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

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Evaluation of organic and IPM conventional fungicide programs for downy mildew in a resistant sweet basil cultivar, 2022.

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. The main objectives were to evaluate an organic fungicide program applied on a preventive schedule and a conventional fungicide program applied on an IPM schedule (applications started after symptoms were found), with both implemented on a partially resistant cultivar (Rutgers Passion DMR). To determine if these treatments were effective, they were compared to susceptible and resistant cultivars left untreated and treated with a similar conventional fungicide program on the recommended preventive schedule. An experimental organic fungicide (M-306) was also tested. A sweet basil cultivar bred to be resistant to downy mildew, Rutgers Passion DMR, and a susceptible cultivar, DiGenova, were 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 12 Apr. 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 5 Jul. Beds were formed with drip tape and covered with black plastic mulch on 7 Jul. Weeds between mulched beds were managed by 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 7 Jun. All plants were placed outdoors to harden for a few days and then transplanted in the field by hand on 11 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. Treatments were applied nine times on a 7-day schedule beginning on 22 Jul, with a backpack CO_2-pressurized sprayer and hand-held boom (R&D Sprayers, Opelousas, LA) with TJ60-4004EVS nozzle(s) operated at 55 psi and 2.35 mph. Applications 1-4 were made using a boom with a single nozzle delivering 29.9 gal/A. Starting with application 5, 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 77.6 gal/A. Downy mildew was assessed in each plot weekly from 27 Jul through 20 Sep. Incidence of plants with symptoms (yellowing in vein-delimited bands) was recorded and percentage of leaves per plant with symptoms was estimated for each plant in each plot. Sporulation of the pathogen was usually visible on the underside of leaves, especially when humidity the previous night was high to promote their formation. Area under disease progress curve (AUDPC) values were calculated from 3 Aug to 20 Sep 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. Defoliation, which was mostly due to downy mildew, was assessed on 7, 12, and 20 Sep. 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 85.3 and 68.9 in Jul, 85.4 and 68.7 in Aug, and 76.3 and 60.3 in Sep. Rainfall (in.) was 4.1, 2.0, and 4.3 for these months, respectively.

Symptoms of downy mildew were first observed at LIHREC on 27 Jul in one untreated DiGenova plot in this experiment. On 3 Aug, 3 of the 28 plots had symptoms (all untreated DiGenova). On 8 Aug symptoms were first found on Rutgers Passion DMR in 3 of the 20 plots. The conventional fungicide program applied on a preventive schedule to the susceptible cultivar provided 66% control based on AUDPC values. The resistant cultivar provided a greater degree of suppression than expected (96%) which was significantly better than chemical control. Consequently, there was no opportunity to improve control with fungicide. Numerically the best control was achieved with the conventional fungicide program applied on a preventive schedule (9 applications). Second best was this same program on an IPM schedule (4 applications). Defoliation reflected incidence of downy mildew. No phytotoxicity was observed. Photographs are posted at https://blogs.cornell.edu/livegpath/research/basil-downy-mildew/evaluation-of-a-conventional-fungicide-program-applied-on-an-ipm-or-preventive-schedule-for-managing-downy-mildew-in-a-susceptible-or-resistant-sweet-basil-variety-2022/.

Cultivar	Treatment and rate (application dates) [y]	Downy mildew incidence (%) [z]						Defoliation (%) [z]
		Affected plants		Affected leaves on affected plants				
		31 Aug	12 Sep	23 Aug [x]	31 Aug	12 Sep	AUDPC [x]	12 Sep
DiGenova	Untreated control	100 a	100 a	47.0 a	92.5 a	99.0 a	2822 a	99 a
DiGenova	Ranman 3 fl oz + K-Phite 1 qt (1, 4, 7) [v]; Presidio 4 fl oz + K-Phite 1 qt (2, 5, 8) [v]; Orondis Ultra 8 fl oz (3, 6, 9) [v]	100 a	100 a	9.5 b	34.2 b	42.9 b	949 b	33 b
Passion	Untreated control	46 ab	92 a	0.2 bc	0.6 c	7.8 c	98 c	3 c
Passion	M-306 20 fl oz (1-9) [w]	96 ab	96 a	0.2 bc	1.2 c	6.4 c	83 c	4 c
Passion	Stargus 87 fl oz + Regalia 63 fl oz (1, 3, 5, 7, 9); EcoSwing 1 qt + Badge X2 0.75 lb (2, 4, 6, 8)	55 ab	100 a	0.0 c	0.9 c	5.9 c	65 c	4 c
Passion	Orondis Ultra 8 fl oz (6, 9) [v]; Ranman 3 fl oz + K-Phite 1 qt (7) [v]; Presidio 4 fl oz + K-Phite 1 qt (8) [v]	81 ab	49 b	0.5 bc	1.1 c	1.7 c	32 c	2 c
Passion	Ranman 3 fl oz + K-Phite 1 qt (1, 4, 7) [v]; Presidio 4 fl oz + K-Phite 1 qt (2, 5, 8) [v]; Orondis Ultra 8 fl oz (3, 6, 9) [v]	41 b	19 b	0.0 c	0.8 c	0.3 c	15 c	1 c
P-value (treatment)		0.0059	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

[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] Rate of formulated product/A. Application dates were 1=22 Jul, 2=29 Jul, 3=4 Aug, 4=9 Aug, 5=18 Aug, 6=25 Aug, 7=1 Sep, 8=8 Sep, and 9=14 Sep.

[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.

[v] Treatment applied with the nonionic surfactant Induce at 0.125% v/v.