Field evaluation of fungicides for management of Sclerotinia on dry edible (pinto) beans

Carrington, ND (2010) ■ 15-inch row spacing

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KEY FINDINGS:

Under high Sclerotinia disease pressure, Sclerotinia disease control and pinto bean yields were optimized with two sequential fungicide applications. A single fungicide application at bloom initiation provided poor Sclerotinia disease control, possibly due to late disease onset. A sharp, statistically significant increase in disease control was observed when a second fungicide application was made 11 days later.

ProPulse (10.3 fl oz/ac) was more effective against Sclerotinia than Topsin (1 lb/ac) + Headline (6 fl oz/ac). The performance of Proline (5.7 fl oz/ac) was intermediate.

Yield impacts of the fungicide treatments could not be rigorously assessed in this trial due to poor stand establishment. Yield differences were primarily determined by differences in plant populations, not differences in disease control.

ProPulse = *prothioconazole (200 g ai/L) + fluopyram (200 g ai/L)*
Proline = *prothioconazole (480 g ai/L)*
Headline = *pyraclostrobin (250 g ai/L)*
Topsin = *thiophanate-methyl (700 g ai/kg).*

The Type I error rate was controlled at the level of the experiment with the Bonferroni multiple comparison procedure (disease data) and the Tukey multiple comparison procedure (seed yield and quality data).

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

Treatment, application rate, timing[1]	WHITE MOLD SEV. INDEX[2] (1 to 9 scale)		WHITE MOLD INCIDENCE[3] (percent)		WHITE MOLD SEVERITY[4] (2 to 9 scale)		YIELD (lbs/acre)	TEST WEIGHT (lbs/bu)	SEEDS per POUND (seeds)	GRAMS per 100 seeds (grams)
Proline and ProPulse applied with 0.25% NIS.	Aug. 10-11	Sept. 3	Aug. 10-11	Sept. 3	Aug. 10-11	Sept. 3				
Non-treated check 1	3.83 f	6.09 d	90 f	93 e	4.15 de	6.48 de	2298 a	61.7 a	1436 a	31.6 a
Non-treated check 2	3.84 f	6.11 d	77 ef	91 de	4.46 e	6.59 de	1992 a	62.0 a	1396 a	32.5 a
Confidential	2.59 de	5.98 d	59 de	90 cde	3.66 bcd	6.52 e	2595 a	62.0 a	1391 a	32.7 a
Confidential	3.00 e	5.86 d	75 ef	93 e	3.58 bcd	6.21 cde	2735 a	63.6 a	1396 a	32.5 a
ProPulse 400SC, 10.3 fl oz/ac (A)	1.95 cd	5.34 cd	43 cd	85 b-e	3.17 ab	6.08 cde	2148 a	62.0 a	1406 a	32.3 a
Confidential	3.00 e	5.86 d	75 ef	93 e	3.58 bcd	6.21 cde	2735 a	63.6 a	1396 a	32.5 a
Proline 480SC, 5.7 fl oz/ac (A)	3.23 ef	5.88 ef	72 ef	86 b-e	4.08 de	6.64 e	2479 a	61.7 a	1381 a	32.9 a
Topsin-M 70WSP, 1 lb/ac + Headline 250EC, 6.0 fl oz/ac (A)	2.93 e	5.98 d	67 e	91 de	3.74 cd	6.41 cde	2812 a	62.1 a	1380 a	32.9 a
Confidential	1.56 abc	4.63 bc	20 ab	73 abc	3.57 bcd	5.95 b-e	3049 a	62.3 a	1317 a	34.5 a
ProPulse 400SC, 10.3 fl oz/ac (A,B)	1.20 a	3.45 a	10 a	63 a	2.44 ND[5]	4.81 a	2484 a	61.7 a	1333 a	34.1 a
Confidential	1.28 ab	3.49 a	18 ab	61 a	2.60 ab	5.12 ab	2502 a	62.0 a	1351 a	33.6 a
Proline 480SC, 5.7 fl oz/ac (A,B)	1.77 bc	4.20 ab	36 bcd	72 ab	2.68 ab	5.53 abc	2776 a	62.4 a	1402 a	32.4 a
Topsin-M 70WSP, 1 lb/ac + Headline 250EC, 6.0 fl oz/ac (A,B)	1.64 abc	4.60 b	28 abc	76 a-d	3.23 abc	5.66 a-d	2491 a	62.2 a	1412 a	32.2 a
Treatment differences, X^2 and F[6]	X^2, df: 442.9, 11	X^2, df: 198.2, 11	X^2, df: 356.3, 11	X^2, df: 116.6, 11	X^2, df: 130.3, 11	X^2, df: 91.1, 11	F = 1.09	F = 0.69	F = 1.25	F = 1.25
Treatment differences, P[7]	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.4097	0.7362	0.3102	0.3072
C.V.:							22.28	0.91	4.43	4.5

[1] **Application timing:** (A) July 15, beans at R1, approx. 75% of plants with an open flower; (B) July 26, beans in full bloom, most mature pods 1.5-2 in. long. All applications of Proline and ProPulse were made with 0.25% v/v non-ionic surfactant (Induce).

[2] **White mold severity index:** a combination of disease severity and disease incidence. The 1-9 scale developed by CIAT (1987) was used: 1 = no visible symptoms, 2 = very light symptoms (< 5% of plant affected), 3 = light symptoms (5-10% of plant affected), 4 = visible and conspicuous symptoms (10-20% of plant affected), 5 = visible and conspicuous symptoms (20-30% of plant affected), 6 = visible and conspicuous symptoms (30-40% of plant affected), 7 = severe symptoms (40-60% of plant affected), 8 = severe symptoms (60-80% of plant affected), and 9 = very severe symptoms (80-100% of plant affected; plant dead). Within each treatment, 100 plants were evaluated (25 plants per treatment per experimental replicate) on Aug. 10-11 and 120 plants were evaluated (30 plants/treatment/replicate) on Sept. 3.

[3] **White mold incidence:** The percent of plants with white mold symptoms. Within each treatment, 100 plants were evaluated (25 plants per treatment per experimental replicate) on Aug. 10-11 and 120 plants were evaluated (30 plants/treatment/replicate) on Sept. 3.

[4] **White mold severity:** White mold severity on plants showing disease. A 2 to 9 scale (CIAT 1987) was used: 2 = very light symptoms (< 5% of plant affected), 3 = light symptoms (5-10% of plant affected), 4 = visible and conspicuous symptoms (10-20% of plant affected), 5 = visible and conspicuous symptoms (20-30% of plant affected), 6 = visible and conspicuous symptoms (30-40% of plant affected), 7 = severe symptoms (40-60% of plant affected), 8 = severe symptoms (60-80% of plant affected), and 9 = very severe symptoms (80-100% of plant affected; plant dead). Within each treatment, 100 plants were evaluated (25 plants per treatment per experimental replicate) on Aug. 10-11 and 120 plants were evaluated (30 plants/treatment/replicate) on Sept. 3.

[5] **No Data (ND):** The sample size of diseased plants was too small to conduct pairwise contrasts with this treatment; insufficient numbers of plants were diseased.

[6] **Treatment differences, X^2 and F:** Chi-square statistics, degrees of freedom, and F-values associated with the test of the null hypothesis that there are no differences among treatments.

[7] **Treatment differences, P:** The probability of observing a chi-square value or F-statistic greater than that observed, an assessment of the significance of treatment differences.

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METHODS:

Experiment design, seeding, planting, and harvest: The experiment was a randomized complete block design with four replicates. Plots were seeded May 26 and harvested September 27. Pinto bean cultivar 'Lariat' was seeded in 16-inch rows at a seeding rate of 89,000 seeds/acre. Plots consisted of four rows, each 25 ft long (plot dimensions = 5.33 ft. by 25 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-foot 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 inititiation of flowering until plants approached physical maturity. Beans were harvested for yield from 12 feet of each of the two center rows of each treatment plot.

Fungicide applications: Application A was made at R1 (about 75% of plants with an open flower) on July 15 at 10:00 am, and application B was made at full bloom (with most mature pods 1.5 to 2 inches long) on July 26 at 10:30 am. A 60-in. hand boom with four equally spaced TeeJet 80015 nozzles was used. Applications were made with 17.5 gal./ac. water and 35 PSI pressure.

Inoculation: The experiment was inoculated with laboratory produced ascospores of *Sclerotinia sclerotiorum* July 18 at 11:30 pm (approx. 890,000 spores/square meter); the temperature at the time of inoculation was approx. 24 C. A 60-inch hand boom with four equally spaced TeeJet 8002 nozzles was used for applications. Spores were applied in 73.5 gal./ac. of water with 35 PSI pressure.

Disease assessment: Disease ratings were conducted on 25 plants per plot on August 10 (replicate 4) and August 11 (replicates 1-3) and on 30 plants per plot September 3 (replicates 1-4). Plants in the middle two rows of each plot were assessed, and no plants sampled at plot edges. The 1-9 scale developed by CIAT (1987) was used: 1 = no visible symptoms, 2 = very light symptoms (< 5% of plant affected), 3 = light symptoms (5-10% of plant affected), 4 = visible and conspicuous symptoms (10-20% of plant affected), 5 = visible and conspicuous symptoms (20-30% of plant affected), 6 = visible and conspicuous symptoms (30-40% of plant affected), 7 = severe symptoms (40-60% of plant affected), 8 = severe symptoms (60-80% of plant affected), and 9 = very severe symptoms (80-100% of plant affected; plant dead).

Statistical analysis (1): 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 possible pairwise combinations of treatments were conducted with Wald chi-square tests. Replicate and treatment were included in the model as main effects, and replicate-by-treatment interaction was included in the model. Pairwise treatment contrasts were conducted on the full model (main effects plus interaction) for the Sept. 3 disease severity index and Sept. 3 disease severity analyses but on a reduced model with only the main effects (no interaction term) for the other analyses, for which the Wald chi-square tests could not be properly implemented using the full model. Analyses were implemented in PROC GENMOD of SAS (version 9.2; SAS Institute, Cary, NC), and the Bonferroni multiple comparison procedure was used to control the Type I error rate at the level of the experiment across the 66 pair-wise contrasts of treatments.

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 were adjusted to 13.0% moisture. The assumption of constant variance was assessed by plotting residuals against predicted values, and the assumption of normality will be assessed with a normal probability plot. The assumptions were met, and systematic transformations were not 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) will be employed. Analyses were conducted with replicate and treatment as main factor effects and with all interactions included in the model, and they 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 above.
- 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.