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Field evaluation of fungicides for management of Sclerotinia stem rot on soybeans

Carrington, ND (2010)

Michael Wunsch, plant pathologist
Blaine Schatz, director and agronomist
North Dakota State University Carrington Research Extension Center

Within-column means followed by different letters and non-overlapping ranges of letters are significantly different (**alpha = 0.05**).

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						
		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**	60 **c-f**	21 **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 **a-d**	30 **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 **a-e**	26 **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 **ab**	32 **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**	35 **a**	31 **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 **a**	30 **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**	58 **b-f**	22 **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**	75 **f**	17 **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**	71 **ef**	20 **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**	74 **f**	18 **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**	71 **ef**	17 **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**	42 **abc**	31 **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 **f**	12 **f**	60.01 **a**	3720 **ab**	34.40 **a**	18.51 **ab**
Topsin M 70WSP 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 **def**	19 **def**	60.50 **a**	3579 **ab**	34.40 **a**	18.75 **ab**
Endura 70 WG 8 oz/ac **(B)**	10 gal	0.83 **a**	1.59 **bc**	1.84 **c**	44 **ab**	66 **bc**	70 **bc**	1.86 **a**	2.41 **a-d**	2.65 **abc**	39 **abc**	29 **abc**	60.98 **a**	3663 **ab**	35.30 **a**	18.01 **b**
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 **ef**	17 **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 **f**	14 **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* > χ^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

[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):**

$$\text{AUDPC} = \sum_{i=1}^{n}\left((x_i + x_{i+1})/2\right) * (t_{i+1} - t_i)$$

where x_i = disease severity index at the ith 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* > χ^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.

KEY FINDINGS:

Under high Sclerotinia disease pressure, the herbicide Cobra provided excellent Sclerotinia control and statistically significant increases in soybean yield. The optimal application timing was shortly before bloom initiation or at bloom initiation, and the low application rate of 6 fl oz/ac appeared to be sufficient.

The fungicides Domark (5 fl oz/ac), Headline (6 fl oz/ac) and Topsin WP (1 lb/ac) did not show efficacy against Sclerotinia in this trial. The performance of Endura (8 oz/ac) was intermediate.

Active ingredients of products tested in this trial: Cobra contains 240 grams lactofen per liter, Domark contains 230 grams tetraconazole per liter, Endura contains 700 grams boscalid per kilogram, Headline contains 250 grams pyraclostrobin per liter, and Topsin WP contains 700 grams thiophanate-methyl per kilogram.

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METHODS:

- **Location of trial:** NDSU Carrington Research Extension Center, Carrington, ND.
- **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 $2.7x10^6$ ascospores/square meter in 53 gal. water/ac. July 18 at 10:15 to 11:15 pm. Replicate 4 was inoculated with $1.0x10^6$ 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 transfomations 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).

IMPORTANT NOTICE:

- Fungicide performance can differ in response to which diseases are present, levels of disease when products are applied, environmental conditions, plant architecture and the susceptibility to disease of the variety planted, crop growth stage at the time of fungicide application, and other factors.
- This report summarizes fungicide performance as tested at the NDSU Carrington Research Extension Center under the conditions partially summarized in this report. Fungicide efficacy may differ under other conditions; when choosing fungicides, always evaluate results from multiple trials.
- This report is shared for educational purposes and is not an endorsement of any specific products.

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