CUCUMBER, SLICER (*Cucumis sativus*, 'Marketmore 76')
Downy mildew; *Pseudoperonospora cubensis*

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Efficacy of biopesticides for managing downy mildew in cucumber, 2021.

A field experiment was conducted at the Long Island Horticultural Research and Extension Center (LIHREC) in Riverhead, NY, on Haven loam soil. The main objective was to evaluate recently developed biopesticides suitable for organic production. The field was moldboard plowed on 6 Apr and urea fertilizer (46-0-0) was applied at 80 lb/A N on 7 Apr. For management of Phytophthora blight, caused by *Phytophthora capsici*, a mustard biofumigant cover crop (cv. Rojo Caliente) was seeded at 10 lb/A by drilling on 9 Apr. On 14 Jun the mustard was flail chopped, immediately incorporated by disking, and followed by a cultipacker to seal the soil surface; the field could not be irrigated to initiate biofumigation as usually done, but the soil was moist. Controlled-release fertilizer (N-P-K, 19-10-9) at 525 lb/A (101 lb/A N) was broadcast over the bed area and incorporated on 13 Jul. Beds were formed with drip tape and covered with black plastic mulch on 13 Jul. Seeds were sown on 28 Jun in the greenhouse. A waterwheel transplanter was used to make planting holes in the beds and apply starter fertilizer (9-18-9). All plants were placed outdoors to harden for a few days and then transplanted by hand into the holes in the beds on 15 Jul. During the season, water was provided as needed via drip irrigation lines. Weeds were managed between the mulched beds by covering the soil with landscape cloth and by hand weeding. The primary source of initial inoculum of *Pseudoperonospora cubensis* in this area is long-distance wind-dispersed spores from affected plants. Plots were single 18-ft rows with 9 plants at 2-ft spacing. Rows were 4 ft apart. The plots were 6 ft apart within the row initially until plants began to vine partly filling the area. Vines were moved as needed to maintain plot separation. A randomized complete block design with four replications was used. Treatments were applied six times on a weekly schedule beginning on 28 Jul using a backpack boom sprayer equipped with one TwinJet (TJ60-8004VS) nozzle that delivered 31 gal/A at 55 psi and 2.2 mph. For the last three applications, two passes were made treating each plot side separately because plants had grown too large to obtain complete coverage with one pass. Downy mildew severity was assessed weekly by estimating incidence of symptomatic leaves in each plot and rating severity on nine representative affected leaves. Canopy severity was calculated by multiplying incidence by average severity. Area under the disease progress curve (AUDPC) values were calculated from 30 Jul through 30 Aug using the formula: $\sum n_{i=1}[(R_{i+1} + R_i)/2]\,[t_{i+1} - t_i]$, where R = disease severity rating (% of leaf surface with symptoms) at the *i*th observation, t_i = time (days) since the previous rating at the *i*th observation, and n = total number of observations. Defoliation, which was due to downy mildew, was assessed on 24 and 30 Aug. Fruit were harvested and counted when time permitted (18 Aug, 24 Aug, and 27 Sep), rather than more frequently as fruit reached marketable size, because experiment focus was disease control. Mis-shaped fruit but not over-sized fruit were considered unmarketable. Average monthly high and low temperatures (^{o}F) were 82 and 67.4 in Jul and 83.4 and 68.4 in Aug. Rainfall (in.) was 6.2 and 9.0 for these months, respectively. Data was analyzed with one-way ANOVA and Tukey's HSD to separate means using JMP statistical software.

None of the treatments, including the grower standard copper fungicide (Kocide 3000-O), reduced the incidence of leaves with symptoms (data not shown), severity of symptoms on leaves (data not shown), canopy severity (not all data shown), or defoliation. Lack of efficacy may be partly due to downy mildew having already started to develop in the experiment at the time of the first application, which is earlier than previous years. It was intended to have 1-2 preventive applications. Additionally, there was extensive rainfall (2.6 in.) with Hurricane Henri on 22 and 23 Aug. The last application was applied early due to rain forecast with remnants of Hurricane Ida starting late on 1 Sep (3.3 in. total). It is possible efficacy of treatments was affected by the impact of these storms on application timing, product residues, and/or disease development. No phytotoxicity was observed. There were few differences among treatments in yield. Number of fruit per plant was significantly greater in the Tril-21 treatment than the untreated control, Howler, and MBI-121 treatments, but not significantly greater than the other treatments. The Howler and Theia combination treatment resulted in the highest percentage of marketable fruit per plant, but was only significantly greater than Theia alone.

	Canopy severity (%) [z]				Defoliation (%) [z]	Fruit/plant [z]	
Treatment and rate (application dates) [y]	6 Aug [x]	17 Aug	30 Aug	AUDPC	30 Aug	No.	Marketable (%)
Untreated Control	0.8	30	35	575	38	5.2 b	61 ab
Aviv 30 fl oz/100 gal (1-6) [w]	0.1	30	40	492	26	8.1 ab	66 ab
Aviv 30 fl oz/100 gal + Timorex ACT 35 fl oz/A (1-6) [w]	0.7	32	38	561	31	7.4 ab	67 ab
MBI-121 2 qt/A (1-6)	1.1	29	40	550	34	6.3 b	66 ab
Howler 5 lb/A (1-6) [w]	0.7	26	43	544	30	6.2 b	70 ab
Theia 3 lb/A (1-6) [w]	0.2	23	44	438	38	8.2 ab	56 b
Howler 5 lb/A (1, 3, 5) Theia 3 lb/A (2, 4, 6) [w]	1.5	27	46	536	28	7.6 ab	72 a
Tril-21 1% (1-6)	0.1	23	44	462	31	10.7 a	66 ab
Kocide 3000-O 1.25 lb/A (1-6)	0.1	25	34	445	33	8.2 ab	69 ab
P-value (treatment)	0.4475	0.4472	0.386	0.1617	0.6713	0.0026	0.057

[z] Numbers in each column with a letter in common or no letters are not significantly different from each other (Tukey's HSD, P=0.05).
[y] Application dates were 1=28 Jul, 2=3 Aug, 3=11 Aug, 4=18 Aug, 5=25 Aug, and 6=31 Aug.
[x] Values were square root transformed before analysis because raw data were not distributed normally. Table contains de-transformed values.
[w] Treatment applied with the nonionic surfactant Dyne-Amic at 0.38% v/v.