

Improving management of white mold in dry beans:
2. Optimizing fungicide spray droplet size

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Thank you

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- Northarvest Bean Growers Association
- ND Crop Protection Product Harmonization & Registration Board

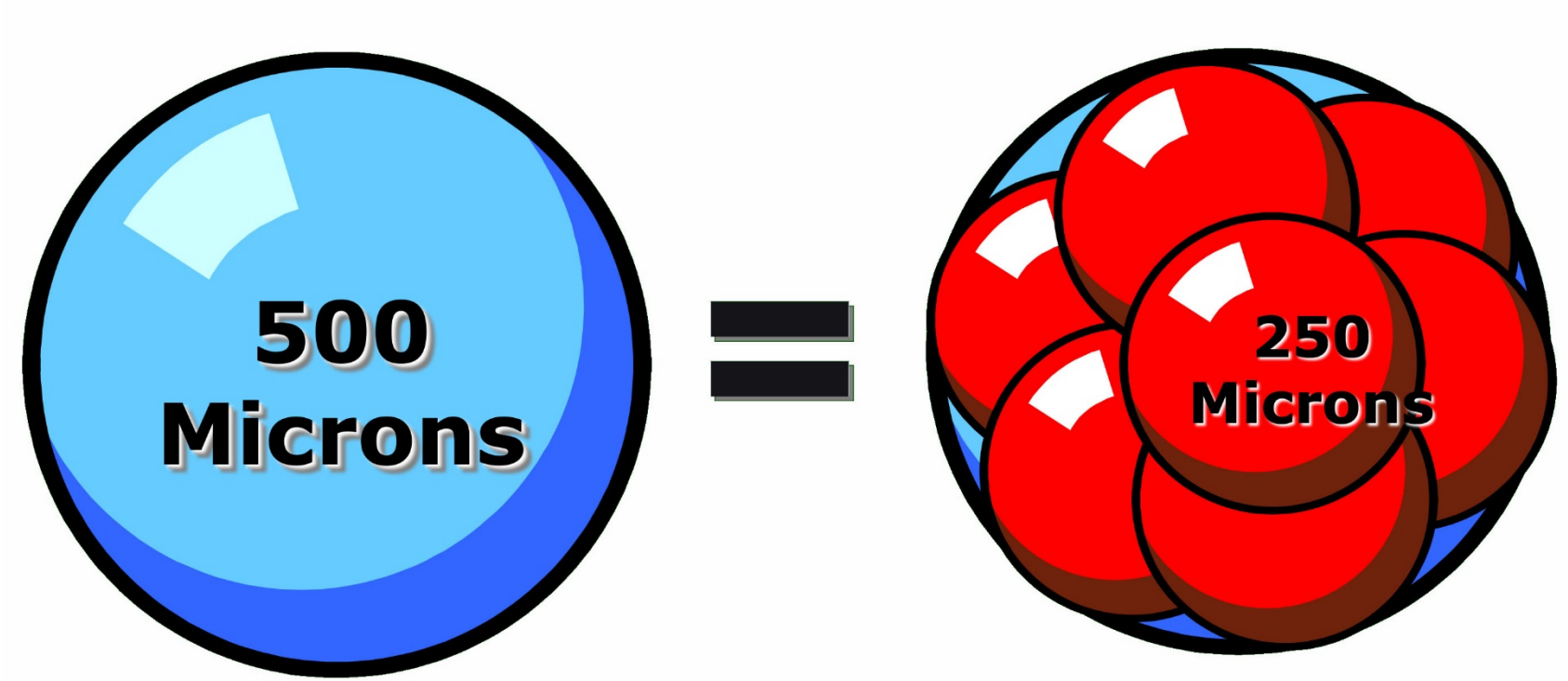
Dry bean seed was donated by:
- **Bollingberg Seeds Company** (Kurt Bollingburg; Cathay, ND)
- **Kelley Bean Company; Hatton, ND** (Dean Nelson)
- **Green Valley Bean Company** (John Berthold; Park Rapids, MN)

Staff members who played critical roles in project execution:
- **Jesse Hafner, Kaitlyn Thompson** and **Gabriela Henson**
- **Billy Kraft**, research technician
- **Suanne Kallis**, research specialist
- **Thomas Miorini**, post-doctoral research associate

Droplet size

Cutting droplet diameter in half

Results in **eight times as many droplets**



(there is one more droplet in the rear)

Image adapted from a presentation by Bob Wolf (Kansas State Univ.); Bobby Grisso and Pat Hipkins (Virginia Tech Univ.); and Tom Reed (TeeJet)

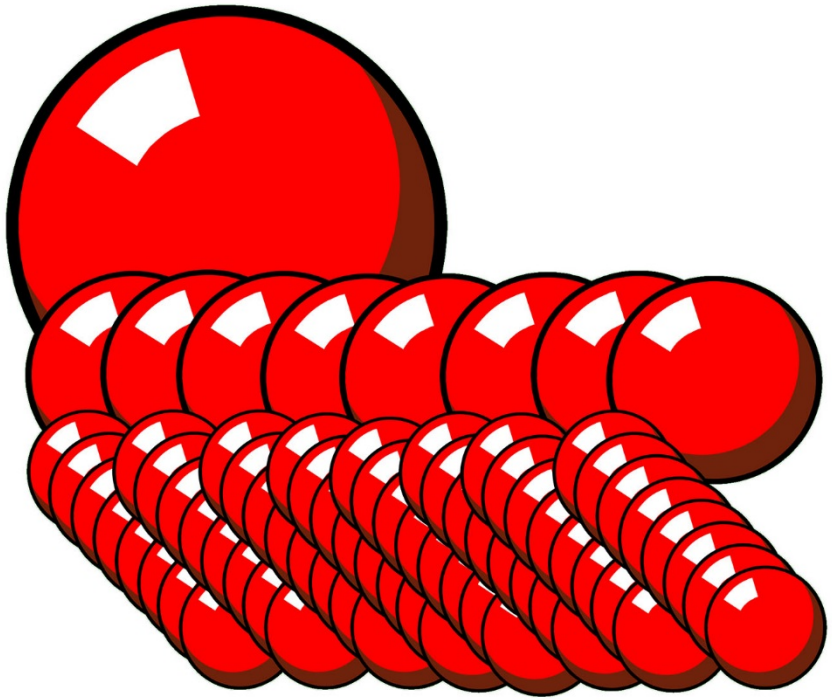
Droplet size

0.065 mm^3 spray volume =

one 500-um diameter droplet

eight 250-um diameter droplets

sixty-four 125-um diameter droplets



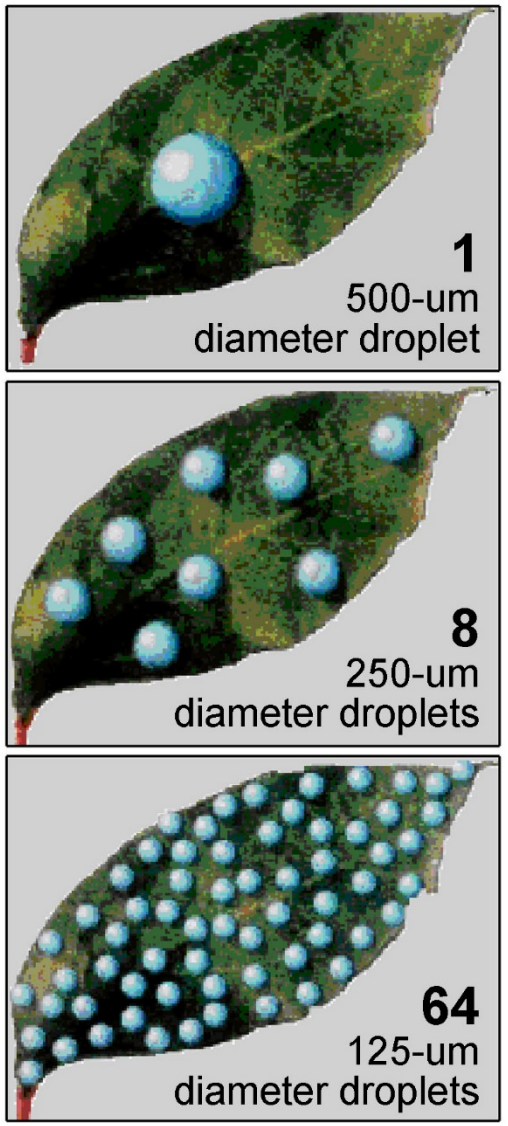
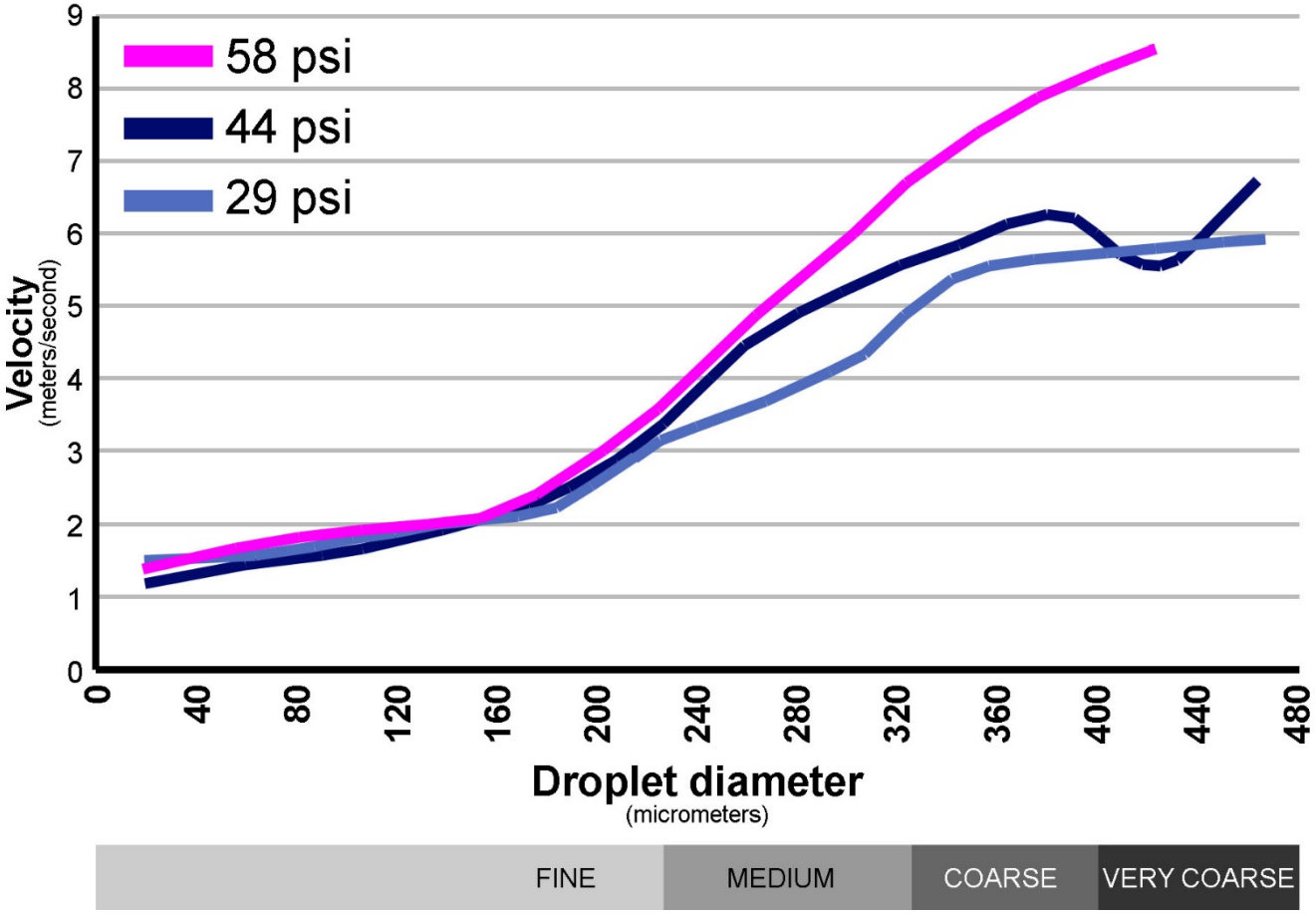


Image adapted from a presentation by Bob Wolf (Kansas State Univ.); Bobby Grisso and Pat Hipkins (Virginia Tech Univ.); and Tom Reed (TeeJet)

Droplet size

… but larger droplets have greater velocity, drift less.

Increased velocity and reduced drift improves canopy penetration.



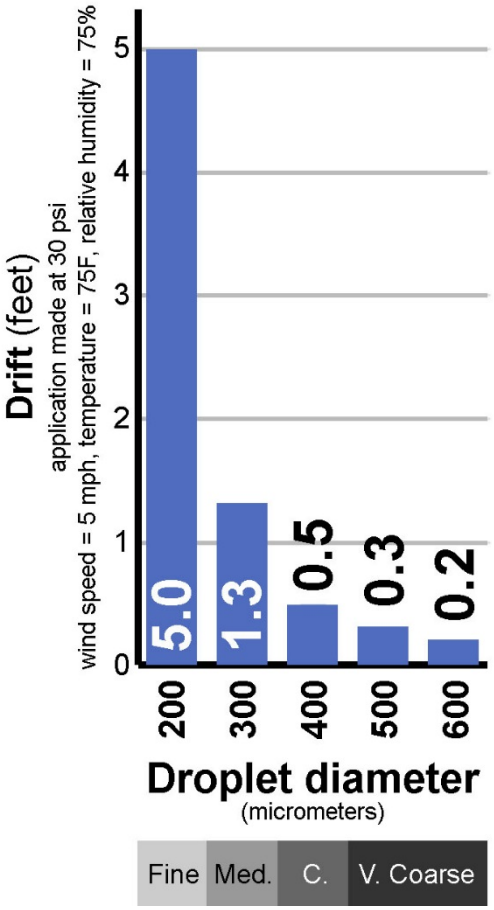


Image adapted from a presentation by Bob Wolf (Kansas State Univ.); Bobby Grisso and Pat Hipkins (Virginia Tech Univ.); and Tom Reed (TeeJet)

Experimental Methods

1. WILGER nozzles

Spray droplet size estimates were based on information provided by the manufacturer.

Tip Cap No.	Flow Rate USGPM	PSI	VMD (Droplet Size in µ); %<141µ (Drift %); %<200µ (Drift %); %<600µ (Small Droplets)															
			110° ER Series				110° SR Series				110° MR Series				110° DR Series			
			VMD	<141	<200	<600	VMD	<141	<200	<600	VMD	<141	<200	<600	VMD	<141	<200	<600
04	0.43	50	209	26%	47%	96%	275	15%	30%	96%	355	8%	17%	91%	447	5%	10%	79%

Fine 106-235µ | Medium 236-340µ | Coarse 341-403µ | Very Coarse 404-502µ

ER110-04
50 psi
FINE DROPLETS

SR110-04
50 psi
MEDIUM DROPLETS

MR110-04
50 psi
COARSE DROPLETS

DR110-04
50 psi
VERY COARSE DROPLETS

Experimental Methods

2. TEEJET nozzles

Spray droplet size estimates were based on information provided by the manufacturer.

XR TeeJet® (XR)

	PSI						
	15	20	25	30	40	50	60
XR11004	M	M	M	M	M	F	F
XR11005	M	M	M	M	M	F	F
XR11006	C	M	M	M	M	M	F
XR11008	C	C	C	C	M	M	M
XR11010	VC	C	C	C	M	M	M

XR11004 50 psi
FINE DROPLETS

XR11005 40 psi
MEDIUM-FINE DROPLETS

XR11006 35 psi
MEDIUM DROPLETS

XR11008 40 psi
MEDIUM-COARSE DROPLETS

XR11010 30 psi
COARSE DROPLETS

Initial Calibration

Spot-On sprayer calibrator model SC-1

Innoquest, Inc.; Woodstock, IL

The initial calibration was conducted with water.

Objectives:

1. **Nozzle selection:** Tips with output deviating from advertised specifications discarded
2. **Initial identification of pulse width** needed to deliver 15 gal/ac spray volume at 8.9 mph driving speed

Final Calibration

The final calibration was conducted with fungicide in the field immediately before application.

Objectives:

1. **Ensure a precise spray volume of 15 gal/ac.** Manual adjustments to pulse width were made as needed.
2. **Confirm that all nozzles are operating correctly** – consistent output across all nozzles; no plugs.

Applications

Tractor-mounted sprayer equipped with a pulse-width modulation system from Capstan AG.

Spray volume: 15 gal/ac Pulse width manually calibrated to maintain a constant spray volume across tips differing in output.

Driving speed: 8.9 mph in all studies conducted in 2019. In studies conducted in 2018, driving speed was 6.7 mph.

Study design, data collection

Replicates: 9 replicates (Wilger study), 11 replicates (TeeJet)

A large number of replicates was utilized due to the inherent spatial variability of white mold and the need to differentiate small treatment differences.

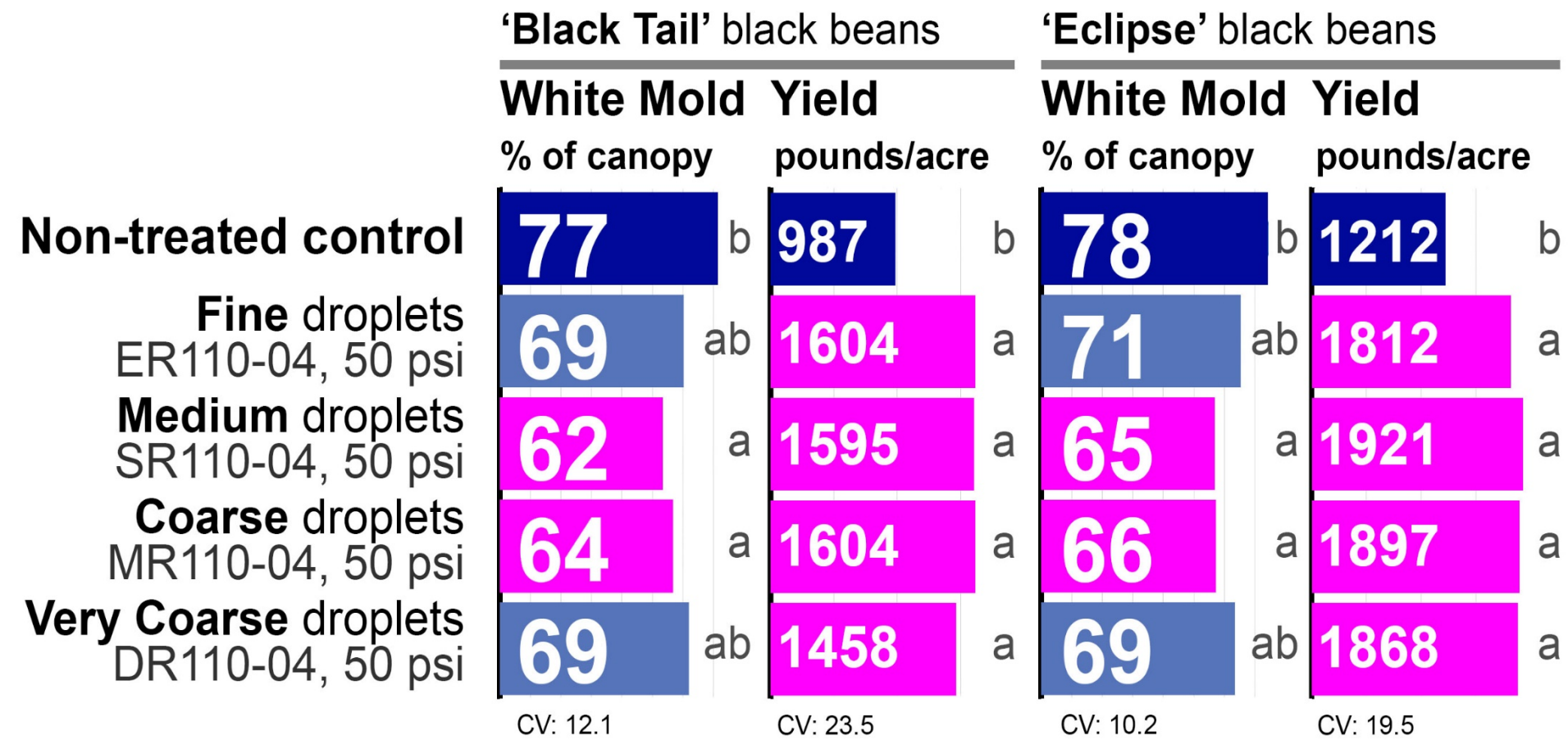
Plot size: 5 ft x 22 ft at planting, 5 ft x average 18 ft at harvest

Disease assessments: Every plant in each plot was individually assessed for white mold severity (%) at/near dry bean maturity.

White mold severity was calculated for each plot by averaging the disease severity ratings taken across all plants in the plot.

Harvest: Plants manually clipped at the base in conjunction with disease assessments and wind-rowed to permit dry-down.

Impact of droplet size (Wilger) – black beans



Study location: Carrington, ND **Year:** 2019

Fungicide: Topsin 4.5FL (40 fl oz/ac) at early bloom + Endura 70WG (8 oz/ac) 12 days later

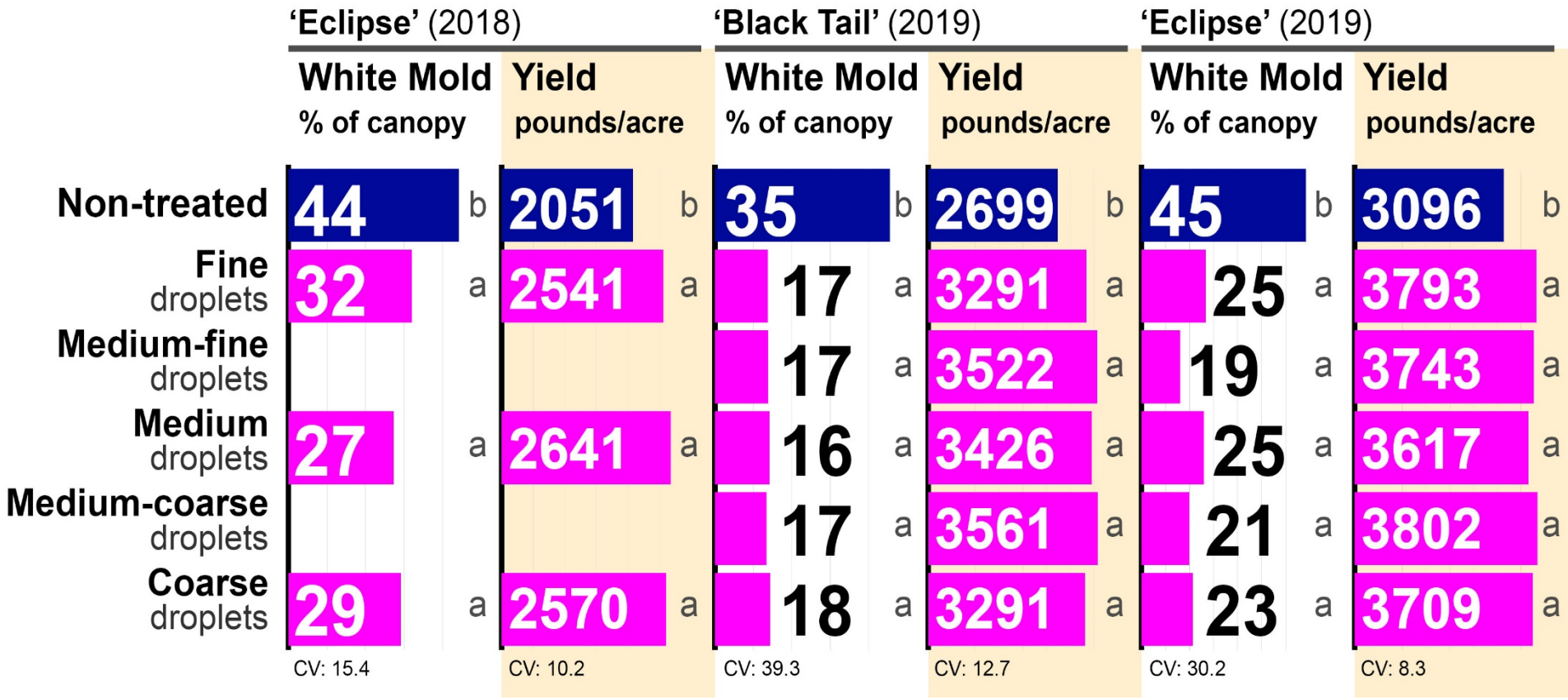
Row spacing: 21 inches **Seeding rate:** 100,000 pure live seeds/ac

Spray volume: 15 gal/ac **Driving speed:** 8.9 mph

NORTHARVEST BEANS

NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

Impact of droplet size (TeeJet) – black beans



Study location: Carrington, ND **Years:** 2018, 2019

Fungicide: Topsin 4.5FL (40 fl oz/ac) at early bloom + Endura 70WG (8 oz/ac) 12 days later (2019) or 14 days later (2018)

Row spacing: 21 inches **Seeding rate:** 100,000 pure live seeds/ac (2019); 110,000 pls/ac (2018)

Spray volume: 15 gal/ac **Driving speed:** 8.9 mph (2019); 6.7 mph (2018)

Nozzles (2018): XR8003, 50 psi (fine); XR8004, 40 psi (medium-fine); XR8006, 40 psi (medium); XR8008, 35 psi (medium-coarse); XR8010, 30 psi (coarse)

Nozzles (2019): XR11004, 50 psi (fine); XR11005, 40 psi (medium-fine); XR11006, 35 psi (medium); XR11008, 40 psi (medium-coarse); XR11010, 30 psi (coarse)

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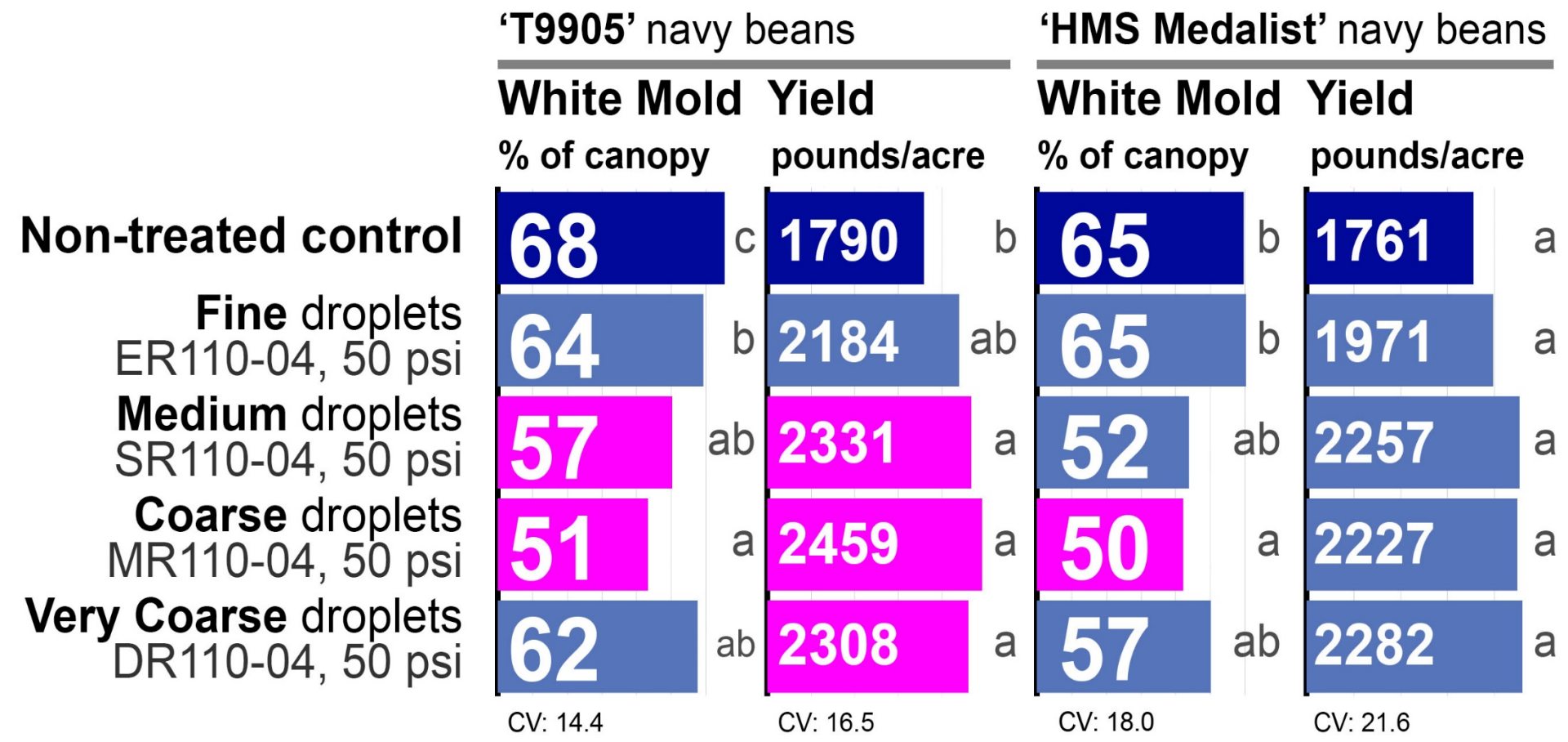
Impact of droplet size (Wilger) – navy beans



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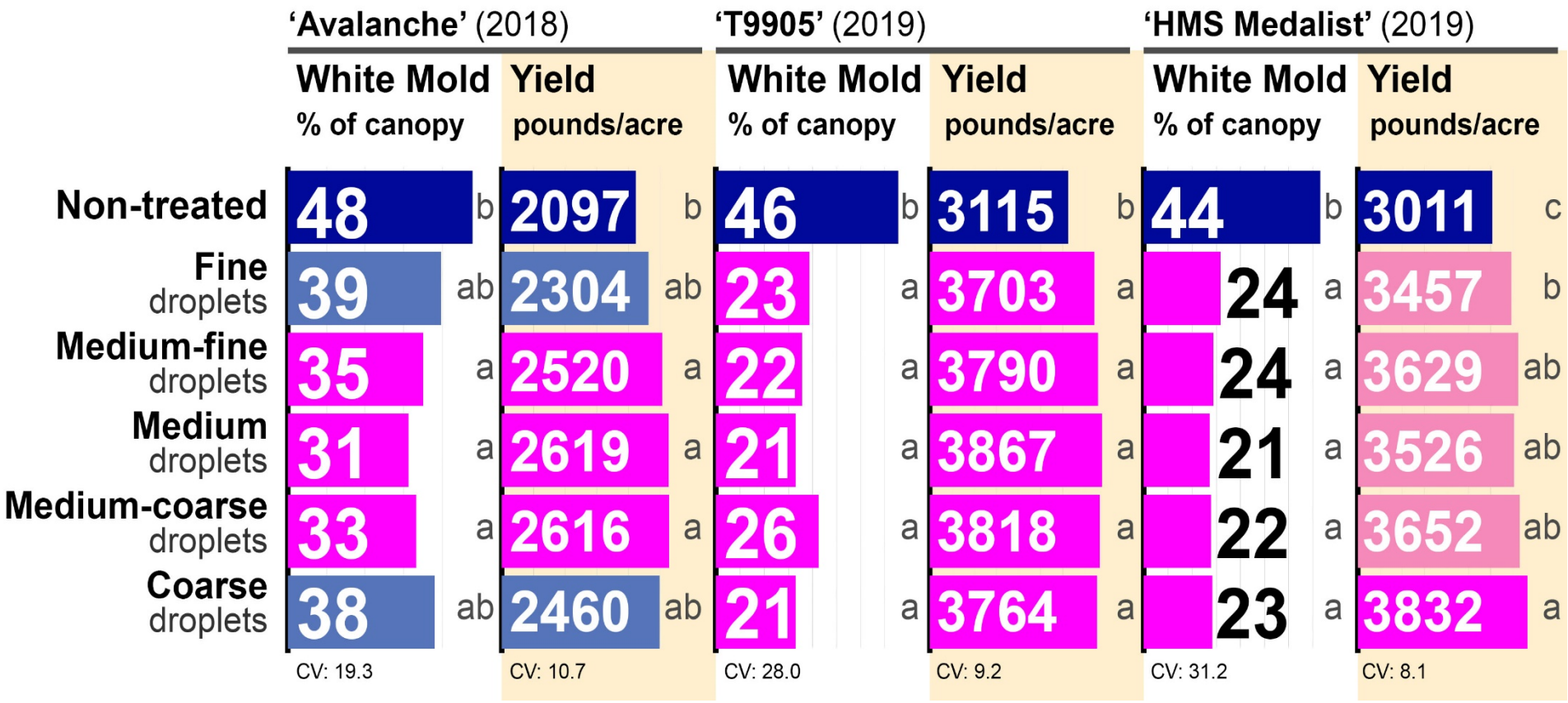
Row spacing: 21 inches **Seeding rate:** 100,000 pure live seeds/ac

Spray volume: 15 gal/ac **Driving speed:** 8.9 mph

NORTHARVEST BEANS

NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

Impact of droplet size (TeeJet) – navy beans



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Spray volume: 15 gal/ac **Driving speed:** 8.9 mph (2019); 6.7 mph (2018)

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NORTHARVEST BEANS

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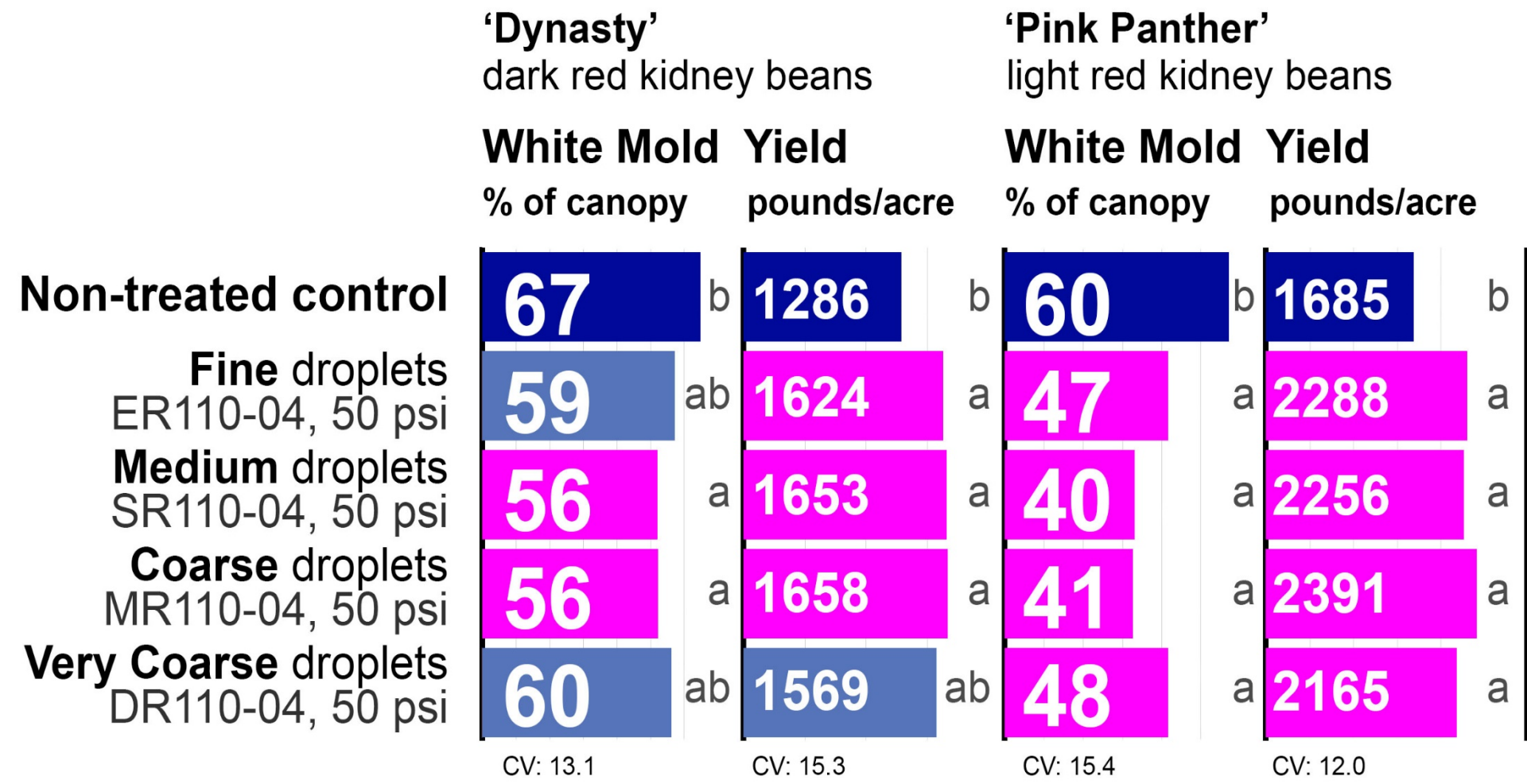
Impact of droplet size (Wilger) – kidney beans



Study location: Carrington, ND **Year:** 2019

Fungicide: Topsin 4.5FL (40 fl oz/ac) at early bloom + Endura 70WG (8 oz/ac) 12 days later

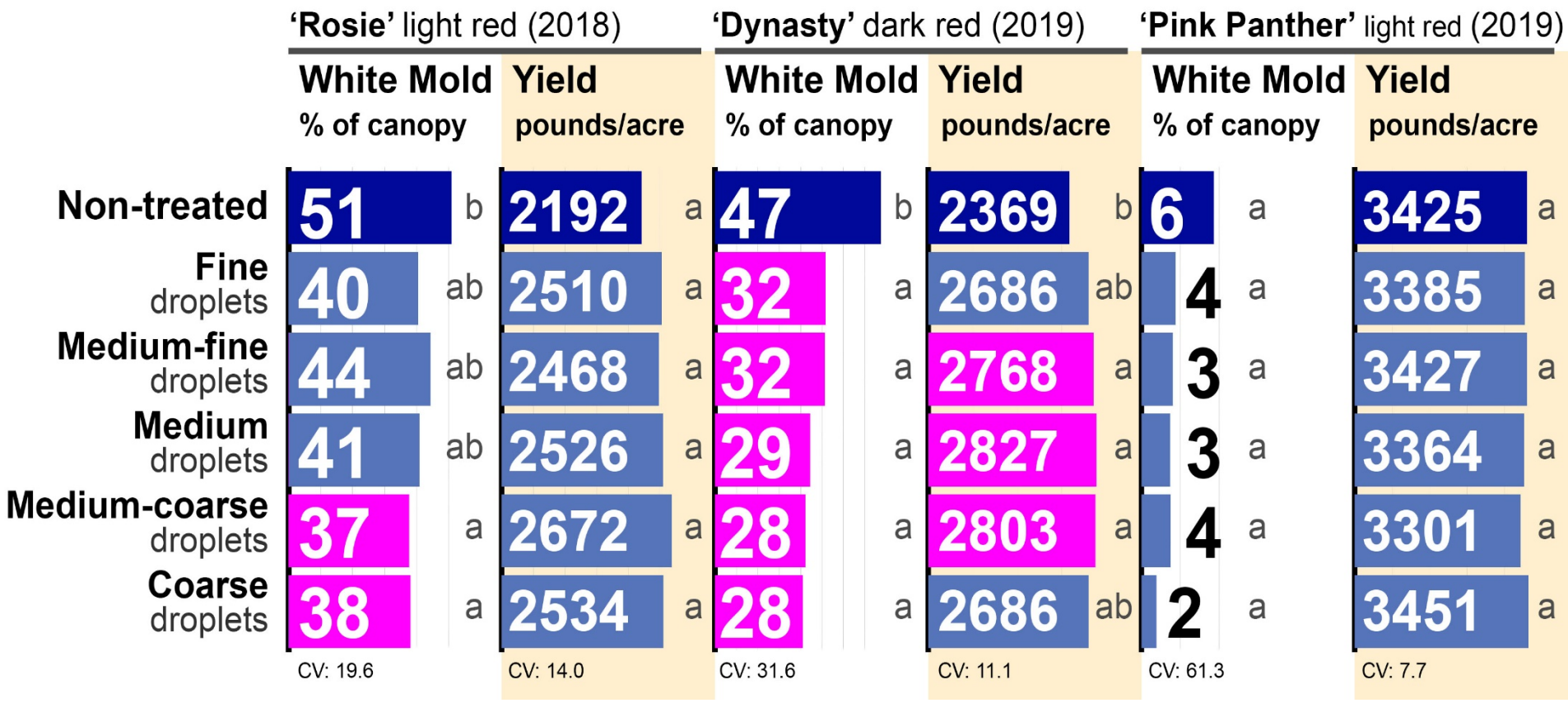
Row spacing: 21 inches **Seeding rate:** 90,000 pure live seeds/ac

Spray volume: 15 gal/ac **Driving speed:** 8.9 mph

NORTHARVEST BEANS

NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

Impact of droplet size (TeeJet) – kidney beans



Study location: Carrington, ND **Years:** 2018, 2019

Fungicide: Topsin 4.5FL (40 fl oz/ac) at early bloom + Endura 70WG (8 oz/ac) 12 days later (2019) or 14 days later (2018)

Row spacing: 21 inches **Seeding rate:** 90,000 pure live seeds/ac (2019); 80,000 pls/ac (2018)

Spray volume: 15 gal/ac **Driving speed:** 8.9 mph (2019); 6.7 mph (2018)

Nozzles (2018): XR8003, 50 psi (fine); XR8004, 40 psi (medium-fine); XR8006, 40 psi (medium); XR8008, 35 psi (medium-coarse); XR8010, 30 psi (coarse)

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NORTHARVEST BEANS

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Conclusions from field trials conducted in 2018-2019

Preliminary results from an ongoing research project

Black, navy and kidney beans:

Applying fungicides with **medium spray droplets**
conferred the most consistent
white mold control and yield response
in black, navy and kidney beans.

Fine spray droplets and very coarse spray droplets never optimized fungicide performance against white mold in black, navy or kidney beans.

Coarse spray droplets sometimes performed well and are most likely to be optimal in applications to dry beans with very dense canopies (generally the second application in a two-application sequence).

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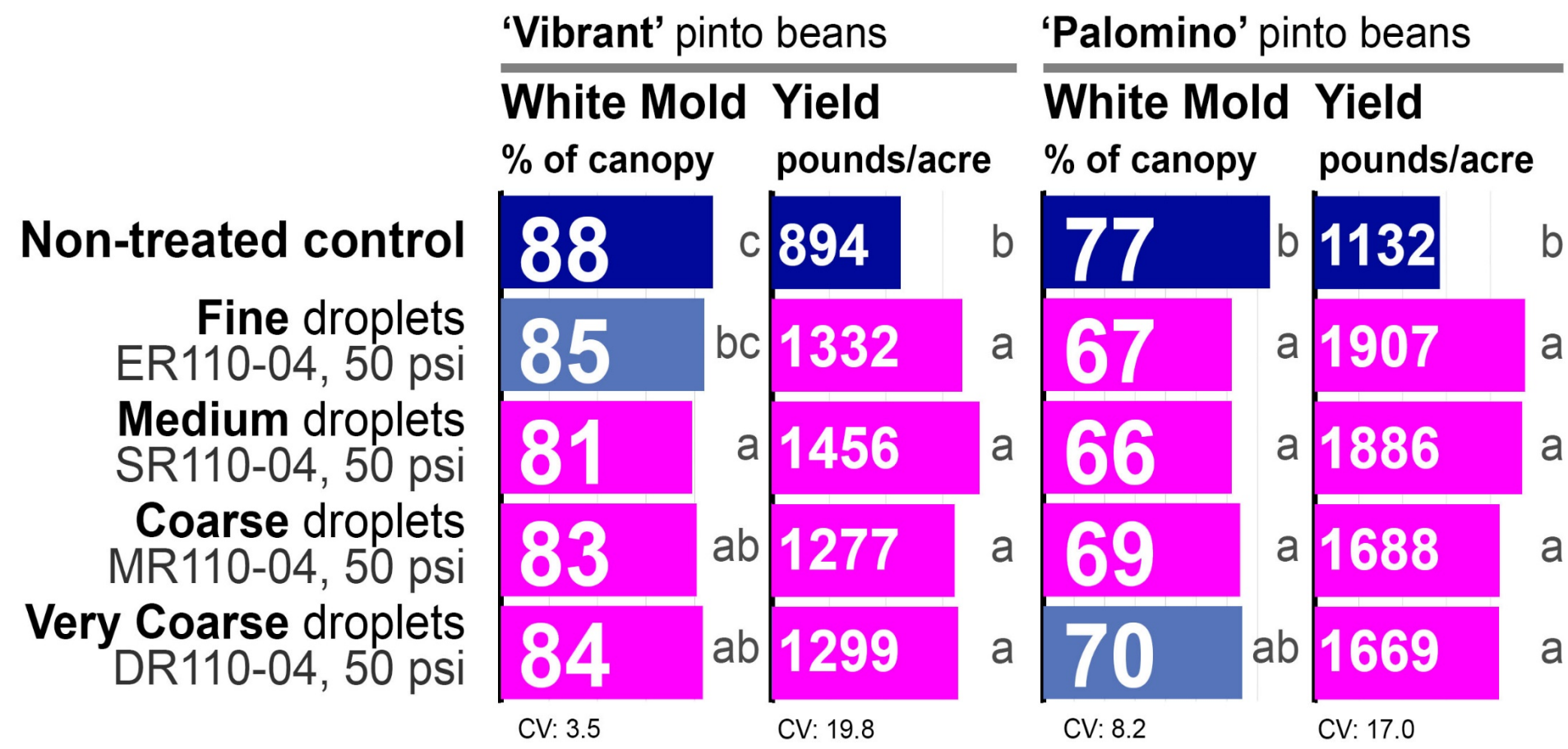
Impact of droplet size (Wilger) – pinto beans



Study location: Carrington, ND **Year:** 2019

Fungicide: Topsin 4.5FL (40 fl oz/ac) at bloom initiation + Endura 70WG (8 oz/ac) 12 days later

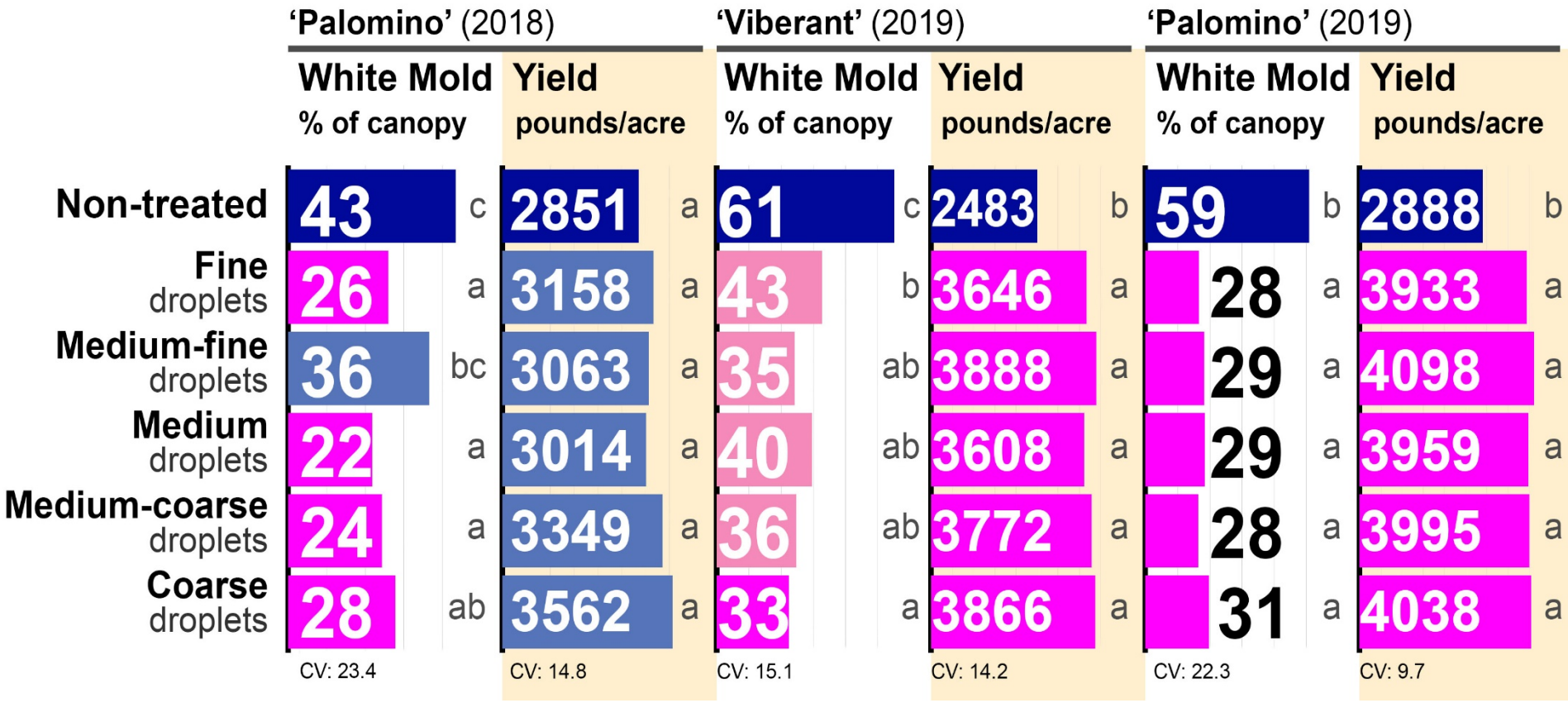
Row spacing: 21 inches **Seeding rate:** 90,000 pure live seeds/ac

Spray volume: 15 gal/ac **Driving speed:** 8.9 mph

NORTHARVEST BEANS

NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

Impact of droplet size (TeeJet) – pinto beans



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Spray volume: 15 gal/ac **Driving speed:** 8.9 mph (2019); 6.7 mph (2018)

Nozzles (2018): XR8003, 50 psi (fine); XR8004, 40 psi (medium-fine); XR8006, 40 psi (medium); XR8008, 35 psi (medium-coarse); XR8010, 30 psi (coarse)

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NORTHARVEST BEANS

NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

Conclusions from field trials conducted in 2018-2019

Preliminary results from an ongoing research project

Pinto beans:

Studies evaluating the impact of spray droplet size on white mold control and dry bean yield in pinto beans under white mold pressure **have been inconclusive.**

Medium droplets optimized fungicide performance with Wilger tips. Inconsistent results and poor treatment separation was obtained in testing with TeeJet tips.

Thank You!

Research funding:
Northarvest Bean Growers Association
ND Crop Protection Product Registration and Harmonization Board

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