



“An evaluation of biological and abiotic controls for grapevine powdery mildew. 1. Greenhouse studies”

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These authors search for materials useful to control powdery mildew in organic viticulture.

- Powdery mildew is caused by the fungus *Erysiphe necator* (formerly *Uncinula necator*). (Yes, they changed the name on us again!) In conventional vineyards, the disease is controlled by regular application of sulfur or synthetic fungicides; in organic vineyards, by sulfur and canola-based oils. But health and environmental concerns about the use of sulfur, as well as the demand for residue-free grapes, point to the need to find an alternative to sulfur.
- In this article the authors tested the effectiveness in controlling powdery mildew of a variety of materials, selected to represent a wide range of modes of action, including 1) dairy products (milk, whey, lactose), 2) other abiotic agents (canola oil, sodium carbonate, potassium bicarbonate, yeast extract), and 3) antagonistic microorganisms (*Bacillus subtilis*, *Trichoderma harzianum*, *Pseudomonas syringae*).
- Additionally, to evaluate whether *Bacillus subtilis* acted directly on *E. necator* or whether metabolites or cell structures were responsible, they tested the bacteria in 3 forms: 1) as living cultures, 2) as a filtrate of the culture, and 3) as cultures killed by autoclave.
- For comparison, the authors also included 3 types of controls: no treatment, water spray, and a standard sulfur treatment. Please refer to *Table 1* of the original text if you are interested in the complete list of the 49 products that the authors tested -and their manufacturers- in the course of 7 consecutive experiments. (There are color photos of infected leaves too!)
- Each product was applied to 4 of the 8 tagged leaves of a test vine, at 2-week intervals over 6 weeks. To avoid contamination, untreated leaves were shielded with a plastic sheet. Each of the experiments tested a fraction of the materials in a completely randomized block design with 2 vines per treatment.
- To assess infection, the selected leaves were scored for disease (0-5 scale) prior to and after the treatment. At the end, leaves were also removed and observed under a dissecting microscope to confirm the leaf area colonized by *E. necator*, as well as observe the presence of cleistothecia. (Cleistothecia are round bodies that carry the fungal spores and help disseminate the disease).
- **Results.** I will report here the 7 main findings for all experiments combined. 1) ***Bacillus subtilis*, milk powder, whey powder, a commercial oil (Synetrol Horti-Oil), and a commercial formulation of potassium bicarbonate (Ecocarb) were the most efficient in preventing, or sometimes reducing, the establishment of powdery mildew on leaves.** 2) The two other microorganisms tested other than *Bacillus* –*Trichoderma* and *Pseudomonas*- were not effective in controlling the disease.

3) **Dead vs. living cultures.** Leaves treated with *B. subtilis* killed through autoclaving showed significantly less mildew severity than those sterile-filtered, or those alive. This suggests that **disease control by *Bacillus subtilis* is not related to living cells.**

4) **Product combinations .** Adding canola oil (*Biotrol*) to the whey improved mildew control compared to either product alone. This trend was also observed when adding the surfactant *Tween 80*. So the authors believe that **agents with added surfactants may be more effective than materials alone .**

5) **White residue.** The authors observed a residue on leaves treated with milk, whey or lactose –sulfur left a residue too. While these residues were not phytotoxic, the authors were concerned they may reduce photosynthesis (but nothing was measured in this direction). On the other hand, these residues may act as a nutrient for antagonistic organisms of *E. necator*.

6) **Microscopic observations.** The number and density of cleistothecia observed under magnification for each material related well to the severity of the disease observed visually. (One exception was lactose, where microscopic damage was higher than visual damage. Even though leaves had been colonized extensively by the fungal filaments –hyphae- when lactose was used, the heavy white residue obscured the hyphae from plain view.)

7) **Mode of action.** None of the tested materials induced systemic resistance to powdery mildew (no resistance developed on untreated leaves on the same plant). So the authors believe the materials that worked to reduce disease may have “eradicant” properties.

So, the conclusion of the authors’ numerous experiments is that *milk, whey, Synetrol Horti-Oil®*, *Ecocarb®* and *Bacillus subtilis* are effective in reducing powdery mildew in the greenhouse. Even though some of these products are more expensive than sulfur, the authors point out that they are safe, easy to handle, readily available, easy to store, and easy to apply (standard equipment OK). So they believe they are worth evaluating under vineyard conditions. And this is what they do in our next summary.

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