PUMPKIN (*Cucurbita pepo* 'Appalachian')
Powdery mildew; *Podosphaera xanthii*

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Evaluation of copper fungicides for managing powdery mildew of pumpkin, 2005.

The objective of this study was to compare different formulations of copper fungicides in their ability to control powdery mildew on pumpkin. Several formulations of copper hydroxide as well as one basic copper sulfate fungicide (Cuprofix) were evaluated in this study. Additional treatments were JMS Stylet-oil (organic formulation), a mineral oil, used alone or mixed with various commonly-used fungicides to address grower concerns about phytotoxicity. A field experiment was conducted at the Long Island Horticultural Research and Extension Center on Haven loam soil. The field was plowed on 13 Apr and fertilizer (N-P-K 10-10-10) at 1000 lb/A was broadcast and incorporated on 10 May. Three rows of black plastic mulch 30 in. apart were laid on 11 May. Dutch white clover was broadcast-seeded between plastic strips as a living mulch to control weeds. During the season weeds were controlled with one application of Roundup Weathermax (32 fl oz/A) before transplanting, hand weeding, and mowing the clover living mulch before the pumpkin vines grew together. The established clover tolerated Roundup as expected. The insecticide Asana XL EC (9.6 fl oz/A) was applied for cucumber beetles on 15 Jul and 12 Aug. To manage Phytophthora blight (*Phytophthora capsici*) and downy mildew (*Pseudoperonospora cubensis*), Phostrol 6.69 EC (5 pt/A) was applied on 5 Aug, and Acrobat 50 WP (6.4 oz/A) was applied on 23 Jul, 12 Aug, 28 Aug, and 17 Sep. Downy mildew was also managed by applying Previcur Flex 66 F (1.2 pt/A) on 19 Aug and 10 Sep. These fungicides were selected because they were not expected to affect powdery mildew. Plots were three 12-ft rows spaced 68-in apart. Each row consisted of 3 plants each spaced 24 in. apart, 15 ft was left unplanted between plots. A randomized complete block design with four replications was used. Average monthly high and low temperatures (°F) were 81/61 in Jun, 84/67 in Jul, 85/69 in Aug, 79/62 in Sep, and 63/51 in Oct. Rainfall (in.) was 1.20, 1.36, 1.48, 3.46, and 20.32 for these months, respectively. All treatments were started on 28 Jul after the IPM threshold of one leaf of 50 old leaves examined with powdery mildew symptoms (Plant Dis. 80:910-916) was reached in 25 of the 32 plots. Treatments were applied weekly on 28 Jul, 4 Aug, 11 Aug, 18 Aug, and 25 Aug with a tractor-mounted boom sprayer equipped with D5-25 hollow cone nozzles spaced 17 in. apart that delivered 85 gal/A at 100 psi. Upper and lower surfaces of 50 leaves were examined weekly for powdery mildew beginning on 26 Jul when fruit were starting to enlarge. The examined leaves were selected from the oldest third of the foliage based on leaf appearance and position in the canopy. As disease progressed, the number of leaves examined was reduced to as few as 10 based on the incidence of affected leaves in a plot. Mid-aged and young 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. A square root transformation was used when needed prior to analysis to achieve homogeneity of variance. Canopy condition including defoliation was assessed on 24 Aug. Fruit quality was evaluated in terms of handle (peduncle) condition for mature fruit without rot on 15 Sep. Handles were considered good if they were green or brown, solid, and not rotting.

Powdery mildew was first observed on 26 Jul in 26 of 32 plots on 79 of 1600 older leaves examined. No significant differences were detected among five copper fungicides in terms of powdery mildew control on upper leaf surfaces (82–97% control based on AUDPC) or lower surfaces (29-51% control). JMS Stylet-oil was not as effective as expected based on results from previous experiments. It was less effective than Kocide DF for controlling powdery mildew on both upper and lower leaf surfaces based on AUDPC values. Additionally, JMS Stylet-oil was the only treatment that did not have significantly less defoliation on 24 Aug than the nontreated control. However, pumpkin treated with JMS Stylet-oil had a high percentage of fruit with good handles that was similar to pumpkin treated with copper fungicides and significantly greater than nontreated pumpkin. No phytotoxicity was observed when JMS Stylet-oil was tank-mixed with Bravo Ultrex, Quintec, Kocide 2000, Nova, or Microthiol Disperss.

Treatment and rate/A (application time)[y]	Powdery mildew disease severity (%)[z]						Defoliation	Good handles
	Upper leaf surface			Lower leaf surface				
	8-Aug	22-Aug	AUDPC	8-Aug	22-Aug	AUDPC	24-Aug	15-Sep
JMS Stylet-oil 5qt/100gal (1,2,3,4,5) + Bravo Ultrex 82.5 WG 2.7 lb (1) + Quintec 2.08 SC 4 floz (2) + Kocide 2000 DF 2 lb(3) + Nova 40 W 5 oz (4) + Microthiol Disperss 80 WP 4 lb (5)..	0.0	1.6 c[x]	10 c	0.0 c	20.9 c	128 d	16 d	98 ab
Kocide DF 2 lb (1-5) …….	0.1	2.7 c	13 c	0.3 bc	37.2 b	308 c	18 cd	91 b
Cuprofix Disperss DF 2.5 lb (1-5) ……	0.0	3.4 c	86 bc	0.2 bc	39.7 b	276 cd	25 cd	100 a
Kocide 2000 DF 2 lb (1-5) ……	0.1	3.5 c	25 bc	0.1 bc	48.9 b	357 bc	21 cd	96 ab
Champion WP 2 lb (1-5) ……..	0.1	5.1 c	42 bc	0.1 bc	38.5 b	321 bc	24 cd	96 ab
DPX GFJ52 1.5 lb (1-5) …..….....	0.1	4.0 c	30 bc	0.3 b	46.8 b	401 bc	29 bc	91 b
JMS Stylet-oil 5 qt/100gal (1-5) ……	0.0	14.8 b	125 b	0.0 bc	45.0 b	477 ab	39 ab	97 ab
Nontreated ……..….....	0.5	51.3 a	486 a	1.7 a	62.8 a	567 a	48 a	78 c
Treatment *P*-value	0.169	0.0001	0.0001	0.0008	0.0002	0.0007	0.0002	0.0012

[z] Exact colony counts were made when possible and severity was estimated using the conversion factor of 30 colonies/leaf = 1%. Severity data is for old leaves on 8 Aug and all leaves on 24 Aug.

[y] Rate of formulated product/A. All treatments were on an IPM schedule with threshold of 1 affected leaf out of 50 older leaves. Application dates were 1=28 Jul, 2=4 Aug, 3=11 Aug, 4=18 Aug and 5=25 Aug.

[x] Numbers followed by the same letter in each column are not statistically different from each other according to Fisher's Protected LSD, *P*=0.05).