

Evaluation of biopesticides and an organic copper fungicide for downy mildew in sweet basil, 2016.

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 objective was to evaluate products approved for organic production in the U.S. (Cueva, Double Nickel, and Procidic) and products being developed for this use (Forticept Agro, Howler, and Milagram). Fertilizer (N-P-K, 10-10-10) at 1000 lb/A (100 lb/A of nitrogen) was broadcast over the bed area and incorporated on 7 Jul. Beds were formed, drip irrigation tape was laid, and beds were covered with black plastic mulch on 7 Jul. Weeds between mulch strips were managed early in the season with Devrinol DF-XT (2 lb/A) applied before transplanting and afterwards by cultivation and hand-weeding. A waterwheel transplanter was used to make planting holes in the beds and apply starter fertilizer. Basil was seeded on 20 Jun in trays in a greenhouse, placed outdoors to harden for about a week, then transplanted by hand on 21 Jul. Basil was planted late in the season since downy mildew incidence is more prevalent during that time and would increase the likelihood of disease development during the experiment. The primary source of initial inoculum in this area is considered to be long-distance wind-dispersed spores from infected plants. Additionally, to provide a source of natural inoculum within the experimental area, a row of non-fungicide-treated basil plants that extended the length of this experiment was transplanted on 11 Jul. These plants were not inoculated. A randomized complete block design with four replications was used. Each plot had 10 plants in 8-ft rows with 9-in. in-row plant spacing. The plots were 4 ft apart in the row. Foliar treatment applications were made with a CO₂-pressurized backpack sprayer using a boom with a single twin-jet nozzle (TJ60-4004evs) delivering 50 gal/A at 55 psi and 2 mph on 22 Jul, 28 Jul, and 4 Aug when basil plants were small. A boom with three twin-jet nozzles (TJ60-8006vs), one delivering spray over the top of the plant plus a drop nozzle directed to each side, delivering 82 gal/A, was used on 11, 18, 25, and 31 Aug. Downy mildew was assessed in each plot on 1, 15, and 22 Aug. Incidence of plants with symptoms (sporulation of the pathogen visible on the underside of leaves) and percentage of leaves per plant with symptoms was estimated for 10 plants in each plot. These two values were multiplied together to calculate incidence of symptomatic leaves in the plot. Percent of leaves that had dropped off of plants because of downy mildew were estimated on 2 Sep. Average monthly high and low temperatures (°F) were 86/70 in Jul, 86/71 in Aug, and 77/61 in Sep. Rainfall (in.) was 2.93, 2.19, and 3.23 for these months, respectively.

Downy mildew developed naturally and became severe as is typical for the area. Symptoms were first observed on 15 Aug in 14 of the 44 plots. On 22 Aug, symptoms were observed in all plots. Initially incidence of symptomatic leaves was very low. Downy mildew increased substantially by the next assessment on 2 Sep resulting in substantial defoliation in most plots. From 15 Aug through 2 Sep during the dark overnight period relative humidity was at least 85% for at least 9 consecutive hours for 14 of the 18 nights. There were three rain events: 20 Aug (1.36 in.), 22 Aug (0.56 in.), and 1 Sep (0.72 in.). None of the treatments tested in this experiment were distinguishable from the untreated control until the last assessment on 2 Sep. Among the fungicides tested for organic production, only one, the copper fungicide Cueva, was able to provide detectable control of downy mildew compared to the untreated control, and only moderately so, providing 44% control compared to the 96% control provided by the conventional grower standard treatment of Ranman alternated with Revus. This treatment was included partly to provide an assessment of control potential with the application timing. Interestingly, adding the biological fungicide Howler to the grower standard rotation of Ranman and Revus provided statistically similar control compared to the standard rotation of Ranman and Revus despite applying these on a 14-day interval, although the rotation with Howler was numerically less effective, providing 58% control compared to 96% control with the standard rotation. Results from this experiment add to previous results documenting that it is difficult to manage downy mildew organically in basil.

Treatment and rate/A (application dates) ^y	Incidence (% symptomatic plants) ^z		Incidence (% symptomatic leaves on affected plants) ^z		Incidence (% symptomatic leaves in plot) ^z		Defoliation (%) ^z
	15 Aug	22 Aug	15 Aug	22 Aug	15 Aug	22 Aug	2 Sep
Untreated control	15.0	77.5	0.44	3.55	0.28	2.54	68.8 a
Double Nickel 55 WDG 3 lb (1-7)	10.0	45.0	0.56	2.63	0.10	1.20	52.5 abc
Procidic 20 oz (1-7)	12.5	87.5	0.29	5.06	0.15	4.80	72.5 a
Procidic 40 oz (1-7)	2.5	74.4	0.38	3.04	0.15	2.34	66.2 ab
Milagrum Plus 40 oz (1-7)	5.0	65.0	0.25	4.80	0.20	4.13	51.2 abc
Forticept Agro 0.66 %v/v (1-7)	0.0	75.0	0.00	3.06	0.00	2.55	65.0 ab
Howler 5 g/L (1-7) ^w	7.5	70.0	0.31	3.56	0.10	2.55	63.8 ab
Howler 7.5 g/L (1-7) ^w	5.0	80.0	0.06	4.18	0.05	3.60	63.8 ab
Howler 5 g/L (1,3,5,7) ^w							
Ranman 400SC 3 oz (2,6) ^v		62.5	0.00	2.96	0.00	2.00	28.8 cd
Revus 250SC 8 oz (4) ^v	0.0						
Cueva 0.16F 4 qt (1-7)	13.3	52.5	0.35	2.45	0.19	1.95	38.8 bc
Ranman 400SC 3 oz (1,3,5,7) ^v							
Revus 250SC 8 oz (2,4,6) ^v	0.0	62.5	0.00	1.88	0.00	1.23	3.0 d
<i>P-value (treatment)</i>	0.208	0.693	0.514	0.596	0.611	0.503	<0.0001

^z Numbers in each column with a letter in common or no letter are not significantly different from each other (Tukey's HSD, P=0.05).

^y Rate of formulated product/A. Application dates were 1=21 Jul, 2=28 Jul, 3=4 Aug, 4=11 Aug, 5=18 Aug, 6=25 Aug, and 7=31 Aug.

^x Some data was square root transformed before analysis. Table contains de-transformed means.

^w Capsil (non-ionic surfactant) included at 0.125% with every application

^v Induce (non-ionic surfactant) included at 0.125% with every application.