
Final Report: Fungicide control of Powdery mildew of Cucurbit: 2016 field trial

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Published 2016 at <http://plantpathology.ucdavis.edu/fruitcropfungicidetrials>
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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 four-week period beginning Sep 1 and continuing through Sep 29. Following two - four applications, depending on the treatment, we assessed disease incidence and powdery mildew colony density on the upper surface of leaves in each treatment on Sep 29.

Temperatures were mild during much of the growing season, providing optimal conditions for the asexual reproduction and dispersal of powdery mildew. Overall disease pressure was moderate. By the end of September, disease incidence in the untreated plots reached 85%.

Materials and Methods

A. Trial Layout

Table 1: Experimental design and treated area/treatment.

Experimental design	Complete randomized block design with 4 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	6-7	Plot area	84 ft ² (14 ft by 6 ft)
Plant spacing	variable	Area/4 plots	336 ft ² (=0.0077 acre)
Application period	Sep 1 – Sep 22 (7 and 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

Note: 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.

No.	Flag color	Treatment	Application interval (days)	Application rate (per acre)	FP/application
1	Y	SP2700 10 WP	7	(root) 500x dilution + (foliar) 600x dilution then 600x dilution	6 g at 100 gal or 8.6 g at 150 gal or 12.0 g at 200 gal
2	O	SP2700 10 WP	7	(root) 500x dilution + (foliar) 300x dilution 300x dilution	12.2 g at 100 gal or 18.3 g at 150 gal or 24.4 g at 200 gal
3	R	Pyriofenone + NIS	7	4 fl oz + 0.1% (v/v)	1.1 ml + 5.3 ml at 100 gal or 5.3 ml at 150 gal or 7.6 ml at 200 gal
4	G/Clear	Pyriofenone + NIS	14	5 fl oz + 0.1% (v/v)	1.4 ml + 3.8 ml at 100 gal or 5.3 ml at 150 gal or 7.6 ml at 200 gal
5	Clear	ISR-2000	7	16 fl oz	4.4 ml
6	Br	GC Pro	7	2 lb	8.7 g
7	K	GC Pro	7	4 lb	17.4 g
8	G	Serenade Opti	7	20 oz	5.4 g
9	P	Howler + Capsil	7	7.5 g/L + 6 oz/100 gallon	28.4 g + 1.7 ml at 100 gal or 39.8 g + 2.5 ml at 150 gal or 54.0 g + 3.4 ml at 200 gal
10	B	Exp Biological J + Capsil	7	7.5 g/L + 6 oz/100 gallon	28.4 g + 1.7 ml at 100 gal or 39.8 g + 2.5 ml at 150 gal or 54.0 g + 3.4 ml at 200 gal
11	Y/O	Exp Biological I + Capsil	7	7.5 g/L + 6 oz/100 gallon	28.4 g + 1.7 ml at 100 gal or 39.8 g + 2.5 ml at 150 gal or 54.0 g + 3.4 ml at 200 gal
12	Br/G	Exp Biological E + Capsil	7	5 g/L + 6 oz/100 gallon	14.2 g + 1.7 ml at 100 gal or 19.9 g + 2.5 ml at 150 gal or 17.0 g + 3.4 ml at 200 gal
13	K/Clear	Exp Biological G + Capsil	7	3 g/L + 6 oz/100 gallon	11.4 g + 1.7 ml at 100 gal or 15.9 g + 2.5 ml at 150 gal or 21.6 g + 3.4 ml at 200 gal
14	K/G	Exp Biological H + Capsil	7	4.5 g/L + 6 oz/100 gallon	17.1 g + 1.7 ml at 100 gal or 23.9 g + 2.5 ml at 150 gal or 32.4 g + 3.4 ml at 200 gal

15	Br/Y	Quintec + Howler + Capsil	7	3 fl oz + 1.2 g/L + 6 oz/100 gallon	0.9 ml + 4.7 g + 1.7 ml at 100 gal or 6.5 g + 2.5 ml at 150 gal or 8.9 g + 3.4 ml at 200 gal
16	Y/Clear	(Rally alt Quintec) + Syl-Coat	10-14	(5 oz alt 6 fl oz) + 0.125% (v/v)	(1.4 g alt 1.7 ml) + 4.7 ml at 100 gal or 6.6 ml at 150 gal or 9.4 ml at 200 gal
17	Br/O	(Fontelis alt Quintec) + Syl-Coat	10-14	(16 fl oz alt 6 fl oz) + 0.125% (v/v)	(4.4 ml alt 1.7 ml) + 4.7 ml at 100 gal or 6.6 ml at 150 gal or 9.4 ml at 200 gal
18	R/Y	Quintec + Syl-Coat	10-14	6 fl oz + 0.125% (v/v)	1.7 ml + 4.7 ml at 100 gal or 6.6 ml at 150 gal or 9.4 ml at 200 gal
19	W	Untreated Control	n/a	n/a	n/a

C. Trial Map

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

				Y/Cl				
				Y	K/Cl	Br/Y	W	G/Cl
					P	G/Cl	K/Cl	Y
				W	R	K	R	
					Y/O	R/Y	G/Cl	Y/Cl
					Br		Br/G	
		K/G	K/Cl	Br/G		P		Br/Y
		Br/Y		G	Br/O	Y/O	Br/O	K/G
		G/Cl		B	K	Br	Cl	K
		Y/Cl	Br/G	R/Y	Br/Y	K/G	W	R/Y
			Y/O	Y	O	Y/Cl	B	K/Cl
		Br/O	B	O	K/G	Br/O	Y/O	P
			P		G/Cl	G	R	O
				R	Cl	O		
		R/Y	G	Cl	Y	B		
		W	K	Br	Br/G	Cl	Br	G



N

D. Plant Management

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

E. Disease and Statistical Analysis

Disease was assessed on Sep 29. Powdery mildew incidence and severity on the leaf upper surface 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 Fisher's LSD test at $\alpha = 0.05$.

F. Weather and Disease

Weather from a CIMIS weather station 6 in Sacramento County, California was followed. Weather for the spray season was dry with 7 precipitation events (13.0 mm total). Overall disease pressure was high with disease severity reaching 13% in the untreated control and incidence reaching 85% on the upper leaf surface.

Figure 3: Daily temperature data from CIMIS weather station 6 for Aug 1 to Sep 30 period.

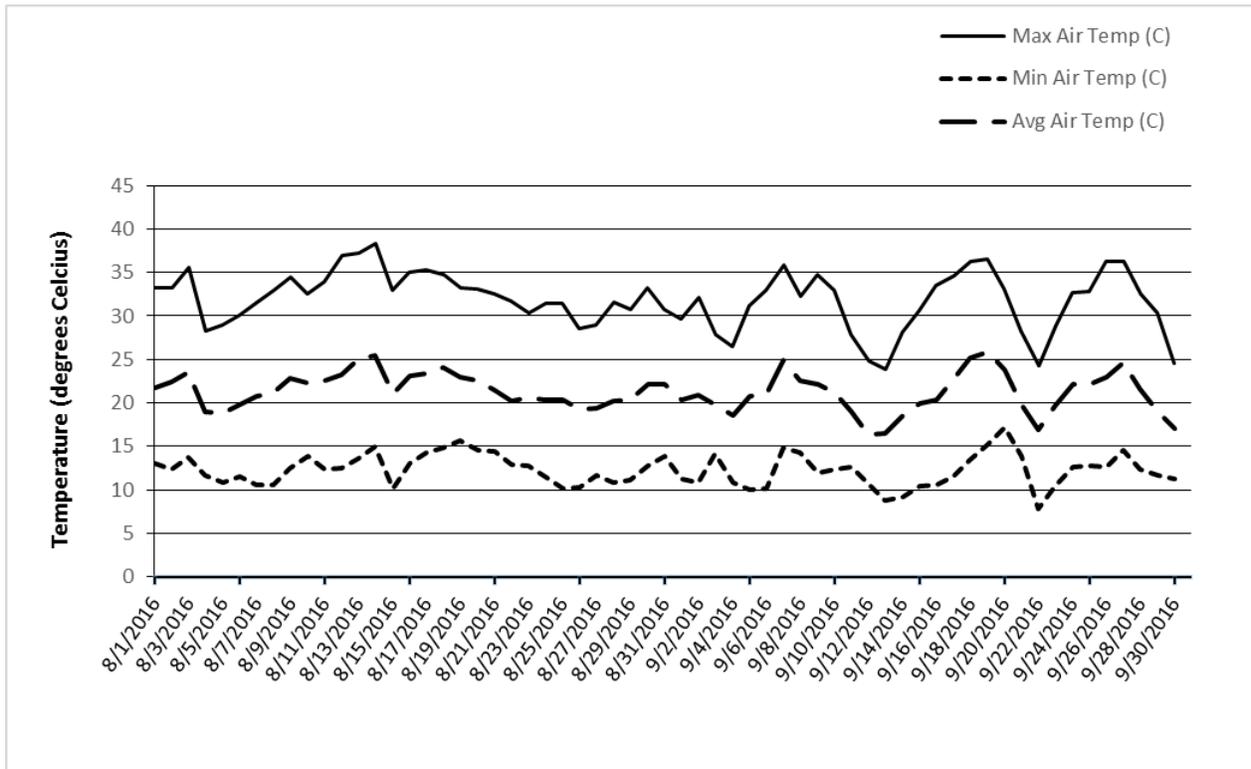


Figure 4: Daily precipitation data from CIMIS weather station 6 for Aug 1 to Sep 30 period.

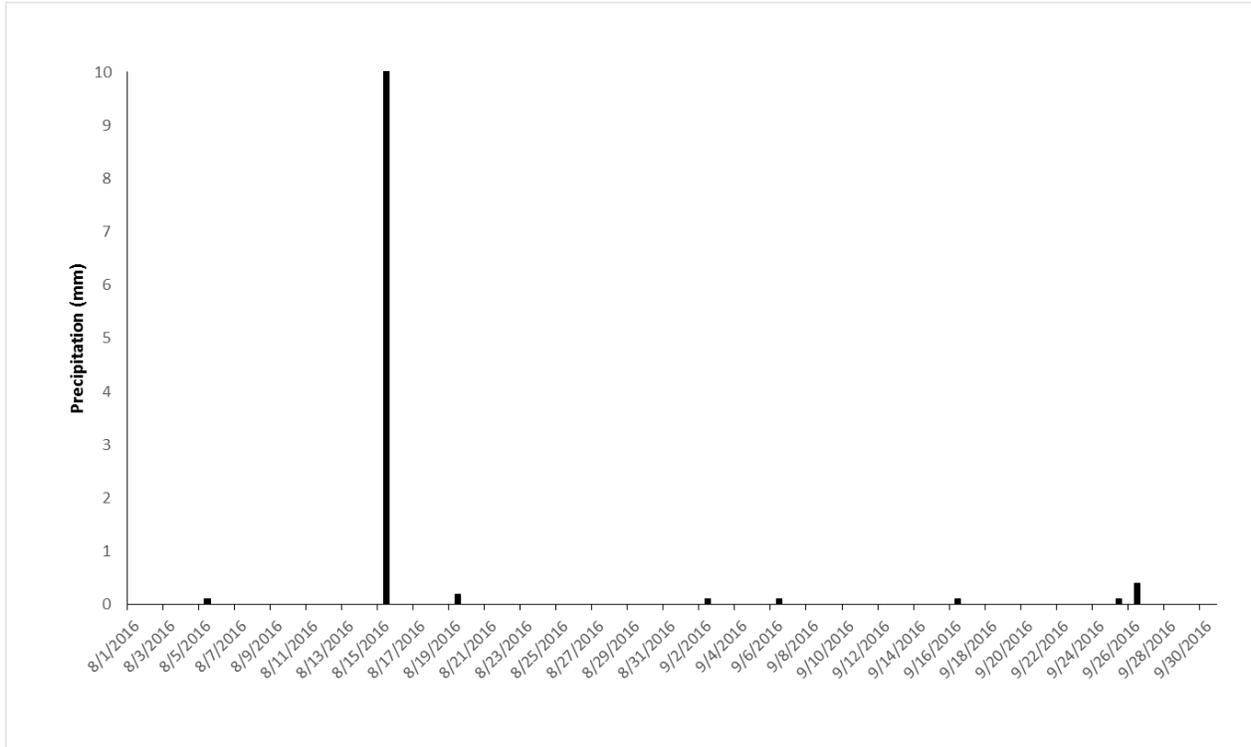
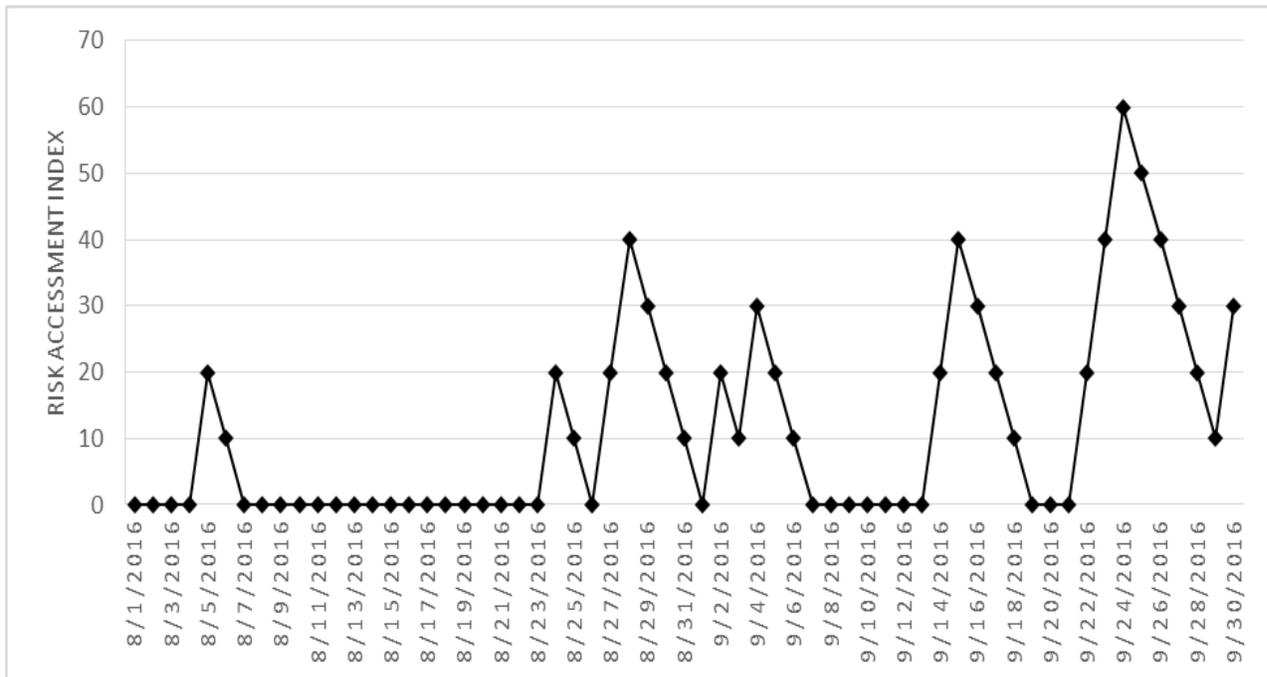


Figure 5: Thomas-Gubler Powdery Mildew risk index data from Aug 1-Sep 30. Data recorded at 6 AM daily.



Results

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

Treatment	Upperleaf Severity (%)	Upperleaf Incidence (%)
Quintec 6 fl oz + Syl-Coat 0.125% (v/v) 14d	0.0 C	0.0 G
(Fontelis 16 fl oz alt Quintec 6 fl oz) + Syl-Coat 0.125% (v/v) 14d	0.2 C	5.0 FG
Pyriofenone 5 fl oz + NIS 0.1% (v/v) 14d	1.2 C	30.0 EFG
ISR-2000 16 fl oz 7d	2.0 BC	36.7 DEF
Pyriofenone 4 fl oz + NIS 0.1% (v/v) 7d	2.0 BC	30.0 EFG
SP2700 10 WP 600x dilution 7d	2.1 BC	45.0 BCDE
(Rally 5 oz alt Quintec 6 fl oz) + Syl-Coat 0.125% (v/v) 14d	2.4 BC	52.5 ABCDE
Exp Biological G 3.0 g/L + Capsil 6 fl oz/100 gal 7d	2.4 BC	40.0 CDE
SP2700 10 WP 300x dilution 7d	3.9 BC	62.5 ABCDE
Exp Biological J 7.5 g/L + Capsil 6 fl oz/100 gal 7d	4.5 BC	70.0 ABC
Howler 7.5 g/L + Capsil 6 fl oz/100 gal 7d	5.1 BC	62.5 ABCDE
GC Pro 4 lb 7d	5.4 BC	67.5 ABCD
Exp Biological H 4.5 g/L + Capsil 6 fl oz/100 gal 7d	5.5 BC	62.5 ABCDE
GC Pro 2 lb 7d	5.9 ABC	75.0 AB
Exp Biological I 7.5 g/L + Capsil 6 fl oz/100 gal 7d	6.6 ABC	85.0 A
Serenade Opti 20 oz 7d	6.9 ABC	82.5 A
Exp Biological E 5.0 g/L + Capsil 6 fl oz/100 gal 7d	8.8 AB	77.5 AB
Untreated control	13.0 A	85.0 A
Quintec 3 fl oz + Howler 1.2 g/L + Capsil 6 fl oz/100 gal 7d	13.2 A	55.0 ABCDE

Acknowledgements

We thank Mike Eldridge and Bryan Pellissier at the Armstrong facility for maintenance of the field and Curtis Waters for assisting in treatment application and rating.

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Appendix: materials

Product	Active ingredient(s) and concentration	Class	Manufacturer or Distributor
Capsil	Polyether-polymethylsiloxane-copolymer and nonionic surfactant (100%)	adjuvant	Aquatrols
Exp Biological E	proprietary	proprietary	N/A
Exp Biological G	proprietary	proprietary	N/A
Exp Biological H	proprietary	proprietary	N/A
Exp Biological I	proprietary	proprietary	N/A
Exp Biological J	proprietary	proprietary	N/A
Fontelis	penthiopyrad (20.4%)	SDHI (7)	Dupont
GC Pro	proprietary	proprietary	N/A
Howler	proprietary	proprietary	N/A
ISR-2000	proprietary	proprietary	N/A
Pyriofenone	proprietary	proprietary	N/A
Quintec	quinoxifen (22.6%)	quinoline	Dow Agrosiences, LLC
Serenade Opti	QST 713 strain of <i>Bacillus subtilis</i> (26.2%)	biological	Bayer CropScience
SP2700	proprietary	proprietary	N/A
Rally 40 WSP	myclobutanil (40%)	DMI-triazole	Dow Agrosiences, 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.