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

(141)

M. T. McGrath
Department of Plant Pathology
Cornell University, LIHRL
39 Sound Avenue, Riverhead, NY 11901

EVALUATION OF FULL-SEASON AND REDUCED-SPRAYS FUNGICIDE PROGRAMS INITIATED AFTER DISEASE DETECTION FOR MANAGING POWDERY MILDEW OF PUMPKIN, 1994: A field experiment was conducted at the Long Island Horticultural Research Laboratory in Riverhead, NY, on Haven loam soil. On 23 May 1000 lb/A of 10-10-10 fertilizer was broadcast and incorporated. Pumpkin seed were planted on 15 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 21 Jul. Weeds were controlled by applying Command 4EC at 8 oz/treated A in a 12-in. band over the row on 15 Jun before planting, mechanically cultivating and hand-weeding. Cucumber beetles and aphids were managed by applying the following insecticides: Asana (9.6 oz/A) on 7 Jul, Sevin 80S (1.5 lb/A) on 22 Jul, and Lannate (1 lb/A) on 29 Jul. To suppress downy mildew, Aliette 80 WP (5 lb/A) plus potassium carbonate (3 lb/A) were applied on 19 Aug and Ridomil 2E (1 pt/A) was applied on 25 Aug. Average monthly high and low temperatures (F) and total rainfall (in.) were 84, 60, and 0.19 in Jun; 88, 67, and 0.7 in Jul; 81.5, 60.5, and 7.26 in Aug; and 75.5, 55.5, and 3.76 in Sep, respectively. The field was irrigated (1.0 in.) 6 times on 15 Jun; 28 - 29 Jun; 11, 13, and 14 Jul; 19-20 Jul; 25-27 Jul; and 10-11 Aug (several days were required to move pipe across the field). All fungicide programs evaluated were started after detecting powdery mildew by scouting. The decision criteria used to initiate fungicide applications was 1 leaf out of 50 leaves with powdery mildew. Using this threshold to initiate fungicide programs was shown previously to be as effective as using a preventive schedule. All fungicide programs consisted of a broad-spectrum contact fungicide (chlorothalonil, formulated as Bravo 825 or formulated with triadimefon as Reach) plus a narrow-spectrum systemic fungicide (propiconazole, formulated as Tilt, or triadimefon, formulated as Reach). For the full-season programs, the systemic fungicide was applied 4 times on a 14-day schedule and the contact fungicide was applied 7 times on a 7-day schedule. Several reduced-sprays programs were included for comparison with the full-season programs: 1) Reach applied 4 times on a 14-day schedule without Bravo applied on alternate weeks to assess the benefit of a 7-day spray schedule, 2) Reach or Tilt applied twice early in the epidemic to determine if there is an additional benefit of applying these systemic fungicides two more times, 3) Reach applied once after disease detection, 4) Reach applied twice plus Bravo applied twice to assess the benefit of fungicides applied during the second half of the epidemic, and 5) Tilt applied alone to determine the value of including Bravo. Treatments were applied on 7 dates (2, 9, 17, 24, 30 Aug; and 7, 14 Sep) with a tractor-mounted boom sprayer equipped with no. 3 hollow cone nozzles that delivered 40 gal/A at 68 psi. A randomized complete block design with 4 replications was used. Upper and lower (under) leaf surfaces in each plot were examined weekly for powdery mildew beginning on 27 Jul. Initially, 50 of the older leaves were examined in each plot. Young and mid-aged leaves were also examined beginning on 16 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. Severity and AUDPC data were transformed by natural log transformation where necessary to obtain constant variance before subjection to analysis of variance. Sensitivity to triadimefon, which is one of the active ingredients in Reach, was determined using fungicide-treated cotyledon disks for isolates collected on 6 Aug from non-fungicide-treated plots and on 19 Aug from plots treated once with Reach.

All nine fungicide programs provided some suppression of powdery mildew as compared with the control group. Although conditions were favorable for disease development, these nontreated plants were less severely infected than nontreated plants of Spirit in previous experiments (Fungicide & Nematicide Tests 47:124, 48:173, 49:142). Wizard was less susceptible when these varieties were compared in 1993 in OH (Biological & Cultural Tests 9:41). There tended to be more disease in one section of the field that cut across replications, resulting in more variation between plots for some treatments than in previous experiments. The plants in this section did not grow as well as in the other sections probably due to lower soil moisture. The best disease control was obtained with the full-season program of Tilt plus Bravo. Powdery mildew severity on lower leaf surfaces was significantly higher for the Tilt reduced-sprays programs than the full-season program on 6 Sep, 20 days after the second Tilt application. Tilt applied alone suppressed powdery mildew well; indicating that a 14-day application schedule may be sufficient for controlling this disease. However, downy mildew was more of a problem in these plots than in plots treated with chlorothalonil. Applying a broad-spectrum fungicide such as chlorothalonil with Tilt is also an antiresistance strategy. Tilt caused minor puckering of a small proportion of treated leaves (less than 5%); however, this growth regulator effect was not perceived to be a problem. There were no consistent differences between the two formulations of Reach when all treatments with Reach F are considered. The reduced-sprays programs with Reach were as effective as the full-season programs; however, none of the programs with Reach provided adequate suppression of powdery mildew on lower leaf surfaces. Triadimefon-resistant isolates were common at the start of the epidemic: 12 of 26 isolates collected on 6 Aug from non-fungicide-treated leaves were able to tolerate 50 ppm. In sharp contrast, no resistant isolates were detected before treatment in 1991, 1992, or 1993. Despite this level of resistance, the first application of Reach on 2 Aug was effective since there was significantly less powdery mildew on lower surfaces of fungicide-treated leaves compared with nontreated leaves on 16 Aug. This disease suppression was not due to Bravo because this fungicide was shown previously to be ineffective on lower leaf surfaces when applied with the sprayer used in this experiment. Only resistant isolates were detected following just one application of Reach, indicating that selection for resistance occurred rapidly. Not surprisingly, there were no significant differences amongst the treatments with 1, 2, or 4 applications of Reach. Development of resistance to triadimefon is the most likely explanation for greater disease severity on lower leaf surfaces of plants treated with Reach than those treated with Tilt beginning with the assessment on 24 Aug, which was 7 days after the second application of the systemic fungicides. The triadimefon-resistant isolates appeared to be sensitive to propiconazole. However, powdery mildew development on lower leaf surfaces was not being suppressed by Tilt in mid-Sep. The average severities for the plots evaluated on 16 Sep, which was two days after the fourth application of Tilt, were 2%/21% and 1%/37% for upper/lower surfaces of leaves treated four times with Tilt and Reach, respectively, plus Bravo.

(cont.)

Treatment and rate/A (application time [2])	Powdery mildew severity (% leaf coverage)					
	upper leaf surface [1]			lower leaf surface [1]		
	16 Aug	29 Aug	6 Sep	16 Aug	24 Aug	6 Sep
Control (No Fungicide)	4.6 b [3]	10.2 b	3.1 a [5]	5.7 c	22.1 d	13.7 bc [5]
Reach SDG 4 lb (1,3,5,7) + Bravo 825 2.7 lb (2,4,6)	.9 a	.7 a	.6 a	1.5 ab	11.9 cd	19.2 cd
Reach F 4.25 pt (1,3,5,7) + Bravo 825 2.7 lb (2,4,6)	.7 a	1.3 a	1.4 a	4.2 c [4]	16.6 cd	32.2 d
Reach F 4.25 pt (1,3,5,7)	.6 a	1.0 a	1.8 a	.8 ab	4.4 b	18.5 cd
Reach F 4.25 pt (1,3) + Bravo 825 2.7 lb (2,4,5,6,7)	.5 a	.7 a	2.2 a	.6 ab	8.4 bc	28.2 d
Reach F 4.25 pt (1) + Bravo 825 2.7 lb (2-7)	.7 a	.9 a	1.7 a	.7 ab	12.0 cd	23.0 cd
Reach F 4.25 pt (1,3) + Bravo 825 2.7 lb (2,4)	.4 a	1.2 a	3.0 a	.6 ab	11.2 cd	28.7 d
Tilt 41.8 GL 4 oz (1,3,5,7) + Bravo 825 2.7 lb (1-7)	.3 a	.5 a	.2 a	.2 a	.6 a	3.0 a
Tilt 41.8 GL 4 oz (1,3) + Bravo 825 2.7 lb (1-7)	.3 a	.7 a	.7 a	.4 ab	.4 a	8.0 b
Tilt 41.8 GL 4 oz (1,3,5,7)	.5 a	.4 a	.1 a	.7 ab	.5 a	1.6 a
P-value	.0002	.0001	.2958	.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 natural logarithmic transformation was used when necessary to stabilize variance. This table contains de-transformed means.
[2] Application times were: 1=2 Aug, 2=9 Aug, 3=17 Aug, 4=24 Aug, 5=30 Aug, 6=7 Sep, and 7=14 Sep.
[3] Numbers in a column with a letter in common are not significantly different according to Fisher's Protected LSD (P=0.05).
[4] This unexpectantly high value is partially due to one plot; it would be 2.6 without this data point.
[5] The severity ratings for the control group during Sep were low because many leaves had senesced prematurely.