

Optimizing Fungicide Spray Droplet Size for Improved Management of White Mold in Pinto Beans

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Calibrating fungicide spray droplet size relative to canopy closure confers strong improvements in fungicide efficacy against white mold in soybeans, and this research sought to evaluate whether a similar response might be observed in pinto beans.

The impact of fungicide spray droplet size was tested with a PTO-driven tractor-mounted sprayer equipped with a pulse-width modulation system (Capstan AG; Topeka, KS). Pulse width was modified as needed to maintain a constant spray volume (15 gal/a) and constant driving speed across nozzles differing in output, with pulse width calibrated on the basis of measured output immediately before spraying treatments. The fungicide Topsin or T-methyl (40 fl oz/a) was applied at early bloom followed by Endura (8 oz/a) 11-14 days later. Applications were made at 6.0, 10.0, or 10.5 mph, depending on the study, using TeeJet extended-range flat fan nozzles. Fungicides were applied with XR11004 or XR11005 nozzles at 60 psi (fine droplets); XR11006 nozzles at 35 psi (medium droplets), and XR11010 nozzles at 30 psi (coarse droplets). To permit overspray of plots, treatment plots were bordered by 5- or 10-foot wide non-harvested plots. On ends of each treatment plot, a non-harvested plot was established to permit turning on and off the sprayer at full driving speed. Dry beans were seeded to rows 14, 15, or 28 inches apart at a seeding rate of 90,000 viable seeds. Seven treatments were evaluated: Non-treated, fine followed by fine droplets, fine followed by medium droplets, fine followed by coarse, medium followed by medium, medium followed by coarse, and coarse followed by coarse. All testing was conducted under conventional tillage except in Oakes in 2021, where testing was conducted with dry beans direct-seeded into fallow ground, into winter rye with rye terminated 12 days prior to planting, and into winter rye terminated 2 days after planting. To ensure rigorous results, testing was conducted with 8 to 12 experimental replicates.

The droplet size that optimized fungicide performance was contingent on canopy characteristics. In four studies, yields were maximized with fine droplets at the first application and fine or medium droplets at the second application (**Figure 1**). In four studies, yields were optimized with medium droplets at the first application and coarse droplets at the second application (**Figure 2**). Visual estimates of canopy closure were similar across these eight studies, and additional research is needed to identify the canopy characteristics when fine droplets vs. medium droplets are optimal in the first application. When canopy closure averaged 94% at the first application and 97-99% at the second application, yields were optimized with coarse droplets at both applications (**Figure 3**).

Location, year	Oakes, 2021	Carrington, 2022	Oakes, 2022	Oakes, 2022	COMBINED ANALYSIS
Variety	'Palomino'	'Palomino'	'Palomino'	'Palomino'	Average across four studies
Row spacing	15"	14"	28"	14"	
Canopy closure, applic. #1	68% (45-95%)	61% (50-75%)	59% (40-80%)	78% (60-100%)	
Canopy closure, applic. #2	86% (60-100%)	90% (75-98%)	96% (90-100%)	98% (85-100%)	

WHITE MOLD (% of canopy)

Non-treated control	29 b*	69 b*	42 b*	37 b*	44 b*
Fine f.b. fine droplets	16 ab	54 ab	22 a	24 a	29 a
Fine f.b. medium droplets	10 a	43 a	25 a	19 a	24 a
Fine f.b. coarse droplets	14 ab	39 a	28 ab	28 ab	27 a
Medium f.b. medium droplets	21 ab	40 a	28 ab	20 a	27 a
Medium f.b. coarse droplets	16 ab	48 a	24 a	19 a	27 a
Coarse f.b. coarse droplets	16 ab	43 a	24 a	20 a	26 a
CV:	45.4	19.4	38.5	39	14.7

YIELD (pounds/acre)

Non-treated control	2912 a*	2612 b*	2987 b*	3529 a*	3010 b*	
Fine f.b. fine droplets	3407 a	3277 a	3461 a	3861 a	3502 a	+492 ab**
Fine f.b. medium	3336 a	3631 a	3426 a	3942 a	3584 a	+574 a
Fine f.b. coarse	3208 a	3254 a	3210 ab	3728 a	3350 a	+340 b
Medium f.b. medium	3060 a	3411 a	3240 ab	3816 a	3382 a	+371 ab
Medium f.b. coarse	3186 a	3210 ab	3332 ab	3774 a	3375 a	+365 ab
Coarse f.b. coarse	3173 a	3606 a	3366 ab	3630 a	3444 a	+434 ab
CV:	13.6	9.0	9.1	8.0	4.1	

YIELD GAIN
conferred by the fungicide

Bar = average
Circle = result from one study

Figure 1. Applying fungicides with fine droplets at the early bloom and fine or medium droplets 10-14 days later optimized yields in four studies. T-methyl (40 fl oz) was applied first followed by Endura (8 oz) 10-14 days later. Within-column means followed by different letters are significantly different ($P < 0.05$) or ($P < 0.10$) if followed by two asterisks.

Location, year	Carrington, 2022	Carrington, 2021	Oakes, 2021	Oakes, 2021	COMBINED ANALYSIS
Variety	'Palomino'	'Palomino'	'Palomino'	'Palomino'	Average across four studies
Row spacing	28"	14"	15"	15"	
Canopy closure, applic. #1	61% (55-68%)	52% (40-60%)	79% (60-90%)	64% (40-85%)	
Canopy closure, applic. #2	88% (80-98%)	95% (80-100%)	92% (75-100%)	96% (90-100%)	

WHITE MOLD (% of canopy)

Non-treated control	69 b*	55 b*	27 b*	12 a*	41 b*
Fine f.b. fine droplets	50 a	46 a	12 a	8 a	29 a
Fine f.b. medium droplets	46 a	45 a	14 a	9 a	29 a
Fine f.b. coarse droplets	49 a	47 a	16 a	10 a	31 a
Medium f.b. medium droplets	43 a	48 a	14 a	10 a	29 a
Medium f.b. coarse droplets	52 a	43 a	14 a	7 a	29 a
Coarse f.b. coarse droplets	47 a	42 a	15 a	7 a	28 a
CV:	12.0	13.2	34.1	48.4	11.1

YIELD (pounds/acre)

Non-treated control	2444 b*	2161 a*	2944 b*	3363 a*	2728 b*	
Fine f.b. fine droplets	3137 a	2642 a	3282 ab	3382 a	3111 a	+383 b**
Fine f.b. medium	3369 a	2529 a	3337 a	3416 a	3163 a	+435 ab
Fine f.b. coarse	3241 a	2605 a	3573 a	3445 a	3216 a	+488 ab
Medium f.b. medium	3316 a	2522 a	3230 ab	3523 a	3148 a	+420 ab
Medium f.b. coarse	3373 a	2829 a	3510 a	3536 a	3312 a	+584 a
Coarse f.b. coarse	3220 a	2716 a	3509 a	3473 a	3230 a	+502 ab
CV:	8.4	9.8	8.1	7.4	4.5	

YIELD GAIN
conferred by the fungicide

Bar = average
Circle = result from one study

Figure 2. Applying fungicides with medium droplets at the early bloom and coarse droplets 10-14 days later optimized yields in four studies. T-methyl (40 fl oz) was applied first followed by Endura (8 oz) 10-14 days later. Within-column means followed by different letters are significantly different ($P < 0.05$) or ($P < 0.10$) if followed by two asterisks.

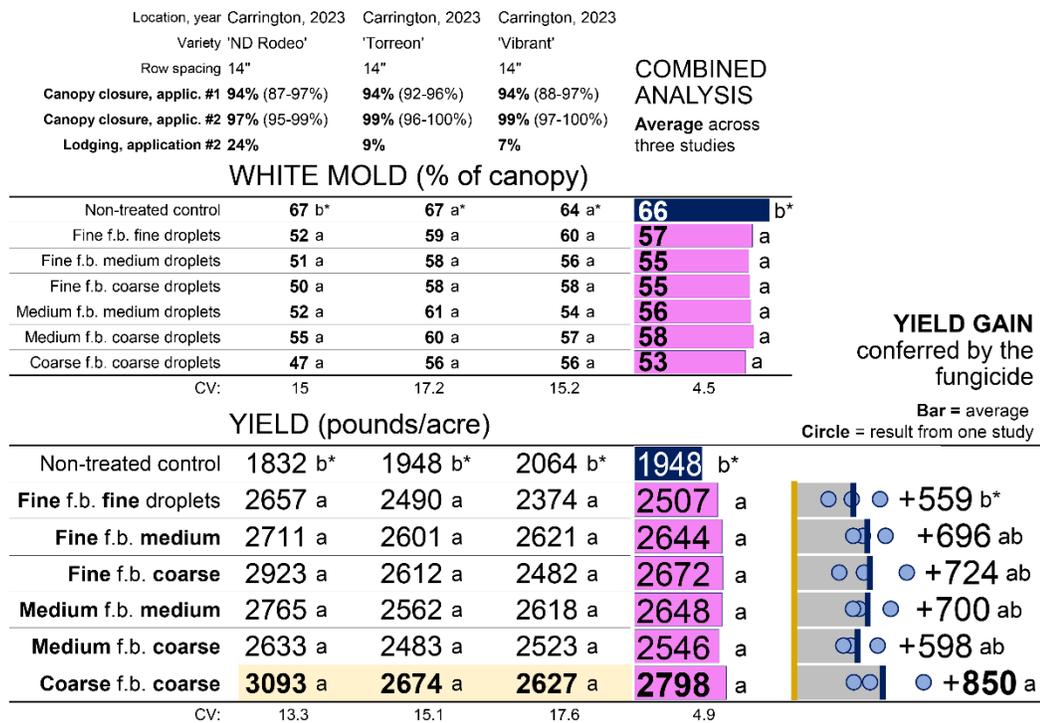


Figure 3. Applying fungicides with coarse droplets at the early bloom and coarse droplets 10-14 days later optimized yields in three studies. T-methyl (40 fl oz) was applied first followed by Endura (8 oz) 10-14 days later. Within-column means followed by different letters are significantly different ($P < 0.05$).