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

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Evaluation of organic fungicides for downy mildew in sweet basil, 2019.

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 Devotion DMR, was used to evaluate fungicides approved or in development for organic production. None were labeled for basil downy mildew. Organic products tested previously were ineffective applied to susceptible and partially resistant cultivars. Rutgers Devotion DMR was selected because of its reported popularity with growers and it exhibited good but not sufficient suppression of downy mildew in a cultivar evaluation in 2018. A treatment with an untreated susceptible cultivar, DiGenova, was included to obtain a measure of downy mildew severity with no management practices to suppress this disease. The field was plowed on 3 Jun. Controlled-release fertilizer (N-P-K, 15-5-15) was broadcast at 675 lb/A (101 lb/A N) over the bed area and incorporated on 5 Jun. Beds were formed with drip tape and covered with black plastic mulch on 5 Jun. Weeds between mulched beds were managed by applying Devrinol DF-XT (2 lb/A) before transplanting, 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. Basil for the experiment was seeded in trays in a greenhouse on 13 Jun. All plants were placed outdoors to harden for a few days and then transplanted in the field by hand on 9 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 4 ft apart in the row. Fungicides were applied over a 9-week period, weekly for some treatments and twice a week for the other treatments, with a backpack CO_2-pressurized sprayer and hand-held boom with TJ60-4004EVS nozzle(s) operated at 55 psi and 2.4 mph. Applications 1-5 were made using a boom with a single nozzle delivering 50 gal/A. Starting with application 6 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 82 gal/A. Downy mildew was assessed in each plot weekly from 29 Aug through 4 Oct. 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 Disease Progress Curve (AUDPC) values were calculated from 29 Aug to 4 Oct using the formula: $\sum n_{i=1}[(R_{i+1} + R_i)/2]\ [t_{i+1} - t_i]$, where R = disease incidence rating (% leaves with symptoms on affected plants) at the ith observation, t_i = time (days) since the previous rating at the ith 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 (°F) were 86.3/71.3 in Jul, 82/68.8 in Aug, 76/66.1 in Sep, and 66.9/54.5 in Oct. Rainfall (in.) was 3.00, 1.52, 1.83 and 6.94 for these months, respectively.

Symptoms of downy mildew were first observed at LIHREC on 16 Aug in an adjacent planting. On 29 Aug all plants of DiGenova in this experiment had symptoms while no symptoms were found on any plants of Rutgers Devotion DMR. The susceptible cultivar became severely affected, as is typical for this area, but untreated Rutgers Devotion DMR did not become affected to the degree it had in a cultivar evaluation conducted in 2018 (PDMR 13:V115). The high degree of suppression of downy mildew provided by the resistant cultivar may at least partly account for lack of additional suppression detected with the fungicide treatments. Statistically, the rotation treatment of LifeGard + Kocide 3000-O with Magna-Bon was able to manage downy mildew compared to the untreated resistant cultivar based on the 26 Sep assessment. However, symptoms of phytotoxicity were only observed with Magna-Bon which caused black spotting typical of copper injury. This was first noticed on 29 Aug during the first assessment. Further testing is needed to identify an organic fungicide management program.

Treatment and rate (application dates) [y]	Downy mildew incidence [z]						
	Affected plants (%)			Affected leaves on affected plants (%)			
	19 Sep	26 Sep [x]	4 Oct [x]	19 Sep [x]	26 Sep [x]	4 Oct [x]	AUDPC [x]
Untreated (DiGenova, susceptible cultivar)	100.0 a	100.0 a	100.0 a	100.00 a	100.00 a	100.00 a	3216.5 a
Untreated (Rutgers Devotion DMR, resistant)	37.5 bc	100.0 a	100.0 a	1.00 b	1.64 b	1.38 b	44.9 b
Sil-Matrix 1% v/v (1-13)	50.0 b	100.0 a	100.0 a	1.00 b	1.44 b	2.61 b	49.1 b
OSO 5% SC 6.5 fl oz/A (1-13)	31.3 bc	37.5 ab	81.6 a	1.00 b	0.97 bc	2.47 b	41.2 b
Stargus 4 qt/A (1,3,5,7,9,11,13)	28.1 bc	89.8 ab	96.8 a	0.56 b	1.35 bc	2.01 b	39.2 b
Zinkicide 2 qt/A (1,3,5,7,9,11,13)	15.6 bc	89.8 ab	100.0 a	0.56 b	1.15 bc	1.98 b	29.1 b
SP2700 4 fl oz/A (1,3,5,7,9,11,13)	18.8 bc	85.9 ab	86.6 a	0.56 b	1.22 bc	1.30 b	27.9 b
Magna-Bon CS 2500 0.105 % v/v (1-13)	12.5 c	25.0 b	67.7 a	0.56 b	0.50 bc	1.83 b	11.9 b
LifeGard 2 oz/A (1,2,3,4,6,8,10,12) Sil-Matrix 1% v/v (1,2,3,4,6,8,10,12) Magna-Bon CS 2500 0.105 %v/v (7,9,11,13)	6.3 c	40.5 ab	65.0 a	0.25 b	0.93 bc	1.20 b	29.2 b
LifeGard 2 oz/A (1,2,3,4,6,8,10,12) Kocide 3000-O 0.75 lb/A (1,2,3,4,6,8,10,12) Magna-Bon CS 2500 0.105 %v/v (7,9,11,13)	18.8 bc	25.4 b	55.4 a	0.25 b	0.18 c	1.83 b	16.9 b
P-value (treatment)	<0.0001	0.0004	0.1317	<0.0001	<0.0001	<0.0001	<0.0001

[z] Numbers in each column with a letter in common are not significantly different from each other (Tukey's HSD, P=0.05).

[y] Rate of formulated product. Application dates were 1=30 Jul, 2=2 Aug, 3=8 Aug, 4=12 Aug, 5=16 Aug, 6=20 Aug, 7=23 Aug, 8=27 Aug, 9=30 Aug, 10=4 Sep, 11=10 Sep, 12=17 Sep, 13=24 Sep.

[x] Values were square root transformed before analysis because raw data were not distributed normally. Table contains de-transformed values.