

Valent: Field evaluation of Cobra and Domark for management of white mold on soybean

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2010

OBJECTIVES:

- (1) Evaluate application rates (4.0 fl. oz./ac. to 12.0 fl. oz./ac.) and timings (V4/R1, R1/R2, and R3) of the herbicide Cobra for white mold control on soybean.
- (2) Evaluate application timings (R1/R2, R3, and R5), application strategies (once versus twice, alone or following Cobra), and carrier volumes (5, 10, or 20 gal. water/ac.) for the fungicide Domark (tetraconazole) for white mold control on soybeans.

METHODS:

Experimental design, seeding, planting, and harvest: The experiment was a randomized complete block design with four replicates. Plots were seeded May 19 and harvested September 28. Soybean cultivar Dairyland 'DSR0401' was seeded in 7 in. rows at a seeding rate of 220,000 live seeds/acre. Plots consisted of seven rows, each 20 ft long (plot dimensions = 5 ft. by 20 ft.), and buffer plots were established between treatment plots in order to minimize spray drift between treatments. A misting system was established for the plots on a 20-ft grid using 'Nelson' R-10 rotators, P-2 9-degree plates, and #40 nozzles and 40 PSI water pressure. The misting system was turned off during rain events and during fungicide applications and kept off for a short period thereafter (approx. 9 to 12 hrs. for fungicide applications); otherwise, misting was conducted for 3 min. every 30 min. from shortly before initiation of flowering until plants approached physiological maturity. Plots were trimmed to 17 to 20 ft before harvest, plot lengths were measured at harvest, and yields were calculated on the basis of the harvested plot length. Seed moisture levels were assessed for each plot, and test weights and yields were adjusted to 13% moisture.

Fungicide applications: A 60-inch hand boom with four equally spaced XR TeeJet 8001VS nozzles was used. Applications were made at 35 PSI in 5, 10, or 20 gal. of water/ac on July 9 (plants at V4 to R1, with R1 predominant), July 12 (plants at R1 to R2, with R2 predominant), July 23 (plants at R3), and Aug. 3 (plants at R5), as indicated by the Valent protocol.

Inoculation: The experiment was inoculated with ascospores July 18-19. Replicates 1 to 3 were inoculated with 2.7×10^6 ascospores/square meter in 53 gal. water/ac. July 18 at 10:15 to 11:15 pm. Replicate 4 was inoculated with 1.0×10^6 ascospores/square meter in 20 gal. water/ac. July 18 at 11:15 pm and with 5.6×10^5 ascospores/square meter in 40 gal. water/ac. July 19 at 9:00 pm. Applications were made at 35 PSI with a 60-in. hand boom with four equally spaced TeeJet 8002 nozzles.

Disease assessment: Disease ratings were conducted Aug. 5-6, Aug. 16-17, and Aug. 27 using a 0 to 3 scale: 0 = no symptoms; 1 = lesions on lateral branches only; 2 = lesions on main stem, no wilt, and normal pod development; and 3 = lesions on main stem resulting in plant death and poor pod fill. In each plot, 90 plants were assessed, with 30 plants sampled in each third of the plot and no plants sampled at plot ends.

Statistical analysis: Disease severity index, disease severity, and disease incidence were evaluated with cumulative, cumulative, and binary logistic regression, respectively, (Hosmer and Lemeshow, 2000), and single-degree-of-freedom contrasts of all pairwise comparisons of treatments were implemented with Wald chi-square tests. Analyses were conducted controlling for the effect of experimental replicate and, where possible, replicate-by-treatment interaction. Analyses were implemented in PROC GENMOD of SAS (version 9.2; SAS Institute, Cary, NC), and the Bonferroni multiple comparison procedure (Neter et al. 1996) was utilized to control the Type I error rate at the level of the experiment across the 136 pairwise treatment comparisons.

Statistical analysis (2): Analysis of variance was conducted on the plot-level yield and test weight data. Seed moisture levels were evaluated for each sample, and yields and test weights were adjusted to 13% moisture. The assumptions of constant variance and normality were assessed by plotting residuals against predicted values and evaluating their variance and by plotting residuals against their ranks and examining their linearity. The assumptions were met, and no transformations were applied to the data. Single-degree-of-freedom contrasts were performed for all pairwise combinations of isolates; to control the Type I error rate at the level of the experiment, the Tukey multiple comparison procedure (Neter et al. 1996) was employed. Analyses were conducted controlling for the effects of experimental replicate and replicate-by-treatment interaction and were implemented in PROC GLM of SAS (version 9.2; SAS Institute, Cary, NC).

CONCLUSIONS:

Under conditions of severe disease pressure, appropriately timed applications of Cobra significantly lowered levels of white mold and significantly raised yields relative to the non-treated control ($\alpha = 0.05$). Appropriately timed applications of Cobra provided comparable or better white mold control than the labeled rate of Endura and better white mold control and higher yields than the labeled rate of Topsin-M ($\alpha = 0.01$). The efficacy of Cobra applied at the late V4/early R1 development stage increased as the application rate of Cobra increased, but at the labeled rate of 6 fl oz/ac, Cobra was most effective when applied at the R1/early R2 development stage. However, it is unclear whether the increased effectiveness of the R1/R2 application of 6 fl oz/ac of Cobra relative to the corresponding V4/R1 application was due to the inherent superiority of that timing or by differences in the amount of time between the application of Cobra and inoculation; the trial was inoculated with ascospores of *Sclerotinia sclerotiorum* 9-10 days after the V4/R1 application of Cobra and 6-7 days after the R1/R2 application of Cobra. In future evaluations of application timing, inoculations will be conducted over multiple days and with a shorter interval between the first application of Cobra and inoculation.

Domark did not provide white mold control and did not raise yields relative to the non-treated control ($\alpha = 0.05$). The efficacy of Domark was not influenced by application timing (R1/R2, R3, or R5), application strategy (one applications or two), or application carrier volume (5, 10, or 20 gal. water/ac.). The application of Domark 14 days after Cobra did not improve disease control relative to the corresponding rate and timing of Cobra applied alone ($\alpha = 0.05$).

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Within-column means followed by different letters and non-overlapping ranges of letters are significantly different ($\alpha = 0.01$).

Product, rate, and timing (A-D) ¹	Water ²	WHITE MOLD SEV. INDEX ³			WHITE MOLD INCIDENCE ⁴			WHITE MOLD SEVERITY ⁵			AUDPC ⁶	YIELD	TEST WEIGHT	Seeds per pound	percent PROTEIN	percent OIL
		Aug. 5-6	Aug. 16-17	Aug. 27	Aug. 5-6	Aug. 16-17	Aug. 27	Aug. 5-6	Aug. 16-17	Aug. 27		bu/ac	lbs/bu	seeds	percent	percent
		0 to 3 scale			percent			1 to 3 scale								
Non-treated check	NA	1.40 de	2.39 fg	2.44 efg	63 cd	88 de	89 cd	2.08 a-d	2.74 efg	2.76 de	59.7 a-f	20.6 b-f	60.36 a	3731 a	34.7 a	18.36 a
Cobra 2.0 EC 4 fl oz/ac (A)	10 gal	1.27 bcd	1.64 bcd	1.78 bc	53 bc	65 ab	70 ab	2.38 c-f	2.46 a-d	2.54 abc	46.2 a-f	30.2 abc	60.17 a	3446 ab	33.5 ab	19.00 a
Cobra 2.0 EC 6 fl oz/ac (A)	10 gal	1.42 cde	1.84 cd	1.90 cd	61 cd	74 bc	73 b	2.28 a-e	2.45 a-d	2.58 a-d	51.2 a-f	26.0 a-e	61.03 a	3731 a	34.6 ab	18.45 a
Cobra 2.0 EC 9 fl oz/ac (A)	10 gal	0.84 a	1.48 ab	1.59 abc	41 ab	64 ab	64 ab	2.04 a-d	2.29 a	2.49 ab	37.1 abc	32.1 a	60.52 a	3606 ab	34.1 ab	18.75 a
Cobra 2.0 EC 12 fl oz/ac (A)	10 gal	0.91 ab	1.26 a	1.44 ab	44 ab	53 a	58 a	2.00 abc	2.35 ab	2.50 abc	34.7 ab	31.1 ab	61.02 a	3576 ab	34.6 ab	18.36 a
Cobra 2.0 EC 6 fl oz/ac (B)	10 gal	0.69 a	1.24 a	1.36 a	38 a	53 a	56 a	1.87 a	2.34 ab	2.43 a	31.0 a	30.0 abc	60.89 a	3860 ab	34.1 ab	18.18 a
Cobra 2.0 EC 6 fl oz/ac (C)	10 gal	1.64 e	1.96 de	2.24 de	70 de	80 cd	89 cd	2.31 b-e	2.44 abc	2.52 abc	57.6 a-f	22.1 b-f	60.40 a	4005 b	32.1 b	19.32 a
Domark 1.90 ME 5 fl oz/ac (B)	20 gal	2.09 fg	2.72 gh	2.67 fgh	82 ef	99 g	98 f	2.48 ef	2.74 d-g	2.72 a-d	74.7 ef	16.7 ef	59.82 a	3368 ab	33.5 ab	19.11 a
Domark 1.90 ME 5 fl oz/ac (C)	20 gal	2.10 fg	2.42 fg	2.45 efg	85 f	95 efg	92 c-f	2.44 ef	2.53 a-e	2.66 a-d	70.5 c-f	19.8 c-f	59.61 a	3663 ab	33.9 ab	18.77 a
Domark 1.90 ME 5 fl oz/ac (D)	20 gal	2.25 fg	2.46 fg	2.55 efg	90 f	94 efg	93 c-f	2.50 ef	2.61 b-f	2.75 b-e	73.6 def	18.1 ef	60.04 a	3403 ab	34.1 ab	18.92 a
Domark 1.90 ME 5 fl oz/ac (B, C)	20 gal	2.08 fg	2.45 fg	2.50 efg	83 ef	91 def	91 cde	2.52 ef	2.70 d-g	2.75 cde	70.8 c-f	17.3 ef	60.00 a	3601 ab	34.4 ab	18.68 a
Cobra 2.0 EC 6 fl oz/ac (A) / Domark 1.90 ME 5 fl oz/ac (C)	10 gal / 20 gal	0.99 abc	1.60 abc	1.78 bc	49 abc	69 bc	72 b	1.95 ab	2.26 a	2.47 ab	41.5 a-e	30.7 ab	60.52 a	3595 ab	34.0 ab	18.68 a
Headline 2.09 EC 6 fl oz/ac (B)	10 gal	2.13 fg	2.76 h	2.79 h	81 ef	97 fg	97 def	2.59 f	2.84 g	2.88 e	76.3 f	11.6 f	60.01 a	3720 ab	34.4 ab	18.51 a
Topsin M 70 WSP 1 lb/ac (B)	10 gal	2.04 f	2.24 ef	2.36 ef	85 f	89 de	88 c	2.39 def	2.53 a-e	2.70 a-e	67.2 b-f	19.2 def	60.50 a	3579 ab	34.4 ab	18.75 a
Endura 70 WG 8 oz/ac (B)	10 gal	0.83 a	1.59 a-d	1.84 c	44 ab	66 ab	70 ab	1.86 a	2.41 abc	2.65 a-d	39.4 a-d	28.8 a-d	60.98 a	3663 a	35.3 a	18.01 a
Domark 1.90 ME 5 fl oz/ac (B)	5 gal	2.05 fg	2.54 fgh	2.71 gh	81 ef	95 efg	97 def	2.53 ef	2.68 c-g	2.81 de	72.4 def	16.9 ef	59.90 a	3449 ab	34.1 ab	19.02 a
Domark 1.90 ME 5 fl oz/ac (B)	10 gal	2.39 g	2.68 gh	2.73 gh	91 f	97 fg	98 ef	2.62 f	2.76 fg	2.80 de	79.1 f	13.5 f	59.67 a	3470 ab	33.6 ab	18.93 a
Treatment differences, χ^2 , df: ⁷											8.94	15.56	2.84	2.91	2.82	1.99
Treatment differences, $P > \chi^2$: ⁸											< 0.0001	< 0.0001	0.0055	0.0043	0.0055	0.0449
C.V.:											19.25	15.15	0.92	5.38	2.42	2.63

¹ Application timing: A -- July 9, plants at V4 to R1, with R1 predominant; B -- July 12, plants at R1 to R2, with R2 predominant; C -- July 23; plants at R3; D -- Aug. 3; plants at R5.

² Water/ac: Volume of water carrier (per acre) used to apply product.

³ White mold severity index: A combination of disease severity and disease incidence; a 0 to 3 scale was used, with 0 = no symptoms; 1 = lesions on lateral branches only; 2 = lesions on main stem, no wilt, and normal pod development; and 3 = lesions on main stem resulting in plant death and poor pod fill. For each treatment, 360 plants were evaluated (90 plants per treatment per replicate).

⁴ White mold incidence: Percent of plants exhibiting white mold symptoms. For each treatment, 360 plants were evaluated (90 plants per treatment per replicate across four replicates).

⁵ White mold severity: White mold severity on plants showing disease; a 1 to 3 scale was used, with 1 = lesions on lateral branches only; 2 = lesions on main stem, no wilt, and normal pod development; and 3 = lesions on main stem resulting in plant death and poor pod fill. For each treatment, 360 plants were evaluated (90 plants per treatment per replicate across four replicates).

⁶ Area Under the Disease Progress Curve (AUDPC): $AUDPC = \sum_{i=1}^n ((x_i + x_{i+1})/2) * (t_{i+1} - t_i)$

where x_i = disease severity index at the i th observation, t_i = time in days at the i th observation, and n = number of observations

⁷ Treatment differences, χ^2 , df or F : Chi-square values and degrees of freedom associated with the test of the null hypothesis that there are no differences among treatments.

⁸ Treatment differences, $P > \chi^2$ or $P > F$: The probability of observing a chi-square value greater than that observed; an assessment of the significance of the treatment differences.

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		0 to 3 scale			percent			1 to 3 scale			bu/ac		lbs/bu	seeds	percent	percent	
Non-treated check	NA	1.40 cd	2.39 fgh	2.44 efg	63 de	88 ef	89 d	2.08 a-d	2.74 fgh	2.76 cd	59.7 a-e	20.63 cde	60.36 a	3731 ab	34.73 a	18.36 ab	
Cobra 2.0 EC 4 fl oz/ac (A)	10 gal	1.27 bc	1.64 bcd	1.78 bc	53 bcd	65 abc	70 bc	2.38 d-g	2.46 a-e	2.54 ab	46.2 a-d	30.15 ab	60.17 a	3446 a	33.48 ab	19.00 ab	
Cobra 2.0 EC 6 fl oz/ac (A)	10 gal	1.42 cd	1.84 cd	1.90 cd	61 cde	74 cd	73 c	2.28 b-e	2.45 a-e	2.58 abc	51.2 a-e	25.98 a-d	61.03 a	3731 ab	34.63 a	18.45 ab	
Cobra 2.0 EC 9 fl oz/ac (A)	10 gal	0.84 a	1.48 ab	1.59 abc	41 ab	64 abc	64 abc	2.04 a-d	2.29 ab	2.49 a	37.1 a	32.12 a	60.52 a	3606 ab	34.08 ab	18.75 ab	
Cobra 2.0 EC 12 fl oz/ac (A)	10 gal	0.91 a	1.26 a	1.44 ab	44 ab	53 a	58 ab	2.00 abc	2.35 a-d	2.50 ab	34.7 a	31.07 ab	61.02 a	3576 ab	34.63 a	18.36 ab	
Cobra 2.0 EC 6 fl oz/ac (B)	10 gal	0.69 a	1.24 a	1.36 a	38 a	53 ab	56 a	1.87 a	2.34 abc	2.43 a	31.0 a	29.99 ab	60.89 a	3860 ab	34.08 ab	18.18 ab	
Cobra 2.0 EC 6 fl oz/ac (C)	10 gal	1.64 d	1.96 de	2.24 de	70 ef	80 de	89 d	2.31 cde	2.44 a-d	2.52 ab	57.6 a-e	22.13 b-e	60.40 a	4005 b	32.10 b	19.32 a	
Domark 1.90 ME 5 fl oz/ac (B)	20 gal	2.09 ef	2.72 ghi	2.67 fgh	82 g	99 i	98 f	2.48 efg	2.74 fgh	2.72 abc	74.7 de	16.72 ef	59.82 a	3368 a	33.50 ab	19.11 ab	
Domark 1.90 ME 5 fl oz/ac (C)	20 gal	2.10 ef	2.42 fg	2.45 ef	85 gh	95 ghi	92 def	2.44 efg	2.53 c-f	2.66 abc	70.5 cde	19.82 c-f	59.61 a	3663 ab	33.90 ab	18.77 ab	
Domark 1.90 ME 5 fl oz/ac (D)	20 gal	2.25 ef	2.46 fg	2.55 efg	90 gh	94 f-i	93 def	2.50 efg	2.61 d-g	2.75 bcd	73.6 de	18.06 def	60.04 a	3403 a	34.10 ab	18.92 ab	
Domark 1.90 ME 5 fl oz/ac (B, C)	20 gal	2.08 e	2.45 fgh	2.50 efg	83 gh	91 fgh	91 de	2.52 efg	2.70 fgh	2.75 cd	70.8 cde	17.33 def	60.00 a	3601 ab	34.40 ab	18.68 ab	
Cobra 2.0 EC 6 fl oz/ac (A) / Domark 1.90 ME 5 fl oz/ac (C)	10 gal / 20 gal	0.99 ab	1.60 bc	1.78 c	49 abc	69 c	72 c	1.95 ab	2.26 a	2.47 a	41.5 abc	30.72 ab	60.52 a	3595 ab	34.00 ab	18.68 ab	
Headline 2.09 EC 6 fl oz/ac (B)	10 gal	2.13 ef	2.76 i	2.79 h	81 fg	97 hi	97 ef	2.59 g	2.84 h	2.88 d	76.3 e	11.57 f	60.01 a	3720 ab	34.40 a	18.51 ab	
Topsin M 70 WSP 1 lb/ac (B)	10 gal	2.04 e	2.24 ef	2.36 ef	85 gh	89 efg	88 d	2.39 ef	2.53 b-f	2.70 abc	67.2 b-e	19.18 def	60.50 a	3579 ab	34.40 a	18.75 ab	
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Domark 1.90 ME 5 fl oz/ac (B)	5 gal	2.05 e	2.54 fgh	2.71 gh	81 fg	95 f-i	97 ef	2.53 efg	2.68 e-h	2.81 cd	72.4 de	16.95 def	59.90 a	3449 a	34.05 a	19.02 ab	
Domark 1.90 ME 5 fl oz/ac (B)	10 gal	2.39 f	2.68 hi	2.73 gh	91 h	97 hi	98 f	2.62 g	2.76 gh	2.80 cd	79.1 e	13.53 ef	59.67 a	3470 a	33.58 ab	18.93 ab	
Treatment differences, χ^2 , df: ⁷		1007.0, 16	1040.8, 16	885.6, 16	1221.2, 16	1097.6, 16	877.7, 16	276.05, 16	237.34, 16	150.36, 16	F: ⁷	8.94	15.56	2.84	2.91	2.82	1.99
Treatment differences, $P > \chi^2$: ⁸		< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	P > F: ⁸	< 0.0001	< 0.0001	0.0055	0.0043	0.0055	0.0449
C.V.:		19.25	15.15	0.92	5.38	2.42	2.63										

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where x_i = disease severity index at the i th observation, t_i = time in days at the i th observation, and n = number of observations

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Type I Sum of Squares:

Significance of variation among replicates, treatments, and replicate-by-treatment interactions

<u>DISEASE SEVERITY INDEX, AUG. 5-6</u>			<u>DISEASE INCIDENCE, AUG. 5-6</u>			<u>DISEASE SEVERITY, AUG. 5-6</u>			<u>YIELD</u>			
	χ^2 , df	$P > \chi^2$		χ^2 , df	$P > \chi^2$		χ^2 , df	$P > \chi^2$	F	$P > F$		
Rep	157.47, 3	<0.0001	Rep	150.44, 3	<0.0001	Rep	24.63, 3	<0.0001	Rep	0.1	0.76	
Treatment	1221.16, 16	<0.0001	Treatment	1006.99, 16	<0.0001	Treatment	276.05, 16	<0.0001	Treatment	15.6	< 0.0001	
Rep*Treatment	561.65, 48	<0.0001	Rep*Trt	504.23, 48	<0.0001	Rep*Treatment	205.34, 48	<0.0001	Rep*Treatment	1.45	0.18	
<u>DISEASE SEVERITY INDEX, AUG. 15-16</u>			<u>DISEASE INCIDENCE, AUG. 15-16</u>			<u>DISEASE SEVERITY, AUG. 15-16</u>			<u>TEST WEIGHT</u>			
	χ^2 , df	$P > \chi^2$		χ^2 , df	$P > \chi^2$		χ^2 , df	$P > \chi^2$	F	$P > F$		
Rep	160.63, 3	<0.0001	Rep	146.84, 3	<0.0001	Rep	26.79, 3	<0.0001	Rep	1.24	0.2736	
Treatment	1097.62, 16	<0.0001	Treatment	1040.88, 16	<0.0001	Treatment	237.34, 16	<0.0001	Treatment	2.84	0.0055	
Rep*Treatment	181.87, 48	<0.0001	Rep*Trt	164.84, 48	<0.0001	Rep*Treatment	103.05, 48	<0.0001	Rep*Treatment	1.7	0.0965	
<u>DISEASE SEVERITY INDEX, AUG. 27</u>			<u>DISEASE INCIDENCE, AUG. 27</u>			<u>DISEASE SEVERITY, AUG. 27</u>			<u>PROTEIN CONTENT</u>			
	χ^2 , df	$P > \chi^2$		χ^2 , df	$P > \chi^2$		χ^2 , df	$P > \chi^2$	F	$P > F$		
Rep	75.72, 3	0.0532	Rep	111.52, 3	<0.0001	Rep	0.63, 3	0.8883	Rep	2.37	0.1330	
Treatment	877.67, 16	<0.0001	Treatment	885.64, 16	<0.0001	Treatment	136.1, 16	<0.0001	Treatment	2.82	0.0055	
Rep*Treatment	158.57, 48	<0.0001	Rep*Trt	136.56, 48	<0.0001	Rep*Treatment	109.53, 48	<0.0001	Rep*Treatment	0.85	0.6246	
						<u>AUDPC</u>			<u>OIL CONTENT</u>			
							F	$P > F$	F	$P > F$		
							Rep	9.74	0.0037	Rep	2.56	0.1187
							Treatment	8.94	< 0.0001	Treatment	1.99	0.0449
							Rep*Treatment	0.36	0.9837	Rep*Treatment	0.66	0.8109
									<u>SEEDS PER POUND</u>			
							F	$P > F$	F	$P > F$		
							Rep	3.52	0.0693	Rep	3.52	0.0693
							Treatment	2.91	0.0043	Treatment	2.91	0.0043
							Rep*Treatment	1.09	0.4003	Rep*Treatment	1.09	0.4003

Literature cited:

Hosmer, D. W., and Lemeshow, S. 2000. Applied Logistic Regression. John Wiley & Sons, New York.
Neter, J., Kutner, M. H., Nachtsheim, C. J., and Wasserman, W. 1996. Applied Linear Statistical Models. 3rd ed. McGraw Hill