

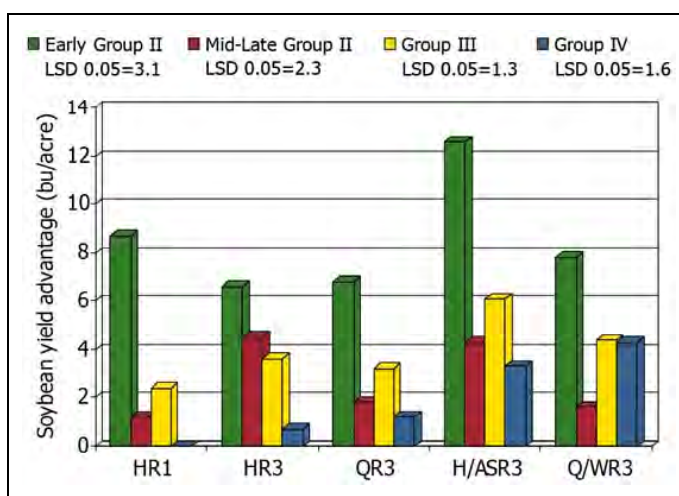


Figure 1. Soybean yield advantage with fungicide application averaged over varieties at the early Group II, mid-late Group II, Group III, and Group IV locations for the six treatments in the 2007 foliar fungicide study.

Is the improvement in soybean yields in response to foliar fungicide and insecticide treatments consistent across recent years?

Yes, numerous comparisons over the past four years have demonstrated a consistent positive response to foliar fungicide and insecticide treatments (Table 3). Pioneer began evaluating foliar fungicides in 2004 at a limited number of locations. The foliar treatments have evolved over time and the number of testing locations has increased. The highest yield responses have occurred when applications were made at the R3/4 growth stage and when an insecticide was co-applied.

Table 3. Average yield response for the fungicide and insecticide treatments evaluated in 2004-2007 soybean foliar fungicide studies.

Treatment	Years Tested	Number of Comparisons	Yield Response (bu/acre)
Headline R1	2007	40	2.3
Headline R3	2004-07	88	3.8
Quadris R3	2004-07	88	2.9
Folicur R3	2004-06	48	1.5
Quadris/Warrior R3	2005-07	76	3.9
Headline/Asana R3	2007	40	5.9
Headline R5	2004-06	48	2.7
Quadris R5	2004-06	48	1.6
Headline R3 + R5	2004-06	48	4.6

How often is there an economic yield response from a foliar fungicide application under Midwest conditions?

This research has shown there was a positive yield response the majority of the time depending on the fungicide used and the time of application. This research has also shown that applying a strobilurin fungicide at growth stage R3/4 frequently results in a significant yield response. The graphs below illustrate whether the yield gains are economical and the frequency of positive responses and economic responses. Values above the red line represent a positive return on investment (i.e. an economic response). The treatment cost (fungicide + application) was calculated to be equal to two bushels/acre for a fungicide only application and 2.5 bushels/acre for a fungicide/insecticide application. Data in the graphs represent a summary of all the years of testing, but not all treatments were included every year.

Headline applied at the R3 stage resulted in an average yield response of 3.8 bushels/acre. A positive yield response was observed 78% of the time and an economic yield response 65% of the time (Figure 2). Quadris applied at the R3 stage resulted in an average yield response of 2.9 bushels/acre. Although the overall yield response was lower than Headline, the positive and economic yield responses were slightly above Headline (Figure 3). Quadris/Warrior applied at the R3 stage resulted in an average yield response of 4.2 bushels/acre. A positive yield response was observed 80% of the time and an economic yield response 67% of the time (Figure 4). Headline/Asana applied at the R3 stage resulted in an average yield response of 5.9 bushels/acre. A positive yield response was observed 95% of the time and an economic response 80% of the time (Figure 5). This treatment was only tested in 2007.

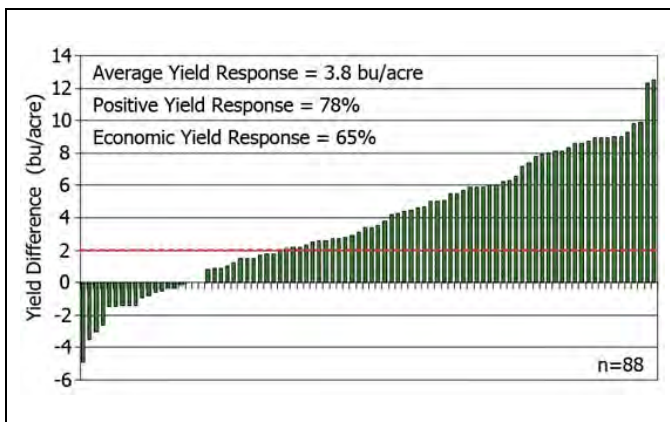


Figure 2. Yield response to **Headline** applied at the R3 stage (2004-07).

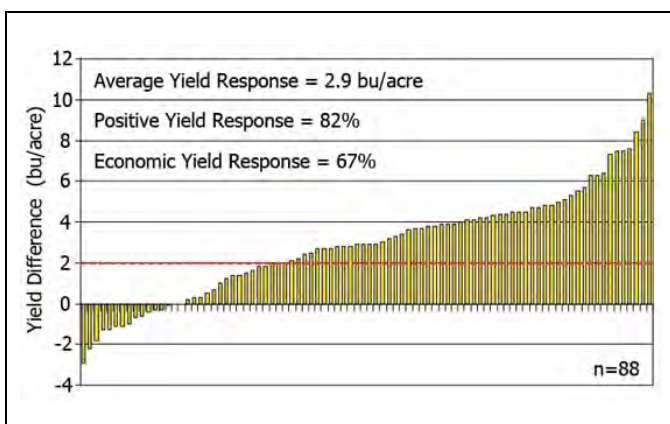


Figure 3. Yield response to **Quadris** applied at the R3 stage (2004-07).

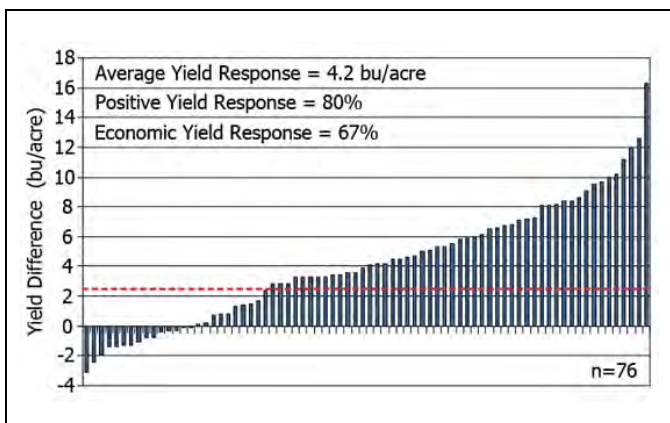


Figure 4. Yield response to **Quadris/Warrior** applied at the R3 stage (2005-07).

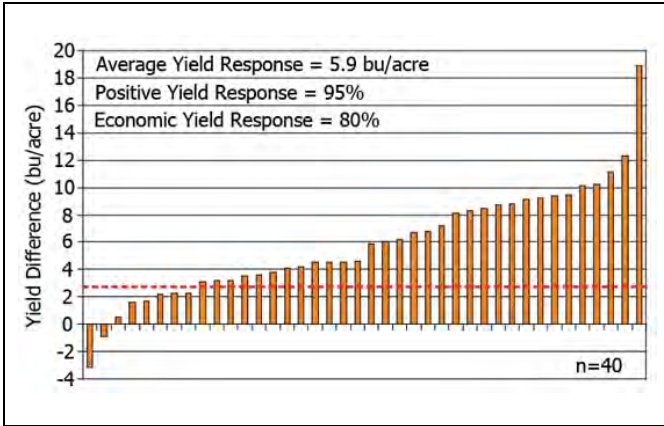


Figure 5. Yield response to **Headline/Asana** applied at the R3 stage (2007).



Spraying soybeans with fungicide in commercial field.

Other Considerations

All treatments in these studies were applied by ground at 15-20 GPA. These results may not be strictly comparable to aerial applications. Good coverage is important in controlling foliar diseases. Also, if applying by ground rig, wheel traffic from the sprayer can decrease yield slightly. The amount of this yield decrease will depend on spray boom width and soybean row width.