

Improving white mold management in dry beans:

Comparative fungicide efficacy – general methods

Michael Wunsch, Jesse Hafner, Suanne Kallis, Aaron Fauss, Thomas Miorini, Billy Kraft, Michael Schaefer
North Dakota State University Carrington Research Extension Center

Scott Halley and Amanda Arens, NDSU Langdon Research Extension Center

Questions should be directed to Michael Wunsch (michael.wunsch@ndsu.edu, 701-652-2951)

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

Row spacing = 14 inches in most studies; 28 inches in some 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 CO₂.

Fungicide spray droplet size: fine or medium in studies conducted from 2010-2021; fine, medium or coarse, calibrated relative to canopy density and lodging, 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 or near dry bean maturity by evaluating every plant individually in for the percent of the plant impacted by white mold.

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.

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Endura: active ingredient, boscalid (FRAC 7)

Omega: active ingredient, fluazinam (FRAC 29)

Endura 8 oz versus Omega 13.6 fl oz

Two sequential applications of the same fungicide (early bloom/pin-pod + 12, 13, or 14 days apart)

	location	Carrington	Langdon	Langdon	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington
	year	2012	2014	2012	2013	2012	2013	2014	2014	2023
	days between applications	13	12	13	14	13	14	12	12	13
nozzles, pressure, first fungicide	XR8001	XR8001	AI11002	XR8001	XR8001	XR8001	XR8001	XR8001	XR8001	DG110015
application	35 psi	40 psi	40 psi	35 psi	35 psi	35 psi	35 psi	35 psi	35 psi	30 psi
nozzles, pressure, 2 nd fungicide	XR8001	XR8001	AI11002	XR8001	XR8001	XR8001	XR8001	XR8001	XR8001	AIXR110015
application	35 psi	40 psi	40 psi	35 psi	35 psi	35 psi	35 psi	35 psi	35 psi	60 psi
droplet size, applic. #1	fine	fine	extra coarse	fine	fine	fine	fine	fine	fine	medium
droplet size, applic. #2	fine	fine	extra coarse	fine	fine	fine	fine	fine	fine	medium
market class	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto	DR Kidney
variety	'Maverick'	'Lariat'	'Maverick'	'Lariat'	'Othello'	'Lariat'	'Lariat'	'Lariat'	'Lariat'	'Red hawk'
row spacing	30 inches	30 inches	30 inches	28 inches	14 inches	14 inches	14 inches	14 inches	14 inches	14 inches

WHITE MOLD SEVERITY (% of canopy)

Non-treated control	24 b	33 b	36 a	45 b	46 b	54 b	72 b	83 b	34 a	65 b
Endura 8 oz/ac	2 a	12 ab	25 a	37 b	10 a	28 a	48 a	51 a	22 a	50 ab
Omega 13.6 fl oz/ac	10 ab	10 a	21 a	23 a	30 ab	36 a	31 a	33 a	13 a	41 a
CV:	78.4	20.5	2.24	31.1	35.3	32.7	9.0	13.9	42.8	4.9

YIELD (lbs/ac)

Non-treated control	2906 a	1188 b	3593 a	1949 b	2271 a	1984 b	2245 b	2004 b	2579 b	1963 b
Endura 8 oz/ac	3154 a	1844 a	4115 a	2656 a	3009 a	2789 a	3088 a	2819 a	2994 ab	2774 ab
Omega 13.6 fl oz/ac	3685 a	1929 a	3632 a	2701 a	2310 a	2783 a	3370 a	3444 a	3182 a	3018 a
CV:	12.4	14.1	0.72	9.9	19.6	9.4			9.5	16.3

White mold (%)		Yield (lbs/ac)		COMBINED ANALYSIS 10 studies
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	

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Endura: active ingredient, boscalid (FRAC 7) Omega: fluazinam (FRAC 29)

Topsin: thiophanate-methyl (FRAC 1) ProPulse: prothioconazole (FRAC 3) + fluopyram (FRAC 7)

Omega 8 or 13.6 fl oz versus Endura 8 oz, Topsin 30 fl oz, ProPulse 10.3 fl oz

Two sequential applications of the same fungicide (early bloom/pin-pod + 12 days apart)

location	Langdon	Carrington	Carrington	COMBINED ANALYSIS 3 studies
year	2014	2014	2014	
days between applications	12	12	12	
nozzles, pressure, 1 st application	XR8001, 40 psi	XR8001, 35 psi	XR8001, 35 psi	
nozzles, pressure, 2 nd application	XR8001, 40 psi	XR8001, 35 psi	XR8001, 35 psi	
droplet size	fine	fine	fine	
variety	'Lariat' pinto	'Lariat' pinto	'Lariat' pinto	
row spacing	30 inches	14 inches	14 inches	
WHITE MOLD SEVERITY (% of canopy)				White mold (%)
Non-treated control	33 b	72 c	83 c	63 c
ProPulse 10.3 fl oz/ac	25 ab	50 b	62 b	46 b
Topsin 30 fl oz/ac	14 ab	46 ab	59 b	40 ab
Omega 8 fl oz/ac	13 ab	40 ab	57 b	37 ab
Endura 8 oz/ac	12 ab	48 ab	51 ab	37 ab
Omega 13.6 fl oz/ac	10 a	31 a	33 a	25 a
CV:	20.5	9.0	13.9	13.2
YIELD (lbs/ac)				Yield (lbs/ac)
Non-treated control	1188 b	2245 c	2004 c	1813 c
ProPulse 10.3 fl oz/ac	1741 a	2770 bc	2608 bc	2373 b
Topsin 30 fl oz/ac	1944 a	2924 ab	2657 abc	2508 ab
Omega 8 fl oz/ac	1646 ab	3122 ab	2763 abc	2510 ab
Endura 8 oz/ac	1844 a	3088 ab	2819 ab	2584 ab
Omega 13.6 fl oz/ac	1929 a	3370 a	3444 a	2914 a
CV:	14.1			6.5

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Topsin: active ingredient, thiophanate-methyl (FRAC 1) Endura: bosacilid (FRAC 7)

location	Carrington	Langdon	Langdon	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington
year	2012	2014	2012	2012	2014	2020	2014	2012	2013	2014	2022	2022	2023
days between applications	13	12	13	13	12	13	12	13	14	13	12	12	13
nozzles, pressure, first fungicide application	XR8001 35 psi	XR8001 40 psi	AI11002 40 psi	XR8001 35 psi	XR8001 35 psi	AIXR110015 50 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	DG110015 40 psi	DG110015 40 psi	DG110015 30 psi
nozzles, pressure, 2 nd fungicide application	XR8001 35 psi	XR8001 40 psi	AI11002 40 psi	XR8001 35 psi	XR8001 35 psi	AIXR110015 50 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	AIXR110015 60 psi	AIXR110015 60 psi	AIXR110015 60 psi
droplet size, applic. #1	fine	fine	extra-coarse	fine	fine	medium	fine	fine	fine	fine	fine	fine	medium
droplet size, applic. #2	fine	fine	extra-coarse	fine	fine	medium	fine	fine	fine	fine	medium	medium	medium
market class	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto
variety	'Maverick'	'Lariat'	'Maverick'	'Othello'	'Lariat'	'Palomino'	'Lariat'	'Maverick'	'Lariat'	'ND-307'	'Lariat'	'Lariat'	'Vibrant'
row spacing	30 inches	30 inches	30 inches	14 inches	14 inches	14 inches	14 inches	15 inches	14 inches	14 inches	14 inches	14 inches	14 inches

WHITE MOLD SEVERITY (% of canopy)

Non-treated control	24 b	33 a	36 a	46 b	72 b	74 a	83 b	56 c	54 b	74 a	90 b	91 b	48 a
Topsin 30 fl oz/ac	5 ab	14 a	21 a	35 ab	46 a	71 a	59 a	16 b	44 ab	61 a	81 ab	88 b	32 a
Endura 8.0 oz/ac	2 a	12 a	25 a	10 a	48 a	55 a	51 a	5 a	36 a	63 a	76 a	81 a	46 a
CV:	78.4	20.5	2.24	35.3	9.0	16.4	13.9	8.2	15.0	14.9	8.1	4.1	26.8

YIELD (lbs/ac)

Non-treated control	2906 a	1188 b	3593 a	2271 a	2245 b	1842 a	2004 b	2162 b	2459 b	1992 b	1498 b	1151 b	2737 a
Topsin 30 fl oz/ac	3174 a	1944 a	3916 a	2602 a	2924 a	2170 a	2657 ab	2682 ab	3063 a	2308 ab	2104 a	1369 b	3304 a
Endura 8.0 oz/ac	3154 a	1844 a	4115 a	3009 a	3088 a	2692 a	2819 a	2750 a	3185 a	2151 b	2478 a	1845 a	2844 a
CV:	12.4	14.1	0.72	19.6	0.7	18.4	0.7	14.8	9.6	10.8	17.2	14.4	14.9

White mold (%)	Yield (lbs/ac)	COMBINED ANALYSIS	13 studies	Topsin, 30 fl oz/ac versus Endura, 8 oz/ac Two sequential applications of the same fungicide (early bloom/pin-pod + 12, 13, or 14 days apart)
Non-treated control	60 b			
Topsin 30 fl oz/ac	44 a			
Endura 8.0 oz/ac	39 a			
CV:	16.0			

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Endura: active ingredient, boscalid (FRAC 7) Badge SC: copper oxychloride + copper hydroxide

Endura 8 oz versus Endura 8 oz + Badge 2 pt

Two sequential applications of the same fungicide (early bloom/pin-pod + 11, 12 or 13 days apart)

	location Carrington	Carrington	Carrington	COMBINED ANALYSIS 3 studies
	year 2020	2019	2022	
days between applications	13	14	12	
nozzles, pressure, 1 st application	AIXR110015, 60 psi	AIXR110015, 50 psi	DG110015, 40 psi	
nozzles, pressure, 2 nd application	AIXR110015, 50 psi	XR11002, 30 psi	AIXR110015, 60 psi	
droplet size	medium, medium	medium, fine	fine, medium	
variety	'Palomino' pinto	'Palomino' pinto	'Lariat' pinto	
row spacing	14 inches	14 inches	14 inches	
WHITE MOLD SEVERITY (% of canopy)				White mold (%)
Non-treated control	74 b	37 b	90 b	67 b
Endura 8.0 oz/ac	55 ab	5 a	76 a	45 a
Endura 8 oz/ac + Badge 2 pt/ac	51 a	3 a	79 ab	44 a
CV:	16.4	36.5	8.1	12.1
YIELD (lbs/ac)				Yield (lbs/ac)
Non-treated control	1842 b	3190 a	1498 b	2177 b
Endura 8.0 oz/ac	2692 ab	3472 a	2478 a	2881 a
Endura 8 oz/ac + Badge 2 pt/ac	2886 a	3755 a	2387 a	3010 a
CV:	18.4	10.0	17.2	7.4

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Endura: active ingredient, boscalid (FRAC 7) ProPulse: prothioconazole (FRAC 3) + fluopyram (FRAC 7)

location	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	Langdon	Langdon	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington
year	2017	2017	2021	2021	2017	2012	2014	2012	2013	2013	2013	2014	2020	2014	2022	2022	2022	2023	2024	2023
days between applications	10	10	10	10	10	13	12	13	14	14	11	12	13	12	14	14	12	12	7	6
nozzles, pressure, first fungicide application	DG110015 35 psi	DG110015 35 psi	DG110015 30 psi	DG110015 30 psi	DG110015 35 psi	XR8001 35 psi	XR8001 40 psi	AI11002 40 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	AIXR110015 60 psi	XR8001 35 psi	DG110015 40 psi	DG110015 40 psi	DG110015 40 psi	DG110015 30 psi	DG110015 30 psi	DG110015 30 psi
nozzles, pressure, 2 nd fungicide application	DG110015 35 psi	DG110015 35 psi	DG110015 30 psi	DG110015 30 psi	DG110015 35 psi	XR8001 35 psi	XR8001 40 psi	AI11002 40 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	AIXR110015 50 psi	XR8001 35 psi	AIXR110015 60 psi	AIXR110015 60 psi	AIXR110015 60 psi	AIXR110015 60 psi	AIXR110015 60 psi	AIXR110015 60 psi
droplet size, applic. #1	medium	medium	medium	medium	medium	fine	fine	extra coarse	fine	fine	fine	fine	medium	fine	fine	fine	fine	medium	medium	medium
droplet size, applic. #2	medium	medium	medium	medium	medium	fine	fine	extra coarse	fine	fine	fine	fine	medium	fine	medium	medium	medium	medium	medium	medium
market class	DR kidney	DR kidney	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto	LR kidney	pinto	pinto	pinto	pinto
variety	'Talon'	'Talon'	'Palomino'	'Palomino'	'La Paz'	'Maverick'	'Lariat'	'Maverick'	'Lariat'	'Lariat'	'Lariat'	'Lariat'	'Palomino'	'Lariat'	'Lariat'	'Rosie'	'Lariat'	'Vibrant'	'Vibrant'	'Vibrant'
row spacing	14 inches	28 inches	14 inches	14 inches	14 inches	30 inches	30 inches	30 inches	28 inches	14 inches	14 inches	14 inches	14 inches	14 inches	14 inches	14 inches	14 inches	14 inches	14 inches	14 inches

WHITE MOLD SEVERITY (% of canopy)

Non-treated control	6 a	7 a	9 a	15 a	21 a	24 b	33 a	36 a	45 b	54 b	55 a	72 b	74 a	83 b	92 c	60 b	90 b	56 a	70 a	73 a
Endura 8.0 oz/ac	4 a	5 a	6 a	7 a	10 a	2 a	12 a	25 a	37 ab	28 a	33 a	48 a	55 a	51 a	83 a	37 a	76 a	44 a	66 a	67 a
ProPulse 10.3 fl oz/ac	5 a	2 a	3 a	6 a	10 a	6 ab	25 a	17 a	30 a	30 a	44 a	50 a	68 a	62 a	88 ab	46 a	81 ab	30 a	62 a	58 a
CV:	70.8	90.9	39.5	35.2	50.7	78.4	20.5	2.24	31.1	32.7	18.0	9.0	16.4	13.9	4.8	14.2	8.1	26.3	10.5	16.1

YIELD (lbs/ac)

Non-treated control	2469 a	2887 a	2600 b	2562 a	2991 a	2906 a	1188 b	3593 a	1949 b	1984 b	2258 b	2245 b	1842 a	2004 b	1286 b	2267 b	1498 b	2327 b	1226 a	1247 b
Endura 8.0 oz/ac	2955 a	2916 a	2768 ab	2778 a	3311 a	3154 a	1844 a	4115 a	2656 a	2789 a	3296 a	3088 a	2692 a	2819 a	2147 a	3010 a	2478 a	3128 a	1578 a	1765 ab
ProPulse 10.3 fl oz/ac	2678 a	2812 a	3068 a	2782 a	3357 a	3191 a	1741 a	4435 a	2549 a	2802 a	2895 ab	2770 ab	2369 a	2608 ab	1745 ab	2702 a	2162 a	3426 a	1736 a	1958 a
CV:	10.8	5.1	8.1	9.8	10.7	12.4	14.1	0.72	9.9	9.4	11.1	0.7	18.4	0.7	16.4	7.4	17.2	14.8	16.0	17.1

White mold (%)	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																		

COMBINED ANALYSIS
20 studies

Endura 8 oz versus ProPulse 10.3 fl oz

Two sequential applications of the same fungicide (early bloom/pin-pod + 6, 7, 10, 11, 12, 13, or 14 days apart)

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Endura: active ingredient, boscalid (FRAC 7) ProPulse: prothioconazole (FRAC 3) + fluopyram (FRAC 7)

Endura 8 oz versus ProPulse 8.6 fl oz

Two sequential applications of the same fungicide (early bloom/pin-pod + 11, 12, or 13 days apart)

location	Carrington	Langdon	Langdon	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	COMBINED ANALYSIS 10 studies
year	2012	2014	2012	2012	2013	2014	2014	2014	2023	2023	
days between applications	13	12	13	13	11	12	12	13	13	13	
nozzles, pressure, first fungicide application	XR8001 35 psi	XR8001 40 psi	AI11002 40 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	DG110015 30 psi	DG110015 30 psi	
nozzles, pressure, 2 nd fungicide application	XR8001 35 psi	XR8001 40 psi	AI11002 40 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	AIXR110015 60 psi	AIXR110015 60 psi	
droplet size, applic. #1	fine	fine	extra coarse	fine	fine	fine	fine	fine	medium	medium	
droplet size, applic. #2	fine	fine	extra coarse	fine	fine	fine	fine	fine	medium	medium	
market class	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto	DR kidney	pinto	
variety	'Maverick'	'Lariat'	'Maverick'	'Othello'	'Lariat'	'Lariat'	'Lariat'	'Lariat'	'ND-307'	'Red hawk'	
row spacing	30 inches	30 inches	30 inches	14 inches	14 inches	14 inches	14 inches	14 inches	14 inches	14 inches	
WHITE MOLD SEVERITY (% of canopy)											White mold (%)
Non-treated control	24 b	33 a	36 a	46 b	55 a	72 b	83 b	74 b	34 a	65 a	52 b
Endura 8.0 oz/ac	2 a	12 a	25 a	10 a	33 a	48 a	51 a	63 ab	22 a	50 a	32 a
ProPulse 8.6 fl oz/ac	2 a	23 a	20 a	43 ab	47 a	57 ab	65 ab	48 a	26 a	56 a	39 a
CV:	78.4	20.5	2.24	35.3	18.0	9.0	13.9	14.9	42.8	4.9	16.8
YIELD (lbs/ac)											Yield (lbs/ac)
Non-treated control	2906 a	1188 b	3593 a	2271 a	2258 b	2245 b	2004 b	1992 a	2579 a	1963 a	2300 b
Endura 8.0 oz/ac	3154 a	1844 a	4115 a	3009 a	3296 a	3088 a	2819 a	2151 a	2994 a	2774 a	2924 a
ProPulse 8.6 fl oz/ac	2898 a	1652 ab	4179 a	2291 a	2679 ab	2738 ab	2793 ab	2474 a	3037 a	2664 a	2741 a
CV:	12.4	14.1		19.6	11.1			10.8	9.5	16.3	7.6

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Endura: active ingredient, boscalid (FRAC 7) Miravis Neo: azoxystrobin (FRAC 11), propiconazole (FRAC 3), pydiflumetofen (FRAC 7)

Miravis Neo (13.7 fl oz) versus Endura (8 oz)

Two sequential applications of the same fungicide (early bloom/pin-pod + 13 or 14 days apart)

location	Carrington	Carrington	Carrington	Carrington	Carrington	COMBINED ANALYSIS 5 studies
year	2019	2022	2022	2023	2024	
canopy closure, 1 st application		95-97%	90-95%	90-95%	85-95%	
days between applications	12	14	14	12	7	
nozzles, pressure, first fungicide application	AIXR110015 50 psi	DG110015 40 psi	DG110015 40 psi	DG110015 30 psi	DG110015 30 psi	
nozzles, pressure, 2 nd fungicide application	XR11002 X 30 psi	AIXR110015 60 psi	AIXR110015 60 psi	AIXR110015 60 psi	AIXR110015 60 psi	
droplet size, applic. #1	medium	fine	fine	medium	medium	
droplet size, applic. #2	fine	medium	medium	medium	medium	
market class	pinto	pinto	LR kidney	pinto	pinto	
variety	'Palomino'	'Lariat'	'Rosie'	'Vibrant'	'Vibrant'	
row spacing	14 inches	14 inches	14 inches	14 inches	14 inches	
WHITE MOLD SEVERITY (% of canopy)						White mold (%)
Non-treated control	25 b	92 b	60 b	56 a	70 a	70 b
Endura 8.0 oz/ac	3 a	83 a	37 a	44 a	66 a	58 a
Miravis Neo 13.7 fl oz/ac	20 b	92 b	64 b	55 a	66 a	69 b
CV:	25.6	4.8	14.2	26.3	10.5	10.3
YIELD (lbs/ac)						Yield (lbs/ac)
Non-treated control	3510 a	1286 b	2267 b	2327 b	1226 a	1776 b
Endura 8.0 oz/ac	3838 a	2147 a	3010 a	3128 a	1578 a	2466 a
Miravis Neo 13.7 fl oz/ac	3317 a	1361 b	2209 b	2555 ab	1478 a	1901 b
CV:	9.7	16.4	7.4	14.8	16.0	7.4

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Endura: active ingredient, boscalid (FRAC 7) Aproach: picoxystrobin (FRAC 11)

Endura 8 oz versus Aproach 12 fl oz

Two sequential applications of the same fungicide (early bloom/pin-pod + 11, 13, or 14 days apart)

	location	Carrington	Langdon	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	COMBINED ANALYSIS 7 studies
	year	2012	2012	2013	2013	2010	2012	2013	2019	
	days between applications	13	13	14	14	11	13	14	14	
	nozzles, pressure, first fungicide application	XR8001 35 psi	AI11002 40 psi	XR8001 35 psi	XR8001 35 psi	XR80015 35 psi	XR8001 35 psi	XR8001 35 psi	AIXR110015 50 psi	
	nozzles, pressure, 2 nd fungicide application	XR8001 35 psi	AI11002 40 psi	XR8001 35 psi	XR8001 35 psi	XR80015 35 psi	XR8001 35 psi	XR8001 35 psi	XR11002 30 psi	Approach @ 12 fl oz/ac
	droplet size, applic. #1	fine	extra coarse	fine	fine	fine	fine	fine	medium	
	droplet size, applic. #2	fine	extra coarse	fine	fine	fine	fine	fine	fine	
	market class	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto	
	variety	'Maverick'	'Maverick'	'Lariat'	'Lariat'	'Lariat'	'Maverick'	'Lariat'	'Palomino'	
	row spacing	30 inches	30 inches	28 inches	14 inches	15 inches	15 inches	14 inches	14 inches	White mold (%)
WHITE MOLD SEVERITY (% of canopy)										
Non-treated control		24 b	36 a	45 a	54 b	66 b	56 b	54 b	37 b	
Endura 8 oz/ac		2 a	25 a	37 a	28 a	46 a	5 a	36 a	5 a	
Approach 8 fl oz/ac		65 b								
Approach 9 fl oz/ac		57 b								
Approach 10 fl oz/ac		38 b								
Approach 12 fl oz/ac		9 ab	34 a	38 a	37 a	69 b	42 b	59 b	41 b	
CV:		78.4	2.24	31.1	32.7		8.2	15.0	36.5	
YIELD (lbs/ac)										
Non-treated control		2906 a	3593 a	1949 b	1984 b	2419 a	2162 b	2459 b	3190 a	
Endura 8 oz/ac		3154 a	4115 a	2656 a	2789 a	3172 a	2750 a	3185 a	3472 a	
Approach 8 fl oz/ac		2237 a								
Approach 9 fl oz/ac		2020 b								
Approach 10 fl oz/ac		3529 a								
Approach 12 fl oz/ac		3198 a	4005 a	1927 b	2168 b	2525 a	2183 b	2492 b	2643 b	
CV:		12.4	0.72	9.9	9.4		14.8	9.6	10.0	

Comparative fungicide efficacy: Management of white mold in dry edible beans

North Dakota State Univ. Carrington Research Extension Center; Michael Wunsch, Jesse Hafner, Suanne Kallis, Aaron Fauss, Michael Schaefer, Thomas Miorino, Billy Kraft

Endura: active ingredient, boscalid (FRAC 7) Proline: active ingredient, prothioconazole (FRAC 3)

Proline 5.7 fl oz versus Endura 8 oz

Two sequential applications of the same fungicide (early bloom/pin-pod + 6, 7, 10, 11, 12, 13, or 14 days apart)

location	Carrington	Langdon	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	COMBINED ANALYSIS 9 studies
year	2012	2012	2013	2012	2013	2013	2012	2013	2019	
days between applications	13	13	14	13	14	11	13	14	14	
nozzles, pressure, first fungicide application	XR8001 35 psi	AI11002 40 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	AIXR110015 50 psi	
nozzles, pressure, 2 nd fungicide application	XR8001 35 psi	AI11002 40 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR11002 30 psi	
droplet size, applic. #1	fine	extra coarse	fine	fine	fine	fine	fine	fine	medium	
droplet size, applic. #2	fine	extra coarse	fine	fine	fine	fine	fine	fine	fine	
market class	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto	pinto	
variety	'Maverick'	'Maverick'	'Lariat'	'Othello'	'Lariat'	'Lariat'	'Maverick'	'Lariat'	'Palomino'	
row spacing	30 inches	30 inches	28 inches	14 inches	14 inches	14 inches	15 inches	14 inches	14 inches	
WHITE MOLD SEVERITY (% of canopy)										White mold (%)
Non-treated control	24 b	36 a	45 a	46 b	54 b	55 a	56 b	54 b	37 b	45 b
Endura 8.0 oz/ac	2 a	25 a	37 a	10 a	28 a	33 a	5 a	36 a	5 a	20 a
Proline 5.7 fl oz/ac	14 ab	29 a	46 a	53 b	43 ab	52 a	40 b	48 ab	23 ab	39 b
CV:	78.4	2.24	31.1	35.3	32.7	18.0	8.2	15.0	36.5	23.0
YIELD (lbs/ac)										Yield (lbs/ac)
Non-treated control	2906 a	3593 a	1949 c	2271 a	1984 c	2258 b	2162 b	2459 b	3190 a	2530 b
Endura 8.0 oz/ac	3154 a	4115 a	2656 a	3009 a	2789 a	3296 a	2750 a	3185 a	3472 a	3158 a
Proline 5.7 fl oz/ac	3428 a	4012 a	2309 b	1982 a	2379 b	2441 b	2084 b	2843 ab	3698 a	2797 b
CV:	12.4	0.72	9.9	19.6	9.4	11.1	14.8	9.6	10.0	8.4

Comparative fungicide efficacy: Management of white mold in dry edible beans

North Dakota State Univ. Carrington Research Extension Center; Michael Wunsch, Jesse Hafner, Suanne Kallis, Aaron Fauss, Michael Schaefer, Thomas Mior

Endura: active ingredient, boscalid (FRAC 7) Quash: metconazole (FRAC 3) ProPulse: prothioconazole (FRAC 3) + fluopyram (FRAC 7)

Quash (2.5 oz) versus Endura (8 oz), ProPulse (10.3 fl oz)

Two sequential applications of the same fungicide (early bloom/pin-pod + 13 or 14 days apart)

	location Carrington	Langdon	Carrington	Carrington	COMBINED ANALYSIS 4 studies
	year 2012	2012	2013	2013	
days between applications	13	13	14	14	
nozzles, pressure, 1 st applic.	XR8001, 35 psi	AI11002, 40 psi	XR8001, 35 psi	XR8001, 35 psi	
nozzles, pressure, 2 nd applic.	XR8001, 35 psi	AI11002, 40 psi	XR8001, 35 psi	XR8001, 35 psi	
droplet size	fine	extra-coarse	fine	fine	
variety	'Maverick' pinto	'Maverick' pinto	'Lariat' pinto	'Lariat' pinto	
row spacing	30 inches	30 inches	28 inches	14 inches	
WHITE MOLD SEVERITY (% of canopy)					White mold (%)
Non-treated control	24 b	36 a	45 b	54 c	40 b
Endura 8.0 oz/ac	2 a	25 a	37 ab	28 a	23 a
ProPulse 10.3 fl oz/ac	6 ab	17 a	30 a	30 ab	21 a
Quash 2.5 oz/ac	17 ab	40 a	43 ab	45 bc	36 b
CV:	78.4	2.24	31.1	32.7	13.8
YIELD (lbs/ac)					Yield (lbs/ac)
Non-treated control	2906 a	3593 a	1949 b	1984 b	2608 b
Endura 8.0 oz/ac	3154 a	4115 a	2656 a	2789 a	3178 a
ProPulse 10.3 fl oz/ac	3191 a	4435 a	2549 a	2802 a	3244 a
Quash 2.5 oz/ac	3057 a	3770 a	1995 b	2183 b	2751 b
CV:	12.4	0.72	9.9	9.4	5.3

Comparative fungicide efficacy: Management of white mold in dry edible beans

North Dakota State Univ. Carrington Research Extension Center; Michael Wunsch, Jesse Hafner, Suanne Kallis, Aaron Fauss, Michael Schaefer, Thomas Miorino, Billy Kraft
Topsin: thiophanate-methyl (FRAC 1) Endura: boscalid (FRAC 7) Quash: metconazole (FRAC 3)

location: Carrington		Carrington	COMBINED ANALYSIS	location: Carrington		Carrington	COMBINED ANALYSIS
year: 2010		2013		year: 2013		2014	
days between applications	11	14		days between applications	14	12	
nozzles, pressure, first fungicide application	XR80015 35 psi	XR80015 35 psi		nozzles, pressure, first fungicide application	XR80015 35 psi	XR80015 35 psi	
nozzles, pressure, second fungicide application	XR80015 35 psi	XR80015 35 psi		nozzles, pressure, second fungicide application	XR80015 35 psi	XR80015 35 psi	
droplet size, application #1	fine	fine		droplet size, application #1	fine	fine	
droplet size, application #2	fine	fine	2 studies	droplet size, application #2	fine	fine	2 studies
market class:	pinto	pinto		market class:	pinto	pinto	
variety: 'Lariat'		'Lariat'		variety: 'Lariat'		'ND-307'	
row spacing: 15 inches		14 inches		row spacing: 14 inches		14 inches	

Quash (4 oz/ac) versus Endura (8 oz/ac)

WHITE MOLD (% of canopy)			
Non-treated control	66 b	54 b	60 b**
Endura 8.0 oz/ac	43 a	36 a	40 a
Quash 4 oz/ac	65 b	47 ab	56 b
CV:	15.0		6.9
YIELD (lbs/ac)			
Non-treated control	2419 b	2459 b	2439 b
Endura 8.0 oz/ac	3439 a	3185 a	3312 a
Quash 4 oz/ac	2734 ab	2512 b	2623 b
CV:	9.6		4.1

Quash (4 oz/ac) versus Topsin (30 fl oz/ac)

WHITE MOLD (% of canopy)			
Non-treated control	54 a	62 b	58 a
Topsin 30 fl oz/ac	44 a	38 a	41 a
Quash 4 oz/ac	47 a	56 b	52 a
CV:	15.0	10.8	11.1
YIELD (lbs/ac)			
Non-treated control	2459 b	2300 b	2380 b**
Topsin 30 fl oz/ac	3063 a	3298 a	3180 a
Quash 4 oz/ac	2512 b	2413 b	2462 b
CV:	9.6	12.0	5.6

Within column means significantly different ($P < 0.05$, Tukey procedure; where denoted with a double asterisk, $P < 0.06$).

Comparative fungicide efficacy: Management of white mold in dry edible beans

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Active ingredients Rovral: iprodione (FRAC 2) Switch: cyprodinil (FRAC 12), fludioxonil (FRAC 9)

Endura: boscalid (FRAC 7) ProPulse: prothioconazole (FRAC 3) + fluopyram (FRAC 7)

Rovral (2 pt), Switch (14 oz) versus Endura (8 oz), ProPulse (10.3 fl oz)

Two sequential applications of the same fungicide (early bloom/pin-pod + 13 or 14 days apart)

	location Carrington	Langdon	Carrington	Carrington	COMBINED ANALYSIS 4 studies
	year 2012	2012	2013	2013	
days between applications	13	13	14	14	
nozzles, pressure, 1 st applic.	XR8001, 35 psi	AI11002, 40 psi	XR8001, 35 psi	XR8001, 35 psi	
nozzles, pressure, 2 nd applic.	XR8001, 35 psi	AI11002, 40 psi	XR8001, 35 psi	XR8001, 35 psi	
droplet size	fine	extra-coarse	fine	fine	
variety	'Maverick' pinto	'Maverick' pinto	'Lariat' pinto	'Lariat' pinto	
row spacing	30 inches	30 inches	28 inches	14 inches	
WHITE MOLD SEVERITY (% of canopy)					White mold (%)
Non-treated control	24 b	36 a	45 b	54 b	40 b
Endura 8.0 oz/ac	2 a	25 a	37 b	28 a	23 a
ProPulse 10.3 fl oz/ac	6 ab	17 a	30 a	30 a	21 a
Rovral 2.0 pt/ac	7 ab	30 a	37 ab	36 a	27 a
Switch 14 oz/ac	5 a	32 a	26 a	41 a	26 a
CV:	78.4	2.24	31.1	32.7	17.7
YIELD (lbs/ac)					Yield (lbs/ac)
Non-treated control	2906 a	3593 a	1949 b	1984 c	2608 b
Endura 8.0 oz/ac	3154 a	4115 a	2656 a	2789 a	3178 a
ProPulse 10.3 fl oz/ac	3191 a	4435 a	2549 a	2802 a	3244 a
Rovral 2.0 pt/ac	2966 a	4186 a	2472 a	2437 b	3015 a
Switch 14 oz/ac	3029 a	4065 a	2459 a	2362 b	2979 a
CV:	12.4		9.9	9.4	4.4

Comparative fungicide efficacy: Management of white mold in dry edible beans

NDSU Carrington Research Extension Center; Michael Wunsch, Jesse Hafner, Suanne Kallis, Aaron Fauss, Michael Schaefer, Thomas Miorino, Billy Kraft

Endura: boscalid (FRAC 7) Vertisan: penthiopyrad (FRAC 7)

Endura 8 oz versus Vertisan

Two sequential applications of the same fungicide (early bloom/pin-pod + 11 or 13 days apart)

location	Carrington	Langdon	Carrington	COMBINED ANALYSIS 3 studies Vertisan @ 20 fl oz or @ 24 fl oz/ac
year	2012	2012	2010	
days between applications	13	13	11	
nozzles, pressure, 1 st applic.	XR8001, 35 psi	AI11002, 40 psi	XR80015, 35 psi	
nozzles, pressure, 2 nd applic.	XR8001, 35 psi	AI11002, 40 psi	XR80015, 35 psi	
droplet size	fine	extra-coarse	fine	
variety	'Maverick' pinto	'Maverick' pinto	'Lariat' pinto	
row spacing	30 inches	30 inches	15 inches	
WHITE MOLD SEVERITY (% of canopy)				White mold (%)
Non-treated control	24 b	36 a	66 b	42 b
Endura 8.0 oz/ac	2 a	25 a	46 a	24 a
Vertisan 14 fl oz/ac			67 b	
Vertisan 20 fl oz/ac	15 ab	34 a		39 b
Vertisan 24 fl oz/ac			67 b	
CV:	78.4	2.24		11.2
YIELD (lbs/ac)				Yield (lbs/ac)
Non-treated control	2906 a	3593 a	2419 a	2973 b
Endura 8.0 oz/ac	3154 a	4115 a	3172 a	3481 a
Vertisan 14 fl oz/ac			2489 a	
Vertisan 20 fl oz/ac	2986 a	3902 a		3165 ab
Vertisan 24 fl oz/ac			2608 a	
CV:	12.4	0.72		4.5

Comparative fungicide efficacy: Management of white mold in dry edible beans

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Endura: active ingredient, boscalid (FRAC 7) Priaxor: pyraclostrobin (FRAC 11) + fluxapyroxad (FRAC 7)

Endura followed by Endura versus Endura f.b. Priaxor

Two-application fungicide program (early bloom/pin-pod + 7, 12 or 13 days apart)

	location	Carrington	Carrington	Carrington	Carrington	Carrington	COMBINED ANALYSIS 5 studies
	year	2020	2012	2014	2019	2024	
	days between applications	13	13	13	12	7	
nozzles, pressure, first fungicide application		AIXR110015 60 psi	XR8001 35 psi	XR8001 35 psi	AIXR110015 50 psi	DG110015 30 psi	
nozzles, pressure, 2 nd fungicide application		AIXR110015 50 psi	XR8001 35 psi	XR8001 35 psi	XR11002 30 psi	AIXR110015 60 psi	
droplet size, applic. #1	medium	fine	fine	medium	medium		
droplet size, applic. #2	medium	fine	fine	fine	medium		
market class	pinto	pinto	pinto	pinto	pinto		
variety	'Palomino'	'Maverick'	'ND-307'	'Palomino'	'Vibrant'		
row spacing	14 inches	15 inches	14 inches	14 inches	14 inches		
WHITE MOLD SEVERITY (% of canopy)							White mold (%)
Non-treated control	74 a	11 b	74 a	25 b	70 a		51 b
Endura 8.0 oz/ac	55 a	1 a	62.6 a	3 a	66 a		38 a
Endura 8.0 oz/ac / Priaxor 4 fl oz/ac	67 a	1 a	62.5 a	12 b	74 a		43 ab
CV:	16.4	53.6	14.9	25.6	10.5		10.8
YIELD (lbs/ac)							Yield (lbs/ac)
Non-treated control	1842 a	2566 a	1992 a	3510 a	1226 a		2227 a
Endura 8.0 oz/ac	2692 a	2663 a	2151 a	3838 a	1578 a		2584 a
Endura 8.0 oz/ac / Priaxor 4 fl oz/ac	1897 a	2697 a	2261 a	3805 a	1285 a		2389 a
CV:	18.4	12.5	10.8	9.7	16.0		8.3

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: Management of white mold in dry edible beans

NDSU Carrington Research Extension Center; Michael Wunsch, Jesse Hafner, Suanne Kallis, Aaron Fauss, Michael Schaefer, Thomas Miorino, Billy Kraft

Topsin: active ingredient, thiophanate-methyl (FRAC 1) Endura: bosacilid (FRAC 7)

Topsin, 40 fl oz/ac versus Endura, 8 oz/ac

Two sequential applications of the same fungicide (early bloom/pin-pod + 6, 7, or 13 days apart)

location	Carrington	Langdon	Carrington	Carrington	Carrington	COMBINED ANALYSIS 5 studies
year	2012	2012	2012	2024	2023	
days between applications	13	13	13	7	6	
nozzles, pressure, first fungicide application	XR8001 35 psi	AI11002 40 psi	XR8001 35 psi	DG110015 30 psi	DG110015 30 psi	
nozzles, pressure, 2 nd fungicide application	XR8001 35 psi	AI11002 40 psi	XR8001 35 psi	AIXR110015 60 psi	AIXR110015 60 psi	
droplet size, applic. #1	fine	extra-coarse	fine	medium	medium	
droplet size, applic. #2	fine	extra-coarse	fine	medium	medium	
variety	'Maverick' pint	'Maverick' pint	'Othello'	'Vibrant' pinto	'Vibrant' pinto	
row spacing	30 inches	30 inches	14 inches	14 inches	14 inches	
WHITE MOLD SEVERITY (% of canopy)						White mold (%)
Non-treated control	24 b	36 a	46 b	70 a	73 b	50 b
Topsin 40 fl oz/ac	5 ab	22 a	26 ab	56 a	49 a	32 a
Endura 8.0 oz/ac	2 a	25 a	10 a	66 a	67 ab	34 a
CV:	78.4	2.24	35.3	10.5	16.1	20.1
YIELD (lbs/ac)						Yield (lbs/ac)
Non-treated control	2906 a	3593 a	2271 a	1226 b	1247 b	2249 c
Topsin 40 fl oz/ac	3421 a	4399 a	2917 a	2038 a	2351 a	3025 a
Endura 8.0 oz/ac	3154 a	4115 a	3009 a	1578 ab	1765 ab	2724 b
CV:	12.4	0.72	19.6	16.0	17.1	5.9

Read the label carefully.

The labels for some brands of the flowable formulation of thiophanate-methyl explicitly 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 (maximum 80 fl oz/ac). Making two applications at 40 fl oz/ac should be considered off-label unless the manufacturer indicates otherwise.

Comparative efficacy data of Topsin/generic applied at 40 fl oz versus Endura at 8 oz 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: Management of white mold in dry edible beans

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Topsin: active ingredient, thiophanate-methyl (FRAC 1) Endura: bosacilid (FRAC 7)

	location	Carrington	Langdon	Langdon	Carrington	Carrington	Carrington	Carrington	Carrington
	year	2012	2014	2012	2013	2013	2014	2014	2022
	days between applications	13	12	13	14	14	12	12	14
nozzles, pressure, first fungicide application	XR8001 35 psi	XR8001 40 psi	AI11002 40 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	DG110015 40 psi	DG110015 40 psi
nozzles, pressure, 2 nd fungicide application	XR8001 35 psi	XR8001 40 psi	AI11002 40 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	AIXR110015 60 psi	AIXR110015 60 psi
	droplet size	fine	fine	extra-coarse	fine	fine	fine	fine	fine, medium
	market class	pinto	pinto	pinto	pinto	pinto	pinto	pinto	LR Kidney
	variety	'Maverick'	'Lariat'	'Maverick'	'Lariat'	'Lariat'	'Lariat'	'Lariat'	'Rosie'
	row spacing	30 inches	30 inches	30 inches	28 inches	14 inches	14 inches	14 inches	14 inches

WHITE MOLD SEVERITY (% of canopy)

Non-treated control	24 b	33 b	36 a	45 b	54 b	72 b	83 b	92 b	60 b
Topsin 40 fl oz / Endura 8 oz/ac	2 a	14 a	31 a	31 a	31 a	38 a	51 a	88 ab	47 a
Endura 8.0 oz/ac	2 a	12 ab	25 a	37 ab	28 a	48 a	51 a	83 a	37 a
CV:	78.4	20.5	2.24	31.1	32.7	9.0	13.9	4.8	14.2

YIELD (lbs/ac)

Non-treated control	2906 a	1188 b	3593 a	1949 c	1984 c	2245 b	2004 b	1286 b	2267 b
Topsin 40 fl oz / Endura 8 oz/ac	3283 a	1925 a	4158 a	3028 a	3106 a	3215 a	3141 a	1940 a	2784 a
Endura 8.0 oz/ac	3154 a	1844 a	4115 a	2656 b	2789 b	3088 a	2819 a	2147 a	3010 a
CV:	12.4	14.1	0.72	9.9	9.4	0.7	0.7	16.4	7.4

	White mold (%)	Yield (lbs/ac)	COMBINED ANALYSIS 9 studies	Topsin 40 fl oz/ac rotated with Endura 8 oz/ac Two-application fungicide program (early bloom/pin-pod + 12, 13, or 14 days apart)
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		

Comparative fungicide efficacy: Management of white mold in dry edible beans

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Topsin: active ingredient, thiophanate-methyl (FRAC 1) Endura: boscalid (FRAC 7)

Topsin 40 fl oz/ac rotated with Endura 8 oz/ac

Two-application fungicide program (early bloom/pin-pod + 12, 13, or 14 days apart)

	location	Carrington	Langdon	Langdon	Carrington	Carrington	Carrington	Carrington	COMBINED ANALYSIS 7 studies White mold (%)
	year	2012	2014	2012	2013	2013	2014	2014	
	days between applications	13	12	13	14	14	12	12	
nozzles, pressure, first fungicide application		XR8001 35 psi	XR8001 40 psi	AI11002 40 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	
nozzles, pressure, 2 nd fungicide application		XR8001 35 psi	XR8001 40 psi	AI11002 40 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	XR8001 35 psi	
droplet size		fine	fine	extra-coarse	fine	fine	fine	fine	
market class		pinto	pinto	pinto	pinto	pinto	pinto	pinto	
variety		'Maverick'	'Lariat'	'Maverick'	'Lariat'	'Lariat'	'Lariat'	'Lariat'	White mold (%)
row spacing		30 inches	30 inches	30 inches	28 inches	14 inches	14 inches	14 inches	
WHITE MOLD SEVERITY (% of canopy)									
Non-treated control		24 b	33 b	36 a	45 b	54 b	72 b	83 b	50 b
Topsin 40 fl oz / Endura 8 oz/ac		2 a	14 ab	31 a	31 a	31 a	38 a	51 a	28 a
Endura 8 oz / Topsin 40 fl oz/ac		12 ab	8 a	35 a	27 a	30 a	49 a	54 a	31 a
Endura 8.0 oz/ac		2 a	12 ab	25 a	37 a	28 a	48 a	51 a	29 a
CV:		78.4	20.5	2.24	31.1	32.7	9.0	13.9	16.2
YIELD (lbs/ac)									Yield (lbs/ac)
Non-treated control		2906 a	1188 b	3593 a	1949 c	1984 c	2245 b	2004 b	2267 b
Topsin 40 fl oz / Endura 8 oz/ac		3283 a	1925 a	4158 a	3028 a	3106 a	3215 a	3141 a	3122 a
Endura 8 oz / Topsin 40 fl oz/ac		3571 a	1937 a	4072 a	2814 ab	3074 ab	2981 a	3031 a	3068 a
Endura 8.0 oz/ac		3154 a	1844 a	4115 a	2656 b	2789 b	3088 a	2819 a	2924 a
CV:		12.4	14.1	0.72	9.9	9.4	0.7	0.7	5.2



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