Improving management of white mold in dry beans: Comparative **fungicide efficacy:** Endura

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Improving white mold management in dry beans:
Comparative fungicide efficacy – methods

Market class = pinto in most studies; kidney in some studies

Row spacing = 14 inches in most studies

Seeding rate = 90,000 viable seeds/ac in most studies; sometimes 80,000 viable seeds/ac

Fungicide spray volume = 15 gal/ac.

Fungicides applied with a hand-held boom pressurized by CO_2.

Fungicide spray droplet size: fine or medium in studies conducted from 2010-2021; fine, medium or coarse, calibrated relative to canopy characteristics, from 2022-2024.

Number of fungicide applications: two

Application timing, first fungicide application: early bloom and initial pin pod-pod

Interval between fungicide applications: 7 to 14 days later, depending on study

Number of experimental replicates = 5 or 6 replicates (most studies)

White mold assessment: Assessed at/ near dry bean maturity by evaluating every plant individually in for percent of the plant impacted by white mold in a minimum half of the plot.

Harvest: To ensure that variability in dry bean standability did not bias yields, plants were clipped at base concurrent with disease assessments, wind-rowed to dry, and manually lifted into the combine.

Supplemental irrigation: Supplemental overhead irrigation was applied as needed to establish the white mold disease pressure needed to evaluate fungicide performance.

1. Fungicides and fungicide application rates that can be applied twice in-season

Testing was conducted with two sequential applications of the same fungicide with the goal of rigorously assessing comparative efficacy.

These comparative efficacy results are provided to help facilitate informed decisions for selecting products for application once or twice in-season, either alone or in rotation with another fungicide.

Comparative fungicide efficacy: white mold in dry edible beans

Two sequential applications of the same fungicide,
initial pin-pod + 12, 13 or 14 days later

Endura 8 oz/ac vs. **Omega** 13.6 fl oz/ac

Within-column means followed by different letters are significantly different. ($P < 0.05$).

Combined analysis across ten studies

Carrington and Langdon, ND (2012, 2013, 2014, 2023)

	WHITE MOLD Severity index % of canopy	**DRY BEAN YIELD** lbs/ac
Non-treated control	**49** b	**2268** b
Endura 8 oz/ac	**29** a	**2924** a
Omega 13.6 fl oz/ac	**25** a	**3005** a
CV:	23.2	9.5

Comparative fungicide efficacy: white mold in dry edible beans

Two sequential applications of the same fungicide,
initial pin-pod + 6-14 days later

Endura 8 oz/ac vs. **ProPulse** 10.3 fl oz/ac

Combined analysis across 20 studies

Carrington and Langdon, ND (2012, 2013, 2014, 2017, 2020, 2021, 2022, 2023, 2024)

	WHITE MOLD Severity index % of canopy	**DRY BEAN YIELD** lbs/ac
Non-treated control	**49** b	**2166** b
Endura 8.0 oz/ac	**35** a	**2764** a
ProPulse 10.3 fl oz/ac	**36** a	**2689** a
CV:	14.2	7.4

Within-column means followed by different letters are significantly different. ($P < 0.05$; Tukey procedure).

Comparative fungicide efficacy: white mold in dry edible beans

Two sequential applications of the same fungicide,
initial pin-pod + 11-13 days later

Endura 8 oz/ac vs. **ProPulse** 8.6 fl oz/ac

Combined analysis across ten studies
Carrington and Langdon, ND (2012, 2013, 2014, 2023)

	WHITE MOLD Severity index % of canopy	**DRY BEAN YIELD** lbs/ac
Non-treated control	**52** b	**2300** b
Endura 8.0 oz/ac	**32** a	**2924** a
ProPulse 8.6 fl oz/ac	**39** a	**2741** a
CV:	16.8	7.6

Within-column means followed by different letters are significantly different. ($P < 0.05$; Tukey procedure).

Comparative fungicide efficacy: white mold in dry edible beans

Two sequential applications of the same fungicide,
initial pin-pod + 12 or 13 days later

Topsin 30 fl oz/ac vs. **Omega** 8 fl oz/ac

Combined analysis across three studies
Carrington and Langdon, ND (2014)

Within-column means followed by different letters are significantly different. ($P < 0.05$).

	WHITE MOLD Severity index % of canopy	**DRY BEAN YIELD** lbs/ac
Non-treated control	**63** c	**1813** c
ProPulse 10.3 fl oz/ac	**46** b	**2373** b
Topsin 30 fl oz/ac	**40** ab	**2508** ab
Omega 8 fl oz/ac	**37** ab	**2510** ab
Endura 8 oz/ac	**37** ab	**2584** ab
Omega 13.6 fl oz/ac	**25** a	**2914** a
CV:	13.2	6.5

Comparative fungicide efficacy: white mold in dry edible beans

Two sequential applications of the same fungicide,
initial pin-pod + 12-14 days later

Topsin 30 fl oz/ac vs. **Endura** 8 oz/ac

Combined analysis across 13 studies

Carrington and Langdon, ND (2012, 2013, 2014, 2020, 2022, 2023)

	WHITE MOLD Severity index % of canopy	**DRY BEAN YIELD** lbs/ac
Non-treated control	**60** b	**2158** b
Topsin 30 fl oz/ac	**44** a	**2632** a
Endura 8.0 oz/ac	**39** a	**2767** a
CV:	16.0	7.0

Within-column means followed by different letters are significantly different (P < 0.05; Tukey procedure).

Comparative fungicide efficacy: white mold in dry edible beans

Two sequential applications of same fungicide vs. fungicide rotation,
initial pin-pod + 11, 12 or 13 days later

Endura 8 oz/ac applied alone versus

Endura 8 oz plus **Badge** 2 pt/ac

Combined analysis across three studies
Carrington, ND (2019, 2020, 2022)

	WHITE MOLD Severity index % of canopy	**DRY BEAN YIELD** lbs/ac
Non-treated control	**67** b	**2177** b
Endura 8.0 oz/ac	**45** a	**2881** a
Endura 8 oz/ac + **Badge** 2 pt/ac	**44** a	**3010** a
CV:	12.1	7.4

Within-column means followed by different letters are significantly different (P < 0.05; Tukey procedure).

Comparative fungicide efficacy: white mold in dry edible beans

Two sequential applications of the same fungicide,
initial pin-pod + 13 or 14 days later

Endura 8 oz/ac vs. **Miravis Neo** 13.7 fl oz/ac

Combined analysis across five studies
Carrington, ND (2019, 2022, 2023, 2024)

	WHITE MOLD Severity index % of canopy	**DRY BEAN YIELD** lbs/ac
Non-treated control	**70** b	**1776** b
Endura 8.0 oz/ac	**58** a	**2466** a
Miravis Neo 13.7 fl oz/ac	**69** b	**1901** b
CV:	10.3	7.4

Within-column means followed by different letters are significantly different. ($P < 0.05$; Tukey procedure).

Comparative fungicide efficacy: white mold in dry edible beans

Two sequential applications of the same fungicide,
initial pin-pod + 11, 13 or 14 days later

Endura 8 oz/ac vs. **Aproach** 12 fl oz/ac

Combined analysis across seven studies

Carrington and Langdon, ND (2010, 2012, 2013)

	WHITE MOLD Severity index % of canopy	**DRY BEAN YIELD** lbs/ac
Non-treated control	**48** b	**2496** b
Endura 8 oz/ac	**26** a	**3117** a
Aproach 12 fl oz/ac	**41** b	**2643** b
CV:	22.1	5.9

Within-column means followed by different letters are significantly different. ($P < 0.05$; Tukey procedure).

Comparative fungicide efficacy: white mold in dry edible beans

Two sequential applications of the same fungicide,
initial pin-pod + 6-14 days later

Endura 8 oz vs. **Proline** 5.7 fl oz

Combined analysis across nine studies
Carrington and Langdon, ND (2012, 2013, 2019)

	WHITE MOLD Severity index % of canopy	**DRY BEAN YIELD** lbs/ac
Non-treated control	**45** b	**2530** b
Endura 8 oz/ac	**20** a	**3158** a
Proline 5.7 fl oz/ac	**39** b	**2797** b
CV:	23.0	8.4

Within-column means followed by different letters are significantly different. ($P < 0.05$; Tukey procedure).

Comparative fungicide efficacy: white mold in dry edible beans

Two sequential applications of the same fungicide,
initial pin-pod + 13-14 days later

Quash 2.5 oz vs. **Endura** 8 oz

Combined analysis across four studies
Langdon and Carrington, ND (2012, 2013)

	WHITE MOLD Severity index % of canopy	**DRY BEAN YIELD** lbs/ac
Non-treated control	**40** b	**2608** b
Endura 8.0 oz/ac	**23** a	**3178** a
ProPulse 10.3 fl oz/ac	**21** a	**3244** a
Quash 2.5 oz/ac	**36** b	**2751** b
CV:	13.8	5.3

Within-column means followed by different letters are significantly different. ($P < 0.05$; Tukey procedure).

Comparative fungicide efficacy: white mold in dry edible beans

Two sequential applications or the same fungicide,
initial pin-pod + 11 or 14 days later

Quash 4 oz vs. **Endura** 8 oz

Combined analysis across two studies
Carrington, ND (2010, 2013)

	WHITE MOLD Severity index % of canopy	**DRY BEAN YIELD** lbs/ac
Non-treated control	**60** b	**2439** b
Endura 8 oz/ac	**40** a	**3312** a
Quash 4 oz/ac	**56** b	**2623** b
CV:	6.9	4.1

Within-column means followed by different letters are significantly different. ($P < 0.05$; Tukey procedure).

Comparative fungicide efficacy: white mold in dry edible beans

Two sequential applications of the same fungicide,
initial pin-pod + 13-14 days later

Rovral 2 pt vs. **Switch** 14 oz vs. **Endura** 8 oz

Combined analysis across four studies
Carrington and Langdon, ND (2012, 2013)

	WHITE MOLD Severity index % of canopy	**DRY BEAN YIELD** lbs/ac
Non-treated control	**40** b	**2608** b
Endura 8.0 oz/ac	**23** a	**3178** a
ProPulse 10.3 fl oz/ac	**21** a	**3244** a
Rovral 2.0 pt/ac	**27** a	**3015** a
Switch 14 oz/ac	**26** a	**2979** a
CV:	17.7	4.4

Within-column means followed by different letters are significantly different. ($P < 0.05$; Tukey procedure).

Comparative fungicide efficacy: white mold in dry edible beans

Two sequential applications of the same fungicide,
initial pin-pod + 11 or 13 days later

Vertisan 20 or 24 fl oz vs. **Endura** 8 oz

Combined analysis across three studies
Carrington and Langdon, ND (2010, 2012)

	WHITE MOLD Severity index % of canopy	**DRY BEAN YIELD** lbs/ac
Non-treated control	**42** b	**2973** b
Endura 8 oz/ac	**24** a	**3481** a
Vertisan 20 or 24 fl oz/ac	**39** b	**3165** ab
CV:	11.2	4.5

Within-column means followed by different letters are significantly different. ($P < 0.05$; Tukey procedure).

Comparative fungicide efficacy: white mold in dry edible beans

Two fungicide applications,
initial pin-pod + 7, 12 or 13 days later

Endura 8 oz applied twice vs. **Endura** 8 oz followed by **Priaxor** 4 fl oz

Combined analysis across five studies
Carrington, ND (2012, 2014, 2019, 2020, 2024)

	WHITE MOLD Severity index % of canopy	**DRY BEAN YIELD** lbs/ac
Non-treated control	**51** b	**2227** a
Endura 8.0 oz/ac	**38** a	**2584** a
Endura 8.0 oz/ac / **Priaxor** 4 fl oz/ac	**43** ab	**2389** a
CV:	10.8	8.3

Within-column means followed by different letters are significantly different. ($P < 0.05$; Tukey procedure).

2. Fungicides and fungicide application rates that can only be applied once in-season

Testing was conducted with two sequential applications of Topsin/generic at 40 fl oz/ac in order to fit the testing within existing protocols in which products were applied twice sequentially.

Comparative efficacy results are provided for Topsin/generic at 40 fl oz/ac to help facilitate informed decisions for selecting products **for application once in-season, either as a single application or in rotation with another fungicide.**

Comparative fungicide efficacy: white mold in dry edible beans

Topsin, 40 fl oz/ac vs. **Endura,** 8 oz/ac

Combined analysis across five studies

Carrington and Langdon, ND (2012, 2023, 2024)

	WHITE MOLD Severity index % of canopy	**DRY BEAN YIELD** lbs/ac
Non-treated control	**50** b	**2249** c
Topsin 40 fl oz/ac	**32** a	**3025** a
Endura 8.0 oz/ac	**34** a	**2724** b
CV:	20.1	5.9

Within-column means followed by different letters are significantly different

($P < 0.05$; Tukey procedure).

Read the label for Topsin/generic carefully.

The labels for some brands of the flowable formulation of thiophanate-methyl explicity state that the product can only be applied once per season at 40 fl oz/ac. When applied twice, the maximum application rate is 30 fl oz/ac.

The labels for other brands of the flowable formulation of thiophanate-methyl lack explicit language prohibiting two applications at 40 fl oz/ac but indicate a usage rate of 30-40 fl oz/ac when applied once and 20-30 fl oz/ac when applied two or more times (max. 80 fl oz/ac). **Two applications at 40 fl oz/ac in the same season should be considered off-label.**

In these studies, same fungicide was applied twice sequentially 6-13 days apart in order to fit the testing within existing protocols in which products were applied twice sequentially. Comparative efficacy data of Topsin/generic applied at 40 fl oz/ac are provided to inform decision-making when applying Topsin/generic once during the season, either as a stand-alone application or in rotation with another fungicide.

Comparative fungicide efficacy: white mold in dry edible beans

Two sequential applications of same fungicide vs. fungicide rotation,
initial pin-pod + 12-14 days later

Endura 8 oz/ac applied twice versus

Topsin 40 fl oz/ac f.b. **Endura** 8 oz/ac

Combined analysis across nine studies

Carrington and Langdon, ND (2012, 2013, 2014, 2022)

	WHITE MOLD Severity index % of canopy	**DRY BEAN YIELD** lbs/ac
Non-treated control	**56** b	**2158** b
Topsin 40 fl oz / **Endura** 8 oz/ac	**37** a	**2953** a
Endura 8.0 oz/ac	**36** a	**2847** a
CV:	13.9	6.3

Within-column means followed by different letters are significantly different (P < 0.05; Tukey procedure).

Comparative fungicide efficacy: white mold in dry edible beans

Two sequential applications of same fungicide vs. fungicide rotation,
initial pin-pod + 12-14 days later

Optimal sequence for rotating

Topsin 40 fl oz/ac and **Endura** 8 oz/ac

Combined analysis across seven studies

Carrington and Langdon, ND (2012, 2014)

	WHITE MOLD Severity index % of canopy	**DRY BEAN YIELD** lbs/ac
Non-treated control	**50** b	**2267** b
Topsin 40 fl oz / **Endura** 8 oz/ac	**28** a	**3122** a
Endura 8 oz / **Topsin** 40 fl oz/ac	**31** a	**3068** a
Endura 8.0 oz/ac	**29** a	**2924** a
CV:	16.2	5.2

Within-column means followed by different letters are significantly different (P < 0.05; Tukey procedure).

Improving white mold management in dry beans:

Comparative fungicide efficacy versus Endura

Conclusions from comparative efficacy testing

Most effective fungicides: two applications/season
Omega at 13.6 fl oz/ac, Endura at 8 oz/ac, ProPulse at 10.3 fl oz/ac, Topsin at 30 fl oz/ac

Most effective fungicides: if only a single application is made
Omega at 13.6 fl oz/ac, Topsin at 40 fl oz/ac, Endura at 8 oz/ac, ProPulse at 10.3 fl oz/ac

Optimal fungicide rotation sequence with Topsin/generic
Topsin applied first, Endura applied second

Less effective fungicides
Proline at 5.7 fl oz, Quash at 2.5 or 4.0 oz, Miravis Neo 13.6 fl oz/ac, Rovral 2 pt/ac, Switch 14 oz/ac, Priaxor 4 fl oz/ac




People

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