

Comparative fungicide efficacy: Management of white mold in soybeans

North Dakota State University Carrington Research Extension Center; Michael Wunsch, Jesse Hafner, Suanne Kallis, Aaron Fauss, Thomas Miorino

Endura: boscalid (FRAC 7) **Topsin/T-methyl:** thiophanate-methyl (FRAC 1)

year	2021	2021	2021	2021	2021	2022	2022	2022	2022	2022	HIGH DISEASE PRESSURE
location	Oakes	Oakes	Oakes	Carrington							
funding	ND Soybean Council										
variety	AG06X8	AG09XF0	AG11X8	AG06X8	AG09XF0	AG06X8	XO0602E	XO0731E	AG09XF0		
brand, maturity	Asgrow, 0.6	Asgrow, 0.9	Asgrow, 1.1	Asgrow, 0.6	Asgrow, 0.9	Asgrow, 0.6	Xitavo, 0.6	Xitavo, 0.7	Asgrow, 0.9		
row spacing	21 inches	21 inches	21 inches	14 inches							
seeding rate	165,000 pls/ac										
previous crop	various crops	various crops	various crops	sunflowers	sunflowers	dry bean	dry bean	dry bean	dry bean		
planting date	May 4	May 4	May 4	May 17	May 17	May 27	May 27	May 27	May 27		
disease assessment date	Sept. 30	Sept. 30	Sept. 30	Oct. 4-5	Oct. 4-5	Oct. 14-19	Oct. 14-19	Oct. 14-19	Oct. 14-19		
rows assessed for disease	1	1	1	1	1	1	1	1	1	COMBINED ANALYSIS	
harvest date	Oct. 7-8	Oct. 7-8	Oct. 7-8	Oct. 15-16	Oct. 15-16	Oct. 21	Oct. 20	Oct. 20	Oct. 20		
dates, applications 1 and 2	July 5, 12	July 5, 12	July 5, 19	July 23, 30	July 23, 30	July 21, 28	July 21, 28	July 21, 28	July 21, 28		
interval between applications	7 days	7 days	14 days	7 days	7 days	7 days	7 days	7 days	7 days		
growth stage, 1st applic.	81% R2 100% bloom	66% R2 100% bloom	70% R2 100% bloom	100% R2	100% R2	100% R2	100% R2	98% R2 100% bloom	100%R2		
canopy closure, 1st applic	90-100%	95-100%	95-100%	95-100%	95-100%	99-100%	95%	98-100%	97-100%		
nozzles, pressure, 1st applic.	AIXR110015, 50 psi										
droplet size, 1st applic.	medium-coarse										
canopy closure, 2nd applic.	100%	100%	100%	100%	100%	100%	100%	100%	100%		
nozzles, pressure, 2nd applic.	AIXR110015, 50 psi										
droplet size, 2nd applic.	medium-coarse										
adjuvant	none										
fungicide spray volume	15 gal/ac										
application method	hand-held boom										

White mold incidence (% of plants)										White mold (% plants)
Non-treated control	55 a	43 b	51 b	77 b	62 b	92 b	80 b	91 b	79 b	70 b
Endura 5.5 oz f.b. Endura 5.5 oz/ac	38 a	12 a	17 a	34 a	19 a	67 a	55 a	71 a	71 a	43 a
Topsin 40 fl oz f.b. Endura 5.5 oz/ac	38 a	24 a	29 a	62 b	36 a	65 a	54 a	66 a	59 a	48 a
CV:	29.9	38.4	37.4	27.9	32	13	13.2	11.3	12.9	13.8

White mold severity index (% of canopy)										White mold (% canopy)
Non-treated control	38 a	29 b	34 b	49 b	37 b	86 b	72 b	84 b	70 b	55 b
Endura 5.5 oz f.b. Endura 5.5 oz/ac	27 a	8 a	10 a	17 a	6 a	55 a	44 a	58 a	58 a	31 a
Topsin 40 fl oz f.b. Endura 5.5 oz/ac	29 a	16 a	16 a	37 b	15 a	54 a	44 a	54 a	43 a	34 a
CV:	36.2	52.1	17.1	39.4	49	15.3	16.5	13	15.5	15.5

Soybean yield (bu/ac; 13% moisture)										Yield (bu/ac)
Non-treated control	60 a	67 a	68 b	42 b	41 a	25 b	29 b	21 b	25 b	42 b
Endura 5.5 oz f.b. Endura 5.5 oz/ac	67 a	76 a	85 a	59 a	58 a	47 a	47 a	38 a	38 a	57 a
Topsin 40 fl oz f.b. Endura 5.5 oz/ac	65 a	73 a	82 a	48 b	53 a	43 a	44 a	40 a	42 a	54 a
CV:	14.7	8	11.5	9.1	9	12.1	10.6	13.3	10.6	6.8

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Endura: boscalid (FRAC 7) **Topsin/T-methyl:** thiophanate-methyl (FRAC 1)

year	2021	2022	2022	2022	LOW DISEASE PRESSURE
location	Carrington	Oakes	Oakes	Oakes	
funding	ND Soybean Council	ND Soybean Council	ND Soybean Council	ND Soybean Council	
variety	AG009X8	DSR1120	AG11X8	AG09Xf0	
brand, maturity	Asgrow, 0.09	Dairyland, 1.1	Asgrow, 1.1	Asgrow, 0.9	
row spacing	14 inches	14 inches	14 inches	14 inches	
seeding rate	165,000 pls/ac	165,000 pls/ac	165,000 pls/ac	165,000 pls/ac	
previous crop	sunflowers	various	various	various	
planting date	May 17	June 2	June 2	June 2	
disease assessment date	Oct. 4-5	Oct. 21	Oct. 21	Oct. 21	
rows assessed for disease	1	1	1	1	COMBINED ANALYSIS
harvest date	Oct. 15-16	Oct. 21-22	Oct. 21-22	Oct. 21-22	
dates, applications 1 and 2	July 23, 30	July 24, Aug. 5	July 24, Aug. 5	July 24, Aug. 3	
interval between applications	7 days	12 days	12 days	10 days	
growth stage, 1st applic.	100% R2	100% R2	100% R2	100% R2	4 studies
canopy closure, 1st applic	90-95%	95-100%	95-100%	95-100%	
nozzles, pressure, 1st applic.	AIXR110015, 50 psi	AIXR110015, 50 psi	AIXR110015, 50 psi	AIXR110015, 50 psi	Endura 5.5 oz/ac applied twice sequentially
droplet size, 1st applic.	medium-coarse	medium-coarse	medium-coarse	medium-coarse	
canopy closure, 2nd applic.	100%	100%	100%	100%	<i>versus</i>
nozzles, pressure, 2nd applic.	AIXR110015, 50 psi	AIXR110015, 50 psi	AIXR110015, 50 psi	AIXR110015, 50 psi	Topsin/T-methyl 5.5 40 fl oz/ac followed by
droplet size, 2nd applic.	medium-coarse	medium-coarse	medium-coarse	medium-coarse	
adjuvant	none	none	none	none	Endura 5.5 oz/ac
fungicide spray volume	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	
application method	hand-held boom	hand-held boom	hand-held boom	hand-held boom	

White mold incidence (% of plants) **White mold (% plants)**

Non-treated control	8 b	3 a	12 a	8 a	8 b
Endura 5.5 oz f.b.	2 a	2 a	4 a	3 a	3 a
Endura 5.5 oz/ac	2 a	2 a	4 a	3 a	3 a
Topsin 40 fl oz f.b.	3 a	1 a	3 a	2 a	2 a
Endura 5.5 oz/ac	3 a	1 a	3 a	2 a	2 a
CV:	91.7	105.9	78.5	73.2	40.5

White mold severity index (% of canopy) **White mold (% canopy)**

Non-treated control	4 b	1 a	5 a	3 a	3 b
Endura 5.5 oz f.b.	1 a				
Endura 5.5 oz/ac	1 a				
Topsin 40 fl oz f.b.	1 a	0 a	1 a	1 a	1 a
Endura 5.5 oz/ac	1 a	0 a	1 a	1 a	1 a
CV:	117.1	133.6	98.2	84.8	24.5

Soybean yield (bu/ac; 13% moisture) **Yield (bu/ac)**

Non-treated control	58 a	67 a	73 a	71 a	67 b
Endura 5.5 oz f.b.	58 a	68 a	76 a	70 a	68 a
Endura 5.5 oz/ac	58 a	68 a	76 a	70 a	68 a
Topsin 40 fl oz f.b.	58 a	68 a	79 a	69 a	68 a
Endura 5.5 oz/ac	58 a	68 a	79 a	69 a	68 a
CV:	6.1	4.8	5.8	4.8	2.4

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Endura: boscalid (FRAC 7) **Topsin/T-methyl:** thiophanate-methyl (FRAC 1)

	2020	2020	2020	2020	COMBINED ANALYSIS	2023
year	2020	2020	2020	2024		
location	Oakes	Oakes	Carrington	Carrington		Carrington
funding	ND Soybean Council	ND Soybean Council	ND Soybean Council	Corteva		ND Soybean Council
variety	GH0543X	14R09N	14R09N	P08A44E		21Xf07
brand, maturity	Golden Harvest, 0.5	Peterson Farms, 0.9	Peterson Farms, 0.9	Pioneer, 0.8		Peterson Farms, 0.7
row spacing	22.5 inches	22.5 inches	21 inches	15 inches	4 studies	14 inches
seeding rate	165,000 pls/ac	165,000 pls/ac	165,000 pls/ac	140,000 pls/ac		165,000 pls/ac
previous crop	sunflowers	sunflowers	dry bean	sunflowers		chickpeas
planting date	May 12	May 12	May 18	May 16	Endura	May 24-25
disease assessment date	Aug. 26. 28	Sept. 25	Oct. 12-15	Oct. 9	5.5 or 6.0 oz/ac	Oct. 12-13
rows assessed for disease	1	1	1	2	versus	1
harvest date	Oct. 8-9	Oct. 8-9	Oct. 15-16	Oct. 14	Topsin / T-methyl	Oct. 17
dates, applications 1 and 2	July 8, 15	July 8, 15	July 10, 20	July 24, July 31	20 fl oz/ac	July 22, Aug. 2
interval between applications	7 days	7 days	10 days	7 days		11 days
growth stage, 1st applic.	65% R2, 35% R3	79% R2, 21% R3	89% R2, 100% bloom	100% R2	Two sequential applications of the same fungicide	100% R2
canopy closure, 1st applic	91% average	87% average	87% average	75-90%		98-100%
nozzles, pressure, 1st applic.	AIXR110015, 60 psi	AIXR110015, 60 psi	AIXR110015, 60 psi	AIXR110015, 60 psi		AIXR110015, 50 psi
droplet size, 1st applic.	medium	medium	medium	medium		medium-coarse
canopy closure, 2nd applic.	95% average	94% average	98% average	90-98%		100%
nozzles, pressure, 2nd applic.	AIXR110015, 40 psi	AIXR110015, 40 psi	AIXR110015, 40 psi	AIXR110015, 40 psi		AIXR110015, 40 psi
droplet size, 2nd applic.	coarse	coarse	coarse	coarse		coarse
adjuvant	none	none	none	Induce, 0.25% v/v		none
fungicide spray volume	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac		15 gal/ac
application method	hand-held boom	hand-held boom	hand-held boom	hand-held boom		hand-held boom
	Endura 5.5 oz/ac	Endura 5.5 oz/ac	Endura 5.5 oz/ac	Endura 6.0 oz/ac		

White mold incidence (% of plants)					White mold (% plants)	
Non-treated control	4 b	2 b	18 b	46 b	18 b	79 b
Endura 5.5 or 6.0 oz/ac	1 a	0 a	6 a	16 a	6 a	NOT TESTED
Topsin/T-methyl 20 fl oz/ac	3 ab	3 b	11 ab	31 ab	12 b	68 a
CV:	55.1	45.6	43.5	14.9	9.1	12.6

White mold severity index (% of canopy)					White mold (% canopy)	
Non-treated control	2 b	1 b	11 b	20 b	19 b	60 b
Endura 5.5 or 6.0 oz/ac	0 a	0 a	3 a	5 a	2 a	NOT TESTED
Topsin/T-methyl 20 fl oz/ac	1 ab	1 b	7 ab	12 ab	14 b	47 a
CV:	45.9	48.8	53.0	22.6	14.5	15.4

Soybean yield (bu/ac; 13% moisture)					Yield (bu/ac)	
Non-treated control	77 a	76 a	53 a	53 a	58 b	32 a
Endura 5.5 or 6.0 oz/ac	77 a	79 a	57 a	58 a	68 a	NOT TESTED
Topsin/T-methyl 20 fl oz/ac	79 a	76 a	55 a	57 a	62 b	40 a
CV:	3.5	3.8	6.8	7.9	2.2	17

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Endura: boscalid (FRAC 7) **Topsin/T-methyl:** thiophanate-methyl (FRAC 1)

year	2021	2021	2021	2021	2021	2022	2022	2022	2022	
location	Oakes	Oakes	Oakes	Carrington	Carrington	Carrington	Carrington	Carrington	Carrington	HIGH DISEASE PRESSURE
funding	ND Soybean Council									
variety	AG06X8	AG09XF0	AG11X8	AG06X8	AG09XF0	AG06X8	XO0602E	XO0731E	AG09XF0	
brand, maturity	Asgrow, 0.6	Asgrow, 0.9	Asgrow, 1.1	Asgrow, 0.6	Asgrow, 0.9	Asgrow, 0.6	Xitavo, 0.6	Xitavo, 0.7	Asgrow, 0.9	
row spacing	21 inches	21 inches	21 inches	14 inches						
seeding rate	165,000 pls/ac									
previous crop	various crops	various crops	various crops	sunflowers	sunflowers	dry bean	dry bean	dry bean	dry bean	
planting date	May 4	May 4	May 4	May 17	May 17	May 27	May 27	May 27	May 27	
disease assessment date	Sept. 30	Sept. 30	Sept. 30	Oct. 4-5	Oct. 4-5	Oct. 14-19	Oct. 14-19	Oct. 14-19	Oct. 14-19	
rows assessed for disease	1	1	1	1	1	1	1	1	1	
harvest date	Oct. 7-8	Oct. 7-8	Oct. 7-8	Oct. 15-16	Oct. 15-16	Oct. 20	Oct. 20	Oct. 20	Oct. 20	
date fungicide was applied	July 5	July 5	July 5	July 23	July 23	July 21	July 21	July 21	July 21	
growth stage, 1st applic.	81% R2 100% bloom	66% R2 100% bloom	70% R2 100% bloom	100% R2	100% R2	100% R2	100% R2	98% R2 100% bloom	100% R2	
canopy closure, 1st applic	90-100%	95-100%	95-100%	95-100%	95-100%	99-100%	0.95	98-100%	97-100%	
nozzles, pressure, 1st applic.	AIXR110015, 50 psi									
droplet size, 1st applic.	medium-coarse									
adjuvant	none									
fungicide spray volume	15 gal/ac									
application method	hand-held boom									

COMBINED ANALYSIS

9 studies

Topsin / T-methyl
40 fl oz/ac
versus
Endura
5.5 oz/ac

Single fungicide application

White mold incidence (% of plants) White mold (% plants)

Non-treated control	55 a	43 b	51 a	77 b	62 a	92 a	80 b	91 b	79 b	70 b
Endura 5.5 oz/ac	54 a	27 a	44 a	51 a	42 a	81 a	63 a	79 ab	65 a	56 a
Topsin/T-methyl 40 fl oz/ac	61 a	37 ab	52 a	62 a	55 a	83 a	65 a	74 a	65 a	62 a
CV:	29.9	38.4	37.4	27.9	32	13	13.2	11.3	12.9	7.9

White mold severity index (% of canopy) White mold (% canopy)

Non-treated control	38 a	29 a	34 a	49 b	37 b	86 a	72 b	84 b	70 b	55 b
Endura 5.5 oz/ac	40 a	18 a	30 a	30 a	19 a	71 a	53 a	68 a	55 a	42 a
Topsin/T-methyl 40 fl oz/ac	42 a	26 a	36 a	37 ab	31 ab	73 a	55 a	64 a	53 a	46 a
CV:	36.2	52.1	17.1	39.4	49	15.3	16.5	13	15.5	10.3

Soybean yield (bu/ac; 13% moisture) Yield (bu/ac)

Non-treated control	60 a	67 a	68 a	42 b	41 a	25 b	29 b	21 b	25 b	42 b
Endura 5.5 oz/ac	64 a	72 a	68 a	55 a	53 a	37 a	37 a	31 a	40 a	51 a
Topsin/T-methyl 40 fl oz/ac	58 a	66 a	68 a	48 ab	43 a	34 a	40 a	32 a	34 a	47 a
CV:	14.7	8	11.5	9.1	9	12.1	10.6	13.3	10.6	7.4

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Endura: boscalid (FRAC 7) Topsin/T-methyl: thiophanate-methyl (FRAC 1)					LOW DISEASE PRESSURE COMBINED ANALYSIS 4 studies Topsin / T-methyl 40 fl oz/ac versus Endura 5.5 oz/ac Single fungicide application
year	2021	2022	2022	2022	
location	Carrington	Oakes	Oakes	Oakes	
funding	ND Soybean Council	ND Soybean Council	ND Soybean Council	ND Soybean Council	
variety	AG009X8	DSR1120	AG11X8	AG09Xf0	
brand, maturity	Asgrow, 0.09	Dairyland, 1.1	Asgrow, 1.1	Asgrow, 0.9	
row spacing	14 inches	14 inches	14 inches	14 inches	
seeding rate	165,000 pls/ac	165,000 pls/ac	165,000 pls/ac	165,000 pls/ac	
previous crop	sunflowers	various	various	various	
planting date	May 17	June 2	June 2	June 2	
disease assessment date	Oct. 4-5	Oct. 21	Oct. 21	Oct. 21	
rows assessed for disease	1	1	1	1	
harvest date	Oct. 15-16	Oct. 21-22	Oct. 21-22	Oct. 21-22	
date fungicide was applied	July 23	July 24	July 24	July 24	
growth stage when fungicide applied	100% R2	100%R2	100%R2	100%R2	
canopy closure when fungicide applied	90-95%	95-100%	95-100%	95-100%	
nozzles, application pressure	AIXR110015, 50 psi	AIXR110015, 50 psi	AIXR110015, 50 psi	AIXR110015, 50 psi	
spray droplet size	medium-coarse	medium-coarse	medium-coarse	medium-coarse	
adjuvant	none	none	none	none	
fungicide spray volume	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	
application method	hand-held boom	hand-held boom	hand-held boom	hand-held boom	
White mold incidence (% of plants)					White mold (% plants)
Non-treated control	8 b	3 a	12 a	8 a	8 b
Endura 5.5 oz/ac	3 a	2 a	4 a	3 a	3 a
Topsin/T-methyl 40 fl oz/ac	2 a	2 a	4 a	5 a	3 a
CV:	91.7	105.9	78.5	73.2	18.7
White mold severity index (% of canopy)					White mold (% canopy)
Non-treated control	4 b	1 a	5 a	3 a	3 b
Endura 5.5 oz/ac	2 ab	1 a	1 a	1 a	1 a
Topsin/T-methyl 40 fl oz/ac	1 a	1 a	2 a	1 a	1 a
CV:	117.1	133.6	98.2	84.8	23
Soybean yield (bu/ac; 13% moisture)					Yield (bu/ac)
Non-treated control	58 a	67 a	73 a	71 a	67 b
Endura 5.5 oz/ac	59 a	70 a	75 a	72 a	69 a
Topsin/T-methyl 40 fl oz/ac	60 a	67 a	75 a	71 a	68 a
CV:	6.1	4.8	5.8	4.8	1.3

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Topsin / T-methyl: thiophanate-methyl (FRAC 1)

year	2020	2020	2020	2020	2020	2023	COMBINED ANALYSIS
location	Oakes	Oakes	Carrington	Carrington	Carrington	Carrington	
funding	ND Soybean Council	ND Soybean Council	ND Soybean Council	Gowan	BASF	ND Soybean Council	
variety	GH0543X	14R09N	14R09N	DSR-0418	DSR-0418	21XF07	
brand, maturity	Golden Harvest, 0.5	Peterson Farms, 0.9	Peterson Farms, 0.9	Dairyland, 0.4	Dairyland, 0.4	Peterson Farms, 0.7	
row spacing	22.5 inches	22.5 inches	21 inches	21 inches	21 inches	14 inches	
seeding rate	165,000 pls/ac	165,000 pls/ac	165,000 pls/ac	165,000 pls/ac	165,000 pls/ac	165,000 pls/ac	
previous crop	sunflowers	sunflowers	dry bean	spring wheat	spring wheat	chickpeas	
planting date	May 12	May 12	May 18	May 18	May 18	May 24-25	
disease assessment date	Aug. 26. 28	Sept. 25	Oct. 12-15	Oct. 16	Oct. 15	Oct. 12-13	
rows assessed for disease	1	1	1	1	1	1	
harvest date	Oct. 8-9	Oct. 8-9	Oct. 15-16	Oct. 19	Oct. 16	Oct. 17	
date fungicide was applied	July 8	July 8	July 10	July 16	July 14	July 22	
growth stage when fungicide applied	65% R2, 35% R3	79% R2, 21% R3	89% R2, 100% bloom	100% R2	100% R2	100% R2	
canopy closure when fungicide applied	91% average	87% average	87% average	75-85%	65-95%	98-100%	
nozzles, application pressure	AIXR110015, 60 psi	AIXR110015, 60 psi	AIXR110015, 60 psi	AIXR110015, 60 psi	AIXR110015, 60 psi	AIXR110015, 50 psi	
spray droplet size	medium	medium	medium	medium	medium	medium-coarse	
adjuvant	none	none	none	none	none	none	
fungicide spray volume	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	15 gal/ac	
application method	hand-held boom	hand-held boom	hand-held boom	hand-held boom	hand-held boom	hand-held boom	

6 studies

**Topsin / T-methyl
20 fl oz/ac
versus
Non-treated**

**Single fungicide
application**

White mold incidence (% of plants) White mold (% plants)

Non-treated control	4 a	2 a	18 a	25 a	26 a	79 a	26 a
Topsin/T-methyl 20 fl oz/ac	4 a	4 a	25 a	26 a	16 a	69 a	24 a
CV:	55.1	45.6	43.5	52.5	30.7	12.6	20.2

White mold severity index (% of canopy) White mold (% canopy)

Non-treated control	2 a	1 a	11 a	8 a	10 a	60 b	15 a
Topsin/T-methyl 20 fl oz/ac	2 a	2 a	17 a	8 a	5 a	48 a	13 a
CV:	45.9	48.8	53.0	68.4	39.5	15.4	13.2

Soybean yield (bu/ac; 13% moisture) Yield (bu/ac)

Non-treated control	77 a	76 a	53 a	46 a	45 a	32 a	55 a
Topsin/T-methyl 20 fl oz/ac	79 a	76 a	50 a	45 a	46 a	38 a	56 a
CV:	3.5	3.8	6.8	8.2	15.1	17	3.1