M. T. McGrath and G. M. Fox Dept of Plant Pathology & Plant-Microbe Biology Cornell University, LIHREC 3059 Sound Avenue, Riverhead, NY 11901

Integrated programs with biopesticides and a resistant cultivar evaluated for powdery mildew in butternut squash, 2009.

The objective of this experiment was to evaluate on butternut squash integrated programs with two biopesticides, Organocide (5% sesame oil) and Milstop (85% potassium bicarbonate) that effectively controlled powdery mildew in experiments conducted previously with pumpkin. This experiment was part of a study that included two parallel, adjacent field experiments conducted with muskmelon and pumpkin. Biopesticides were evaluated alone and in integrated programs with powdery mildew-resistant cultivars and/or conventional, mobile fungicides (Quintec, Pristine, and Procure). The integrated programs evaluated consisted of biopesticides plus conventional fungicides applied on a 7-day spray interval to a susceptible cultivar and to a cultivar with resistance to powdery mildew. The experiment was conducted in a field with Haven loam soil. The field was plowed on 28 Apr and tilled on 14 May, 21 May, and 1 Jun. Fertilizer (500 lb/A of 10-20-20) was applied on 19 May. Black plastic mulch and drip tape were laid on 27 May. Additional fertilizer (N-P-K 46-0-0) at 30 lb/A was injected through the drip irrigation system on 21 Jul and 11 Aug. Water was provided as needed through drip irrigation. Seeds were hand-planted on 10 Jun into holes cut into the plastic. Plots consisted of 3, 12-ft rows of 5 plants each and were separated by 18 ft in the row. Plants within each plot were at 24-in. in-row spacing and rows were at 68-in. spacing. Weeds were controlled between plastic mulch strips by applying Strategy (3 pt/A) and Sandea (0.5 oz/A) on 3 Jun and hand weeding. Cucumber beetles were managed with Admire 2F applied after plant emergence as a soil drench around seedlings (0.0007 fl oz/plant) on 23 Jun and with Asana XL (9.6 oz/A) applied to foliage on 24 Jun and 1 Jul. The following fungicides were applied preventively for downy mildew (Pseudoperonospora cubensis) and Phytophthora blight (Phytophthora capsici): Fosphite (3 qt/A) on 24 Jun; Forum 4.16SC (6 oz/A) on 27 Jul, 8 Aug, 27 Aug, 12 Sep, and 23 Sep; and Ranman 400 SC (2.75 fl oz/A) on 17 Jul, 1 Aug, 15 Aug, 3 Sep, 17 Sep, and 30 Sep. Neither disease was detected before the end of this experiment. Treatment applications were made with a tractor-mounted boom sprayer operated at 100 psi and 96 gpa (D5-25 hollow cone nozzles spaced 17 in. apart). Upper and lower surfaces of 10 to 30 leaves in each plot were examined weekly for powdery mildew beginning on 13 Jul, which was the start of flowering. Initially the examined leaves were selected from the oldest third of the foliage based on leaf appearance and position in the canopy. As disease progressed mid-aged and young leaves also were examined. 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. Area under Disease Progress Curve (AUDPC) was calculated for severity from 5 Aug through 8 Sep. Canopy condition including defoliation was assessed on 17 and 24 Sep. Mature fruit were harvested and weighed on 25 Aug and 3 Sep. Average monthly high and low temperatures (°F) were 73/58 in Jun, 80/64 in Jul, 83/68 in Aug, and 74/58 in Sep. Rainfall (in.) was 6.43, 4.82, 2.01, and 2.39 for these months, respectively.

Powdery mildew was first seen on 30 Jul in 11 of the 20 plots planted to the susceptible cultivar, Butternut Supreme. The resistant cultivar was not examined then. Fungicide treatments were started the next day. The first application was re-applied on 3 Aug because conditions became windy and rainy on 31 Jul. The resistant cultivar suppressed powdery mildew through the last assessment on 8 Sep, when the degree of control was 77% and 43% on upper and lower leaf surfaces, respectively, which was lower than on previous assessment dates. Both biopesticides effectively controlled powdery mildew on both leaf surfaces in both cultivars. Milstop and Organocide did not differ significantly. On upper leaf surfaces they provided 64% and 83% control, respectively, based on severity on 8 Sep in the susceptible cultivar and 95% and 88% control in the resistant cultivar. Three treatments included mobile fungicides (Quintec, Procure, and Pristine) for controlling powdery mildew on lower leaf surfaces plus Organocide applied weekly. Mobile fungicides did improve control numerically on both leaf surfaces, but only significantly for the susceptible cultivar treated with mobile fungicides every week, which exhibited 100% and 78% control on upper and lower leaf surfaces, respectively, on 8 Sep. Degree of powdery mildew control influenced canopy condition, expressed as percentage of leaves that died.

	Powdery mildew severity (%) ^{z, y}											
	U	pper le	af surface		Lower leaf surface			e		Defol	iation	
Cultivar; Fungicide treatment (application date) ^x	27-Aug		8-Sep		27-Aug		8-Sep		17-Sep		24-Sep	
Butternut Supreme (susceptible cultivar)												
Organocide (1-6), Quintec 4 oz/A (1,3,5), Procure 8 oz/A	0.0											
(2,6), Pristine 18.5 oz/A (4)	3	d ^w	0.06	e	0.86	d	9.17	d	39	e	58	с
	0.1						26.6					
Organocide (1-6), Quintec (1), Procure (2)	9	cd	3.97	bcd	1.54	cd	5	bc	63	cd	79	ab
	0.9						30.8					
Organocide 2 fl oz/gal (1-6)	3	bc	3.47	bcd	4.89	bc	9	b	76	ab	83	ab
	2.0						30.4					
Milstop 3 lb/A (1-6)	6	b	7.55	b	9.60	ab	3	b	70	bc	81	ab
	6.7		20.6		15.2		41.6					
Nontreated	5	a	7	a	7	a	9	а	83	а	86	а
Betternut 401 (mildew resistant cultivar)												
	0.4						25.0					
Organocide (1-6), Quintec (1), Procure (2)	3	cd	1.13	cde	1.98	cd	8	bc	21	f	56	с
	0.3						21.5					
Organocide 2 fl oz/gal (1-6)	4	cd	2.50	cd	1.99	cd	3	с	54	d	74	b
	0.6						25.4					
Milstop 3 lb/A (1-6)	6	bcd	1.00	de	2.59	cd	7	bc	51	d	81	ab
	1.1						23.7					
Nontreated	5	bc	4.78	bc	3.83	bcd	3	bc	70	bc	79	ab
<i>P</i> -value	< .0001		< .0001		0.001		< .0001		< .0001		<.0001	

^z Exact colony counts were made when possible and severity was estimated using the conversion factor of 30 colonies/leaf = 1%.

^y Data were transformed from percentages by a square root transformation when needed to obtain normality of variance before analysis of variance was performed. The table has back-transformed means.

^x Fungicides used in the programs were Organocide 2 oz/gal, Quintec 2.08SC 4 fl oz/A, Procure 480SC 8 fl oz/A, and Pristine 38WG 18.5 oz/A. Application dates were 1=31 Jul and 3 Aug, 2=10 Aug, 3=17 Aug, 4=24 Aug, 5=31 Aug and 6=9 Sep.

^w Means followed by the same letter are not statistically different from each other (Tukey's HSD, P=0.05).