Report Submission
for the
Ontario Processing Vegetable Growers (OPVG)
on behalf of
Sandy Knolls Research Inc.

Sponsor: Ontario Processing Vegetable Growers
Research Conduction: Sandy Knolls Research Inc. located in Vienna, Ontario
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Title:

Evaluation of Downy Mildew (*Pseudoperonospora cubensis*) efficacy and crop tolerance of experimental fungicide rotations in Ontario produced pickling cucumbers.

Objectives:

1. Verify suitable crop tolerance with a lack of phytotoxicity within fungicide rotation.
2. Determine level of Downy Mildew control by assessing pathogen incidence and severity.
3. Quantify efficacy by determining impacts on marketable yields.
4. Compare input costs relative to crop tolerance and efficacy of treatments.

Products:

Allegro (Fluazinam 500 g/L) SC
Orondis Ultra (Mandipropamid and Oxathiapiprolin 280 g/L) SC
Torrent (Cyazofamid 400 g/L) SC
Zampro (Ametoctradin and Dimethomorph 525 g/L) SC
Activate Plus (Alcohol Ethoxylate and Alkyl Phenol Ethoxyate 90%) NIS

Establishment:

The trial was conducted on site of Sandy Knolls Research located at 56992 Tunnel Line, Vienna, Ontario in a pocket of loamy sand that is conducive to the proper agronomic production of pickling cucumbers. The trial area was conventionally tilled by a series of disc and cultivation passes prior to planting in order to incorporate broadcasted nutrients as well as to prepare an adequate seed bed. The fertilizer program was selected in accordance with proper production of pickling cucumber crops based on the soil analysis that the trial was placed. The trial was maintained throughout the season to proper fertility, moisture, and pest standards while implementing a fungicide free spray program outside of trial treatments. The cucumber crop was planted approximately 1" (2.54 cm) deep on 40" (1.01 m) row spacing at a rate of 26,692 seeds/acre using Puccini cultivar and a vacuum planter on June 19, 2025. The trial was staked with 5 treatment plots, 3.03m wide containing 3 plot rows and 6.5m long replicated 4 times in a randomized complete block design, excluding the first replication as non-randomized. The crop emerged 10 days after planting with a uniform stand on June 29, 2025.

Application:

Foliar applications occurred throughout the growing season beginning 8 days after crop emergence on July 7, 2025 at the crop's second leaf stage. The initial application was made pre-infection of the disease and subsequent applications made on 6–8-day re-treatment intervals based on suitable weather conditions. Treatment applications were made using a 1m hand held spray boom equipped with 2 Turbo TeeJet 11004 nozzles spaced 20" (50 cm) a part and held 20" (50 cm) above the crop canopy to facilitate uniform spray coverage. The spray boom was powered using compressed carbon dioxide gas regulated at 34 PSI in order to properly displace the spray solution at 400 L/ha. Prior to the first treatment's application a set of calibrations were performed with water to verify that each nozzle was discharging the same volume and to verify accurate ground speed. Experimental products were measured using a graduated syringe at the trial location and then added to a pre-measured volume of water carrier, agitated, and inserted into the spraying apparatus for immediate application. A water rinse was circulated through the spraying apparatus between treatments of new products or lower concentration of products. The rinse was rendered insignificant if subsequent treatments were identical tank mixes with the addition of a new product or with increasing tank mix concentrations. Treatments were applied to the centre row only (Row #2) in each of the 3 row plots, effectively providing treatment coverage to the middle row and not the exterior rows per plot (Row #1 and Row #3). By omitting coverage in each exterior row per plot, an unofficial untreated check was observed within each plot to determine whether treatments have control or whether the pathogen simply has not infected that plot yet as it spread across the trial.

Trial Treatments

DAP = Days After Planting	DAE = Days After Emergence

Planting	Emergence	July 7, 2025	July 14, 2025	July 21, 2025	July 28, 2025	August 4, 2025
June 19	June 29, 2025	8 DAE	15 DAE	22 DAE	29 DAE	36 DAE
Treatment #	-	Application 1	Application 2	Application 3	Application 4	Application 5
1	Untreated Check	-	-	-	-	-
2	Lower Cost Rotation	Torrent + NIS	Zampro	Torrent + NIS	Zampro	Torrent + NIS
3	Moderate Cost Rotation	Torrent + NIS	Allegro	Orondis Ultra	Torrent + NIS	Zampro
4	Moderate Cost Rotation	Torrent + NIS	Allegro	Zampro	Torrent + NIS	Orondis Ultra
5	Higher Cost Rotation	Allegro	Allegro	Torrent + NIS	Orondis Ultra	Zampro

Planting	Emergence	August 11, 2025	August 18, 2025	August 25, 2025	September 2, 2025	September 8, 2025
June 19	June 29, 2025	Harvest Week 1	Harvest Week 2	Harvest Week 3	Harvest Week 4	N/A
Treatment #	-	Application 6	Application 7	Application 8	Application 9	Application 10
1	Untreated Check	-	-	-	-	
2	Lower Cost Rotation	Orondis Ultra	Torrent + NIS	Orondis Ultra	Torrent + NIS	Zampro
3	Moderate Cost Rotation	Orondis Ultra	Torrent + NIS	Zampro	Zampro	Torrent + NIS
4	Moderate Cost Rotation	Torrent + NIS	Zampro	Torrent + NIS	Orondis Ultra	Torrent + NIS
5	Higher Cost Rotation	Torrent + NIS	Orondis Ultra	Zampro	Zampro	Torrent + NIS

Evaluation:

Assessments were taken throughout the growing season to document crop phytotoxicity, disease incidence, disease severity, and yield effects at crop maturity. Assessments were made before the first application, between each subsequent application, and after the last application. Each assessment was completed by starting at the first replication and working toward the fourth replication with each replication beginning at the untreated check plot. Each replication began at the untreated check for a reference point of crop health in order to evaluate each treatment's crop tolerance relative to the untreated check and as a reference point of disease pressure in order to evaluate each treatment's efficacy relative to the untreated check. Every plot was rated by observing the level of crop tolerance and control in the centre row compared to the centre row of the untreated check. 10 randomized plants along the centre row were assessed for the presence of Downy Mildew infections throughout the crop canopy. Two passes were completed by travelling down each side of the centre row from front to back and again back to front taking care in noting differences on the external and internal canopy. Infection severity was documented by recording the foliage's percent area infected per plant sampled and infection incidence was calculated by the percent of plants infected of the 10 plants sampled per plot. Harvest assessments were completed by hand harvesting each plot's centre row twice a week for 4 consecutive weeks. Yield data collected were fruit weights per grade with a grading scale of 1A/1B (up to 1-1/16" diameter), 2A (1-1/16" to 1-1/4" diameter), 2B (1-1/4" to 1-1/2" diameter), 3A (1-1/2" to 1-3/4" diameter), 3B (1-3/4" to 2" diameter), 4 (2" to 2-1/8" diameter), and Oversized (>2-1/8" diameter). All assessment data was subjected to statistical models within an Analysis of Variance (ANOVA) using the Duncan's New MRT test at a confidence level of 95% and is included in the trial report.

Results/Conclusions:

This trial demonstrated sufficient and statistically significant results of all 4 objectives providing a successful study. Each fungicide rotational treatment resulted in no observed crop phytotoxic symptoms throughout the duration of the study from initial application through crop maturity when compared to the untreated check (treatment 1). The lack of phytotoxic symptoms provides support that all fungicides used and in the specific rotational program had no negative impact on the crop. Natural infection of Downy mildew (*Pseudoperonospora cubensis*) infected the crop in the second week of July shortly after crop emergence, results provided significant treatment differences in the control of the pathogen. All rotational treatments did not provide any level of incidence control compared to the untreated check as downy mildew was observed to have infected each plant sampled for lesions as the season progressed. Rotational treatments did however have statistical differences in the level of downy mildew severity compared to the untreated check which resulted in differences among treatments for season long marketable yields.

Rotational treatment 2 had statistically significant control compared to the untreated check late in the season with 31.7% less infection severity, while maintaining statistically better severity control (29.4% - 38.2% less) early to mid season when compared to the untreated check. Rotational treatment 3 had statistically significant control compared to the untreated check throughout the duration of the season with 40.1% less infection severity late in the season, while maintaining statistically better severity control (50.0%-58.6% less) early to mid season when compared to the untreated check. Rotational treatment 4 also had statistically significant control compared to the untreated check throughout the duration of the season with 30.3% less infection severity late in the season, while maintaining statistically better severity control (21.5%-73.5% less) early to mid season when compared to the untreated check. Rotational treatment 5 similar to treatments 2, 3 and 4 had statistically significant control compared to the untreated check throughout the duration of the season with 19.3% less infection severity late in the season, while maintaining statistically better severity control (3.4%-50.0% less) early to mid season when compared to the untreated check. All rotational treatments had significantly higher marketable yields compared to the untreated check indicating the necessary need for a fungicide program, however all rotational treatments were not comparable to one another. Rotational treatment 2 had a yield increase of 226.0% (approximately 18.1 tonnes/hectare) over the untreated check whereas rotational treatment 3 had a yield increase of 235.9% (approximately 18.9 tonnes/hectare) over the untreated check. Rotational treatment 4 had a yield increase of 317.3% (approximately 25.4 tonnes/hectare) over the untreated check whereas rotational treatment 5 had a yield increase of 349.2% (approximately 28.0 tonnes/hectare) over the untreated check. Although, rotational treatment 5 yielded higher than rotational treatment 4 which yielded higher than rotational treatment 3 which yielded higher than rotational treatment 2, all 4 treatments were statistically insignificant to one another albeit numerically different.

	% Severity	% Severity	% Severity	% Severity	% Severity	% Severity	% Severity	% Severity	% Severity	% Severity	% Severity
	July 4	July 11	July 18	July 25	Aug 1	Aug 8	Aug 15	Aug 22	Aug 29	Sept 5	Sept 15
TRT 1	0.0	0.1	1.0	4.3	34.8	47.8	50.1	70.6	92.3	96.3	99.1
TRT 2	0.0	0.3	0.6	1.6	0.9	22.3	14.8	13.0	18.0	22.1	31.4
TRT 3	0.0	0.3	0.5	2.1	0.0	8.0	29.4	22.3	23.8	26.3	39.8
TRT 4	0.0	0.5	2.3	3.1	0.3	10.2	10.8	10.6	11.9	23.0	30.0
TRT 5	0.0	1.7	1.0	2.1	0.4	1.7	1.7	2.3	6.3	12.4	19.1

The trial results demonstrated that rotational treatments 3 and 5 had significantly better season long efficacy of downy mildew compared to treatments 2 and 4. Treatments 2-5 had insignificant and comparable yields statistically while noting that there were numerical differences between treatments, the differences were not statistically significant. All rotational treatments 2-5 had significant efficacy and yield compared to the untreated check. Over the 10 in season applications treatment 1 (untreated check) had an expense of $0.00, treatment 2 (low cost) had an expense of $1,022.09/hectare, treatment 3 (moderate cost) had an expense of $1,1157.42/hectare, treatment 4 (moderate cost) had an expense of $1,149.77/hectare, and treatment 5 (high cost) had an expense of $1,292.76/hectare. All rotational treatments 2-5 provided sufficient evidence to support the economical use in Ontario produced pickling cucumbers, however rotational treatment 5 of high costs provided the greatest return on investment when factoring in cost per hectare relative to the level of downy mildew control and inherent yield impacts.

Rotational Treatment	Cost/Hectare (Canadian Dollars)	Yield (Metric Tonnes/Hectare)
TRT 1 (Untreated Check)	$0.00	8.0
TRT 2 (Low Cost)	$1,022.09	18.1
TRT 3 (Moderate Cost)	$1,157.42	18.9
TRT 4 (Moderate Cost)	$1,149.77	25.4
5 (High Cost)	$1,292.76	28.0