

EFFICACY OF FUNGICIDES APPLIED PREVENTIVELY OR FOLLOWING DISEASE DETECTION FOR MANAGING POWDERY MILDEW OF PUMPKIN, 1993: A field experiment was conducted at the Long Island Horticultural Research Laboratory in Riverhead, NY, on Riverhead sandy loam soil. The field was fumigated with Busan 1020 (60 gal/A) on 8 Jun. On 23 Jun 1000 lb/A of 10-10-10 fertilizer was broadcast and incorporated. Pumpkin seed were planted on 24 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. Weeds were controlled by applying Amiben 2S at 1.5 pt/treated A in a 12-in. band over the row immediately after planting, mechanically cultivating and hand-weeding. Cucumber beetles and aphids were managed by applying the following insecticides: Metasystox-R 2SC (2 pt/A) on 6 Aug, Phosdrin 4EC (1 pt/A) on 26 Jul, Sevin 4F (1 qt/A) on 15 Jul, and Thiodan 3EC (2 pt/A) on 15 Jul and 20 Aug. Average monthly high and low temperatures (F) and total rainfall (in.) were 80, 58, and 2.42 in Jun; 81, 63, and 3.45 in Jul; 80, 62, and 6.92 in Aug; and 76, 57, and 7.61 in Sep, respectively. The field was irrigated (0.5-1.0 in.) 5 times on 29 Jun - 2 Jul; 8, 9, and 12 Jul; 22-23 Jul; 23-25 Aug, and 30 Aug-1 Sep (several days were required to move pipe across the field). The goals of this study were: 1) to compare Nova and Tilt, two systemic mildicides that are not registered for use on cucurbits in the U.S., with Omni, a new prepackaged mix of Bravo and Bayleton, the predominant mildicide used commercially; 2) to further evaluate an action threshold established in 1989 for initiating fungicide applications after disease detection within an IPM context; and 3) to determine the effect of 1, 2 and 3 applications of Omni. The decision criteria used to initiate fungicide applications was 1 leaf out of 50 leaves with powdery mildew. This threshold (Threshold 1) was evaluated by including the following treatment groups in the experiment: 1) Omni applied on a preventive schedule, 2) Omni applied beginning 1 week after treatment was initiated in response to Threshold 1 (Threshold 2), and 3) Omni applied beginning 2 weeks after treatment was initiated in response to Threshold 1 (Threshold 3). Threshold 1 was used to initiate the other six fungicide treatments. Treatments were applied on 6 dates (1, 9, 12, 20, 27 Aug; and 4 Sep) with a tractor-mounted boom sprayer equipped with no. 3 hollow cone nozzles that delivered 40 gal/A at 68 psi. The final application scheduled for mid-Sep could not be made because of equipment failure. Consequently, the maximum number of Omni applications that could be made after Threshold 1 was 2 instead of 3. Applications were started on 12, 20 and 27 Aug for treatments using Thresholds 1, 2 and 3, respectively. 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 11 Aug. Initially, 50 of the older leaves were examined in each plot. Young and mid-aged leaves were also examined beginning on 26 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. Severity and AUDPC data were transformed by natural log transformation where necessary to obtain constant variance before subjection to analysis of variance. Sensitivities to the active ingredients in Bayleton, Benlate, Nova and Tilt were determined using fungicide-treated cotyledon disks for isolates collected before fungicide treatment on 11 Aug and afterwards on 1 and 20 Sep. Fruit were counted, weighed, and evaluated in mid-Oct.

The 1993 growing season was unusually hot and dry; consequently, plants grew slowly during Jul and the onset of powdery mildew was delayed compared with previous years. However, disease development was rapid following onset and non-fungicide-treated control plants were severely infected by early Sep. All 9 fungicide treatment groups controlled this disease as compared with the control group, especially on upper leaf surfaces. Effective management was achieved by using an IPM approach to initiate fungicide applications after reaching Threshold 1. Powdery mildew severity exceeded Threshold 1 considerably one day before the first fungicide application because of rapid initial disease development: an average of 7.7 colonies/older leaf were found on 11 Aug. Waiting 1 or 2 weeks to begin applying Omni (Threshold 2 and 3, respectively) did not provide as good disease suppression, especially on the lower leaf surface. On 19 Aug, 56 and 5.8 colonies/older leaf were found, respectively, in plots that had not been treated and plots that had been treated with Omni. There were no significant differences in disease severity on plants sprayed once or twice with Omni; however, powdery mildew was more severe on the lower leaf surface of plants sprayed once. Both Nova and Tilt applied in combination with Bravo were more effective than Omni. Fungicide usage apparently had an impact on fungicide sensitivity of the powdery mildew population based on the response of isolates collected on 11 Aug before fungicide treatment and on 1 and 20 Sep from fungicide-treated plants. The following is a list of fungicide concentrations and the proportion of these 3 groups of isolates (collected on 11 Aug, 1 and 20 Sep), respectively, for which this concentration was the highest one tolerated: Bayleton - 0 ppm a.i. (63%, 0%, 2%), 6.25 ppm (33%, 29%, 43%), 50 ppm (1%, 71%, 55%); Nova - 0 ppm (13%, 0%, 0%), 0.1 ppm (77%, 0%, 8%), 1 ppm (0%, 7%, 12%), 2 ppm (10%, 86%, 70%), 20 ppm (0%, 7%, 10%); Tilt - 0.01 ppm (3%, 0%, 0%), 0.05 ppm (77%, 7%, 3%), 0.5 ppm (20%, 93%, 56%), 5 ppm (0%, 0%, 41%). This shift to reduced fungicide sensitivity in the pathogen population appears to have had an impact on Bayleton efficacy but not on Nova or Tilt efficacy, based on powdery mildew severity on lower leaf surfaces. In contrast with previous years, no benomyl-resistant isolates were detected in 1993. There were no significant differences amongst treatments in number or total weight of fruit. However, the percentage of fruit with rotten handles and the percentage of fruit with poor color (yellow) was significantly higher for the control treatment.

Powdery mildew severity (% leaf coverage)

Treatment and rate/A (application time ²)	Schedule ³	upper leaf surface ¹			lower leaf surface ¹		
		26 Aug	2 Sep	AUDPC ⁴	26 Aug	2 Sep	AUDPC ⁴
Control (No Fungicide).....		12.6 b	40.4 b	225.9 c	14.3 d	55.7 e	293.0 f
Omni 4.25 pt (1,4,6) + Bravo 720 3 pt (2,5).....	P	0.0 a	0.0 a	0.4 a	0.5 b	16.0 cd	59.1 c
Omni 4.25 pt (3,5) + Bravo 720 3 pt (4,6).....	T1	0.0 a	0.0 a	0.6 a	0.7 b	14.7 c	56.8 c
Omni 4.25 pt (4,6) + Bravo 720 3 pt (5).....	T2	1.0 b	1.2 b	17.5 b	3.2 c	39.2 de	172.4 ef
Omni 4.25 pt (5) + Bravo 720 3 pt (6).....	T3	3.2 b	6.1 b	48.4 b	5.3 cd	26.8 cde	134.3 de
Omni 4.25 pt (3,5) + Bravo 720 3 pt (4,6).....	T1	0.0 a	0.0 a	0.8 a	1.0 b	12.8 c	53.5 c
Omni 4.25 pt (3) + Bravo 720 3 pt (4,5,6).....	T1	0.0 a	0.0 a	0.2 a	0.6 b	22.0 cde	81.4 cd
Nova 40WP 2 oz (3,5) + Bravo 720 3 pt (3,4,5,6).....	T1	0.0 a	0.0 a	0.5 a	0.1 a	0.3 b	1.6 a
Tilt 41.8 GL 4 oz (3,5) + Bravo 720 3 pt (3,4,5,6).....	T1	0.0 a	0.0 a	0.2 a	0.1 a	0.1 a	0.9 a
Tilt 41.8 GL 2 oz (3,5) + Bravo 720 2 pt (3,4,5,6).....	T1	0.0 a	0.0 a	0.3 a	0.1 a	0.5 b	4.2 b

Numbers in a column with a letter in common are not significantly different according to Fisher's Protected LSD (P=0.05).

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 to stabilize variance for all severity and AUDPC values. This table contains de-transformed means.

² Application times were: 1=1 Aug, 2=9 Aug, 3=12 Aug, 4=20 Aug, 5=27 Aug, and 6=4 Sep.

³ Application schedules were: P=preventive, T1=Threshold 1, T2=Threshold 2, and T3=Threshold 3.

⁴ AUDPC was calculated for severity from 11 Aug through 2 Sep.