

RESEARCH REPORT 2023

Project Title: Efficacy of Fungicides for Downy Mildew Control in Processing Cucumbers

Prepared for: Ontario Processing Vegetable Growers,
Ontario Cucumber Research Committee

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Objective: Cucurbit downy mildew (CDM), an aggressive plant pathogen (*Pseudoperonospora cubensis*), can develop at any time during the cucumber season and have devastating consequences for cucumber growers. It is a very destructive disease and progresses rapidly under favorable weather conditions. In 2006, downy mildew appeared early in Ontario causing extensive crop defoliation and yield losses. The severity of the disease resulted in some growers only meeting about 70% of the contracted tonnage. From 2007 to 2009, with the availability of more fungicides through emergency registrations, the severity of the disease was reduced, and crop yields were maintained. Disease pressure in Ontario varies from year to year, depending on when it first appears in the field. The last couple of years CDM has been detected mid-July. In 2023, the disease was first detected in Norfolk County on July 5, which is a week earlier than detection in 2022. It was first observed in cucumber trials at the research centre in Simcoe on July 31. A few days after first detection, the disease in the trial had increased significantly.

Over the past few years, we have seen disease resistance to some fungicides that were effective in the past in controlling downy mildew in cucumbers. Testing of current registered products is necessary for making informed recommendations on spray programs that will continue to be effective in controlling downy mildew. Evaluating new products is important for the registration of new effective fungicides to control downy mildew, which is a great benefit to the Ontario processing cucumber industry. In addition, the cucumber processing industry in North America is shifting to planting more parthenocarpic-type varieties. Current research on fungicide efficacy should be on the varieties being grown and processed, thus two parth varieties were used in the trial in 2023. These two varieties differ in their tolerance to CDM, with Bowie being more tolerant than Liszt.

Methodology: A fungicide efficacy trial was conducted at Ontario Crops Research Center – Simcoe, in 2023. Two cucumber varieties, 'Liszt' and 'Bowie', were seeded using a precision seeder on July 3 in rows 30 inches apart with in-row plant spacing of 4" to give a plant population of 55,000 plants/per acre. Please note that this was at a higher plant population that is typical of parth machine harvest cucumbers. The crops were grown according to accepted commercial practices used in Ontario. The trial was set up as a randomized complete block design with a split-plot arrangement and three replications with fungicide treatment as main plot and variety as subplot. Treatments were applied using a hand-held CO₂ backpack sprayer with air induction, low drift (AI TeeJet 110015-VS) nozzles at a pressure of 40 psi and water volume of 200 L/ha. Eleven treatments were evaluated, including an untreated control. Treatments were applied to plots on July 25, August 2 and 9.

Downy mildew visual ratings were made at weekly intervals starting on July 24. Mature fruit were harvested by hand on August 21, targeting a crop that was at approximately 10% grade 4 (2" in diameter). Yields were measured as graded fruit numbers and weights. Plot yields were converted to tons/acre and US \$/acre for reporting purposes.

Results: In 2023, downy mildew infection was greater than 2022. The disease was detected in significant amounts (>5%) in untreated trial plots on July 31 which was prior to flowering. By August 9, significant amounts of disease was observed in all plots. A week later, disease had slowed down, due to less favourable weather conditions, allowing the cucumber plants to grow new healthy vines. The last disease assessments just prior to harvest showed slight improvements in disease control for this reason. Despite this, by the time the crop was ready for harvest on August 21, infection in untreated plants was 63% and 83% for the cucumber varieties Bowie and Liszt, respectively. Orondis Ultra and product A24367 (B) provided the best control of the disease with 27% and 28% leaf infection for Bowie and 50 and 47% leaf infection for Liszt, respectively. Intermediate disease control was observed from plants treated with Torrent and Zampro for Bowie. However, with Liszt, all other treatments had more than 63% leaf infection, up to 83% with the poorest treatment (Tables 1 & 2).

When comparing the level of disease between the two varieties, 'Bowie' and 'Liszt' it was observed that Bowie had less disease infection in all treatments. This difference in disease infection was in a range of 5 to 40% less disease with Bowie when compared to Liszt.

Final harvest yields were significantly reduced for most treatments with high downy mildew infection when compared to the best treatments of Orondis Ultra and A24367 (B) for both varieties of Liszt and Bowie (Tables 1 & 2). These results show that Orondis Ultra is still effective at controlling downy mildew to levels that do not have an economic impact on the final yield of cucumbers even under high disease pressure. Torrent and Zampro provided intermediate control suggesting that if used in a program with Orondis, these products remain the best downy mildew control option. Tattoo C also provided comparable control to Zampro.

Overall, Liszt had higher yields than Bowie when comparing all fungicide treatments, however Liszt is an earlier-maturing variety than Bowie. Thus if Bowie had been harvested several days later, allowing more time for the cucumbers to reach a more appropriate size, the yields would have been more comparable.

Table 1: Incidence of cucumber leaves with downy mildew symptoms and yield of cucumbers, variety 'Liszt', harvested from plots sprayed with different fungicides, Simcoe, ON, 2023.

Product**	Rate per Hectare	% Downy Mildew Infection*			Yield	
		Aug 1	Aug 9	Aug 16	T/acre	\$/acre
Bravo ZN	4.8 L	35	73	77	1.8 e-i	425 efg
Torrent + Sylgard	200 mL 0.1 % v/v	12	63	63	8.4 bc	2,439 bc
Zampro + Sylgard	1 L 0.1 % v/v	40	65	63	4.8 c-f	1,327 c-f
Orondis Ultra	600 mL	2	67	47	18.6 a	5,387 a
A24367 (B)	1.31 L	1	43	50	20.0 a	5,926 a
Tattoo C	2.70 L	15	67	72	5.5 cde	1,527 b-e
Allegro	1.75 L	23	73	77	4.2 d-g	1,114 d-g
Torrent, alt Diplomat + Phostrol	200 mL 0.46; 2.9 L	8	78	83	4.2 d-h	957 d-g
Cueva	2.80 % v/v	23	80	80	0.6 ghi	88 g
Cueva + Phostrol	2.8%; 2.9 L	27	73	73	3.0 e-i	688 d-g
Untreated Control		32	767	83	1.7 e-i	356 fg

Planting Date : July 5
Plant Population : 55,000 plants/Ac

Date of First Application : July 25
Harvest Date : August 21

* Based on % leaves infected

** First application was applied at the 3-4-leaf stage, subsequent applications were made on a 7-day spray interval, 3 applications total.

Means followed by the same letter do not significantly differ (P=0.05, Tukey's HSD)

Table 2: Incidence of cucumber leaves with downy mildew symptoms and yield of cucumbers, variety 'Bowie', harvested from plots sprayed with different fungicides, Simcoe, ON, 2023.

Product**	Rate per Hectare	% Downy Mildew Infection*			Yield	
		Aug 1	Aug 9	Aug 16	T/acre	\$/acre
Bravo ZN	4.8 L	8	60	60	0.9 efg	131 ef
Torrent + Sylgard	200 mL 0.1 % v/v	1	37	40	3.9 c-h	673 c-f
Zampro + Sylgard	1 L 0.1 % v/v	12	50	40	2.9 d-h	496 def
Orondis Ultra	600 mL	0	33	28	7.4 abc	1,796 abc
A24367 (B)	1.31 L	0	30	27	10.1 a	2,701 a
Tattoo C	2.70 L	5	53	50	3.5 c-h	791 c-f
Allegro	1.75 L	5	73	73	1.9 d-h	293 ef
Torrent, alt Diplomat + Phostrol	200 mL 0.46; 2.9 L	1	63	57	2.3 d-h	300 ef
Cueva	2.80 % v/v	7	67	67	0.1 h	1 f
Cueva + Phostrol	2.8%; 2.9 L	7	70	63	1.3 e-h	113 f
Untreated Control		13	67	63	0.6 ghi	69 f

Planting Date : July 5
Plant Population : 55,000 plants/Ac

Date of First Application : July 25
Harvest Date : August 21

* Based on % leaves infected

** First application was applied at the 3-4-leaf stage, subsequent applications were made on a 7-day spray interval, 3 applications total.

Means followed by the same letter do not significantly differ (P=0.05, Tukey's HSD)