

# Improving management of white mold in soybeans: Comparative efficacy of registered fungicides

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# **Methods:**

**APPLICATION TIMING:** Fungicides were applied at early to full R2 growth stage unless the canopy closed earlier or daytime highs were in the mid/upper 90s (°F).

- If the canopy closed before early to full R2, applications were made at / shortly before canopy closure.
- If daytime highs were in the mid to upper 90s (°F), applications were delayed until daytime highs dropped to the upper 80s to low 90s.

**FUNGICIDE SPRAY DROPLET SIZE:** Nozzles and application pressures were selected to optimize droplet size relative to canopy closure.

- 110-degree flat-fan nozzles were utilized
- When TeeJet nozzles were utilized, medium droplets were utilized when average canopy closure was 80-90% and coarse droplets were utilized when average canopy closure was >90%.

#### **APPLICATION METHODS:**

- Tractor-applied (usually 5.9 to 6.5 mph driving speed) or hand-held boom
- 15 gal/ac spray volume



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# **Methods:**

**DATA WERE GENERATED FROM COMPARATIVE EFFICACY STUDIES** funded by the North Dakota Soybean Council and by private companies.

- To assess comparative efficacy across multiple studies differing in overall treatment lists, data were analyzed for just the comparisons of interest (for instance, non-treated control vs. Topsin @ 20 fl oz vs. Endura @ 8 oz) for all studies in which these treatments were evaluated.
- Combined analyses were conducted by treating the results from each study as an experimental replicate.
- Analyses were only conducted for fungicides that were evaluated a minimum of 3 times across different studies.

**RESULTS ARE PRESENTED ONLY FROM STUDIES IN WHICH FUNGICIDE DROPLET SIZE WAS CALIBRATED RELATIVE TO CANOPY CLOSURE.** Calibrating droplet size relative to canopy closure sharply improves the efficacy of fungicides against white mold in soybeans. Starting in 2019, fungicide spray droplet size was calibrated relative to canopy closure in all soybean white mold fungicide efficacy studies conducted in Carrington and Oakes, ND.



# Delaro Complete (8 fl oz) applied once

# **Delaro Complete** (8 fl oz) **showed potential** as a white mold fungicide.

Delaro Complete was only tested vs. Endura in one study, an insufficient number of studies for assessing comparative efficacy.

A single application of Delaro Complete @ 8 fl oz/ac conferred a statistically significant (P < 0.05) increase in soybean yield under white mold pressure in two of four studies.





#### Miravis Neo (13.7 fl oz) vs. Endura (5.5 or 6 oz) applied once

**Miravis Neo** (13.7 fl oz) **was generally less effective than Endura** (5.5 or 6 oz) when a single application was made to soybeans under white mold pressure.

Endura (5.5 or 6 oz) conferred a numerical reduction in white mold vs. Miravis Neo (13.7 fl oz) in three of three studies. Statistical separation (P < 0.05) was observed in one study.

Endura (5.5 or 6 oz) conferred a numerical increase in yield vs. Miravis Neo (13.7 fl oz) in two of three studies. Statistical separation (P < 0.05) was observed in one study.

CAUTION: Statistical separation was not achieved between Miravis Neo and Endura, and additional studies are needed before rigorous conclusions can be drawn.





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#### Miravis Neo (20.8 fl oz) vs. Endura (5.5 oz) applied once

**Miravis Neo** (20.8 fl oz) **was generally less effective than Endura** (5.5 oz) when a single application was made to soybeans under white mold pressure.

Endura (5.5 oz) conferred a numerical reduction in white mold vs. Miravis Neo (20.8 fl oz) in three of three studies.

Endura (5.5 oz) conferred a numerical increase in yield vs. Miravis Neo (20.8 fl oz) in two of three studies.

CAUTION: Statistical separation was not achieved between Miravis Neo and Endura, and additional studies are needed before rigorous conclusions can be drawn.







# Miravis Neo (20.8 fl oz) vs. Endura (8 oz) applied once

**Miravis Neo** (20.8 fl oz) **was less effective than Endura** (8 oz) when a single application was made to soybeans under white mold pressure.

Endura (8 oz) conferred a numerical reduction in white mold vs. Miravis Neo (20.8 fl oz) in three of three studies.

Endura (8 oz) conferred a numerical increase in yield vs. Miravis Neo (20.8 fl oz) in three of three studies.

Statistical separation (P < 0.05) was achieved between Miravis Neo and Endura in the combined analysis across studies.





#### Miravis Neo (20.8 fl oz) vs. Endura (8 oz) applied twice

Miravis Neo (20.8 fl oz) was generally less effective than Endura (8 oz) when two applications 7-11 days apart were made to soybeans under white mold pressure.

Endura (8 oz) conferred a statistically significant reduction (P< 0.05) in white mold vs. Miravis Neo (20.8 fl oz) in two of two studies.

Endura (8 oz) conferred a numerical increase in yield vs. Miravis Neo (20.8 fl oz) in one of two studies. Statistical separation (P < 0.05) was observed in one study.

CAUTION: Statistical separation was not achieved between Miravis Neo and Endura, and additional studies are needed before rigorous conclusions can be drawn.

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ProPulse (6 or 8 fl oz) vs. Endura (5.5 or 8 oz) applied once

ProPulse and Endura performed similarly:	location year growth stage: average capopy closure:	Carrington 2020 R2 82%	Carrington 2020 early R2 (59% at R2) 81%	Carrington 2019 R2 95%	
Endura @ 5.5 oz performed equivalently to ProPulse @ 6 fl oz	fungicide droplet size: nozzles and pressure: application method: soybean maturity:	medium AIXR110015, 60 psi hand boom <b>0.4</b> DSR-0418	medium XR11006, 35 psi tractor, 6.0 mph 0.6 PFS 18X06N	coarse MR110-03, 40 psi tractor, 5.9 mph 0.4 PES '17X04N'	AVERAGE 2 studies evaluating ProPulse vs Endura
Endura @ 8 oz performed equivalently to ProPulse @ 8 fl oz	White mold percent of canopy	<b>72</b> <b>72</b> <b>72</b> <b>72</b>	<b>10 10 10 10 10 10 10 10</b>	27 29 29 29 27 29 29 29 29 29 20 29 20 20 20 20 20 20 20 20 20 20 20 20 20	23 a a a a a a a a a a a a a a a a a a a
	<b>Yield</b> bushels / acre	49 a 49 a 53 a	50 a 51 a 50 a 49 a 53 a	<mark>25 b</mark> 36 ab 45 a 41 a 42 a	38 a 43 a 45 a 45 a
North Dakota Soybean Council Our World Is Growing Our World Is Growing Our World Is Growing Our World Is Growing Our Station		Non-treated control ProPulse 6.0 fl oz/ac ProPulse 8.0 fl oz/ac Endura 5.5 oz/ac Endura 8.0 oz/ac	Non-treated control ProPulse 6.0 fl oz/ac ProPulse 8.0 fl oz/ac Endura 5.5 oz/ac Endura 8.0 oz/ac	Non-treated control ProPulse 6.0 fl oz/ac ProPulse 8.0 fl oz/ac Endura 5.5 oz/ac Endura 8.0 oz/ac	Non-treated control ProPulse 6.0 fl oz/ac ProPulse 8.0 fl oz/ac Endura 5.5 oz/ac

# ProPulse (8 fl oz) vs. Endura (8 oz) applied once

averac fung

noz

#### ProPulse (8 fl oz) and Endura (8 oz) performed similarly:

Average yield response and white mold control were equivalent for ProPulse (8 fl oz) and Endura (8 oz)

Yields were numerically higher for Endura @ 8 oz in one of three studies, higher for ProPulse @ 8 fl oz in one of three studies, and equivalent in one study.



	<b>\</b> /			
location	Carrington	Oakes	Carrington	
year	2020	2019	2019	
growth stage:	early R2 (59% at R2)	R2	R2	
e canopy closure:	81%	99%	95%	
gicide droplet size:	medium	coarse	coarse	
zles and pressure:	XR11006, 35 psi	MR110-03, 40 psi	MR110-03, 40 psi	
pplication method:	tractor, 6.0 mph	tractor, 5.9 mph	tractor, 5.9 mph	
oybean maturity:	0.6	1.1	0.4	AVERAGE
soybean variety:	PFS 18X06N	PFS '18X11N'	PFS '17X04N'	3 studies
White mold percent of canopy	13 a 14 a 10 a	<b>22</b> b <b>13</b> ab <b>6</b> a	54 b 15 a 29 a	30 a 15 a 3
<b>Yield</b> bushels / acre	50 a 50 a 53 a	58 a 66 a 66 a	<mark>25</mark> b 45 a 42 a	44 a 54 a 54 a
	Von-treated control ProPulse 8 fl oz/ac Endura 8 oz/ac			

## ProPulse (8 fl oz) vs. Endura (8 oz) applied twice

**ProPulse** (8 fl oz) **and Endura** (8 oz) **performed similarly** applied twice 7 to 13 days apart.

ProPulse (8 fl oz) and Endura (8 oz) conferred similar yield gains.

- Endura was associated with numerically higher yields in two of three studies, and ProPulse was associated with higher yield in one study, but statistical separation was not observed between these treatments in any of the studies.
- Average yields for these treatments (across all three studies) were equal.

Endura (8 oz) was sometimes associated with better end-of-season white mold control than ProPulse (8 fl oz).

• Endura was associated with numerical reductions in white mold (vs. ProPulse) in two of three studies, with statistical separation (P < 0.05) observed in one study. In the third study, disease control was equivalent for these fungicides.

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## Revytek (8 fl oz) vs. Endura (6 oz) applied once

**Revytek** (8 fl oz) **was less effective than Endura** (6 oz) when a single application was made to soybeans under white mold pressure.

Endura (6 oz) conferred a numerical reduction in white mold vs. Revytek (8 fl oz) in two of two studies. Statistical separation (P < 0.05) was observed in the combined analysis.

Endura (6 oz) conferred a numerical increase in yield vs. Revytek (8 fl oz) in two of two studies.

CAUTION: Statistical separation for Revytek vs. Endura was only achieved for disease control, not yield, in the combined analysis. Additional studies are needed before rigorous conclusions can be drawn.







#### Topsin (20 fl oz) vs. Endura (5.5 oz) applied once

2020

R2

80%

Carrington

location Carrington

year 2020

growth stage: R2

average canopy closure: 80%

Endura (5.5 oz) conferred a numerical reduction in white mold vs. Topsin (20 fl oz) in 3 of 5 studies, with statistical separation (P < 0.05) observed in one study.

Endura (5.5 oz) conferred a numerical increase in yield vs. Topsin (20 fl oz) in 3 of 5 studies, with statistical separation (P < 0.05) observed in one study.

The combined analysis showed a trend of better disease control and increased yield with Endura (5.5 oz) vs. Topsin (20 fl oz), but statistical separation was not achieved.



Carrington

2020

87%

Carrington

2020

early R2 (89% at R2) early R2 (59% at R2) R2

81%

Carrington

2019

95%



# Topsin (20 fl oz) vs. Endura (8 oz) applied once

Endura (8 oz) conferred a numerical reduction in white mold vs. Topsin (20 fl oz) in three of three studies, with statistical separation (P < 0.05) observed in one study.

Endura (8 oz) conferred a statistically significant (P < 0.05) increase in yield vs. Topsin (20 fl oz) in two of three studies. In the third study, yields were equivalent across both fungicides.

The combined analysis showed a trend of better disease control and increased yield with Endura (8 oz) vs. Topsin (20 fl oz), but statistical separation was not achieved.





#### Topsin (20 fl oz) vs. Endura (5.5 oz) applied twice

Endura (5.5 oz) conferred a numerical reduction in white mold vs. Topsin (20 fl oz) in three of four studies, but statistical separation of these treatments of not observed (P < 0.05). Disease control was equivalent in one study.

Endura (5.5 oz) conferred a numerical increase in yield vs. Topsin (20 fl oz) in two of four studies, but statistical separation of these treatments of not observed (P < 0.05). Yield response was equivalent in one study.

The combined analysis showed a trend of slightly better disease control and increased yield with Endura (5.5 oz) vs. Topsin (20 fl oz), but statistical separation was not achieved.

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#### Topsin (20 fl oz) vs. Endura (8 oz) applied twice

Endura (8 oz) conferred a numerical reduction in white mold vs. Topsin (20 fl oz) in three of three studies, with statistical separation (P < 0.05) observed in one study.

Endura (8 oz) conferred a numerical increase in yield vs. Topsin (20 fl oz) in three of three studies, but statistical separation of these treatments was not observed (P < 0.05).

The combined analysis showed a trend of better disease control and increased yield with Endura (8 oz) vs. Topsin (20 fl oz), but statistical separation was not achieved.



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#### Topsin (40 fl oz) vs. Endura (5.5 oz) applied once

Endura (5.5 oz) conferred a numerical reduction in white mold vs. Topsin (40 fl oz) in five of six studies, but statistical separation was not observed.

Endura (5.5 oz) conferred a numerical increase in yield vs. Topsin (40 fl oz) in four of six studies, with statistical separation (P < 0.05) observed in one study. Yields were equivalent in one study.

The combined analysis showed a trend of better disease control and increased yield with Endura (5.5 oz) vs. Topsin (40 fl oz), but statistical separation between these treatments was not observed.

Carrington 2021 100% R2 95-100% coarse AIXR110015, 50 psi hand-boom 00.9 AG009X8	Oakes 2021 early R2 95-100% coarse AIXR110015, 50 psi hand-boom 0.9 AG09F0	Oakes 2021 early R2 95-100% coarse AIXR110015, 50 psi hand-boom 1.1 AG11X8	Carrington 2021 100% R2 95-100% coarse AIXR110015, 50 psi hand-boom 0.9 AG09F0	Oakes 2021 early R2 95-100% coarse AIXR110015, 50 psi hand-boom 0.6 AG06X8	Carrington 2021 100% R2 95-100% coarse AIXR110015, 50 psi hand-boom 0.6 AG06X8	AVERAGE 6 studies
<b>4</b> b	<mark>29</mark> a	<mark>34</mark> a	<mark>37</mark> b	<mark>38</mark> a	<mark>49</mark> b	<mark>32</mark> b
<b>2</b> ab	16 a	36 a	31 ab	42 a	37 ab	29 ab
ab	18 a	30 a	19 a	40 a	30 a	23 a
58 a	<mark>67</mark> a	68 a	41 b	60 a	<b>42</b> b	<mark>56</mark> b
60 a	66 a	68 a	43 b	58 a	<b>48</b> ab	57 ab
59 a	72 a	68 a	53 a	64 a	<b>55</b> a	62 a
Non-treated control	Non-treated control	Non-treated control	Non-treated control	Non-treated control	Non-treated control	Non-treated control
Topsin 40 fl oz/ac	Topsin 40 fl oz/ac	Topsin 40 fl oz/ac	Topsin 40 fl oz/ac	Topsin 40 fl oz/ac	Topsin 40 fl oz/ac	Topsin 40 fl oz/ac
Endura 5.5 oz/ac	Endura 5.5 oz/ac	Endura 5.5 oz/ac	Endura 5.5 oz/ac	Endura 5.5 oz/ac	Endura 5.5 oz/ac	Endura 5.5 oz/ac
	Carrington   2021   100% R2   95-100%   coarse   AIXR110015, 50 psi   hand-boom   00.9   AG009X8   Page   Carrington   203   a   b   cols   AG009X8   a   b   cols   cols	Carrington 2021Oakes 2021100% R2 95-100%early R2 95-100%95-100% coarsecoarse AIXR110015, 50 psi hand-boom 0.9AG009X8AG09F0QC <td< th=""><th>Carrington 2021Oakes 2021Oakes 2021Oakes 2021100% R2 95-100%early R2 95-100%early R2 95-100%early R2 95-100%early R2 95-100%20arse AlXR110015, 50 psi hand-boom 00.9AlXR110015, 50 psi hand-boom 0.9AlXR110015, 50 psi hand-boom 1.1 AG009X8AG09F0AlXR110015, 50 psi hand-boom 1.1 AG11X844</th><th>Carrington 2021Oakes 2021Carrington 2021Oakes 2021Carrington 2021100% R2 95-100%early R2 95-100%early R2 95-100%early R2 95-100%100% R2 95-100%95-100% coarse coarse coarsecoarse coarse coarsecoarse coarsecoarse coarsecoarse coarseAlXR110015, 50 psi hand-boom bosin 40 fl oz/ac c g g gg g g g g g g g gg g g g g g g g gg g g g g g g g g41010101010100.9 AG09X8AG09F0g g g g g gg g g g g gg g g g g gg g g g g g41010101010g g g gg g g g g gg g g g g g0.9 AG09X810101010g g g gg g g g gg g g g g gg g g g gg g g g g1010101010101010g g g gg g gg g g g gg g g101010101010101010g gg g10</th></td<> <th>Carrington 2021Oakes 2021Corrito 2021Control 2021Cont</th> <th>Carrington 2021Oakes 2021Carrington 2021Oakes 2021Carrington 2021Oakes 2021Carrington 2021Oakes 2021Carrington 2021Carrin</th>	Carrington 2021Oakes 2021Oakes 2021Oakes 2021100% R2 95-100%early R2 95-100%early R2 95-100%early R2 95-100%early R2 95-100%20arse AlXR110015, 50 psi hand-boom 00.9AlXR110015, 50 psi hand-boom 0.9AlXR110015, 50 psi hand-boom 1.1 AG009X8AG09F0AlXR110015, 50 psi hand-boom 1.1 AG11X844	Carrington 2021Oakes 2021Carrington 2021Oakes 2021Carrington 2021100% R2 95-100%early R2 95-100%early R2 95-100%early R2 95-100%100% R2 95-100%95-100% coarse coarse coarsecoarse coarse coarsecoarse coarsecoarse coarsecoarse coarseAlXR110015, 50 psi hand-boom bosin 40 fl oz/ac c g g gg g g g g g g g gg g g g g g g g gg g g g g g g g g41010101010100.9 AG09X8AG09F0g g g g g gg g g g g gg g g g g gg g g g g g41010101010g g g gg g g g g gg g g g g g0.9 AG09X810101010g g g gg g g g gg g g g g gg g g g gg g g g g1010101010101010g g g gg g gg g g g gg g g101010101010101010g gg g10	Carrington 2021Oakes 2021Corrito 2021Control 2021Cont	Carrington 2021Oakes 2021Carrington 2021Oakes 2021Carrington 2021Oakes 2021Carrington 2021Oakes 2021Carrington 2021Carrin

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#### Topsin (40 fl oz) f.b. Endura (5.5 oz) vs. Endura (5.5 oz) applied twice

Endura (5.5 oz) applied twice conferred a numerical reduction in white mold vs. Topsin (40 fl oz) f.b. Endura in 4 of 6 studies, but statistical separation of these treatments was not observed (P < 0.05). Disease control was equivalent in 1 of 6 studies.

Endura applied twice conferred a numerical increase in yield vs. Topsin f.b. Endura in 5 of 6 studies, but statistical separation of these treatments was not observed. Yields were equivalent in 1 of 6 studies.

The combined analysis showed a trend of slightly better disease control and increased yield with Endura (5.5 oz) applied twice vs. Topsin (40 fl oz) followed by Endura, but statistical separation between these treatments was not observed.

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# **Conclusions:**

The comparative efficacy results summarized in this report reflect fungicide performance when application timing and droplet size are optimized.

- If the canopy closed before early to full R2, applications were made at / shortly before canopy closure.
- If daytime highs were in the mid to upper 90s (°F), applications were delayed until daytime highs dropped to the upper 80s to low 90s.
- Nozzles and application pressures were selected to optimize droplet size relative to canopy closure.
- When TeeJet nozzles were utilized, medium droplets were utilized when average canopy closure was 80-90% and coarse droplets were utilized when average canopy closure was >90%.

Previous experience indicates that the fungicides with intermediate efficacy are most impacted when application timing and droplet size are not optimal.





# Thank You!

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