

Evaluation of Fungicides for Alternaria Control On Broccoli

M. Susil¹, T. Cranmer², J. Mosiondz², K. Goldenhar²

¹University of Guelph, Guelph, ON, Canada; ²Ontario Ministry of Agriculture, Food, and Agribusiness, Guelph ON, Canada

Introduction

Alternaria leaf spot (*Alternaria brassicicola*) is a fungal disease that causes serious damage to broccoli in Canada, and can make crops unmarketable. The disease causes yellow-brown spots that develop into target-like lesions with concentric rings on leaves (Fig. 1. A,B). In severe infections, leaves may fall away from the plant, and symptoms may appear on broccoli heads (Fig. 1. C,D). This leads to an unmarketable crop, and thus economic loss. Many growers use fungicides to treat their crop when this disease is developing or has already developed.

The purpose of this research was to evaluate the efficacy of fungicides against *Alternaria brassicicola*. Some fungicides are already approved for commercial use, while some are pending approval. This trial provides insight on fungicides that may be more effective, regardless of registration status.

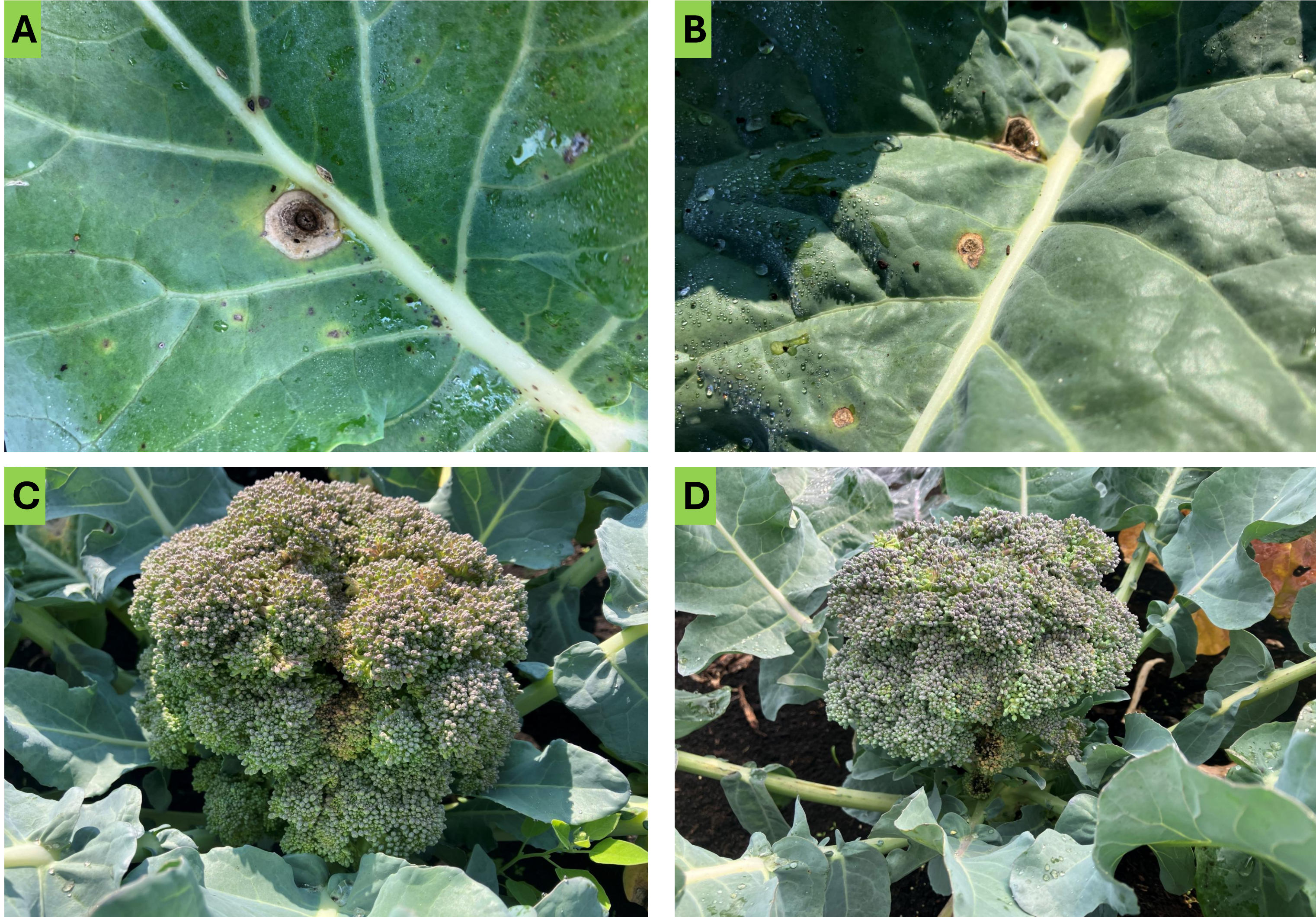


Fig. 1. *Alternaria brassicicola* damage on broccoli leaves (A) and (B) showing target spot lesions with concentric patterns and rot to broccoli heads (C) and (D).

Materials and Methods

Broccoli, cv. 'Eastern Crown', was grown as transplants and transplanted ~4 weeks after seeding at a 45 cm in-row spacing on 16 May into organic soil (organic matter 60.4%, soil pH = 7.3) near the University of Guelph Ontario Crops Research Centre – Bradford (Muck Crops Research Station), in Bradford, Ontario. Four replicates per treatment within a randomized complete block design was used. Each plot consisted of two, 5 m long rows spaced 65 cm apart (Fig. 2).



Fig. 2 Trial site for evaluation at the University of Guelph Ontario Crops Research Centre, Bradford ON.

Treatments were applied as a foliar spray using a CO₂ backpack sprayer equipment with two TeeJet Air Induction XR11005 fan nozzles 50 cm apart, calibrated to deliver 400 L/ha. Treatment rates for all fungicides used can be found in Table 1. An untreated check sprayed with water was also included. Treatments were applied 12, 20, and 26 June and 3, 12, and 19 July. Eight *Alternaria brassicicola* isolates collected from Ontario broccoli fields were grown on barley and mixed together just prior to being spread in the field. The inoculum mixture was scattered by hand between rows and around the perimeter of the trial on 20 and 26 June at a total rate of 6 g/m² to allow for a passive inoculation to occur. Insects were managed using a standard broccoli insecticide program. Plants were visually examined for the presence of *Alternaria* lesions on leaves on 3, 12, 19, and 24 July and broccoli heads once they were formed on 19 and 24 of July (Table 1; Table 2; Fig. 3). Data were analyzed using SAS version 9.3 (SAS Institute, Cary NC). Means were separated using Tukey-Kramer multiple mean comparison test (P=0.05).

Results

Table 1: Fungicide treatment information and average percent marketable heads with no *Alternaria* leaf spot lesions present at harvest.

Treatment	Active Ingredient	FRAC ³	Product rate (per ha)	% Marketable Heads ⁴ 24 July
Untreated Check	N/A	--	--	20.0 b ⁵
ALLEGRO ¹	fluazinam	29	1.16 L/ha	67.5 ab
BRAVO ZN	chlorothalonil	M5	4.8 L/ha	92.5 a
CEVYA ¹	mefentrifluconazole	3	375 mL/ha	82.5 a
FOLPAN 500SC ¹	folpet	M4	2 L/ha	82.5 a
FONTELIS	penthiopyrad	7	1.75L/ha	77.5 a
QUADRIS FLOWABLE ²	azoxystrobin	11	1.12 L/ha	97.5 a
SERCADIS	fluxapyroxad	7	333 mL/ha	67.5 ab

¹Not currently registered on broccoli in Canada

²Registered on broccoli in Canada, but not in flowable form

³Designated mode of action group by the Fungicide Resistance Action Committee

⁴Percentage of heads marketable which had no *Alternaria* lesions present at harvest 24 July, 2024

⁵Treatment means that share a letter are not statistically significant. Means were separated using Tukey-Kramer multiple mean comparison test (P = 0.05)

Table 2: Average lesions per plant, the top 10 newest leaves and average number of lesions per broccoli head assessed 3 to 24 July, 2024.

Treatment	Lesions per plant ¹				Top 10 Leaves ²	Head Damage ³	
	3 July	12 July	19 July	24 July	24 July	19 July	24 July
Untreated Check	9.7 a ⁴	21.9 a	32.1 a	28.3 a	3.5 a	1.13 a	2.10 a
ALLEGRO	3.2 b	10.5 bc	9.1 b	9.0 bc	0.4 b	0.03 b	0.55 b
BRAVO ZN	2.1 b	6.1 c	7.1 b	7.6 c	0.3 b	0.00 b	0.13 b
CEVYA	2.4 b	8.7 bc	9.2 b	9.7 bc	0.5 b	0.08 b	0.20 b
FOLPAN 500SC	2.9 b	7.8 bc	9.3 b	7.7 c	0.3 b	0.28 b	0.30 b
FONTELIS	2.9 b	10.7 bc	15.4 b	14.2 b	1.5 b	0.15 b	0.40 b
QUADRIS FLOWABLE	5.4 b	9.6 bc	10.1 b	6.9 c	0.4 b	0.00 b	0.03 b
SERCADIS	5.2 b	12.5 b	15.7 b	11.1 bc	0.7 b	0.20 b	0.43 b

¹Average number of lesions on leaves per plant; some lower leaves assessed 3 July fell off and were not counted in later assessments

²Average number of lesions on the top 10 newest leaves

³Average number of lesions on broccoli heads

⁴Treatment means that share a letter are not statistically significant. Means were separated using Tukey-Kramer multiple mean comparison test (P = 0.05)

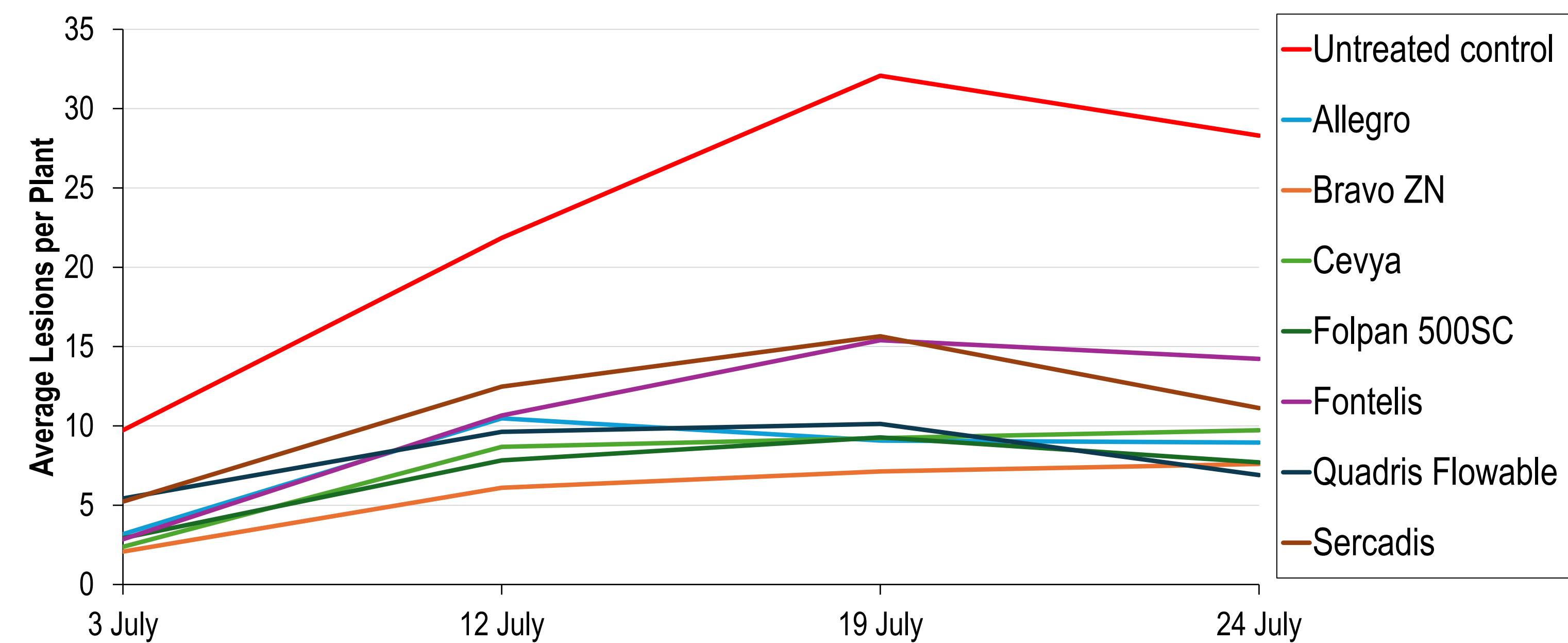


Fig. 3 Average number of lesions per plant counted on all leaves assessed 3 to 24 July 2024.

Conclusions

- All fungicide treatments reduced the number of lesions on leaves and improved the marketability of the heads compared to the untreated control.
- ALLEGRO and SERCADIS were similarly not significantly different to the untreated control for marketable heads.
- On 12 Jul, BRAVO ZN had significantly less lesions than SERCADIS, all treatments were better than the untreated control.
- On 24 Jul, FONTELIS had significantly more lesions than QUADRIS, BRAVO ZN and FOLPAN; all treatments reduced the number of lesions compared to the untreated control.

Discussion

This study emphasizes the importance of disease management in horticultural crops. As observed, without the studied control methods, broccoli had more lesions per plant, more head damage, and fewer marketable heads. The evaluated fungicides all reduced *Alternaria brassicicola* incidence, but some were more effective than others.

Acknowledgements

Thank you Sasha VanDyk, Joseph Roy, Kendra Workman, and Daniel Stein for their help throughout the growing season. Thank you to R. Brush farms for donating broccoli transplants, Zachary Hoegy and Ashley Dickson for preparing the *Alternaria* inoculum, and the University of Guelph Ontario Crops Research Centre – Bradford for donating and preparing land for this trial.