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# Disease-resistant Varieties are on the Way

Can we ensure they last?

Michelle M. Moyer, Timothy Martinson and Lance Cadle-Davidson

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**AN ERA OF LOW-INPUT**, disease-resistant grape varieties is coming. Marker-assisted selection (see "Grape Breeders No Longer Flying Blind," *Wines & Vines*, March 2018) is allowing breeders to confidently incorporate several resistance genes into new varieties that will express a high level of resistance and offer the prospect of very significant reductions in fungicide applications. While today's vinifera grape growers rely heavily on fungicide use (up to 10 to 15 sprays per season, depending on location and management), these new varieties may require only two or three sprays per season.

The first efforts in breeding the next generation of grape varieties have focused on natural resistance to powdery mildew, Pierce's disease and downy

mildew, both because of their economic importance internationally and because genetic solutions are readily available. For example, within the past 20 years, over a dozen powdery mildew resistance loci (i.e., gene regions) have been identified in different grape species, along with DNA markers to track the resistance (see "The Phenotyping Bottleneck: How grape breeders link desired traits to DNA markers," *Wines & Vines*, January 2019). These have been used to create varieties that carry both quality attributes and disease resistance. The economic and environmental benefits of disease-resistant varieties are potentially huge and cumulative.



**PHOTO 1:** Vines in row 7 of Bruce Reisch's "no spray" block at Cornell Agri-Tech, previously selected for disease resistance, most of which have the *Run1* gene for powdery mildew resistance. Vines were photographed after temperatures had dropped to -2° C the previous night, hence some foliar frost damage is evident.



**PHOTO 2:** Vines growing in row 6 of the "no spray" block, a population not previously selected for disease resistance, were photographed the same day as the vines in **PHOTO 1**.

ALL PHOTOS TIMOTHY MARTINSON

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## Disease-resistant Varieties are on the Way

### Will Resistance Last?

The challenge is this: Once we deploy these varieties on a large scale, will their disease resistance last for the entire production lifespan of the vineyard? Disease-resistant varieties are management tools much like fungicides, and we do not have a good track record for fungicide stewardship. With a generation time of seven to 10 days on average, and thousands of spores released daily from each infected leaf, the fungus that causes grapevine powdery mildew (*Erysiphe necator*), is designed to evolve rapidly in response to selection pressure. Under fungicide selection pressure, resistance of powdery mildew to successive groups of new fungicides has typically been reported within a few years of their introduction. Resistance to benzimidazoles (introduced in 1973) was first reported within four years, demethylation inhibitors (introduced in the 1980s) within three and one years (triadimefon and myclobutanil, respectively), and azoxystrobin (introduced in the 1990s) was first reported within six years.

Disease-resistant varieties, like fungicides, will select for pathogen strains that can overcome the resistance, and the selection pressure may be more intense with disease-resistant varieties. Fungicide residues are relatively short-lived, so selection for resistant strains comes and goes as residues decay. Resistant plants are “always there, always on,” and therefore exert constant selection pressure on the powdery mildew fungus.

### HOW CAN BREEDERS AND GROWERS HELP RESISTANT VARIETIES STAY RESISTANT?

Like the development of new fungicides, breeding new disease-resistant varieties through traditional methods takes time and money, even with new tools to speed up the breeding process. Disease resistance is a limited resource, so we want the attributes of these new varieties to last. Two key factors will influence how long disease-resistant varieties will maintain their effectiveness with mildew management in commercial vineyards; that is, how durable the disease resistance will be. First, it's important to consider how resistance genes are incorporated into new varieties. The second, and equally important, factor will be how these new varieties are deployed and managed in commercial vineyards.

### Incorporating Resistance Genes in New Varieties

With more than a dozen resistance loci trackable with markers, grape breeders can choose which, and how many, resistance genes to put into new varieties. The consensus is that it is important to “stack” multiple genes into each variety to improve the odds that the resistance will last. The challenge is deciding which genes and how many to incorporate into a variety.

Each marker-associated gene has a different mode of action and a different effect on the powdery mildew fungus. For example, the *Run1*, *Ren4* and *Ren6* loci can provide complete (major) suppression of powdery mildew in greenhouse and field tests while most others provide partial (minor) protection. By combining “major” and “minor” genes, some tests have shown that the effects are additive—that a grapevine with two resistance genes expresses stronger resistance than a grapevine with one.

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Figure 1: Grape breeding lines with 16 different combinations of 0 to 4 resistance genes have been created to test efficacy of gene “stacking” against varying strains of powdery mildew.

R gene #	RUN1	REN1	REN6	REN7
0				
1	■			
1		■		
1			■	
1				■
2	■	■		
2		■	■	
2	■		■	■
2	■			■
2	■			■
2		■	■	■
3	■	■	■	
3	■		■	
3	■	■		
3		■	■	■
4	■	■	■	■

Another consideration is that *E. necator* strains also are genetically variable and react differently to resistance genes. When tested against different fungal strains from different geographical areas, all the known gene loci, except for *Ren4*, were at least somewhat susceptible to specific strains of the fungus. For example, the *Run1* gene shows strong resistance to most powdery mildew strains, except for strains from the Southeast United States, where the fungus co-evolved with this resistance gene. Pathologists refer to this as race-specific resistance.

The consensus of grape breeders worldwide is that stacking multiple genes into a variety will provide greater durability than single genes. But given the strong evolutionary adaptability of the powdery mildew fungus, it is also assumed that disease resistance genes will eventually select for resistant powdery mildew strains, regardless of how many loci are stacked. There is still scientific debate as to how many, and which, genes should be stacked, and how that will translate into long-lasting disease protection.

To guide these decisions with data, breeding programs in New York, California and Minnesota, as a part of *VitisGen2*, have produced crosses with all possible combinations of four powdery mildew resistance loci (*Run1*, *Ren1*, *Ren6* and *Ren7*), and will be testing these 16 combinations against diverse strains of the powdery mildew fungus (FIGURE 1). Additional tests are being done that will evaluate 32 different combinations of five loci: *Run1*, *Ren1*, *Ren3*, *Ren4* and *Ren10*.

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Photos 3A and 3B: These microscope images show sibling grapevines A) with and B) without the *REN4* powdery mildew resistance gene, that were infected by powdery mildew at the same time. A few small strands of hyphae can be seen on A), the *REN4+* leaf. The white stuff on B), the *REN4-* leaf, is hyphae and tens of thousands of spores.

### Deploying Disease-Resistant Varieties in the Vineyard

The durability of these resistant varieties will be tied to a simple concept: Disease-resistant varieties will still require growers to use chemical and cultural practices to manage powdery mildew. Because these varieties provide constant selection pressure against the powdery mildew fungus, the fungus would likely overcome that plant-based resistance in the absence of additional management intervention.

The use of resistant varieties should be considered as a part of a larger, holistic approach to grape disease management. When coupled with existing chemical and cultural approaches, their adoption could result in significant time and chemical savings relative to approaches that only rely on traditional canopy and chemical management.

### FUNGICIDE PROGRAMS WILL STILL BE IMPORTANT

Less-intensive spray programs will likely be required, even with disease-resistant vines, and one or two fungicide applications could be effective in eliminating rare, virulent types as they develop. While work is still needed to verify the timing and intensity of intervention necessary for disease management, these varieties would allow growers to significantly reduce fungicide inputs while providing more freedom to focus management primarily around the critical window for powdery mildew: immediate pre-bloom to pea-size berries.

For example, developers of the new French varieties with two stacked powdery mildew and two stacked downy mildew genes recommend two fungicide sprays, which is at least an 80 percent reduction in spray applications, especially when compared to a variety like Chardonnay, which would have received 10 to 15 sprays to manage diseases (see Resistant Grape Varieties, 2018 in the references).

### CULTURAL PRACTICES WILL ALSO BE NEEDED

Cultural practices, such as canopy management, shoot-thinning and fruit-zone leaf removal, would still be recommended due to their ability to positively influence fruit quality and promote good spray coverage for chemical disease management. But growers would now have more time to do these practices because they are not spending that time spraying and would have fewer restricted-entry days in the vineyard post-spray application.

Using disease-resistant varieties would also assist in fungicide resistance management. Fewer sprays in a season make it easier to limit the overall use of a single fungicide chemical class to once or twice a season and facilitate the ability to more effectively rotate between fungicide classes.

## Where and How Disease-Resistant Varieties Fit Within Existing Commercial Operations

### MARKETING

Given the perceived market advantage of internationally-grown vinifera cultivars, where could these newer, high-quality, powdery mildew-resistant grape varieties fit?

### “GREEN” MARKETING

Disease-resistant varieties could provide a significant marketing advantage in an age of transparency and consumer food awareness. Given that these varieties require fewer fungicide sprays, there is no better foundation for an accurately-labeled sustainability marketing campaign. Resistant varieties could also make the production of organic wine economically attainable for more producers by reducing pesticide and labor inputs.

### WHEN A VARIETAL NAME IS NOT THE SELLING POINT

While it might be a few years before people are comfortable with growing a new variety and marketing in the ultra-premium category, there is immediate value in the use of these next-generation powdery mildew-resistant varieties to produce blends, dessert and sparkling wines, wines where profit margins may be slim or where recognized varietal typicity is not a major selling point.

### DISEASE-RESISTANT VARIETIES COULD HELP MANAGE “PROBLEM” VINEYARD BLOCKS OR AREAS

Finding a place in a product portfolio is one requirement for adoption of these new varieties—another is figuring out how and where to grow them. A few potential tips and approaches are described below:

1. Admittedly or not, everyone has their “problem” vineyard areas that make consistent management of powdery mildew (PM) challenging. Even with these challenges, though, these problem areas are not removed from production; the fruit has a market of some form. But what if, when the natural production span of these problem areas is reached, they are replanted to powdery mildew-resistant varieties? Could this tool help reduce the inputs needed to reach cost-to-produce goals or, perhaps, allow a higher fruit quality that can increase the tier-status (and value) of the fruit? Planting disease-resistant varieties into problem areas could reduce the amount of time spent and fungicides used in those blocks, freeing up those resources to be spent in other vineyard locations or time spent on other cultural strategies that enhance fruit quality.
2. A grower would not have to plant the entire farm to disease-resistant varieties to gain an economic benefit. The durability of disease resistance in plants is not only based on some level of management intervention (described above) but also on mitigating the risk of potential selection events of the PM pathogen. There is no greater risk of selection events than that posed by planting a monoculture of the same plant genetics, which reflects our current situation with *Vitis vinifera*. **FIGURE 2** depicts several different potential planting schemes for incorporating resistant varieties into blocks or whole-farm. The pros and cons of these different planting schemes are described below.

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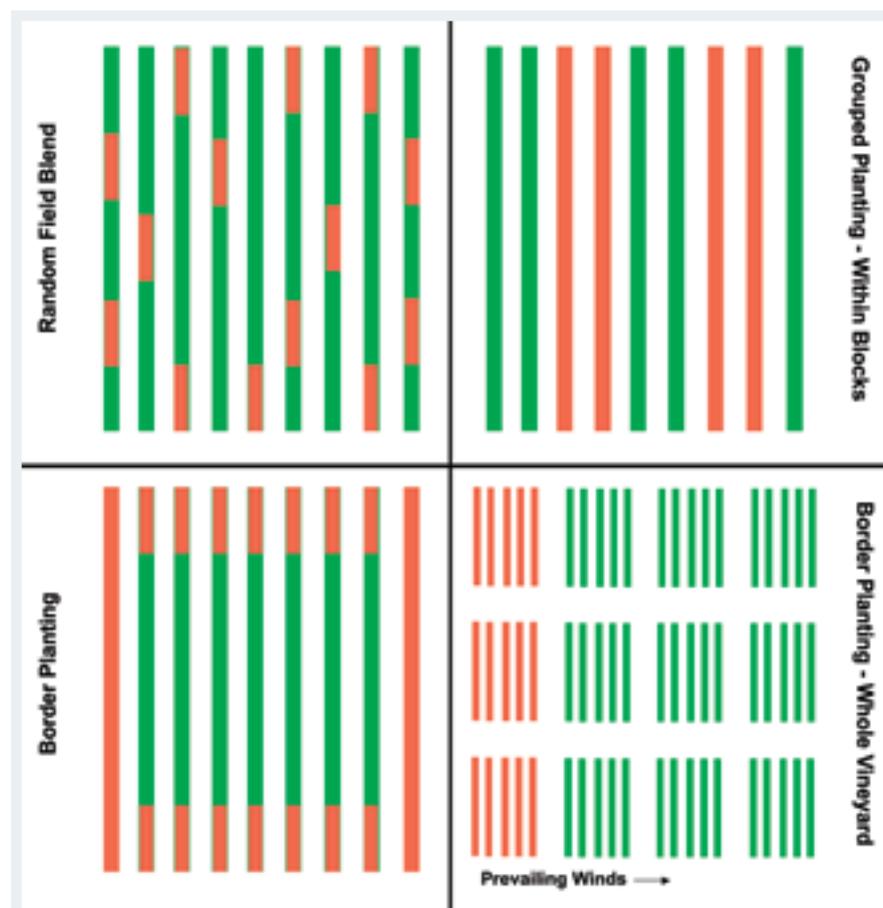
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**FIGURE 2:** Potential planting patterns that incorporate disease-resistant varieties into vineyard blocks, or across whole-farm plantings. Green lines represent either sections or whole rows that were planted to vines that are not disease resistant. Orange lines indicate rows or sections of rows planted to disease-resistant vines.

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**Random field blends and grouped plantings within blocks:** In wheat, for example, random field blends of different varieties (with different attributes, such as disease resistance) have been planted, breaking up the monoculture and preventing widespread loss to disease. Unfortunately, this strategy may not be as feasible in modern grape production. Unlike annual crops where the disease pressure is often reset each year, disease can build up over time in a perennial system. In vineyard field blends the entire block would ultimately have to be treated on a schedule that manages for disease in the most susceptible variety. This could also be true even if resistant varieties are restricted to entire rows; the risk of human error when spraying a complicated planting design might outweigh the product cost savings of not having to spray a few random rows.

The potential benefit to a random field blend, or whole-row blend, is the level of disease control that would be needed during the establishment years of the vineyard. Disease would likely build slowly, so reduced spray programs could potentially be used for more than one or two years after planting. Field blends might also pose additional challenges if preferred cultural practices differ between the varieties.

**Border planting, or border planting across a whole vineyard:** In vineyards, if border rows, or entire blocks within a large production area, are planted to resistant varieties, the ability to coordinate management practices, such as reduced or altered spray schedules and cultural practices, is easier. If a grower has as little as 10 percent of the total acreage planted to resistant varieties, at an 80 percent reduction in product application, there would be a whole-farm reduction in pesticide use of 8 percent. In addition, there would be cost-savings (or potential increase in revenue) related to the ability to reallocate the labor saved from reduced spraying to other tasks or blocks on the farm.

## New Disease-Resistant Grape Varieties Will Be a Part of a Sustainable Future

The new grape varieties of today and tomorrow are not the same as the hybrids of the early 20th century. Marker-assisted selection allows breeders to pursue a more directed focus on both desired traits, such as disease resistance, and required traits like fruit quality (see “Grape Breeders no Longer Flying Blind,” *Wines & Vines*, March 2018). Our centuries of viticulture knowledge in managing our classic *Vitis vinifera* varieties make it hard to embrace change. Wine and grape production is steeped in culture and tradition, but one cannot see what is ahead if you only look back.

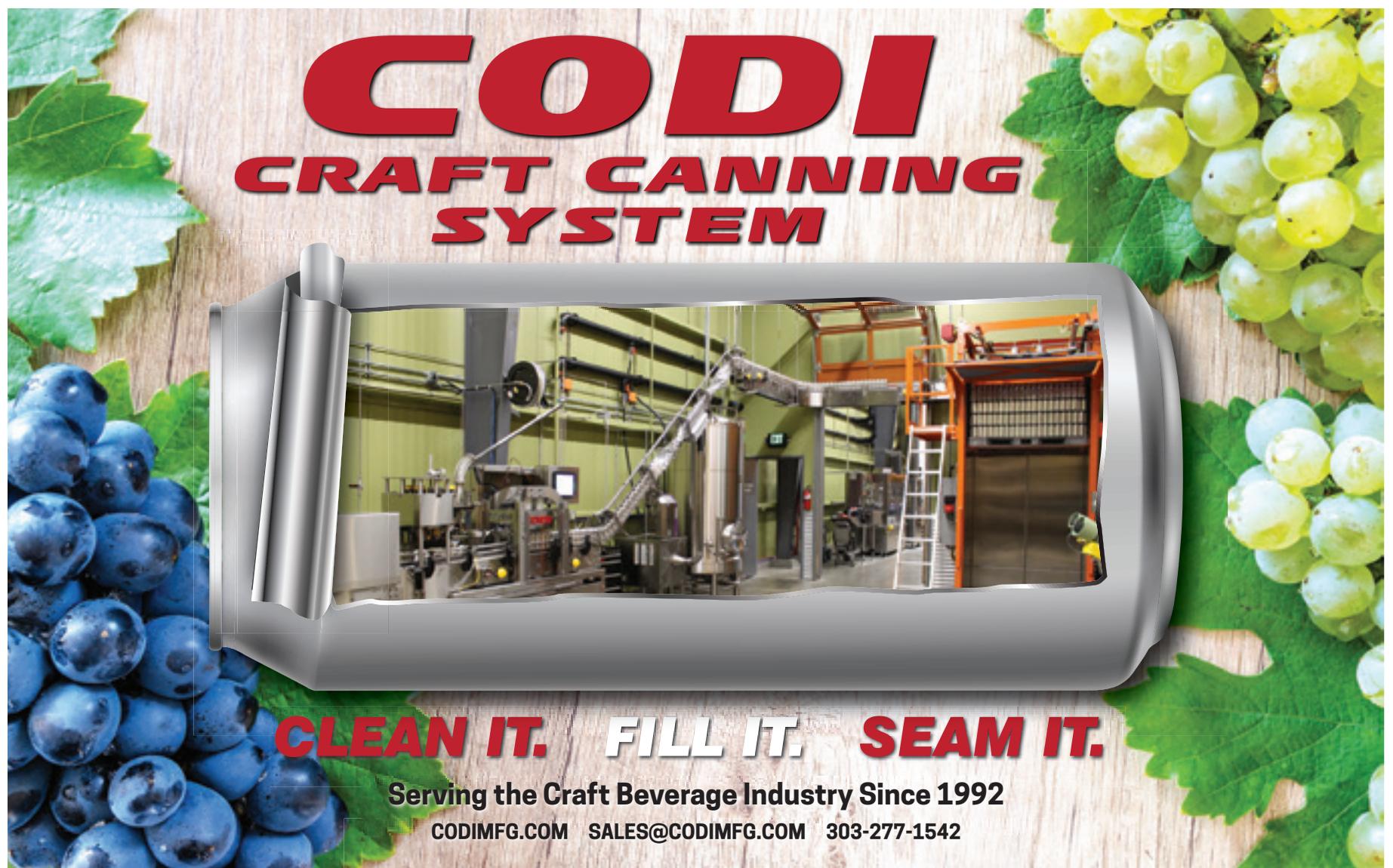
The future will be defined by our ability to embrace all facets of sustainability, which will include some level of adoption of disease-resistant varieties. A proactive approach suggests now is an opportune time to start experimenting with how powdery mildew-resistant varieties can be incorporated into replanting (or planting) schemes, not just for new or niche markets but for all major segments and regions of the winegrape industry. **WBM**

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### References

- Anon. 2018. Resistant Grape Varieties. Science and Policy publication, September 2018 INRA, Paris, France <https://inra-dam-front-resources-cdn.brainsonic.com/ressources/afile/451355-3b8a4-resource-science-et-elus-no1-version-anglaise-vignes-resistantes.pdf>
- Martinson, T. E. 2018. Grape breeders no longer flying blind. *Wines & Vines*, March 2018.
- Martinson, T. E. and L. Cadle-Davidson. 2018. The Phenotyping Bottleneck: How grape breeders link desired traits to DNA markers, *Wines & Vines*, January 2019
- Sambucci, O. J. Alston, and K. Fuller. 2014. The Costs of Powdery Mildew Management in Grapes and the Value of Resistant Varieties: Evidence from California. Robert Mondavi Institute Center for Wine Economics. PDF accessed at <http://vinecon.ucdavis.edu/wp-content/uploads/2014/09/CWE1402.pdf>



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