PUMPKIN (*Cucurbita pepo* 'Wizard')
Powdery mildew; *Sphaerotheca fuliginea*

(138)

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EVALUATION OF FUNGICIDE PROGRAMS INITIATED AFTER DISEASE DETECTION FOR MANAGING POWDERY MILDEW OF PUMPKIN, 1996 A field experiment was conducted at the Long Island Horticultural Research Laboratory in Riverhead, NY, on Haven loam soil. The objectives were: 1) to monitor resistance to triadimefon and to benomyl, the active ingredients in Reach and Benlate, respectively, 2) to evaluate four fungicide programs with Reach and Benlate, and 3) to test new fungicides. All treatments were started after detecting powdery mildew, which was shown previously to be as effective as using a preventive schedule (F&N Tests 47:124). Fertilizer (1000 lb/A of 10-10-10, N-P_2O_5-K_2O) was broadcast and incorporated on 17 Jun. Pumpkin seed were planted on 27 Jun at 24-in. within row plant spacing and 68-in. between row spacing. Plots were thinned by hand to obtain 64 plants in four 35-ft rows. Plants were sidedressed with ammonium nitrate at a rate of 30 lb N/A on 8 Aug. To manage Phytophthora fruit and crown rot, Ridomil 2E (2 qt/A) was broadcast over the entire field on 19 Jun then incorporated and soil drainage was improved by subsoiling between rows on 22 Jul and rototilling driveways. Weeds were controlled by applying herbicides, mechanically cultivating and hand-weeding. Command (5 oz/A) was applied and lightly incorporated on 26 Jun. Curbit EC (1 qt /treated A) was applied in a 10-inch band over the planted rows on 27 Jun. Cucumber beetles and aphids were managed by applying the following insecticides: Admire EC (10 oz/treated A) in a 10-inch band over the planted rows on 2 Jul, Metasystox R (1 qt/A) on 23 Aug, and Lannate LV (3 pt/A) on 1 Sep. Downy mildew was managed by applying Ridomil 2E (1 pt/A) on 3 and 26 Sep and Aliette 80WDG (3 lb/A) on 6 and 26 Sep. Average monthly high and low temperatures (F) were 80/60 in Jun, 80/63 in Jul, 82/63 in Aug, and 75/58 in Sep. Rainfall (in.) was 2.94, 4.78, 2.8, and 4.74 for these months, respectively. The field was irrigated (approx. 1.0 in.) on 11 Jul and 9-10 Aug. Treatments were applied on 16, 23, 30 Aug; 5 and 15 Sep with a tractor-mounted boom sprayer equipped with ALBUZ lilac ceramic hollow cone nozzles spaced 11 in. apart that delivered 71 gal/A at about 250 psi. A randomized complete block design with 4 replications was used. Upper and lower (under) surfaces of 21-50 leaves in each plot were examined weekly for powdery mildew beginning on 6 Aug. Initially, 50 older leaves were examined in each plot. Young and mid-aged leaves were also examined beginning on 29 Aug. Powdery mildew colonies were counted; severity was assessed when colonies could not be counted accurately because they had coalesced and/or were too numerous. Average severity for the entire canopy was calculated from the individual leaf assessments. Two procedures were used to assess fungicide resistance. Fungicide-treated leaf disks (Plant Dis. 80:633-639) were used for isolates collected from nontreated pumpkin plots on 20 Aug (this was a few days before it would be possible to detect any impact of the 16 Aug fungicide application on the frequency of resistant isolates in the fungal population) and isolates collected from treated and nontreated plots on 19 Sep. A seedling assay was tested to evaluate its ability to provide data on fungicide resistance before powdery mildew developed in this experiment. Greenhouse-grown squash seedlings were dipped in 50 ppm triadimefon or 200 ppm benomyl on 6 Aug, then put with nontreated seedlings next to field-grown squash with powdery mildew in an experiment adjacent to the pumpkin experiment. Seedlings were returned to the greenhouse 3 days later. Defoliation, due primarily to downy mildew, was assessed on 19 Sep. Fruit diameter and handle (peduncle) condition were determined for 12 representative fruit per plot on 3 Oct.

Isolates resistant to triadimefon and to benomyl were found prior to treatment. The frequency of resistant isolates in the adjacent squash experiment was 43% for triadimefon and 29% for benomyl, based on the number of colonies on the treated and nontreated seedlings. In this experiment, 48% of the 25 isolates tested were resistant to both fungicides, 4% were resistant to just triadimefon, and the rest were fungicide sensitive. Thus the seedling assay could be a useful tool in an IPM program for pumpkin and other main season cucurbit crops by providing information quickly and inexpensively on resistance before treatment was needed. Since 12 of the 13 resistant isolates (92%) were resistant to both fungicides, using either material would be expected to increase resistance to both. Reach or Benlate applied on 16 Aug, one day after mildew was first observed, provided some disease suppression: compared with the control, mildew was significantly less severe on lower leaf surfaces on 29 Aug. Additional applications did not appear to be effective since none of the 4 treatments with these fungicides had significantly less mildew on lower surfaces on 11 Sep; however, 3 of these treatments had significantly smaller AUDPC values for lower leaf surfaces than the control. The Bravo component of these treatments was not expected to contribute much to control on lower surfaces because spray coverage here was poor as revealed by water-sensitive paper. The frequency of isolates collected on 19 Sep that were resistant to Bayleton was 56%, 66%, 76%, and 100% for nontreated, treated twice with Reach, treated once with Reach and Benlate, and treated twice with Reach and Benlate, respectively. The frequency of isolates resistant to Benlate was 31%, 65%, 66%, and 100%, respectively. Procure, BAS 490, and BWC 010 applied 3 times were quite effective. BAS 114 was not as effective on lower leaf surfaces because it isn't systemic. Nontreated pumpkins and pumpkins treated with Procure or BAS 490 had significantly more defoliation due to downy mildew than pumpkins treated with BWC 0100 or Bravo. Nontreated pumpkins and pumpkins treated with Procure at 4 or 6 oz/A had significantly fewer fruit with good solid handles than pumpkins treated with Bravo or with the BASF materials. There were no significant differences in fruit size.

(continued)

Treatment and rate/A (application time [3])	Powdery mildew severity (% leaf coverage)						Defoliation [2] (%)	Fruit handle condition (% solid)
	upper leaf surface [1]			lower leaf surface [1]				
	29 Aug	11 Sep	AUDPC	29 Aug	11 Sep	AUDPC	19 Sep	3 Oct
Nontreated Control	2.72 a[4]	0.87 a	28.5 a	3.69 a	3.57 ab	54.7 a	73.8 a	35.4 d
Reach F 4.25 pt/A (1,3) + Bravo Ultrex 2.7 lb/A (2,4,5)	0.00 b	0.11 b	0.4 c	0.26 c	3.08 ab	14.2 bcd	26.2 e	83.3 a
Reach F 4.25 pt/A (1) + Benlate 50WP 8 oz/A (3) + Bravo Ultrex 2.7 lb/A (2,3,4,5)	0.01 b	0.13 b	0.5 c	0.86 bc	2.08 bc	18.6 bc	35.0 de	93.8 a
Benlate 50WP 8 oz/A (1) + Reach F 4.25 pt/A (3) + Bravo Ultrex 2.7 lb/A (1,2,4,5)	0.02 b	0.18 b	1.0 bc	0.83 bc	4.57 a	24.3 ab	33.8 de	83.3 a
Benlate 50WP 8 oz/A (1,3) + Reach F 4.25 pt/A (2,4) + Bravo Ultrex 2.7 lb/A (1,3,5)	0.01 b	0.05 b	0.3 c	0.16 c	1.90 bc	8.8 cde	32.5 de	91.7 a
Procure 50WP 4 oz/A (1,3,5)	0.23 b	0.11 b	2.1 bc	0.26 c	0.98 cd	6.4 de	56.2 bc	50.0 cd
Procure 50WP 6 oz/A (1,3,5)	0.03 b	0.03 b	0.4 c	0.12 c	0.50 d	3.1 e	62.5 ab	60.4 bc
Procure 50WP 8 oz/A (1,3,5)	0.20 b[5]	0.04 b	1.6 bc[5]	0.36 c[5]	0.43 d	3.8 e[5]	61.3 ab	77.1 ab
BAS 490 02 F 50WG 2.4 oz/A (1,3,5)	0.02 b	0.00 b	0.4 c	0.09 c	0.60 d	3.1 e	57.5 bc	91.7 a
BWC 010 00 F 2.4 oz/A (1,3,5)	0.27 b	0.15 b	3.2 b	0.39 c	1.10 cd	7.6 cde	36.2 de	91.7 a
BAS 114 UBF 0.5% (1-5)	0.38 b[6]	0.04 b	2.4 bc[6]	2.24 ab[6]	2.97 ab	31.8 ab[6]	43.8 cd	91.7 a
P-value	.0006	.0004	.0001	.0003	.0001	.0001	.0001	.0001

[1] Exact colony counts were made when possible and severity was estimated using the conversion factor of 30 colonies/leaf = 1%. A logarithmic transformation was used to stabilize variance.
[2] Defoliation due primarily to downy mildew.
[3] Application times were: 1=16 Aug, 2=23 Aug, 3=30 Aug, 4=5 Sep, and 5=15 Sep.
[4] Numbers in a column with a letter in common are not significantly different according to Fisher's Protected LSD (P=0.05).
[5] Values are high primarily because one plot, located next to nontreated squash in another experiment, had unusually high severity ratings on 29 Aug. If this plot is excluded, these values would be 0.11, 0.9, 0.03, and 2.7, respectively.
[6] Values are high primarily because one plot, located next to nontreated squash in another experiment, had unusually high severity ratings on 29 Aug. If this plot is excluded, these values would be 0.05, 0.8, 1.21, and 20.8, respectively.