
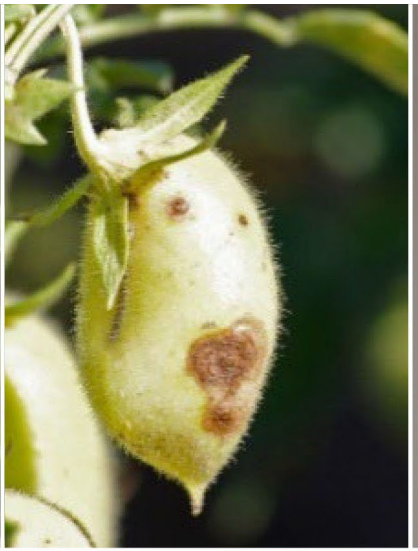

Ascochyta blight of chickpeas:
Optimizing fungicide droplet size

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Improving the management of Ascochyta blight in chickpeas: Optimizing fungicide droplet size

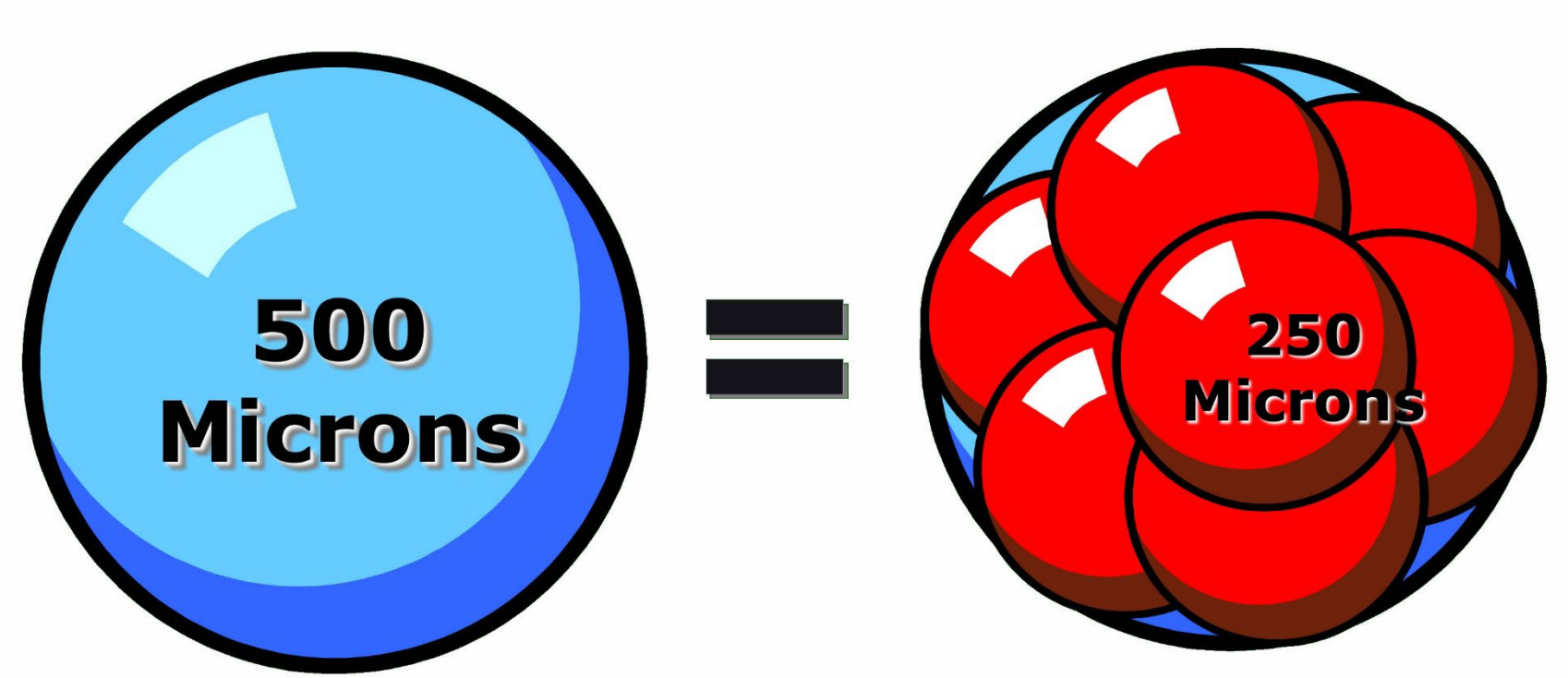
Research question:
How do we optimize fungicide droplet size relative to canopy characteristics to improve Ascochyta management in chickpeas?

- *When moisture is sufficient, the canopy closes during pod-fill. Fungicides must be deposited to the interior of the canopy, where pods are located, to provide satisfactory disease management.*
- *Fine droplets provide excellent coverage to the upper canopy but do not have the velocity to penetrate a dense canopy*
- *Sharp improvements the management of white mold – another disease for which fungicide deposition to the interior of the canopy is critical – have been achieved by calibrating fungicide droplet size relative to canopy closure in soybeans*

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)

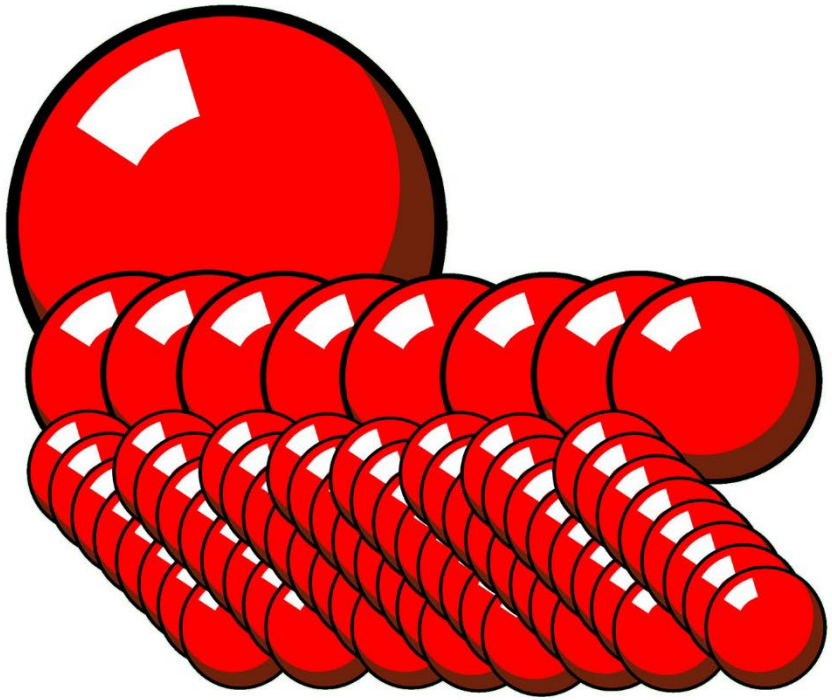
Droplet size

0.065 mm^3 spray volume =

one 500-um diameter droplet

eight 250-um diameter droplets

sixty-four 125-um diameter droplets



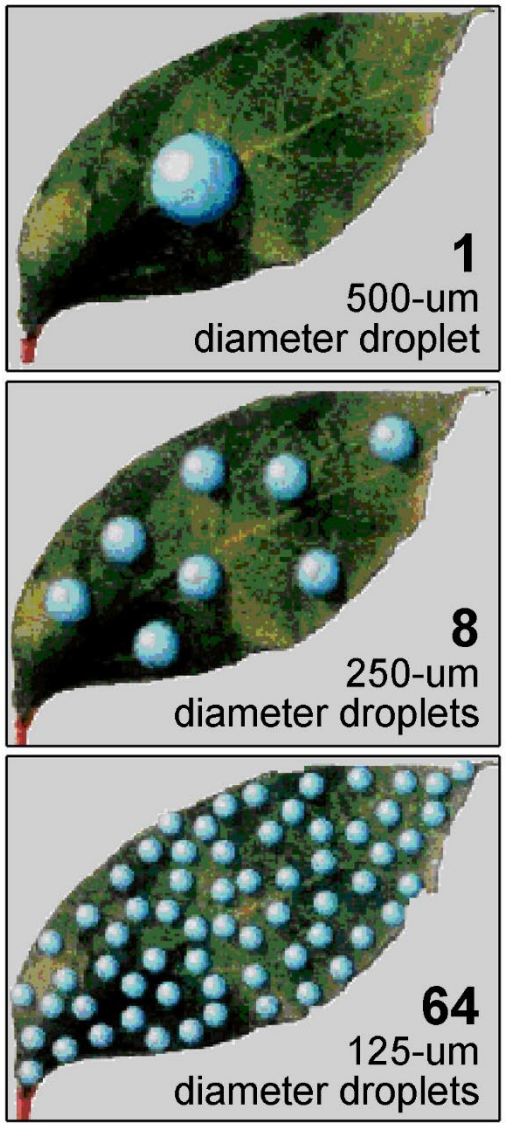
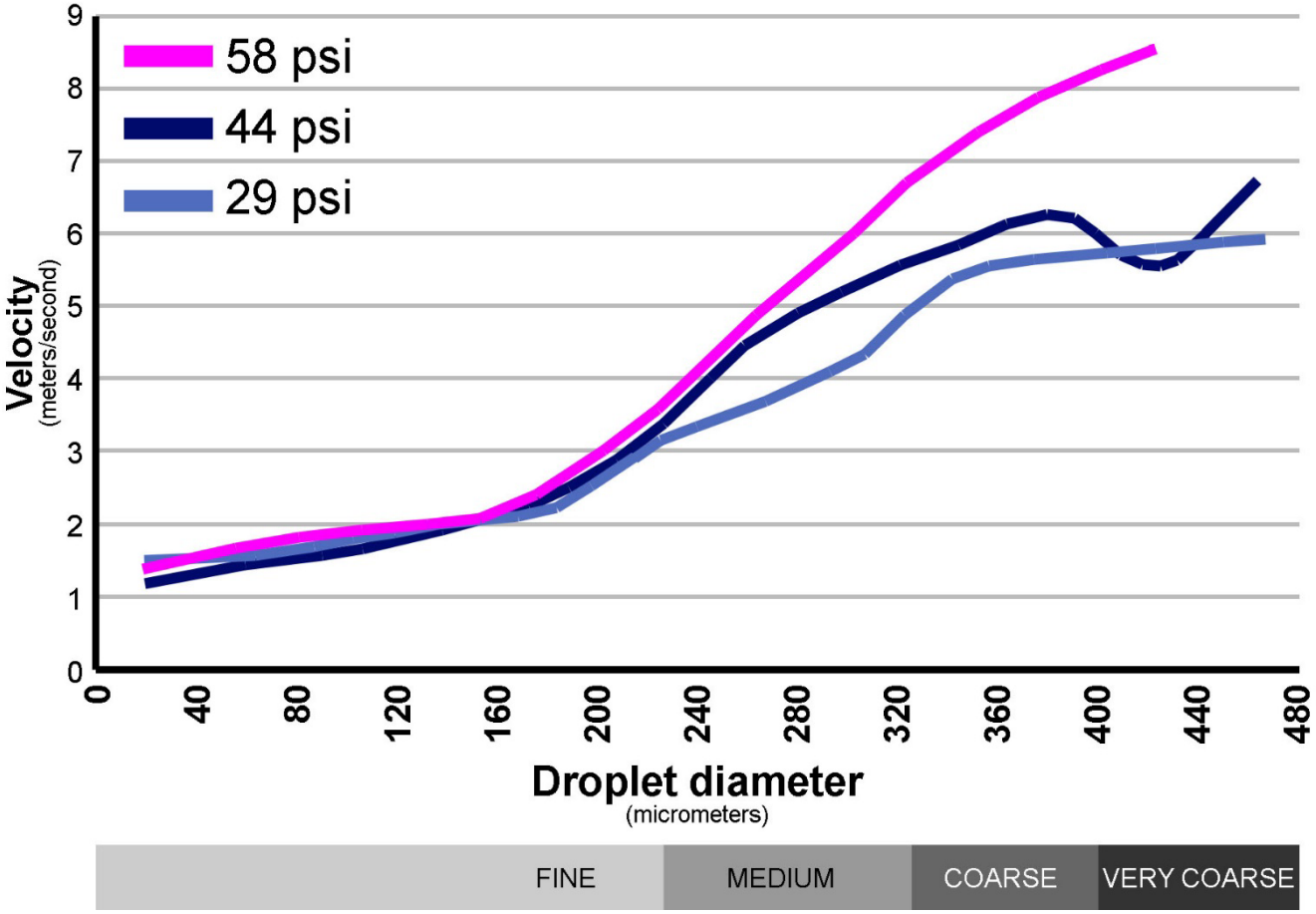


Image adapted from a presentation by Bob Wolf (Kansas State Univ.); Bobby Grisso and Pat Hipkins (Virginia Tech Univ.); and Tom Reed (TeeJet)

Droplet size

… but larger droplets have greater velocity, drift less.

Increased velocity and reduced drift improves canopy penetration.



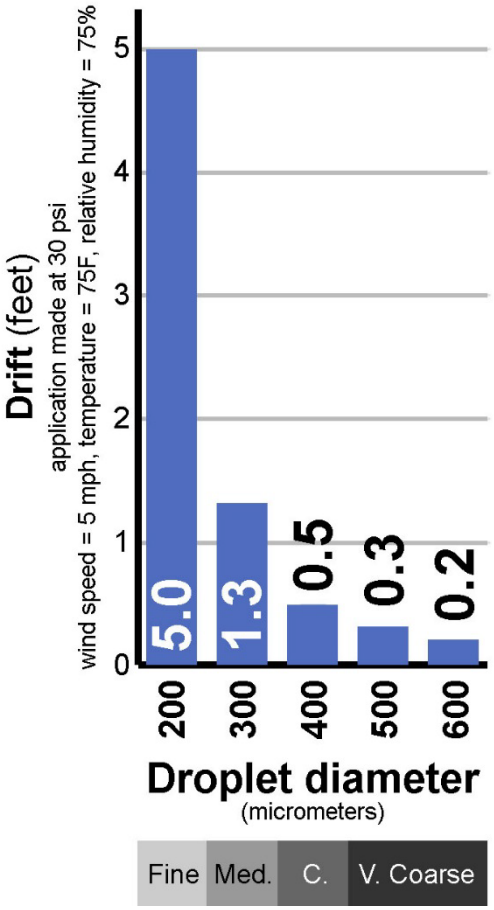


Image adapted from a presentation by Bob Wolf (Kansas State Univ.); Bobby Grisso and Pat Hipkins (Virginia Tech Univ.); and Tom Reed (TeeJet)

Improving the management of Ascochyta blight in chickpeas:
Optimizing fungicide droplet size

TeeJet extended-range (XR) and Wilger combo-jet flat-fan nozzles were used in these studies

Nozzles and application pressures were selected on from the charts in the TeeJet and Wilger nozzle catalogs

The droplet size spectrum with Proline (5.7 fl oz/ac) was characterized with a laser-based system in the wind tunnel at Winfield United's R&D facility in River Falls, WI

Nozzle, pressure	Droplet size TeeJet catalog	DV50 (µm) and droplet size Characterized in wind tunnel
XR11005, 60 psi	Fine	266.7 = medium
XR11006, 35 psi	Medium	337.8 = medium
XR11010, 30 psi	Coarse	401.7 = coarse
ER110-05, 60 psi	Fine	263.3 = fine
SR110-05, 60 psi	Medium	331.8 = medium
MR110-05, 60 psi	Coarse	412.2 = coarse

Improving the management of Ascochyta blight in chickpeas: Optimizing fungicide droplet size

- **Fungicides were applied with 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.
- **Spray volume** was 15 gal/ac, and **application driving speed** was 10.0 or 10.5 mph.
- Studies were generally conducted with 6 or 7 experimental replicates. Plot size was 5 ft x 25 ft plots at seeding and 5 ft x approx. 19 ft at harvest. Yield was calculated on the measured plot length and is reported at a standard 13.5% moisture.
- Consistent Ascochyta disease pressure across plots was facilitated by spreading small quantities of overwintered disease chickpea residues in adjacent non-harvested plots during mid to late vegetative growth. In 2021, Ascochyta severity was assessed 3 times and reported on a 0 to 100 scale corresponding to disease progress over time. In 2023, chickpeas were planted late due to a wet spring and had not yet senesced when cool, wet weather developed in mid-August. Botrytis developed in August, and end-of-season disease was a mixture of Ascochyta and Botrytis. Percent diseased pods and percent canopy necrosis was assessed in September, and disease is reported on a 0 to 100 scale representing the average of both assessments.
- **Nozzles and application pressures to achieve the target droplet sizes were selected utilizing the nozzle manufacturer's catalog.** Follow-up testing with a laser-based system for quantifying droplet size spectrum conducted in the wind tunnel at Winfield United's R&D facility in River Falls, WI indicated that the XR11005 nozzles @ 50 psi emitted droplets on the fine end of the medium droplet size spectrum. All other droplet sizes were consistent with the sizes listed in the charts provided in the Wilger and TeeJet nozzle catalogs.

Improving the management of Ascochyta blight in chickpeas:
Optimizing fungicide droplet size

		Teejet nozzle studies		Wilger nozzle studies	
		2021	2023	2021	2023
Planted		April 29	May 21	April 27	May 21-22
Experimental replicates		6	6	7	6
Total number of fungicide applications		3	4	3	4
Number of applications to open canopy		1	1	1	1
Dates of applications to open canopy		6/24	6/26	6/21	6/26
Number of applications to closed canopy		2	3	2	3
Dates of applications to closed canopy		7/5, 7/22	7/10, 7/20, 8/11	7/5, 7/22	7/10, 7/20, 8/11
Spray volume		15 gpa	15 gpa	15 gpa	15 gpa
Driving speed		10.5 mph	10.0 mph	10.5 mph	10.5 mph
Fine droplets	Nozzle, presure	XR11005, 60 psi		ER110-05, 60 psi	
	Pulse width, Proline	85%	85-89%	81-84%	85-88%
	Pulse width, Proline + Bravo	85-89%	86-88%	85-87%	88-91%
Medium droplets	Nozzle, presure	XR11006, 35 psi		SR110-05, 60 psi	
	Pulse width, Proline	96-97%	97-99%	84%	89-90%
	Pulse width, Proline + Bravo	99%	100%	88-90%	91-92%
Coarse droplets	Nozzle, presure	XR11010, 30 psi		MR110-05, 60 psi	
	Pulse width, Proline	66-70%	70-72%	84-85%	89%
	Pulse width, Proline + Bravo	68-70%	71-72%	88-89%	89-92%
Harvest date		Aug. 16	Oct. 16	Aug. 18	Oct. 16-17
Plot size at harvest		5' x ave. 23.8'	5' x ave. 19.3'	5' x ave. 22.8'	5' x ave. 19.3'

Improving the management of Ascochyta blight in chickpeas: Optimizing fungicide droplet size

Pulse-width calibration was manually conducted in the field (with the fungicide in the tank) **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.

Improving the management of Ascochyta blight in chickpeas:
Optimizing fungicide droplet size

PTO-driven, tractor-mounted sprayer equipped
with a pulse-width modulation system from Capstan AG.

Video taken in a soybean fungicide droplet size study conducted in Carrington (different crop, same methods).

Optimizing fungicide droplet size for improved management of Ascochyta blight in chickpeas:

TeeJet XR flat-fan nozzles

In applications made with TeeJet nozzles, fungicide efficacy under Ascochyta pressure was optimized by calibrating fungicide droplet size relative to canopy closure. **Optimum droplet size differed by fungicide.**

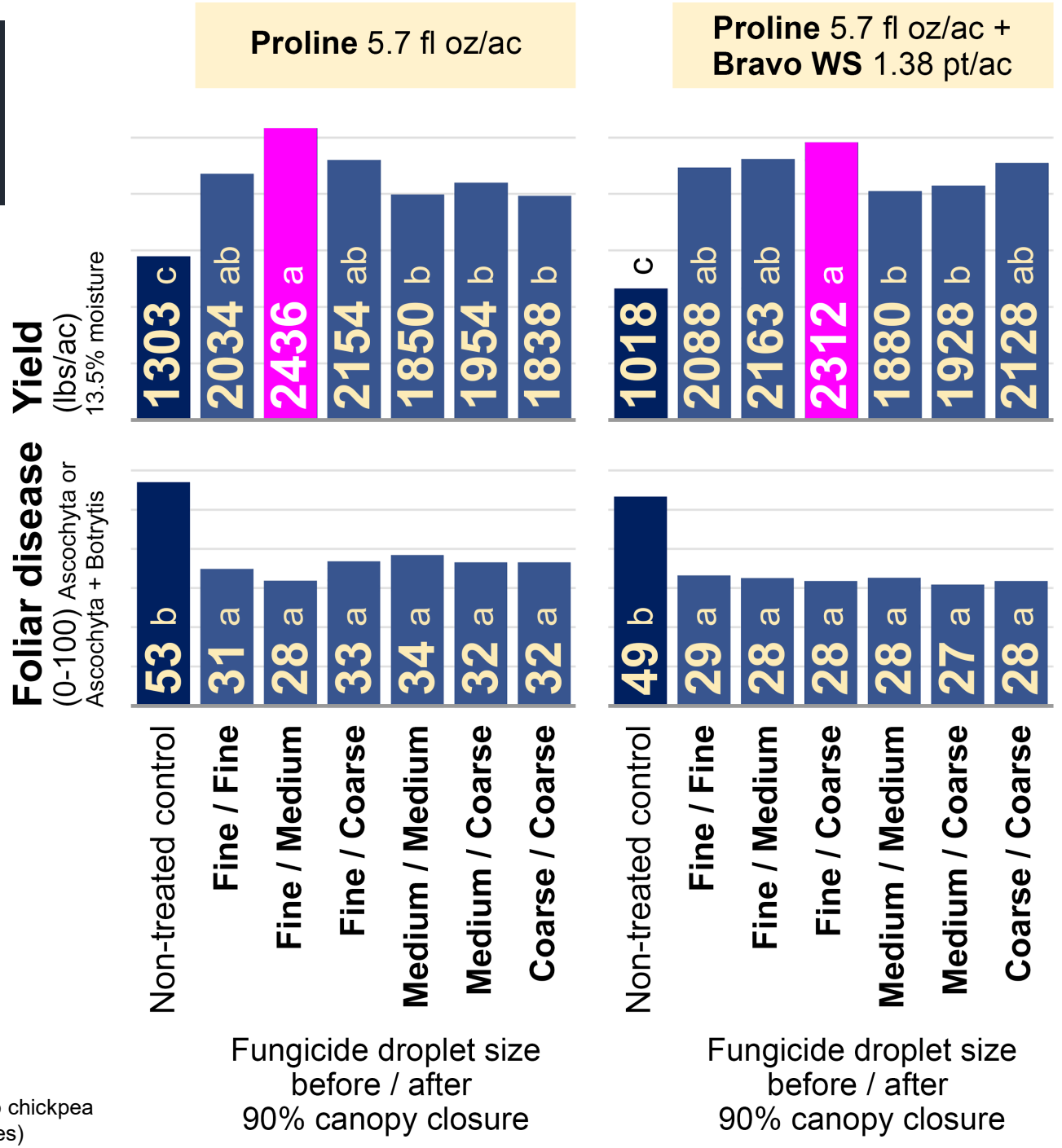
Proline (5.7 fl oz/ac):

Fine droplets at canopy closure < 90% **followed by medium droplets** at canopy closure >90% were optimal.

Proline (5.7 fl oz/ac) + **Bravo WS** (1.38 pt/ac):

Fine droplets at canopy closure < 90% **followed by coarse droplets** at canopy closure >90% were optimal.

Data from Carrington, ND (**2021**, testing on two chickpea varieties; **2023**, testing on four chickpea varieties)



Optimizing fungicide droplet size for improved management of Ascochyta blight in chickpeas:

TeeJet XR flat-fan nozzles

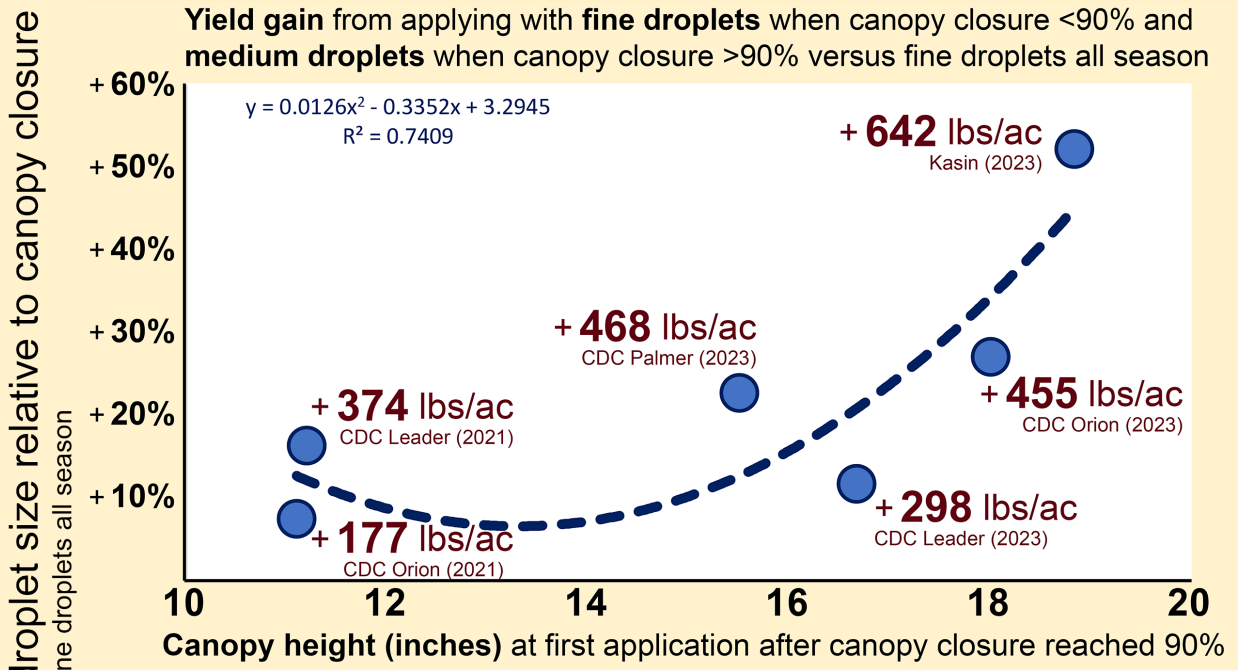
The yield gain conferred by calibrating fungicide droplet size relative to canopy closure **increased with field pea canopy height.**

Data from Carrington, ND

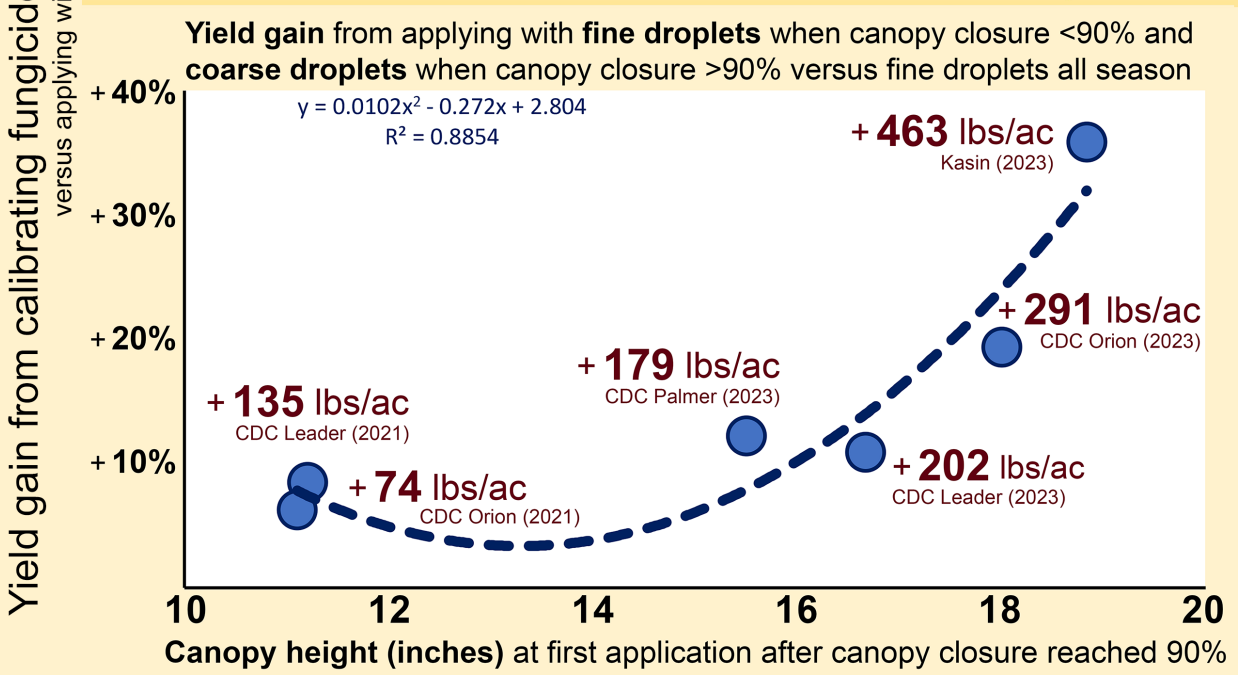
2021, testing on two chickpea varieties

2023, testing on four chickpea varieties

Proline 5.7 fl oz/ac



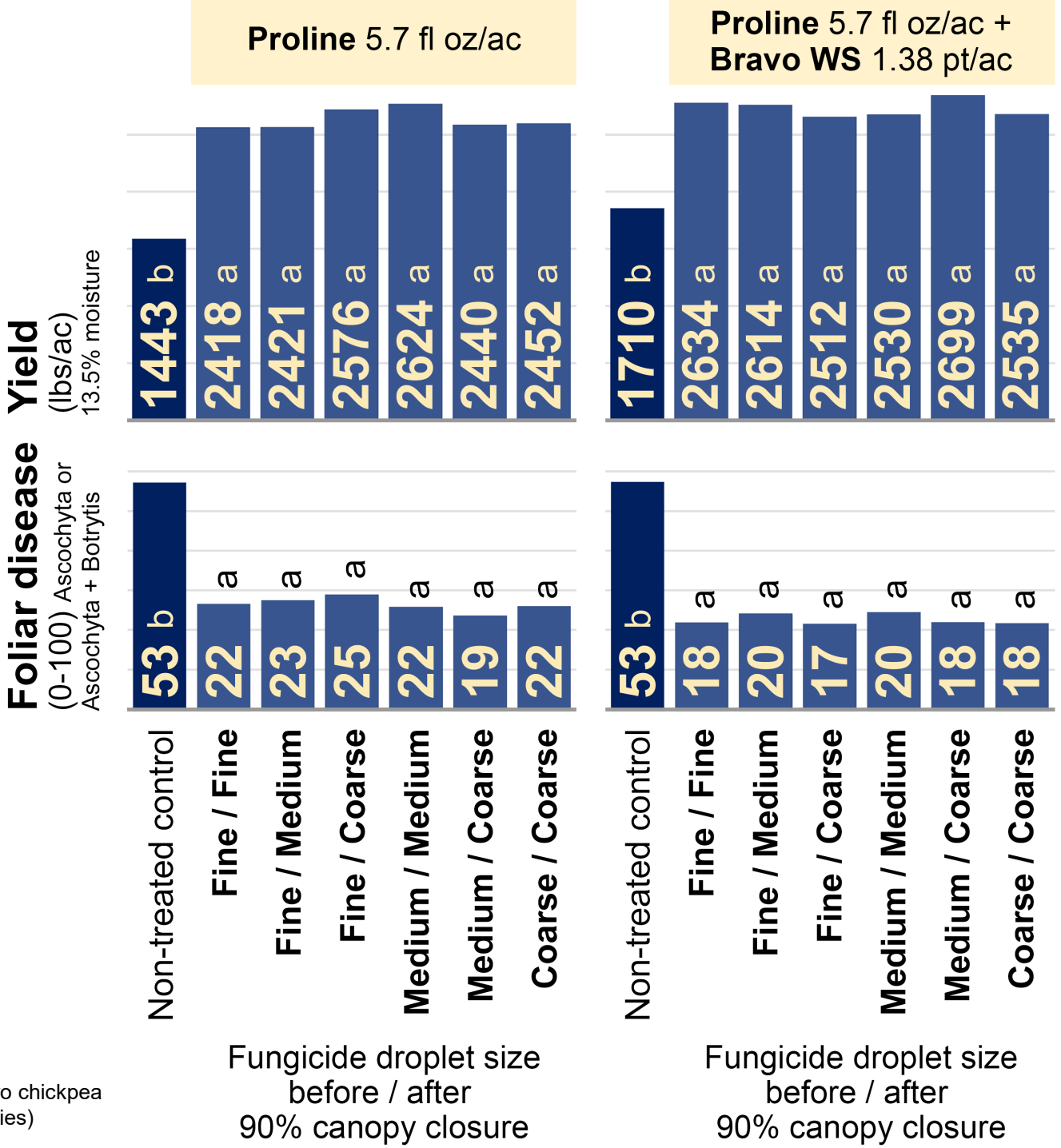
Proline 5.7 fl oz/ac + **Bravo WS** 1.38 pt/ac



Optimizing fungicide droplet size for improved management of Ascochyta blight in chickpeas:

Wilger Combo-Jet flat fan

In applications made with Wilger nozzles, the response to fungicide droplet size was much smaller.



Data from Carrington, ND (**2021**, testing on two chickpea varieties; **2023**, testing on four chickpea varieties)

Optimizing fungicide droplet size for improved management of Ascochyta blight in chickpeas:

Wilger Combo-Jet flat fan

Just as was seen with TeeJet, the response to optimizing fungicide droplet size increased with chickpea canopy height.

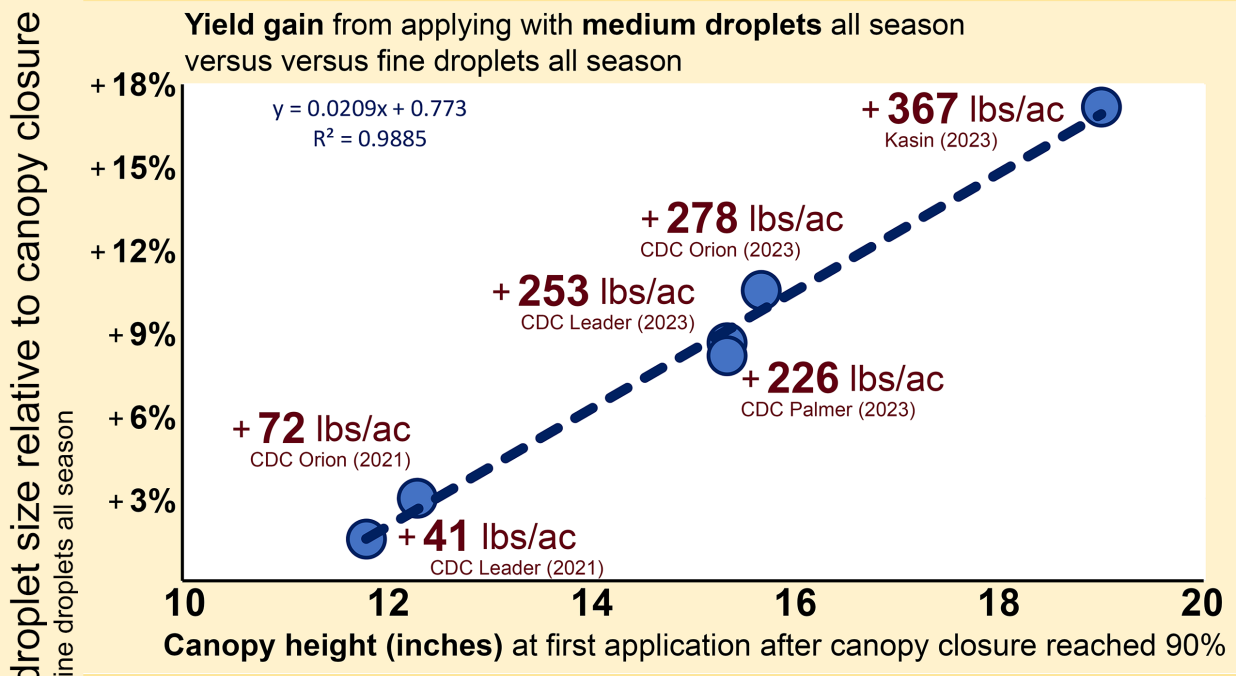
No statistical separation was observed across droplet size treatments, and the droplet size treatments with the numerically highest average yield were analyzed relative to canopy height.

Data from Carrington, ND

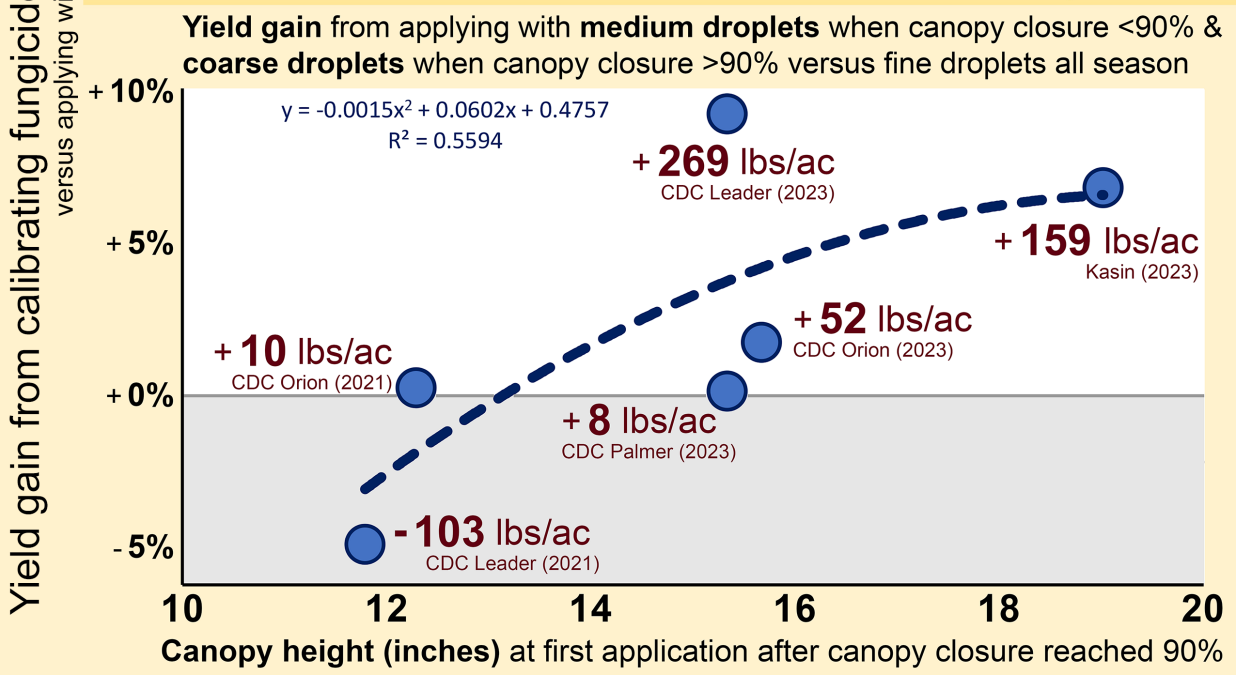
2021, testing on two chickpea varieties

2023, testing on four chickpea varieties

Proline 5.7 fl oz/ac



Proline 5.7 fl oz/ac + **Bravo WS** 1.38 pt/ac



Yield gain from calibrating fungicide droplet size relative to canopy closure versus applying with fine droplets all season

Optimizing fungicide droplet size for improved management of Ascochyta blight in chickpeas: Conclusions

The standard recommendation of applying fungicides with fine droplets is not optimal for Ascochyta blight in chickpeas, even when applying a contact fungicide tank-mixed with a locally systemic fungicide.

- Fungicide droplet size must be calibrated relative to the (1) nozzle manufacturer; (2) the type of fungicide being applied, locally systemic fungicide vs. tank-mix of a contact fungicide with a locally systemic fungicide; and (3) canopy closure.
- **With TeeJet nozzles,** calibrating fungicide droplet size relative to the type of fungicide being applied and canopy closure **increased the yield gain** conferred by fungicides **by 3 to 52%.**
- **With Wilger nozzles,** calibrating fungicide droplet size relative to the type of fungicide being applied and canopy closure, **increased the yield gain** conferred by fungicides by **0 to 17%.**

Optimizing fungicide droplet size for improved management of Ascochyta blight in chickpeas: Conclusions

The yield gain conferred by calibrating fungicide droplet size relative to canopy closure and the type of fungicide being applied **(1) increased with chickpea canopy height** and **(2) was highest for TeeJet nozzles.**

- Calibrating fungicide droplet size relative to the type of fungicide being applied and relative to canopy closure conferred the greatest yield gains when the chickpea canopy was at least 15 to 16 inches tall.
- The penalty to applying with a suboptimal droplet size was lower for Wilger nozzles (versus TeeJet) .

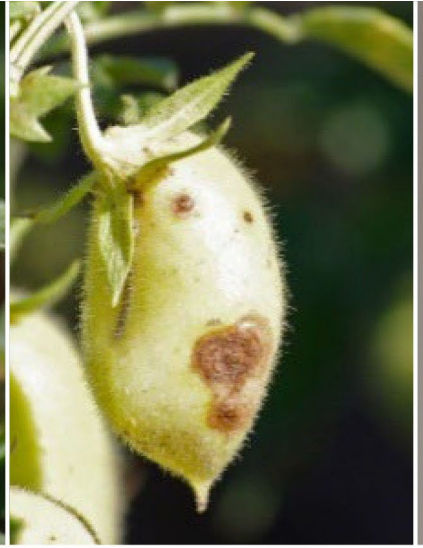
Optimizing fungicide droplet size for improved management of Ascochyta blight in chickpeas: Conclusions

Cautionary note: These are preliminary recommendations based on a research project that is in progress

- Testing was conducted on multiple chickpea varieties differing in architecture each year but at a single location (Carrington, ND) across only two years (2021 and 2023).
- Follow-up testing is planned for 2025.

Thank you!

Staff at the NDSU Carrington Research Extension Center:
Aaron Fauss, Jesse Hafner, Gabriela Henson, Suanne Kallis, and seasonal staff

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