Final Report: Fungicide control of Powdery mildew of Cucurbit: 2015 field trial

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Report Summary

Powdery mildew is an important disease in commercial members of the Cucurbit family. The specific pathogen that infects cucurbits in California is *Podosphaera fusca* (synonyms: *P. xanthii*, *Sphaerotheca fulginea* and *S. fusca*), (Janousek et al. 2009, McGrath and Thomas 1996, Pérez-García et al. 2009). Over-wintering chasmothecia produce ascospores that infect then develop into whitish colonies on leaves, leaf petioles, and stems (McGrath and Thomas 1996, Glawe 2008). Wind or insect vectors disperse asexually-produced conidia and thus spread the disease (Blancard et al. 1994). Favorable conditions for disease epidemics include temperatures between 20-27°C and lower-intensity light (McGrath and Thomas 1996). Disease outbreaks in the Central Valley of California tend to occur during late summer and autumn months, but coastal areas may be continuously threatened (Davis et al. 2008). Infections have the potential to reduce the yield and quality of fruit and can lead to early plant senescence (Blancard et al. 1994, McGrath and Thomas 1996).

A field trial at the UC Davis plant pathology experimental farm in Solano County, California was conducted to evaluate the effectiveness of fungicides in managing powdery mildew on pumpkins (*Cucurbita pepo*) using the susceptible cultivar 'Lil' Pump-Ke-Mon'. We applied fungicides weekly or 10-14 days (RI) for a seven-week period beginning Aug 13 and continuing through Sep 24. Following three - five applications, depending on the treatment, we assessed disease incidence and powdery mildew colony density on the upper and lower surfaces of leaves in each treatment on Sep 25.

Temperatures were dry and mild during much of the 2015 growing season, providing optimal conditions for the asexual reproduction and dispersal of powdery mildew. Overall disease pressure was high. By the end of September, disease incidence in the untreated plots reached 99%.

Materials and Methods

A. Trial Layout

Table 1: Experimental design and treated area/treatment.

Experimental design	Complete randomized block design with 5 replicates.		
Application method	Handgun sprayers (attached to Nifty Fifty brand 25 or 50 gallon sprayers).		
Plot length	14 feet	Bed spacing	16 feet
No. plants/plot	7-8	Plot area	84 ft^2 (14 ft by 6 ft)
Plant spacing	variable	Area/5 plots	420 ft^2 (=0.0096 acres)
Application period	13 Aug – 24 Sept (7 and 10-14 day intervals)		
Volume water applied	100 gallons/acre= 1.0 gallons/treatment 150 gallons/acre (= 1.4 gallons per treatment) 200 gallons/acre (= 1.9 gallons per treatment)		

B. Experimental Treatments

The treatments described in this report were conducted for experimental purposes only and crops treated in a similar manner may not be suitable for commercial or other use, "alt" = alternated with.

Table 2: Experimental fungicide treatments. "alt" = alternated with; "FP" = formulated product

Treatment	No.	Flag color	Application interval (days)	Application rate (per acre)	FP/application
Unsprayed control	1	W	None	none	none
Quintec + Syl-Coat	2	P	10-14	6 fl oz + 8 fl oz/100 gal	1.7 ml + 2.4 ml at 100 gal or 3.3 ml at 150 gal or 4.5 ml at 200 gal
Rally + Syl-Coat	3	G	10-14	5 oz + 8 fl/100 gal	1.4 g + 2.4 ml at 100 gal or 3.3 ml at 150 gal or 4.5 ml at 200 gal
(Rally alt Quintec) + Syl-Coat	4	Y	10-14	(5 oz alt 6 fl oz) + 8 fl oz/100 gal	(1.4 g alt 1.7 ml) + 2.4 ml at 100 gal or 3.3 ml at 150 gal or 4.5 ml at 200 gal
Pyriofenone	5	Br	7	4 fl oz	1.1 ml
Pyriofenone	6	O	7	5 fl oz	1.4 ml

Trial Map

Figure 2: Map layout; Grey box = skipped plot.

S ←

x	x	x
x	G	Br
x	O	O
x	P	W
x	Y	Y
G	Br	P
O	G	O
P	W	Br
W	O	Y
G	Y	G
Br	Br	P
P	W	W
x	x	Y

C. Plant Management

Plants were watered every 5-7 days using drip irrigation.

D. Disease and Statistical Analysis

Disease was assessed on Sep 25. Powdery mildew incidence and severity were assessed in each plot by evaluating ten random leaves. Incidence was defined as the proportion of leaves in a plot having some living powdery mildew. Severity was determined by estimating the percentage of leaf surface area that was infected. Data was analyzed using a one-way ANOVA and means were compared using Student's t-test ($\alpha = 0.05$).

E. Weather and Disease

Weather from a CIMIS weather station in Davis, California was followed. Weather for the spray season was somewhat dry with 7 precipitation events of less than 1 mm each (2.1mm total). Overall disease pressure was high with disease severity reaching 68% (upper leaf) and 70% (bottom leaf) in the untreated control and incidence reaching 96% (upper leaf) and 99% (lower leaf).

Figure 3: Daily temperature data from CIMIS weather station for Aug 10 to Sep 30 period.

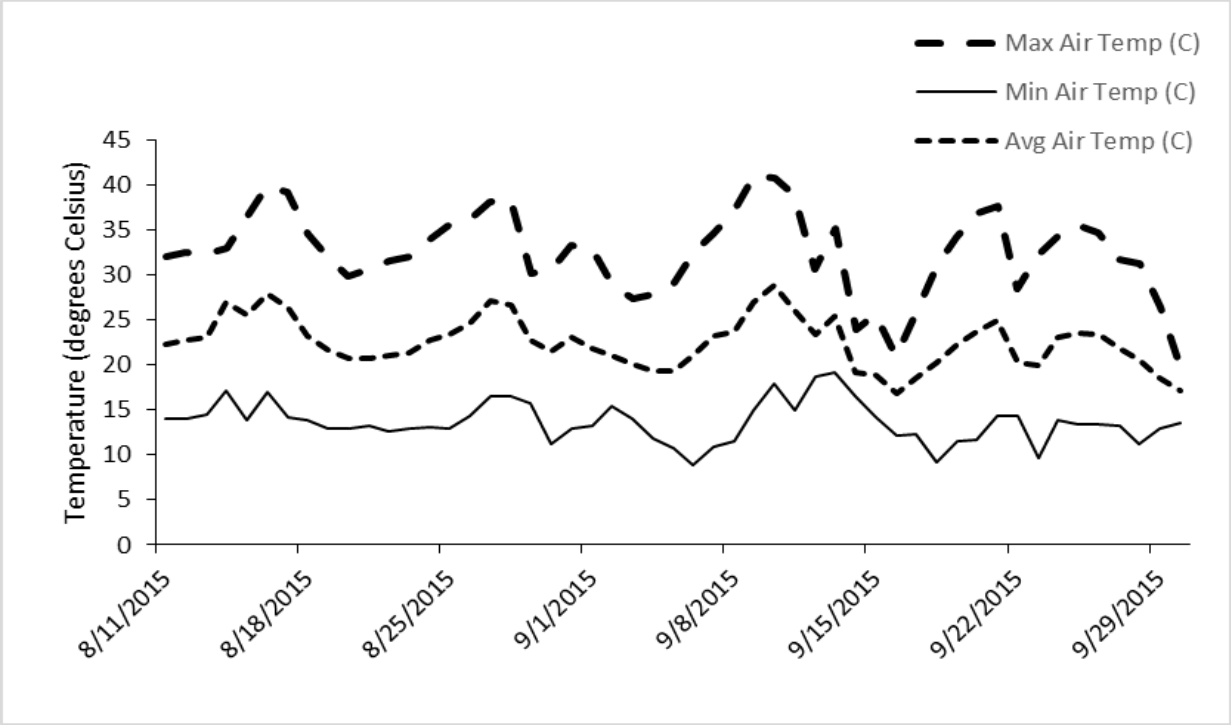


Figure 4: Daily precipitation data from CIMIS weather station for Aug 10 to Sep 30 period.

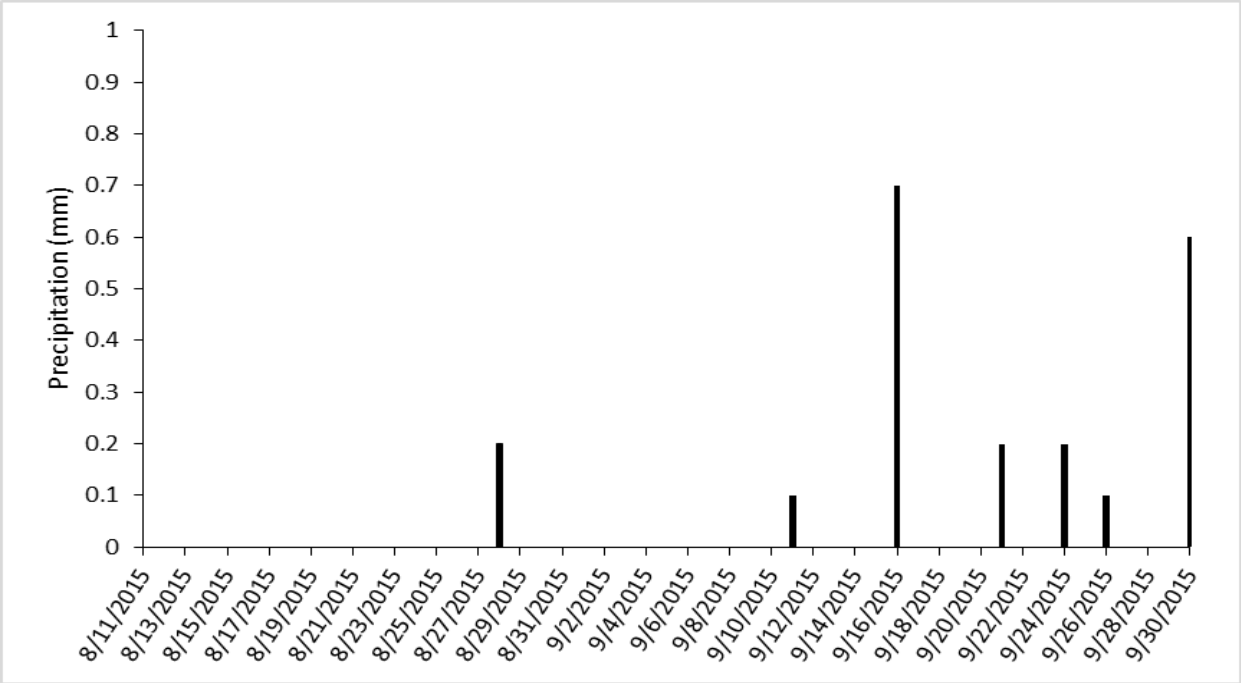
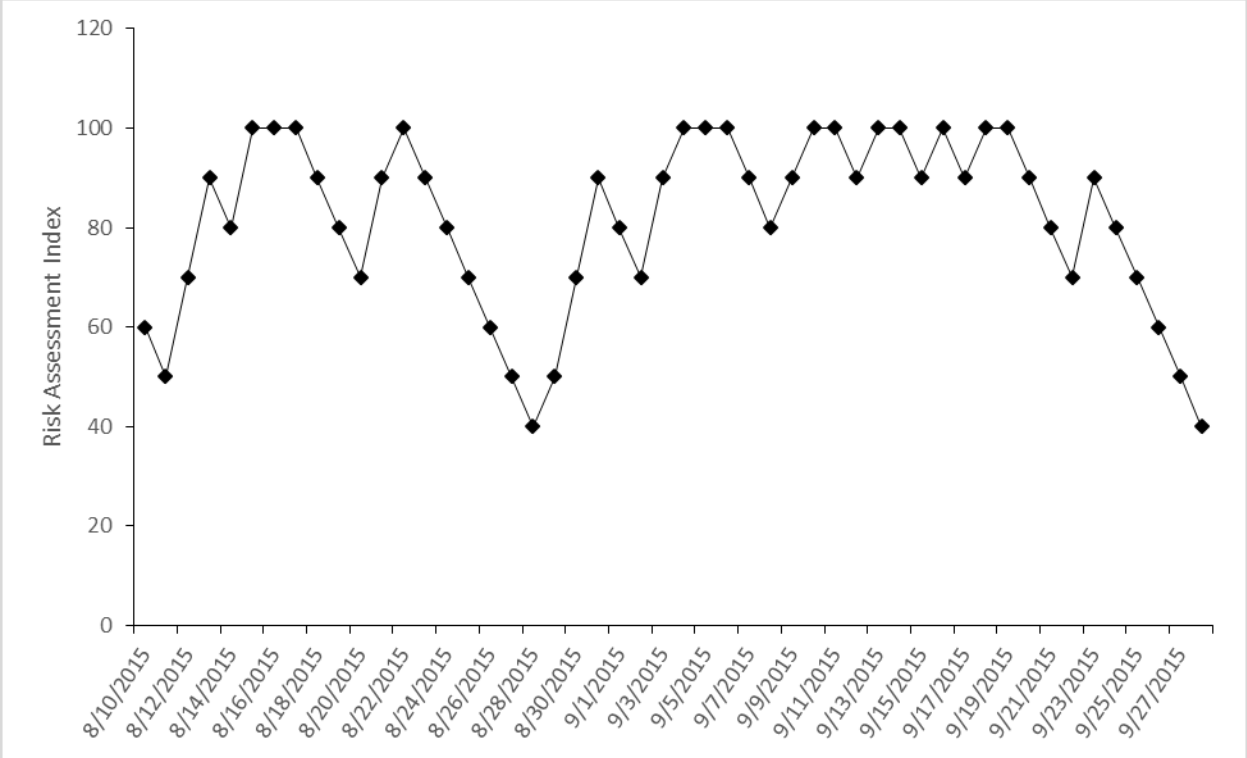


Figure 5: Thomas-Gubler Powdery Mildew risk index data from Aug 10-Sep 28. Early season disease pressure is evident as the index begins to increase on approximately 8/13.



Results

Table 3: Treatment effects on disease incidence and severity on the upper surfaces of leaves of pumpkin. Treatments sharing the same letter within a column are not significantly different according to Student's t-test at $\alpha = 0.05$.

Treatment	Top Leaf Severity (%)		Top Leaf Incidence (%)	
Pyriofenone 5 fl oz, 7d	0.34	c	12.0	d
Pyriofenone 4 fl oz, 7d	1.54	bc	26.0	cd
Quintec, 6 fl oz + Syl-Coat, 8 fl oz/100 gal, 10-14d	2.76	bc	42.0	c
Rally, 5 oz + Syl-Coat, 8 fl oz/100 gal, 10-14d	9.70	bc	84.0	ab
(Rally, 5 oz alt Quintec, 6 fl oz) + Syl-Coat, 8 fl oz, 10-14 d	11.32	b	68.0	b
Untreated Control	68.20	a	96.0	a

Table 4: Treatment effects on disease severity and incidence on the bottom surfaces of leaves of pumpkin. Treatments sharing the same letter within a column are not significantly different according to Student's t-test at $\alpha = 0.05$.

Treatment	Bottom Leaf Severity (%)		Bottom Leaf Incidence (%)	
Quintec, 6 fl oz + Syl-Coat, 8 fl oz/100 gal, 10-14d	3.54	c	56.0	b
Pyriofenone 5 fl oz, 7d	8.82	bc	64.0	b
Rally, 5 oz + Syl-Coat, 8 fl oz/100 gal, 10-14d	15.94	bc	88.0	a
(Rally, 5 oz alt Quintec, 6 fl oz) + Syl-Coat, 8 fl oz, 10-14 d	18.64	b	86.0	a
Pyriofenone 4 fl oz, 7d	18.74	b	87.4	a
Untreated Control	70.40	a	100.0	a

Acknowledgements

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Appendix: materials

Product	Active ingredient(s) and concentration	Class	Manufacturer or Distributor
Pyriofenone	proprietary	proprietary	N/A
Quintec	quinoxyfen (22.6%)	quinoline	Dow Agrosciences, LLC
Rally 40 WSP	myclobutanil (40%)	DMI-triazole	Dow Agrosciences, LLC
Syl-Coat	Polyether-Polymethylsiloxance-Copolymer and Polyether (100%)	adjuvant	Wilbur-Ellis

Appendix sources: (1) Adaskaveg, et al. 2012. Efficacy and timing of fungicides, bactericides and biologicals for deciduous tree fruit, nut, strawberry, and vine crops 2012, available at http://ucanr.edu/sites/plp/files/146650.pdf. (2) Gubler Lab field trials, available at http://plantpathology.ucdavis.edu/Cooperative_Extension/ (3) product-specific MSDS and/or labels.