Drone Applied Fungicide in Over-Wintering Turnip Seed Crop to Suppress Black Leg

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USDA
Specialty Crop Block Grant Program

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Black leg

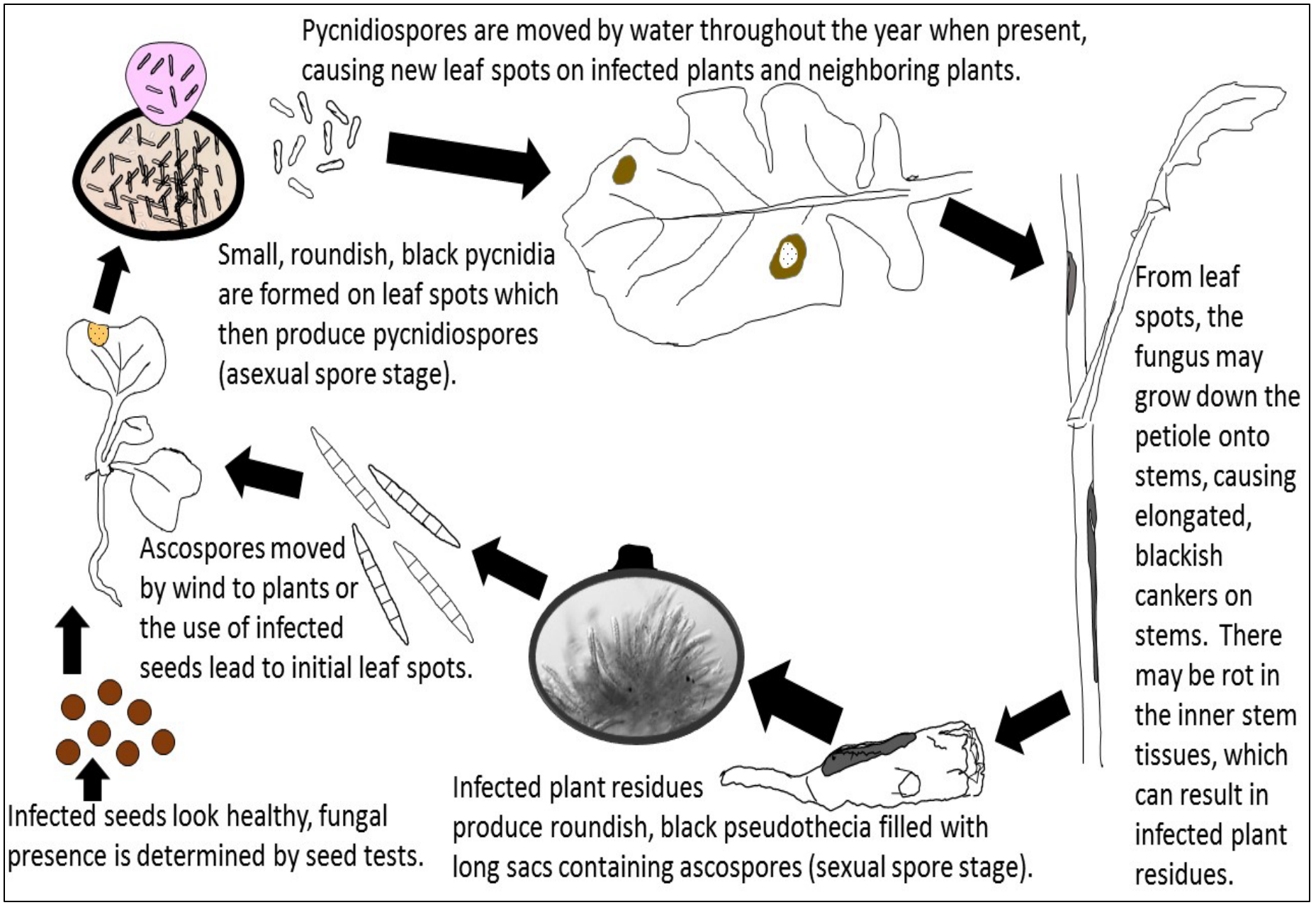
Leptosphaeria maculans and *L. biglobosa*
syn. *Plenodomus lingam* and *P. biglobosus*
asexual stage *Phoma lingam*

Important crop hosts

- ***Brassica*** broccoli, cabbage, kale, mustard greens, canola, pak choi, turnip
- ***Raphanus*** daikon, red radish
- ***Sinapis*** white and yellow mustard
- ***Eruca*** arugula

Important weed hosts

- *Brassica* - birdsrape mustard, black mustard,
- *Rorippa* - western yellow cress (curvepod yellowcress)
- *Descurainia* - tansymustard
- *Sisymbrium* - hedge mustard, tumble mustard, small tumbleweed mustard
- *Thlaspi* - pennycress
- *Arabidopsis* - mouseear cress
- *Diplotaxis* - annual wallrocket, perennial wallrocket
- *Raphanus* - wild radish



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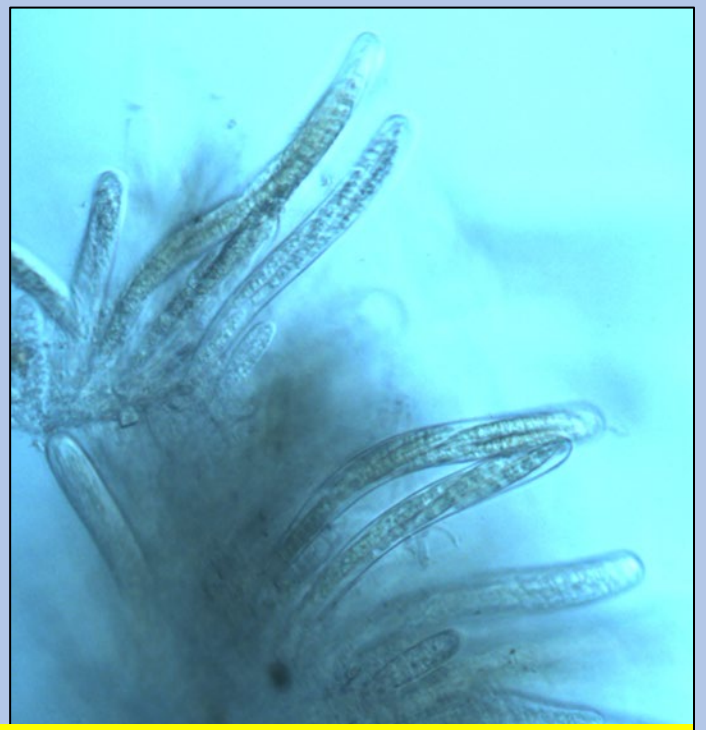
Asexual stage



Sexual stage

Hypothesis and Methods

- Hypothesis: Drone applied fungicide will provide increased protection over the standard boom-applied method.

- Objectives:
  - Compare fungicide coverage with drone vs boom applied.
  - Compare disease incidence and severity of black leg on over wintering turnip with drone vs boom applied.

Treatments

- Untreated control
- Drone applied fungicide program
- Boom applied fungicide program
- 4 spray dates
- 4 replicates

Same application dates and products

2024-2025 Field Design

	Check	Drone	Tractor	Drone	Check	Tractor	Check	Tractor	Drone	Tractor	Drone	Check
100 ft												
N												
	101	102	103	201	202	203	301	302	303	401	402	403
	30 ft											
	Replication 1			Replication 2			Replication 3			Replication 4		

Fungicide Applications in Turnip seed field on the OSU Botany Field Lab

- **Proline 480 SC** (prothioconazole) at 5 to 5.7 fl oz/A -- Oct 2024, Mar 2025
- **Cabrio EG** (pyraclostrobin) at 16 oz/A -- Jan 2025, April 2025

Ground rig -- 20 GPA using a CO_2 **backpack sprayer**

Drone application -- 5 GPA using a XAG p100 **Pro drone** and flight height of 12.2 ft

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Turnip seed field on the OSU Botany Field Lab

- Plots sown with ‘Purple Top White Globe' turnip on 10-Sep-24 (79,200 seeds/acre)
- Black leg-infected plant residues placed on W and N ends of field in Oct
- Plots were rated for disease monthly (Oct-24 through May-25) for foliar leaf spots (100 plants/plot as ten 10-plant transects – black leg quantified on one leaf per plant)
- Black leg was recorded when spots/cankers contained characteristic pycnidia

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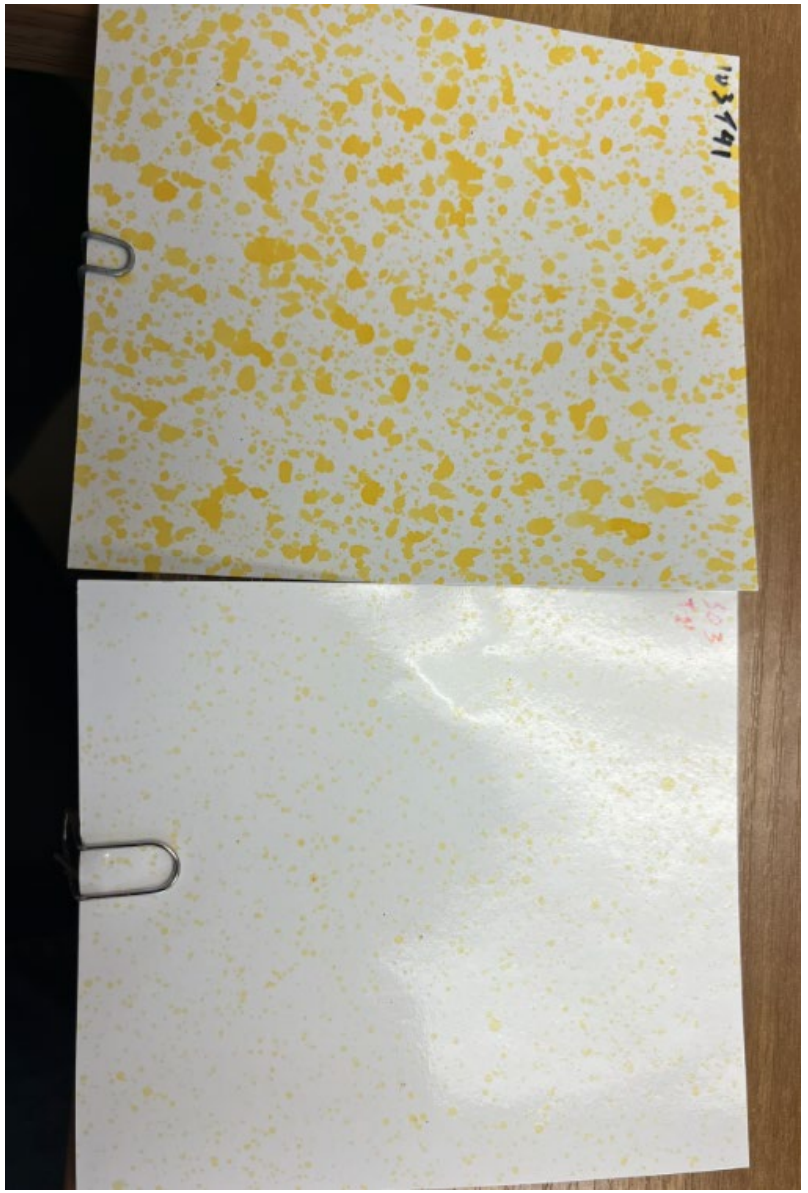
Data Collection

- Stand counts and plant density with drone imaging
- Spray distribution with spray cards
- Plant disease incidence and severity (visually)
- Seed yield

Summary of Results Berry Lab

- Turnip field variation based on aerial imagery
- Spray card coverage
- Image J was used as a binary classification of presence/absence of droplets.

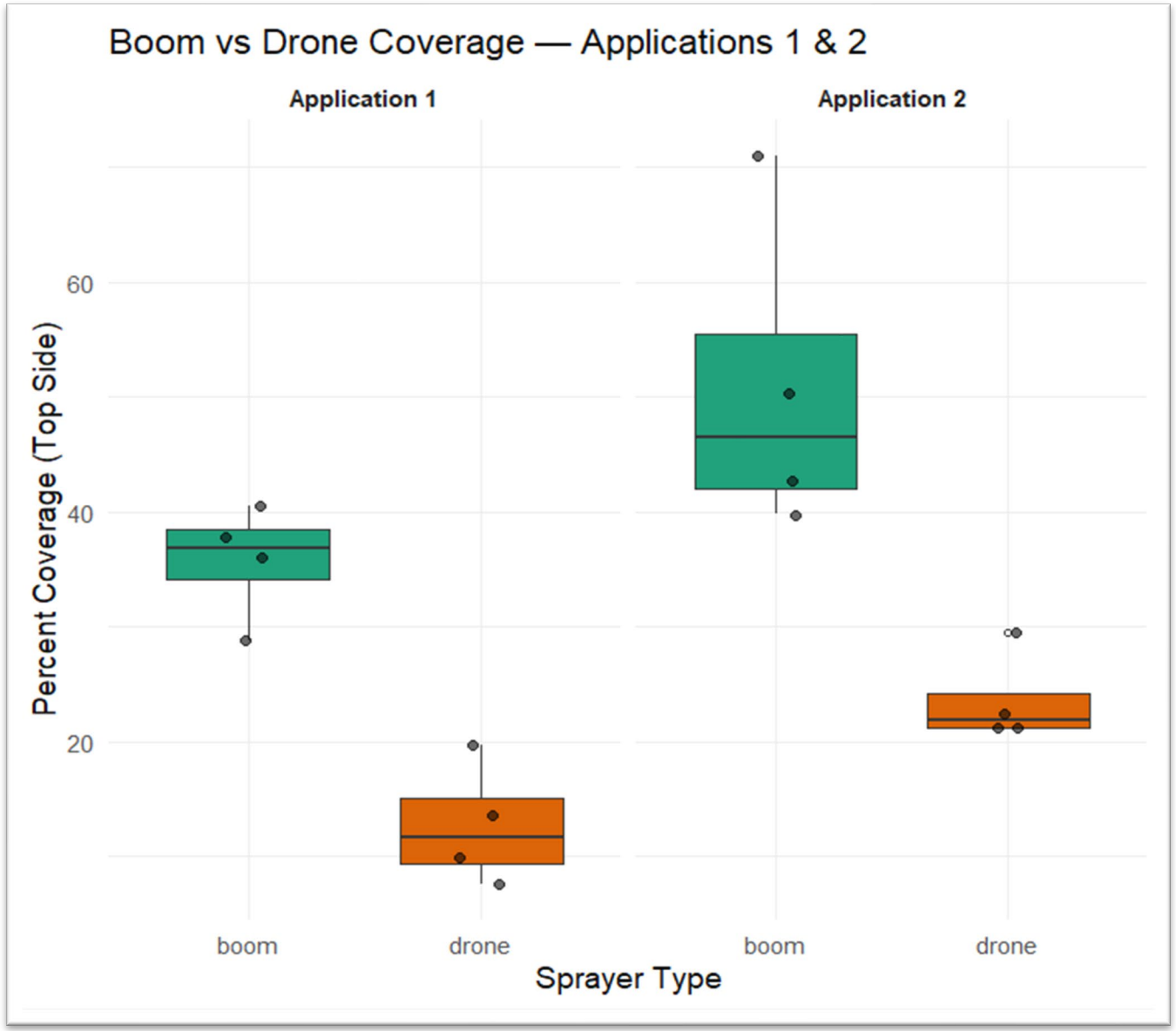


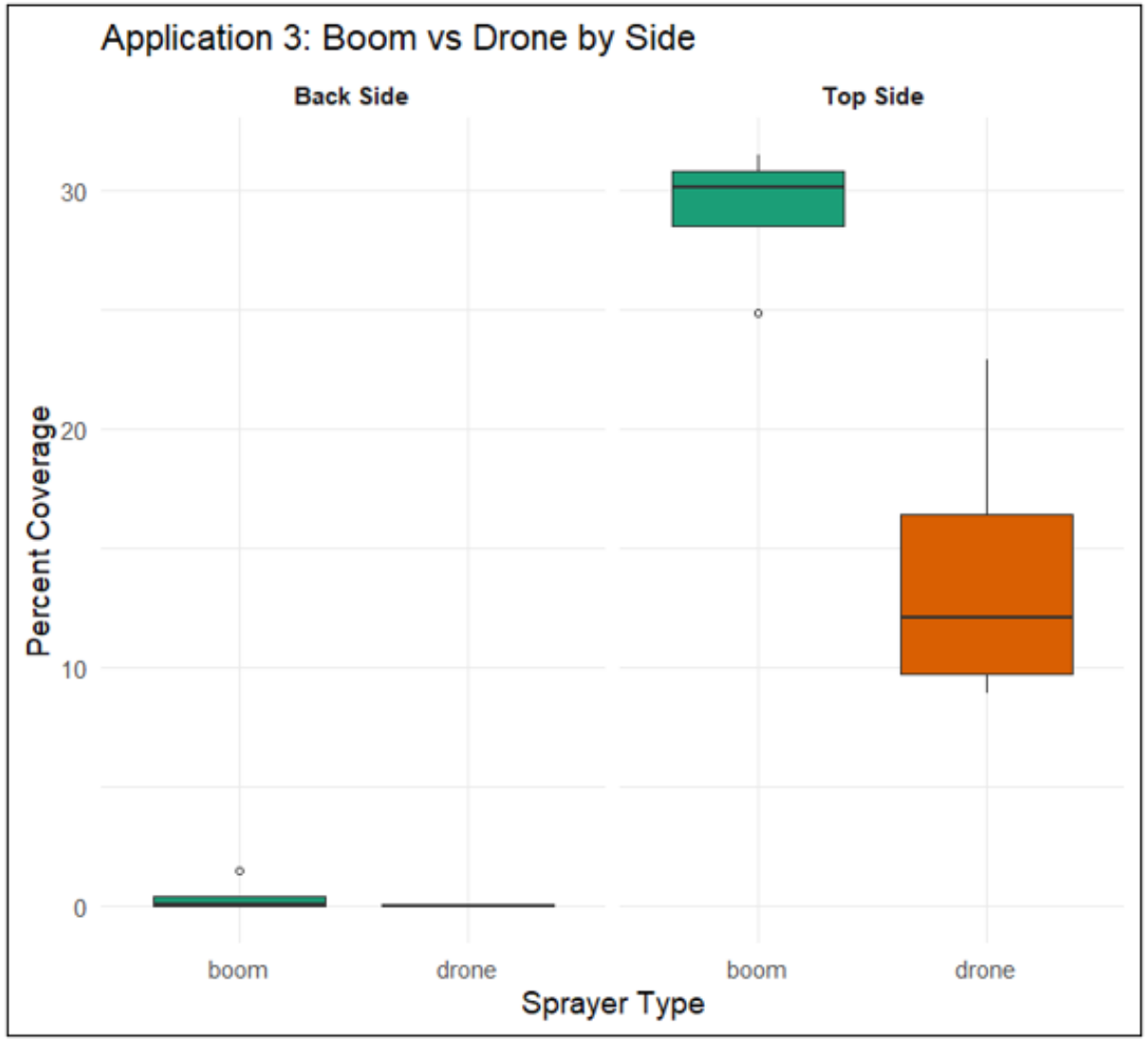
Early Applications

Turnip crop size at application 1 (left) and application 2 (right). Analysis was assessed only on the top of the card.

Comparison of Boom and Drone Sprayers at Application Timings 1 and 2

The boxplot illustrates percent spray card coverage for the boom and drone sprayers at **Application 1** and **Application 2** (top side only). Welch's *t*-tests indicated that the differences between boom and drone were statistically significant at both application timings ($\alpha = 0.05$).





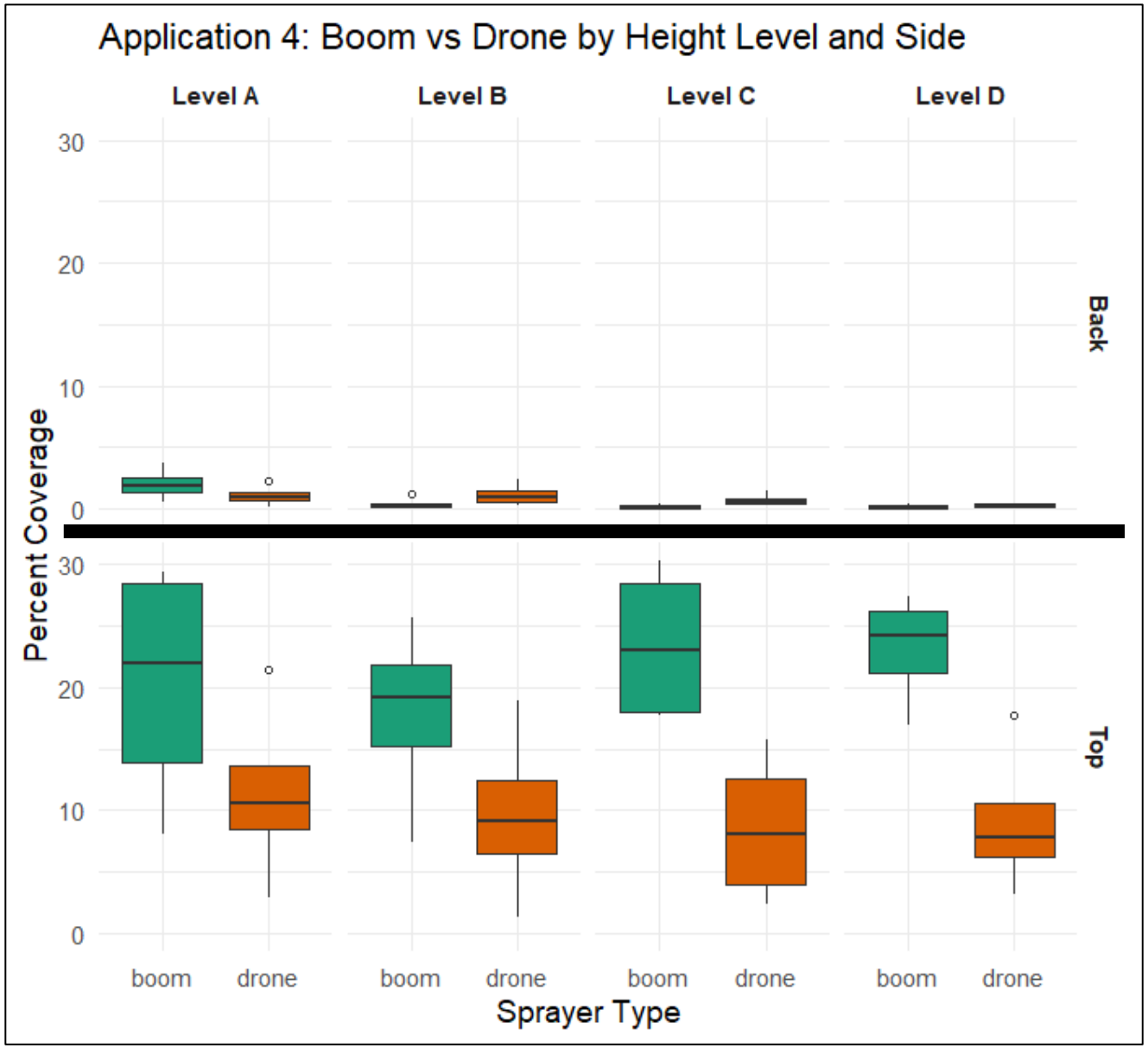
Comparison of Boom and Drone Sprayers at Application Timing 3

The boxplot illustrates percent spray card coverage for the boom and drone sprayers at application 3 (top and back sides of cards). Four sub-samples per plot were averaged for mean comparisons across blocks. Welch's *t*-tests indicated that the differences between boom and drone on the spray card top were statistically significant ($\alpha = 0.05$).

Application 4 (Height levels A–D; Top and Back sides)

Spray cards were positioned at four canopy levels: **D (soil surface), C (45 cm from the ground)**, **C (90 cm from the ground)**, **A (top of canopy- 135 cm from the ground)**. At each level, both the top and back sides of the cards were analyzed separately.

Comparison of Boom and Drone Sprayers at Application Timing 4

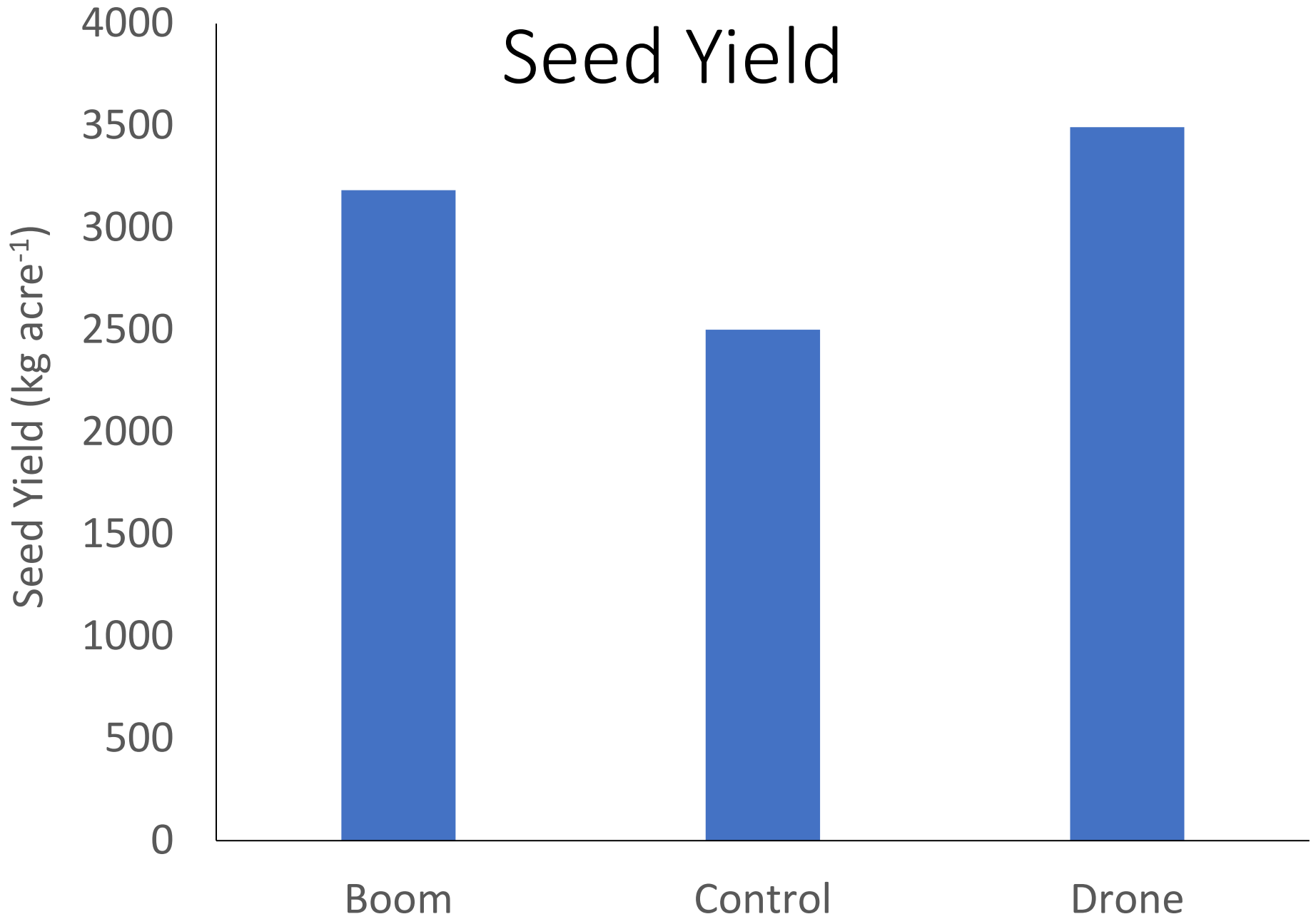


The boxplot illustrates percent spray card coverage for the boom and drone sprayers at application 4 at four different heights throughout the canopy; ground (level D), 45-cm from ground (level C), 90-cm from ground (level B), 135-cm from ground (level A). Both the top and bottom of the cards were assessed.

Results—Spray Coverage

application	location	side	mean_boom	mean_drone	se_drone	se_boom	mean_diff	p.value
1	*NA*	top	35.79	12.68	2.65	2.50	23.11	0.0007
2	*NA*	top	50.96	23.58	1.99	7.02	27.38	0.0256
3	*NA*	back	0.39	0.02	0.01	0.36	0.36	0.3899
3	*NA*	top	29.19	14.01	3.20	1.47	15.18	0.0111
4	A	back	1.99	1.07	0.45	0.68	0.93	0.3079
4	A	top	20.35	11.38	3.83	5.13	8.96	0.2150
4	B	back	0.39	1.09	0.48	0.25	-0.70	0.2528
4	B	top	17.88	9.65	3.64	3.85	8.23	0.1713
4	C	back	0.19	0.68	0.26	0.09	-0.49	0.1551
4	C	top	23.54	8.58	3.10	3.26	14.96	0.0159
4	D	back	0.18	0.27	0.08	0.10	-0.09	0.5165
4	D	top	23.17	9.09	3.08	2.29	14.08	0.0120

Differences in spray coverage% were only noted on top surfaces and near the top of plant canopies.


Seed Yield
Seed Yield (kg acre-1)
4000
3500
3000
2500
2000
1500
1000
500
0
Boom
Control
Drone

Black leg in field on Botany Field Lab

Trt	% *Leptosphaeria*-infected plants 9-Jan-25	11-Feb-25
NTC	25 a	24 a
Drone	7 b	18 b
Ground rig	10 b	12 c

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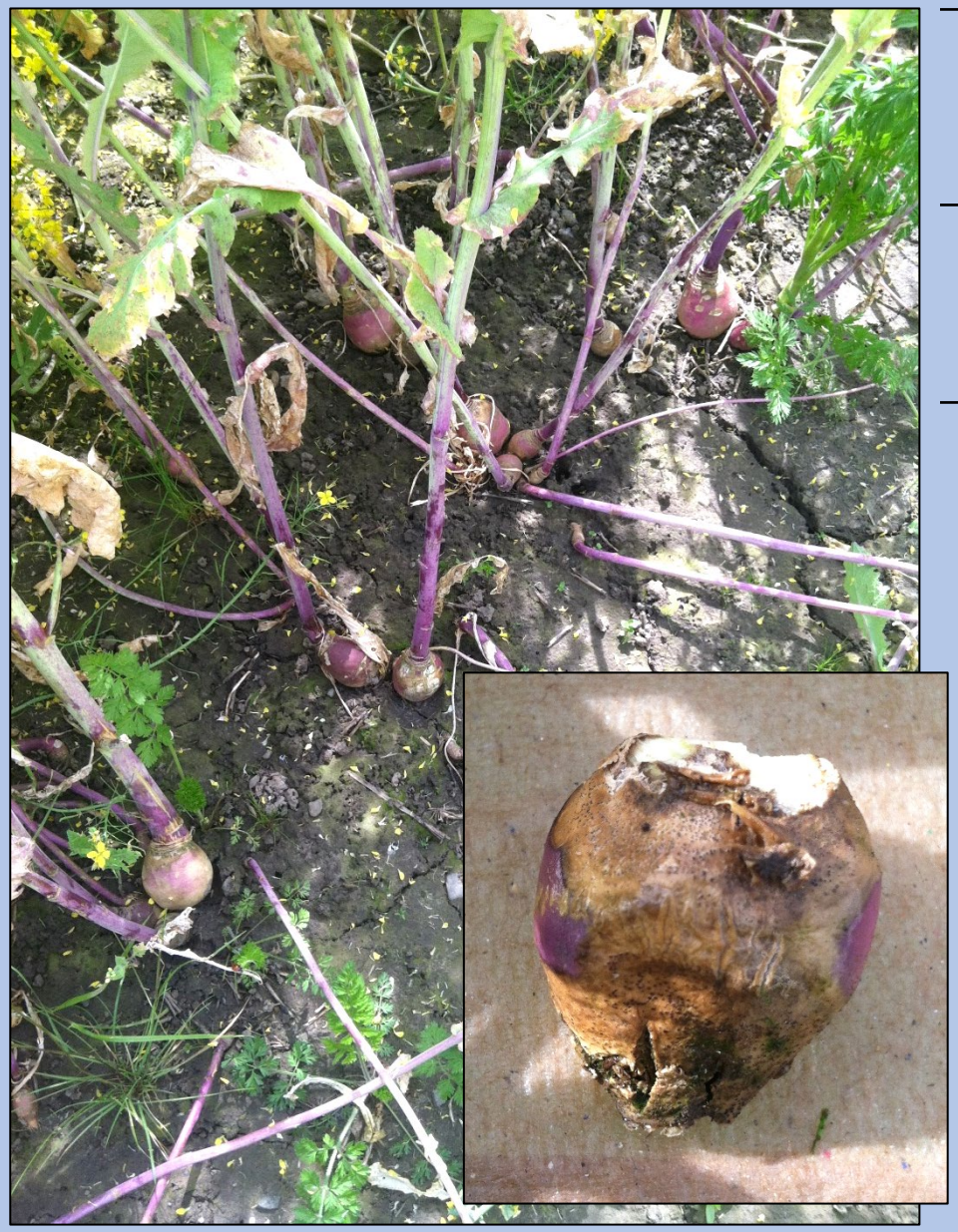
Post-harvest black leg in field on Botany Field Lab



Trt	% plants with *Leptosphaeria* cankers 7-Jul-25
NTC	38.5 a
Drone	3 b
Ground rig	4 b

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Conclusions from 1st year of black leg drone study

- Boom sprayer coverage was consistently higher than drone sprayer coverage at most levels.
- The back of spray cards did not show differences in coverage based on application methods.
- Black leg was present, albeit at low levels, by 12-Dec-2024, when plants were at the 3- to 5-leaf stage. By 9-Jan-2025, disease was more widespread
- Disease severity ratings (# of leaf spots/leaf) were confounded by Alternaria black spot. White leaf spot and chlorotic leaf spot also occurred in plots.
- Plants in the nontreated control plots had greater black leg incidence (~25%) in Jan, Feb, and post-harvest ratings compared to the two fungicide treatments.
- Drone and ground-rig treated plots had similar black leg incidence in Jan and post-harvest ratings. Incidence was slightly greater in the drone-treated plots relative to the ground-rig treated plots in Feb.

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