Improving white mold management in dry beans – Optimizing fungicide spray droplet size
Preliminary report from the first two years of a multi-year research project.
Data from the 2021 and 2022 field seasons. Date of report: March 2023

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METHODS:

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/ac) 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 (40 fl oz/ac) was applied at early bloom followed by Endura (8 oz/ac) 11-14 days later. 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 so as to permit turning on and off the sprayer at full driving speed. Dry beans were seeded to rows 14 or 28 inches apart at a seeding rate of 90,000 viable seeds/ac (pintos and kidneys) or 100,000 viable seeds/ac (blacks and navies). Seven treatments were evaluated: Non-treated, fine followed by fine droplets, fine f.b. medium droplets, fine f.b. coarse, medium f.b. medium, medium f.b. coarse, and coarse f.b. 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.

MAJOR FINDINGS:

In kidney beans, the yield gain conferred by the fungicide was increased by an average 37% when fungicide droplet size was calibrated relative to canopy closure and row spacing versus the standard recommendation of always applying with fine droplets. When kidney beans were seeded to narrow (14- or 15-inch) rows and canopy closure averaged 80-95% at the first fungicide application and 88-99% at the second fungicide application, yields were optimized by applying fungicides with medium droplets in the first application and coarse droplets in the

Table 1. Detailed methods – fungicide droplet size studies

Location and year	Oakes 2021	Carrington 2021	Oakes 2022	Carrington 2022
Driving speed	6.0 mph	10.5 mph	10.0 mph	10.0 mph
Fine droplets	XR11004, 60 psi	XR11005, 60 psi	XR11005, 60 psi	XR11005, 60 psi
Medium droplets	XR11006, 35 psi	XR11006, 35 psi	XR11006, 35 psi	XR11006, 35 psi
Coarse droplets	XR11010, 30 psi	XR11010, 30 psi	XR11010, 30 psi	XR11010, 30 psi
Applic. interval	14 days	12 days	11 days	11 days
Plot size	5 ft. x ave. 16.6 ft.	5 ft. x ave. 16.5 ft.	5 ft. x ave. 20.5 ft.	5 ft. x ave. 15.8 ft.
Experimental reps	5, 6, 8, or 9	12	10	8 or 10

second application (**Figures 1, 2**). When kidney beans were seeded to narrow (15-inch) rows and canopy closure averaged 98% at both applications or when kidney beans were seeded to wide (28-inch) rows with variable canopy closure, yields were optimized by applying fungicides with coarse droplets at both applications (**Figures 1, 2**).

In pinto beans, the yield gain conferred by the fungicide was increased by an average 35% by optimizing fungicide droplet size versus the standard recommendation of always applying with fine droplets. In four of eight pinto bean studies, yields were maximized with fine droplets in the first application and medium droplets at the second application (**Figures 1, 3**). In four of eight studies, yields were optimized with medium droplets in the first application and coarse droplets in the second application (**Figures 1, 3**). Visual estimates of canopy closure were similar in each set of studies, and additional research is needed to identify the canopy characteristics when fine droplets vs. medium droplets are optimal in the first application.

Not enough testing was conducted to develop fungicide droplet size recommendations for black or navy beans. Only three field trials were conducted with black and navy beans, an insufficient number of studies for this type of research. The preliminary findings for pinto and kidney beans presented in this report were developed from eight field studies conducted in each of these market classes.

Follow-up research is planned for the 2023 field season to assess the replicability of the kidney and pinto bean results presented in this report. The goal is to develop rigorous recommendations on the canopy characteristics at which fine, medium, or coarse droplets are optimal at the first application in pinto and kidney beans. Additional fungicide droplet size testing on blacks and navies will be deferred until research on pintos and kidneys is complete.

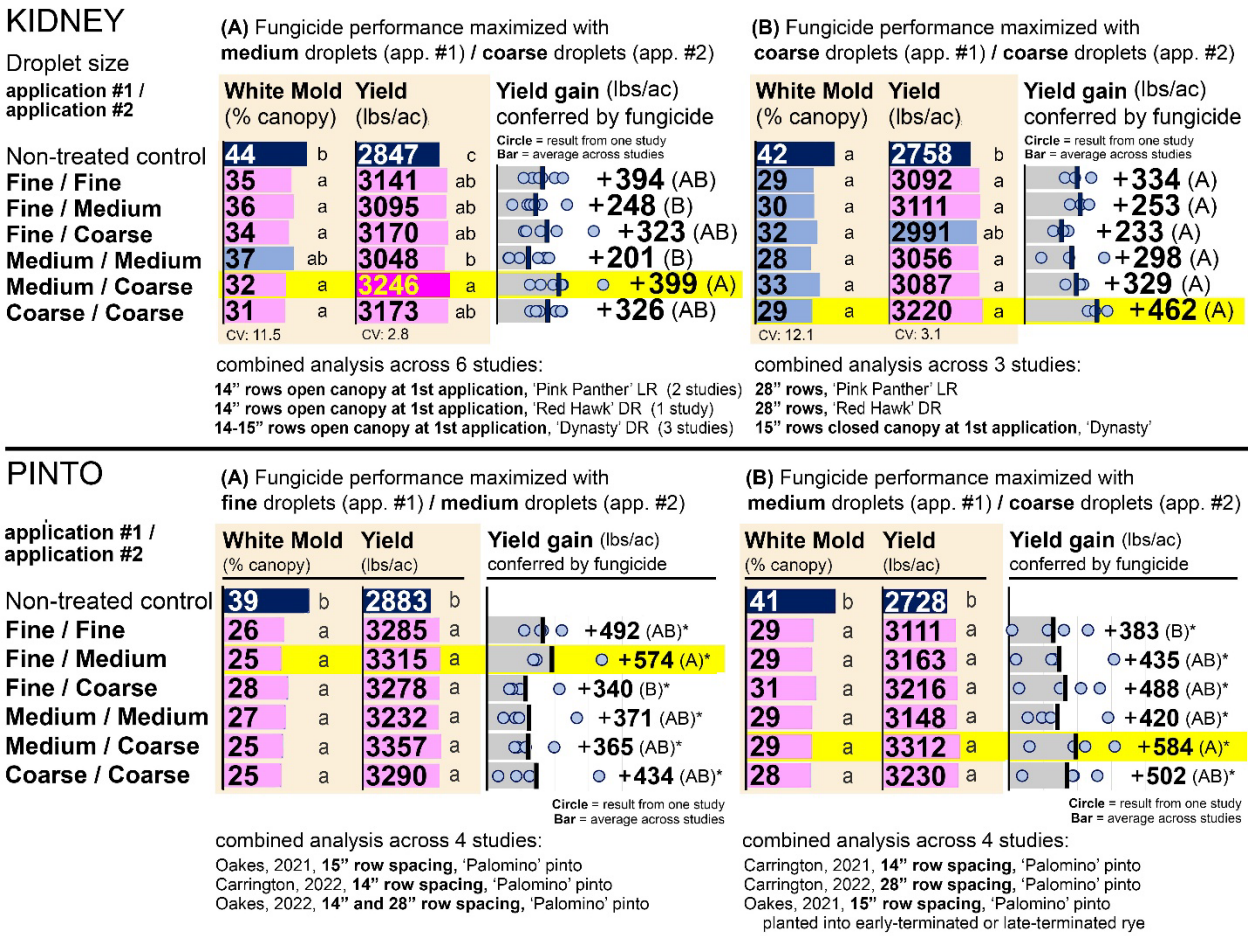

FIGURE 1. Impact of fungicide droplet size on white mold management kidney and pinto beans (Carrington, Oakes; 2021-2022). Topsin (40 fl oz/ac) was applied at early bloom / initial pod and Endura (8 oz/ac) was applied 10-14 days later. Within-column means followed by different letters are significantly different ($P < 0.05$) or ($P < 0.10$) if followed by an asterisk.

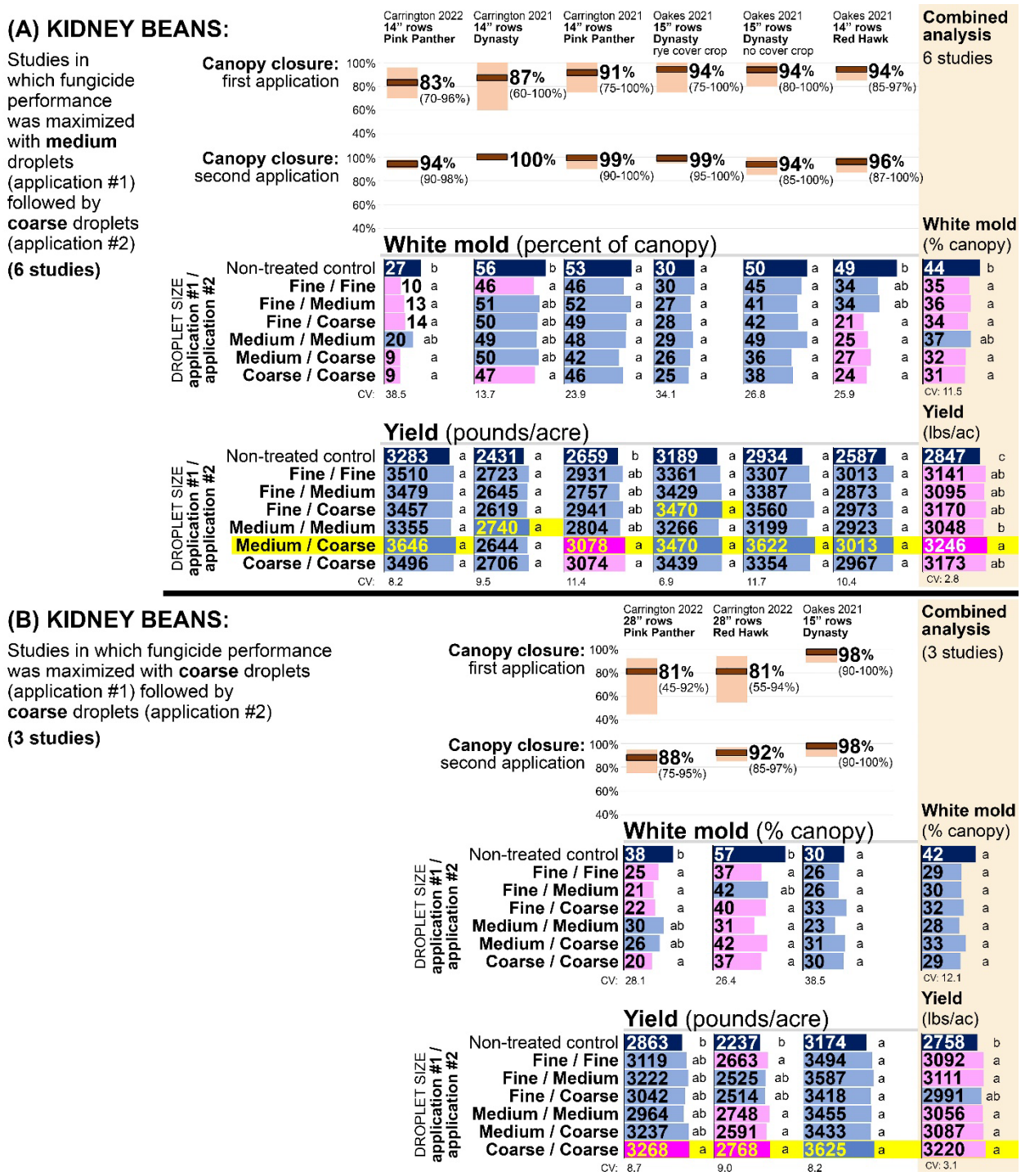

FIGURE 2. Impact of fungicide droplet size on white mold management in kidney beans; Carrington and Oakes, ND (2021-2022). Topsin (40 fl oz/ac) was applied at early bloom and initial pod development, and Endura (8 oz/ac) was applied 10-14 days later. Within-column means followed by different letters are significantly different ($P < 0.05$).

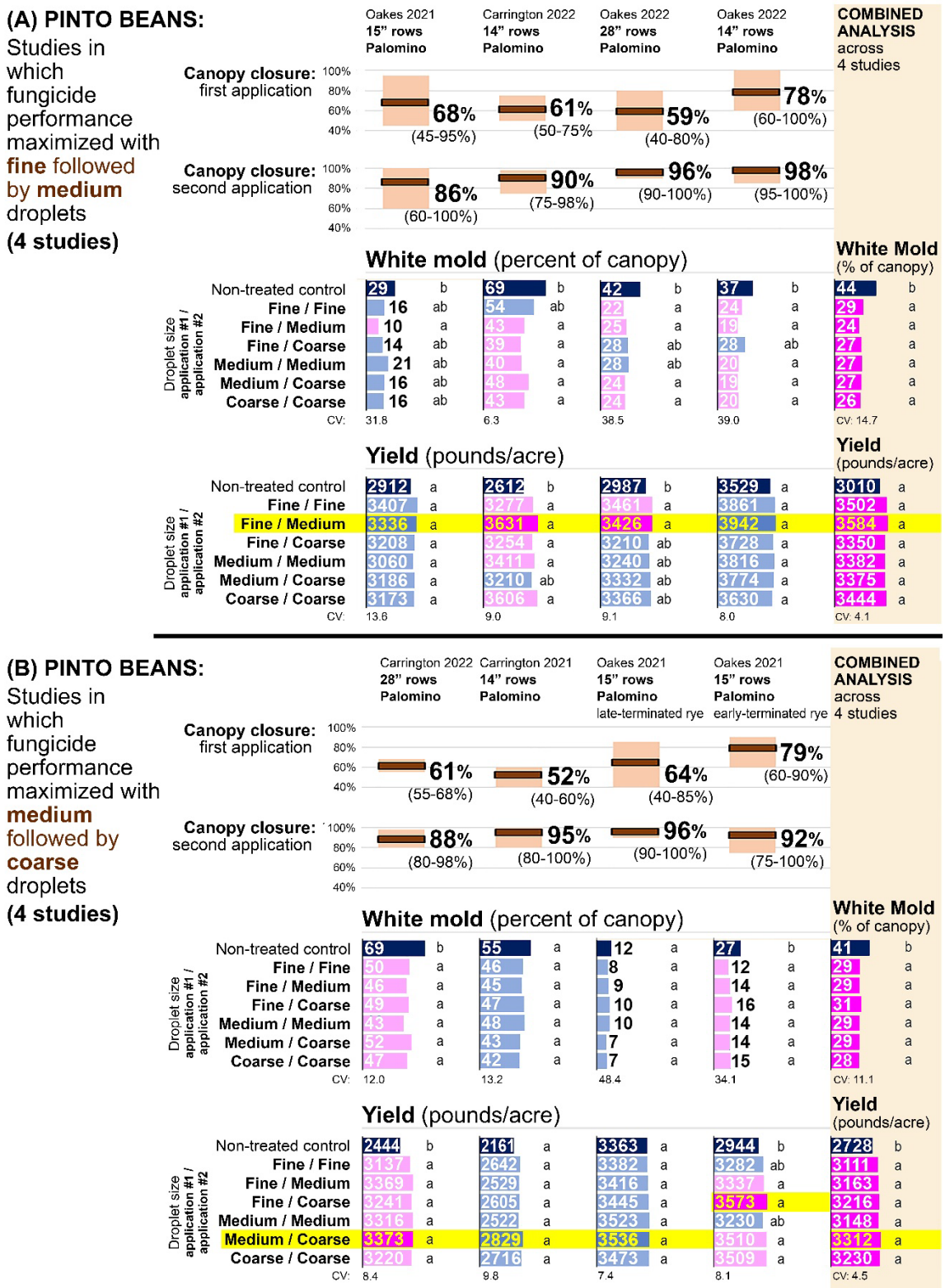

FIGURE 3. Impact of fungicide droplet size on white mold management in pinto beans; Carrington and Oakes, ND (2021-2022). Topsin (40 fl oz/ac) was applied at early bloom and initial pod development, and Endura (8 oz/ac) was applied 10-14 days later. Within-column means followed by different letters are significantly different ($P < 0.05$).