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Evaluation of Foliar Fungicides at Different Growth Stages on Soybean Diseases and Yield

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Abstract
Soybean Sclerotinia stem rot (white mold) caused by Sclerotinia sclerotiorum is a major disease in commercial production, particularly in intensive production regions of the United States, Argentina, and northern China. The occurrence of white mold (Figure 1) depends on various seasonal factors like cool temperatures <85°F, good soil moisture during flowering/early pod formation stage, canopy closure, narrow row spacing, and apothecia production (Figure 1a) at flowering. White mold management measures are preventative and include application of fungicides. Except for seed production, prior to 2005 foliar diseases were not a major concern to soybean production in Iowa and much of the north central region of the United States. Since the report of Asian soybean rust in South America in 2001, and then in the United States in 2004, attention on fungicide applications in soybean production has increased consistently over the years.

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Introduction

Soybean Sclerotinia stem rot (white mold) caused by *Sclerotinia sclerotiorum* is a major disease in commercial production, particularly in intensive production regions of the United States, Argentina, and northern China. The occurrence of white mold (Figure 1) depends on various seasonal factors like cool temperatures <85°F, good soil moisture during flowering/early pod formation stage, canopy closure, narrow row spacing, and apothecia production (Figure 1a) at flowering. White mold management measures are preventative and include application of fungicides. Except for seed production, prior to 2005 foliar diseases were not a major concern to soybean production in Iowa and much of the north central region of the United States. Since the report of Asian soybean rust in South America in 2001, and then in the United States in 2004, attention on fungicide applications in soybean production has increased consistently over the years.

Materials and Methods

Trials were set up in randomized complete block design in fields with a corn-soybean rotation history. In 2012, Asgrow Brand 24-31 was no-till planted on May 17. NK Brand S25-T8 was planted on June 17 in a conventional tillage system (fall chisel plow, spring field cultivate). Both were planted at 188.8k plants/acre in 30-in. row spacing with a Kinze 3000 planter. Fungicides were sprayed using CO_2 backpack (10 ft hand boom/ XR8003 tips) as per the treatment details and protocols provided by the companies (Tables 1 and 2). To maintain weed-free (including glyphosate-resistant water hemp) plots, pre- or post-emergence herbicides (Outlook, Zidua, Roundup WeatherMax and Fusion) were sprayed at recommended rates. Excellent weed control was obtained. To control spider mites, Lorsban insecticide (1.5 pint/acre) was used in 2012. In 2013, soybean aphids were controlled with Warrior II insecticide (1.96 oz/acre). Pre- and post-fungicide spray disease ratings were recorded weekly up to a week before the harvest. However, only the final readings of the diseases are presented in Tables 1 and 2. Plots 10-ft-wide (four 30-in. rows) × 45.5-ft-long trials were harvested using a John Deere 4420 combine with Shivvers grain moisture meter and Avery-Weigh Tronix weigh scale indicator. Yields were measured in bushels/acre converted to 13 percent grain moisture. Data was analyzed using SAS.

Results and Discussion

Diseases observed in 2012 were bacterial leaf blight (<1% severity in all treatments), sudden death syndrome (SDS), and white mold (Table 1). Soybean Vein Necrosis (SVN) incidence was 10-15 percent with 5-10 percent severity in both the sprayed and the unsprayed control. In 2013, white mold (WM) and SDS were observed (Table 2). Due to dry weather in 2012 and late planting in 2013, WM and SDS incidence and severities were low. No significant differences were noted among the diseases observed for each treatment, but there was significant ($P<0.05$) difference for percent defoliation among a few treatments over the unsprayed control (Table 1). Although most fungicide treatments yielded more than the control, no significant ($P<0.05$) yield differences were observed in sprayed versus the unsprayed control (Table 1) regardless of application rate or timing. The average yield advantage across fungicide sprayed treatments in 2012 was bushels/acre (range -1.0 to 3.1 bu/ac) over unsprayed control (Table 1).

In 2013, incidence of WM was more than 2012, and incidence of SDS was less than 2012. In 2013, two of the nine fungicide treatments showed significantly ($P<0.05$) higher yields over the unsprayed control, but showed no correlation to lower incidence of SDS or WM (Table 2). The average yield advantage across fungicide sprayed treatments in 2013 was 2.1 bushels/acre (range 0.5 to 5.4 bu/ac) compared with the unsprayed control (Table 2). Fungicide treatments had no significant ($P<0.05$) reduction in diseases observed over the unsprayed controls.

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Table 1. Effect of foliar fungicides applied at various growth stages on soybean diseases and grain yield during 2012, Nashua, IA.[1]

	Application		Sudden death syndrome (%)		White mold (%)			
Products tested	**Rate/ac**	**Time**	**Inc**	**Sev**	**Inc**	**Sev**	**Defoli-ation (%)**	**Yield bu/ac**
Endura + Endura/Priaxor	4+4/4 oz	R1+R3	1.3 a	23.8 a	0.00 b	0.0 a	26.3 b	71.8 a
Endura + Priaxor	6+4 oz	R1+R3	1.7 a	30.0 a	0.00 b	0.0 a	17.5 d	70.8 a
Endura + Priaxor	4+4 oz	R1+R3	1.6 a	20.0 a	0.00 b	0.0 a	10.0 e	70.2 a
Endura + HSOC[2]	4 oz	R1	0.7 a	17.5 a	0.00 b	0.0 a	25.0 cb	70.1 a
Endura + HSOC	2 oz	R1	0.8 a	27.5 a	0.01 ba	16.3 a	18.8 cd	69.7 a
Endura + HSOC	6 oz	R1	1.8 a	27.5 a	0.00 b	0.0 a	20.0 cbd	69.3 a
Priaxor + NIS[3]	4 oz	R3	0.4 a	23.8 a	0.04 a	15.0 a	10.0 e	69.1 a
Endura + Endura/Priaxor	6+6/4 oz	R1+R3	0.8 a	28.8 a	0.00 b	0.0 a	13.8 ed	68.9 a
Unsprayed control	-	-	0.3 a	15.0 a	0.00 b	0.0 a	33.8 a	68.7 a
Endura + Priaxor	4+4 oz	R1	1.5 a	22.5 a	0.00 b	0.0 a	8.8 e	67.7 a

[1]Means with the same letter are not significantly different ($P<0.05$). Values are mean of four replications.
[2]HSOC=High surfactant oil concentrate @ 0.5% v/v.
[3]NIS=non-ion surfactant @ 0.25% v/v. Inc=incidence, Sev=severity. Percent incidence of white mold and sudden death syndrome was based on infected plants in entire plot, and the severities were of the percent of each plant infected.

Table 2. Effect of foliar fungicides applied at various growth stages on soybean diseases and grain yield during 2013, Nashua, IA.[1]

Products tested	Application Rate/ac	Application time	White mold incidence (%)	Sudden death syndrome incidence (%)	Yield bu/ac
Priaxor + NIS[2]	4 oz	R3	1.08 ba	0.19 a	53.5 a
Endura +NIS /Priaxor+ NIS	6 oz + 3 oz	R1+R3	0.70 ba	0.18 a	52.9 ba
Acanto + NIS	9 oz	R1	1.00 ba	0.18 a	51.4 bac
Endura + NIS	8 oz	R1	0.85 ba	0.20 a	49.4 bc
Domark + NIS	5 oz	R1	1.23 ba	0.09 a	49.3 c
Endura + NIS	6 oz	R1	0.84 ba	0.15 a	49.2 c
Proline + NIS	3 oz	R1	1.22 ba	0.05 a	49.1 c
Cobra + COC[3]	6 oz	R1	0.61 b	0.10 a	48.9 c
Topsin + NIS	20 oz	R1	1.31 a	0.09 a	48.6 c
Unsprayed control	-	-	0.89b a	0.22 a	48.2 c

[1]Means with the same letter are not significantly different (P<0.05). Values are mean of four replications.
[2]NIS=non-ion surfactant @ 0.25% v/v.
[3]COC=crop oil concentrate @ 1% v/v. Percent incidence of white mold and sudden death syndrome was based on infected plants in entire plot in each replication.

Fig 1. Apothecia of *Sclerotinia sclerotiorum* (a) and (b) symptoms of soybean white mold