BASIL, SWEET (*Ocimum basilicum* 'Rutgers Passion DMR')
Downy mildew; *Peronospora belbahrii*

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Evaluation of biopesticides for organic management of downy mildew in sweet basil, 2021.

An experiment with field-grown basil was conducted at the Long Island Horticultural Research and Extension Center (LIHREC) in Riverhead, NY, in a field with Haven loam soil. A sweet basil cultivar bred to be resistant to downy mildew, Rutgers Passion DMR, was used. Organic products tested previously were ineffective when applied to susceptible and partially resistant cultivars (PDMR 9:V026 and 10:V033). Rutgers Passion DMR was selected because it exhibited good but not sufficient suppression of downy mildew in a cultivar evaluation in 2019 (PDMR 14:V071), and some organic treatments tested on it in 2020 were effective (PDMR 15:V077). The field was moldboard plowed on 29 May. Controlled-release fertilizer (N-P-K, 19-10-9) was broadcast at 525 lb/A (101 lb/A N) over the bed area and incorporated on 30 Jun. Beds were formed with drip tape and covered with black plastic mulch on 30 Jun. Weeds between mulched beds were managed by cultivating, covering the soil with landscape cloth, and by hand weeding. A waterwheel transplanter was used to make planting holes in the beds and apply starter fertilizer (9-18-9). Basil for the experiment was seeded in trays in a greenhouse on 8 Jun. All plants were placed outdoors to harden for a few days and then transplanted in the field by hand on 7 Jul. A late planting date was used to increase the likelihood of downy mildew developing during the experiment. The primary source of initial inoculum in this area is considered to be sporangia dispersed by wind from infected plants potentially a long distance away. A randomized complete block design with four replications was used. Each plot had 8 plants in 6-ft rows with 9-in. in-row plant spacing. The plots were 3 ft apart in the row. Fungicides were applied weekly over a 6-wk period, with a backpack CO_2-pressurized sprayer and hand-held boom (R&D Sprayers, Opelousas, LA) with TJ60-8004EVS nozzle(s) operated at 55 psi and 2.3 mph. Applications 1-3 were made using a boom with a single nozzle delivering 32 gal/A. Starting with application 4, plants were large enough to use a boom with two drop nozzles directed to the side of plants as well as a nozzle delivering spray over the top of the plant that delivered 73 gal/A. Downy mildew was assessed in each plot weekly from 12 Aug through 14 Sep. Incidence of plants with symptoms (sporulation of the pathogen visible on the underside of leaves) was recorded and percentage of leaves per plant with symptoms was estimated for each plant in each plot. Area under the disease progress curve (AUDPC) values were calculated from 12 Aug to 7 Sep using the formula: $\sum_{i=1}^{n} [(R_{i+1} + R_i)/2]\,[t_{i+1} - t_i]$, where R = disease incidence rating (% leaves with symptoms on affected plants) at the *i*th observation, t_i = time (days) since the previous rating at the *i*th observation, and n = total number of observations. Data were analyzed with one-way ANOVA and Tukey's HSD to separate means using JMP statistical software. Average monthly high and low temperatures (^{o}F) were 82 and 67.4 in Jul, 83.4 and 68.4 in Aug, and 77.1 and 62.5 in Sep. Rainfall (in.) was 6.2, 9.0 and 4.9 for these months, respectively.

Symptoms of downy mildew were first observed at LIHREC on 3 Aug in an adjacent experiment and in this experiment on 12 Aug in 18 of the 24 plots. Three treatment applications had been made thus the planned preventive schedule was achieved. None of the treatments were effective. Based on AUDPC values, Rango and the program that included a copper fungicide had the lowest incidence of affected leaves, but these were not significantly different from other treatments including the control. Lack of control was at least partly due to the fact that the cultivar used did not suppress downy mildew as well in 2021 as in 2020. In 2002, incidence of leaves with symptoms in untreated control plots reached maximum of only 16% on 24 Sep and all treatments were effective, including the one with MBI-121 (containing the active ingredients in Regalia plus Stargus) alternated with EcoSwing plus Badge X2 (PDMR 15:V077). Additionally, the fifth application scheduled for 25 Aug was delayed by one day because of extensive rainfall (2.6 in.) with Hurricane Henri on 22 and 23 Aug. Further, 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 the efficacy of treatments was affected by the impact of these storms on application timing, product residues, and/or disease development. No phytotoxicity was observed.

Treatment and rate (application dates) [y]	Incidence of downy mildew: affected leaves on affected plants (%) [z]					Defoliation (%) [z]	
	17 Aug [x]	25 Aug [x]	30 Aug	7 Sep	AUDPC	7 Sep	22 Sep
Untreated Control	4	23	62	45	767	2	39
MilStop 4 lb/100 gal (1-6)	5	25	65	48	810	1	40
MilStop 4 lb/100 gal (1,3,5) MilStop 3 lb/100 gal + Double Nickel 4 qt/100 gal (2,4,6)	6	28	60	40	799	2	36
Rango 1.25% v/v (1-6)	2	19	56	34	634	1	45
MBI-121 2 qt/A (1,3,5) EcoSwing 1 qt/A (2,4,6)	9	37	65	44	934	1	39
MBI-121 2 qt/A (1,3,5) EcoSwing 1 qt/A + Badge X2 0.75 lb/A (2,4,6) [w]	5	19	59	26	663	1	33
P-value (treatment)	0.3047	0.2839	0.6428	0.0747	0.07	0.7764	0.7037

[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=4 Aug, 3=11 Aug, 4=18 Aug, 5=26 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] In week 2, Cueva 1 gal/A was applied instead of Badge X2.