PA Vegetable Marketing and Research Program – PA Vegetable Growers Association
Final Report
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Project Title: Developing strategies for organic cucurbit disease management

Principle Investigator(s): Sally A. Miller, Fulya Baysal-Gurel
Phone Number: 330-263-3678
Fax: 330-263-3841
E-mail: miller.769@osu.edu
Cooperating Institution: The Ohio State University OARDC
Mailing Address: Department of Plant Pathology, 1680 Madison Ave., Wooster, OH 44691

Objectives(s) of research proposal: Cucurbit downy mildew and powdery mildew are important diseases of cucurbit crops. Under the U.S. National Organic Program Rule, growers are required to use host resistance, exclusion, sanitation and other cultural practices to disrupt pest and pathogen life cycles before resorting to "rescue" treatments such as the use of biorational pesticides. In our previous studies, the use of row covers until flowering resulted in a reduction in bacterial wilt incidence and powdery mildew severity in organic squash. There was no information available on the potential efficacy of floating row covers as barriers against powdery and downy mildew spores. The objectives of this study were 1) to test the efficacy of several biorational products approved or likely to be approved for organic production to control cucurbit downy and powdery mildew diseases; 2) to test the use of floating row covers for the management of bacterial wilt, and cucurbit downy and powdery mildew diseases; and 3) determine the effects of row covers on yield. We used a parthenocarpic cucumber variety that does not require pollination for this study.

Materials and Methods: The experiment was conducted at the Ohio Agricultural Research and Development Center's Fry Farm in Wooster. Prior to planting, on 8 May, 100 lb/A Replenish 3-4-3 (N-P-K) fertilizer was applied to the test field. The test field was disked, leveled, and raised beds were prepared, drip irrigation tape was laid, and black plastic mulch installed over the beds on 8 May. Black nursery shade cloth was laid between beds for weed control the same day. Untreated 'Lisboa' parthenocarpic slicer cucumber seeds were sown directly into the field and protected rows were covered with Dewitt floating Pro34 row covers over wire hoops on 14 Jun. Row covers were held in place with sand bags. Treatments were arranged in a randomized complete block design with four replications. Each treatment consisted of two rows (protected and non-protected with floating row cover) of 10 plants spaced 2 ft apart on 6 ft centers. Plants were drip irrigated on 14, 17 and 24 Jun. The insecticide Surround WP (25 lbs/A) was applied into non-protected plots on 5, 12, 22 and 30 Jul, 6 Aug. Treatments were applied into protected and non-protected plots with floating row cover using a hand-held sprayer (25 gal/A) on 5, 12, 22 and 30 Jul, 6 and 13 Aug. Floating row

covers were removed at the first application and every 7-10 days thereafter until the end of the experiment. Plots were harvested and rated for downy mildew disease development when row covers are removed for application on 30 Jul, 6 and 13 Aug. The severity of downy mildew on foliage was evaluated using a scale of 0-100% foliage affected. Number and weight of marketable and non-marketable fruit were determined. Floating row covers were replaced within 1 hour after each harvest, evaluation and application of the products. Incidence of bacterial wilt was determined on 16, 23 and 30 Jul. Average maximum temperatures for 14-30 Jun, Jul, and 1-13 Aug were 81.6, 81.5 and 78.5ºF; average minimum temperatures were 59.7, 63.1 and 58.6ºF; and total rainfall amounts were 2.7, 6.6 and 1.2-in., respectively. Analysis of variance was performed using the general linear models procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Results:

Powdery mildew did not appear in this trial. Downy mildew appeared naturally and disease pressure moderate to high. The effects of treatment and floating row cover on downy mildew severity (final rating and AUDPC) were significant. There were significant interactions between treatment and floating row cover in end of season disease severity and AUDPC. Across all treatments downy mildew severity was higher and progressed more rapidly on non-protected than on protected plants. Champ WG, OxiDate and Neem oil significantly reduced downy mildew disease progress during the growing season (AUDPC) compared to the other treatments and non-treated control in non-protected plants. Champ WG and OxiDate significantly reduced downy mildew disease progress during the growing season (AUDPC) compared to the other treatments and non-treated control in protected plants.

Bacterial wilt incidence was low. All of the non-protected plots had significantly higher wilted plants than the protected plots. There were no significant differences between treatments in bacterial wilt incidence. There were no significant differences in marketable or total fruit weight between treatments and between protected and non-protected plots.

Conclusion:

Floating row covers can be use as effective organic disease management approach to managing bacterial wilt and downy mildew diseases. Crop protection materials such as Champ WG and OxiDate can be used together with floating row covers for better success on the management of cucurbit downy mildew.

Table 1. Effect of different treatments and floating row cover and their interactions on severity of downy mildew disease, incidence of bacterial wilt and yield on cucumber plants

Fixed effects*	Downy mildew		% Bacterial wilt**	Marketable fruit Weight/plot (lb)	Total fruit Weight/plot (lb)
	% disease (13 Aug)	AUDPC			
Treatment P values	≤0.0001	0.0008	0.2106	0.3423	0.3210
Floating row cover P values	≤0.0001	0.0006	0.0120	0.5340	0.7592
Treatment X Floating row cover P values	≤0.0001	≤0.0001	0.2106	0.8016	0.7411

*Statistical analyses were performed using linear mixed model with treatment, floating row cover and treatment x floating row cover as fixed variables.

**Percents are based on the number of wilted plant per plot.

Table 2. Effect of different treatments and floating row cover on severity of downy mildew disease, incidence of bacterial wilt and yield on cucumber plants

Treatment and rate	Floating row cover	Downy mildew[x]		%	Marketable fruit	Total fruit
		% disease (13 Aug)	AUDPC[y]	Bacterial wilt[x]	Weight/plot (lb)	Weight/plot (lb)
Microthiol Disperss 7.5 lb/A.....	+	61.3 ef[w]	448.4 efg	0.0 d	39.3 a	43.4 a
Champ WG 2 lb/A	+	35.0 i	235.8 i	0.0 d	46.1 a	51.2 a
Regalia 1% (v/v).....	+	47.5 gh	345.6 ghi	0.0 d	24.6 a	29.0 a
Neem oil 1 fl oz/gal.....	+	46.9 gh	402.5 fg	0.0 d	36.4 a	43.5 a
Serenade Max 2 lb/A.....	+	53.8 fg	393.8 fg	0.0 d	35.1 a	43.7 a
OxiDate 1% (v/v)	+	42.5 hi	267.8 hi	0.0 d	31.3 a	37.0 a
Kaligreen 5 lb/A.....	+	47.5 gh	354.4 gh	0.0 d	34.4 a	40.2 a
Non-treated control	+	55.0 fg	435.3 fg	0.0 d	36.2 a	42.6 a
Microthiol Disperss 7.5 lb/A.....	-	92.5 a	776.6 a	5.0 cd	30.9 a	37.8 a
Champ WG 2 lb/A	-	67.5 de	485.6 ef	12.5 abc	39.0 a	49.6 a
Regalia 1% (v/v).....	-	87.5 ab	693.4 abc	5.0 cd	27.7 a	36.4 a
Neem oil 1 fl oz/gal.....	-	77.5 bcd	605.9 cd	7.5 cd	28.6 a	35.1 a
Serenade Max 2 lb/A.....	-	88.8 a	710.9 abc	10.0 bc	39.6 a	48.0 a
OxiDate 1% (v/v)	-	75.6 cd	560.0 de	7.5 cd	31.8 a	36.9 a
Kaligreen 5 lb/A.....	-	83.8 abc	658.4 bcd	17.5 ab	32.7 a	38.8 a
Non-treated control	-	88.8 a	721.9 ab	20 a	29.9 a	36.4 a
P value		≤0.0001	≤0.0001	≤0.0001	0.6563	0.6678

[z]Downy mildew disease ratings and area under the disease progress curve (AUDPC) were based on percent foliage affected.
[y]AUDPC values were calculated according to the formula: $\sum([(x_i+x_{i-1})/2](t_i-t_{i-1}))$ where x_i is the rating at each evaluation time and (t_i-t_{i-1}) is the number of days between evaluations.
[x]Percents are based on the number of wilted plant per plot.
[w]Values are the means of four replicate plots; means followed by the same letter within a column are not significantly different at P≤0.05. Means were separated using Fisher's least significant difference test.