

Fungicide Sensitivity in Strawberry Powdery Mildew caused by *Podosphaera aphanis* in California

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Introduction

- Strawberry powdery mildew (SPM) can reduce plant photosynthetic capabilities as well as directly infect fruit.
- Difficulties in early detection often merits expensive chemical control².
- Fungicide resistance has been characterized in other mildews^{3,4,5}, but never on SPM in the United States.

Materials and Methods

- Infected leaves and fruit collected from the same field were labeled as an isolate.
- Conidia were brushed onto sterilized leaflets with a camelhair brush with the aid of an Andersen Spore Cascader.
 - Leaflets were cv. Monterey, ontogenic stage 3 or lower¹, sterilized in 0.5% NaClO for 3 minutes



- Inoculated leaves were stored on water agar in a growth chamber at 20°C and 16/8 hours light/dark for 14 days.
- At 14 days more leaflets were collected, sterilized, and treated with one of six assigned fungicide treatments.
- Each treatment consisted of three leaflets, replicated three times.
- 1 cm² sporulating lesion was brushed from previously inoculated leaves onto each treated rep.
- Treated leaves were incubated for 14 days at conditions described above.



- After 14 days leaflets were evaluated for incidence (presence of sporulating lesion) and severity (% abaxial surface colonized).
- An isolate from a greenhouse trial on live plants (using the same treatments) was also processed using the above methods to confirm accuracy of lab assay results.

Table 1. List of treatments used in fungicide assay.

Active Ingredient(s)	Trade Name	FRAC Code(s)	Rate	Resistance Risk *
cyflufenamid	Torino	U6	0.265 mL/L	reported in <i>Sphaerotheca</i>
fluopyram + trifloxystrobin	Luna Sensation	7 + 11	0.312 mL/L	N/A
myclobutanil	Rally	3	0.187 g/L	medium
penthiopyrad	Fontelis	7	1.25 mL/L	high
quinoxifen	Quintec	13	0.312 mL/L	medium
trifloxystrobin	Flint	11	0.15 g/L	high

*resistance risk reported from FRAC Code List 2020

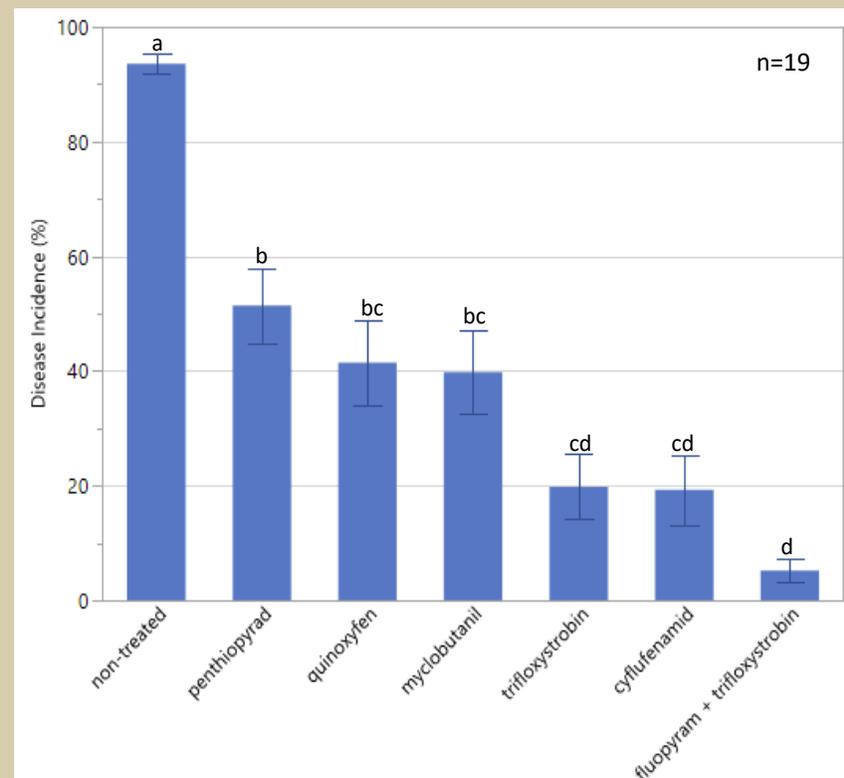


Fig 1. Average disease incidence (%) of each treatment for 19 isolates of SPM. Treatments that do not share a letter are significantly different according to Tukey HSD post-hoc testing.

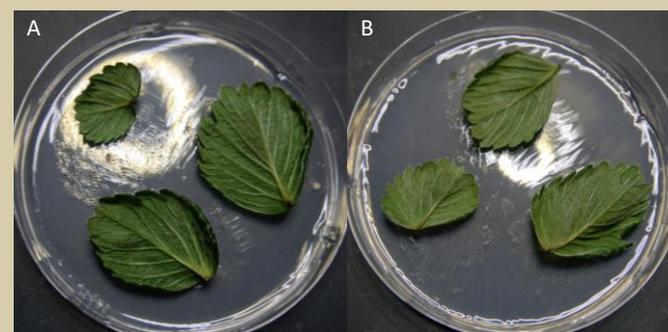


Fig 2. A) Leaflets treated with fluopyram + trifloxystrobin with no mildew growth after 14 days. B) Leaflets treated with penthiopyrad with substantial mildew growth after 14 days.

Results

- Significant differences were found among treatments when averaged over all isolates according a one-way ANOVA.
 - However, treatment efficacy varied among isolates.
- Two isolates from organic production systems were entirely sensitive to all treatments.
- Greenhouse trial results confirmed that lab assay results were accurate apart from a discrepancy in the Rally treatment (see supplemental figure for more info).

Conclusion

- SPM in California is capable of developing resistance to fungicides.
- The high sensitivity to Luna Sensation suggests it is best to use multiple modes of action when controlling SPM.
- Cultural control measures should be taken prior to curative chemical treatment to minimize resistance.
- This assay is useful to those working with multiple isolates of powdery mildew and limited space.

References

- Asalf, B., Gadoury, D. M., Tronsmo, A. M., Seem, R. C., and Stensvand, A. 2016. Effects of development of ontogenic resistance in strawberry leaves upon pre- and postgermination growth and sporulation of *Podosphaera aphanis*. Plant Dis. 100:72-78.
- Bolda, M. and Koike, S. T. 2015. Powdery mildew of strawberry. Online publication. California Strawberry Commission.
- Gubler, W. D., Ypema, H. L., Ouimette, D. G., and Bettiga, L. J. 1996. Occurrence of resistance in *Uncinula necator* to triadimefon, myclobutanil, and fenarimol in California grapevines. Plant Dis. 80:902-909.
- Pertot, I., Fiaming, F., Amsalem, L., Maymon, M., Freeman, S., Gobbin, D., and Elad, Y. 2007. Sensitivity of two *Podosphaera aphanis* isolates to disease control agents. J. Plant Pathol. 89:85-96.
- Sombardier, A., Dufour, M., Blanchard, D., and Corio-Corset, M. 2010. Sensitivity of *Podosphaera aphanis* isolates to DMI fungicides: distribution and reduced cross-sensitivity. Pest Manag. Sci. 66:35-43.



P. aphanis conidia