A Practical Model for Control of Grapevine Powdery Mildew in the Northeast Region

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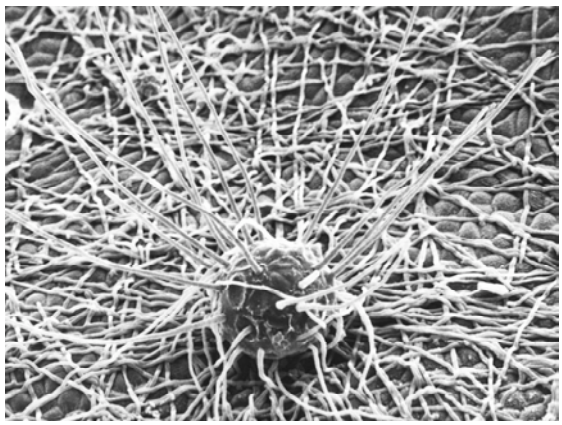
ABSTRACT: Powdery mildew causes extensive losses at the farm level. Loss of the most highly-effective fungicides to resistance has caused a shift towards "soft" and/or organically-acceptable options. Maintaining control with innately less-effective materials will require near-perfect timing with respect to seasonal changes in host susceptibility and environmental conditions. Our objective was to begin the development of a forecasting system that will answer questions (*identified by stakeholders themselves*) that are commercially relevant to decisions made in disease management. In 2006, we found an important piece of the puzzle: the fungus may occasionally discharge nearly all of it's overwintering spores while the vines are still dormant. The next step will be to better forecast this phenomenon so we can to offer news of this significant event to grape growers.

Powdery mildew is the most serious pest management challenge facing NY grape growers. We are developing improved systems to warn of epidemics and provide useful advice for control.



In the Northeastern US, the pathogen can only survive winter as microscopic spore-containing structures called cleistothecia, seen here magnified by a scanning electron microscope. The cleistothecia adhere to grapevine bark, and usually release spores between bud break and bloom. 2006 was not the usual year.

BACKGROUND AND JUSTIFICATION:

We began by asking stakeholders (primarily growers and crop advisors) what critical questions *they* need answered in making decisions. Stakeholders were either contacted directly, or through the NY Wine & Grape Foundation listserve, which included all states of the northeast region. Surveys were developed in consultation with plant pathologists, extension specialists, and crop advisors, and yielded 56 respondents from 5 eastern states. Items from this comprehensive list that were ranked as highly important to more than 50% respondents were selected for inclusion in the present project. Our overall objective is to *develop, refine, validate, and deliver an advisory system and forecasting model for improved management of grapevine powdery mildew.* Essential aspects of the advisory system will answer the questions identified by stakeholders

All are relevant to the number one ranked priority (1 of 28) of the 2006 Fruit IPM Stakeholder Research Priorities for New York State for grape*: "Powdery Mildew Biology and Management*".

Previously-developed advisory systems (10) have dealt with powdery mildew in Mediterranean climates and have not provided accurate recommendations for the Northeastern US. Most would

delay fungicide applications in New York until early July and leave fruit unprotected during the period of greatest susceptibility. Reduced yields, reduced fruit quality, reduced wine quality, and increased populations of spoilage microorganisms can result (4-7). Consumers will remember a single bottle contaminated by the spoilage microorganism *Brettanomyces* (it smells like manure) long after they have forgotten several excellent vintages. If this is their first experience with a particular winery, it is also likely to be their last. Our group has completed research that could serve as the basis of a new forecasting system (1-9). However, more research will be required to answer the specific questions posed by Northeastern growers.

OBJECTIVE: To develop, refine, validate, and deliver an advisory system and forecasting model for improved management of grapevine powdery mildew.

PROCEDURES

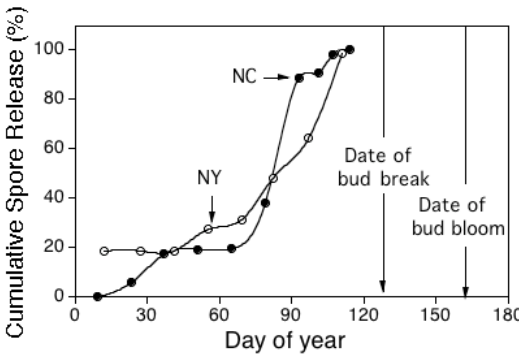
When has an infection period occurred? This was the question posed by growers as the most-important in day-to-day decisions in disease management. Accordingly, it was our first priority in 2006. Post-release conditions required for infection were described in an earlier study (2). We wanted to learn more about the factors that determined when the overwintering inoculum was mature and when the supply was exhausted. Some years should be, based on weather during the 8 weeks after bud break, severe powdery mildew years. And yet in some such years the disease is relatively mild. Is this due to unexpected variations in inoculum maturity and survival during winter?

To determine the impact of regional environmental conditions on ascospore release, heavily mildewed leaves were be collected during September of 2005 at a research vineyard in Geneva, NY. The overwintering structures of the powdery mildew pathogen were washed from the leaves and transferred to 9 cm filter paper disks. These disks were then fastened to white, vertical, north-facing boards in vineyards located in Geneva, NY; Raleigh, NC; Chatsworth, NJ; and Prosser, WA. Cooperators at each site removed three replicate filter paper disks bearing cleistothecia at 1- to 2-week intervals and shipped them to our lab at Geneva via express courier, where they were assessed for maturity and release of spores as previously described (2).

Samples of cleistothecia were transferred to filter paper disks for overwintering at several vineyard sites in the eastern US. This allows us to quickly assess their maturity throughout the growing season.

RESULTS AND DISCUSSION

Spore release from cleistothecia overwintered at the above sites was assessed from Jan. to June 2006. For simplicity, only data from NY and NC are presented in Figure 1, although results from the other sites were similar. Note that at both locations the distributions of spore release are temporally similar. However, they are shifted in time relative to local dates of bud break and bloom. All spores in NY were released before bud break in NY. Bud break and bloom in NC was 1 month earlier (Day 91 and 137, respectively). Normally, the first spores are not



Cumulative release of ascospores from cleistothecia of *Uncinula necator* overwintered in New York (NY) and North Carolina (NC). Dates of bud break and bloom are shown for NY.

released until bud break. This suggests that the normal synchrony of the pathogen can sometimes get out of whack and can cause substantial, even complete depletion of the spore supply before there is host tissue to infect: a highly significant finding relative to disease control if it can be predicted.

Based upon the promising results obtained in the first season, we have begun to repeat and expand upon the above work. We have enlisted cooperators on the east coast of the US as far south as Georgia and will not only overwinter NY cleistothecia at each site, but also overwinter cleistothecia from these states in NY. Our present array includes NY, PA, NJ, VA, NC, GA, and WA. In October of this year, the PhD student supported by the project (Michelle Moyer) traveled to the PA, VA, and NJ sites to assist the cooperators in the collection of cleistothecia and preparation of the samples for the 2006-2007 overwintering studies. These samples are now in place at all sites and we have begun receiving shipments at Geneva for assessment.

RELEVANCE OF THE 2006 RESULTS FOR GRAPE GROWERS AND ADVISORS

Premature mid-winter release of overwintering spores greatly lowers the potential for severe powdery mildew. Prediction of this phenomenon would allow fungicide applications for multiple diseases to be integrated and synchronized (1) with key stages of vine growth (e.g., immediate prebloom and immediate postbloom), thereby reducing the number of sprays and enhancing the impact of remaining sprays on multiple diseases.

ACKNOWLEDGEMENTS

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