Cluster elongation to control bunch rot in winegrapes

BY Stan Grant, Progressive Viticulture

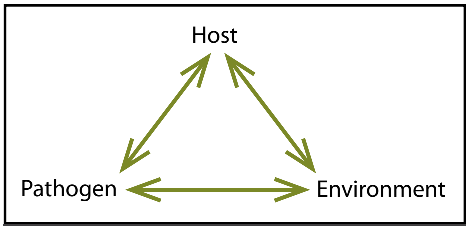


Figure 1. The disease triangle.

Bunch rot in winegrapes has three components: the host, the pathogen and the environment.[1] For bunch rot, the host is the grape cluster, the pathogen is one or more fungi, and the environment is the fruit zone within the grapevine canopy.

Bunch rot fungi include both primary invaders capable of penetrating berry tissues, such as *Botrytis cinerea*, and secondary invaders that enter berries through damaged tissues. Sour rot also includes the bacteria *Acetobacter*.[11] Plant pathologists represent the interactions of the three disease components in the form of a triangle (Figure 1).

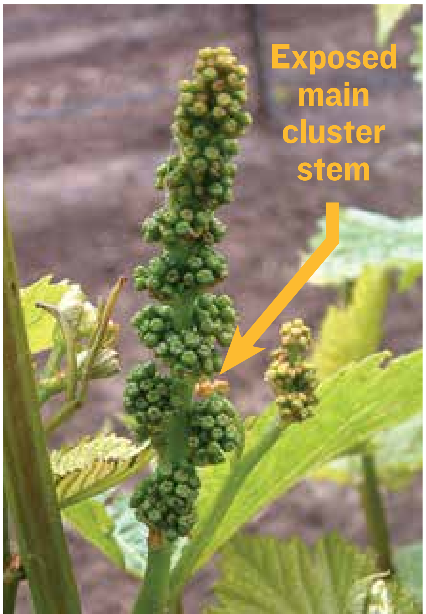
Grapegrowers may limit bunch rot through their influence on any of the three components of the disease triangle. The canopy environment can be influenced through management practices (shoot thinning and leaf removal) that decrease canopy density and thereby increase air movement in the fruit zone. These practices significantly lessen the potential for bunch rot.[5,9,16]

The pathogen, or fungi themselves, can be directly influenced with fungicide applications. The aforementioned canopy-management practices usually enhance the efficacy of the fungicides.[20] Affecting the bunch rot host has proven more challenging in many instances.

Certain wine grape varieties (Table I) are prone to bunch rot due to the compactness (high density) of the clusters.[10,17] In such clusters, surface contact between adjacent berries restricts development of the protective exterior cuticle at the points of contact.[12,14]

Later, during ripening, the pressure exerted by expanding adjacent berries causes leakage of juice where some berries connect to their stems (pedicels). Such leakages—especially in combination with the presence of dead flower parts inside the cluster that hosts disease inoculum, and in varieties that have thin berry skins—promote bunch rot diseases.[6,10,22] The tightness of the berry assemblage also restricts airflow in the cluster, which increases the internal temperature and humidity, making the environment more conducive to disease.

For some tight-cluster varieties, clones are available with looser clusters that are less prone to bunch rot. In addition, some rootstocks such as St. George and Dogridge are known to give rise to looser clusters than others.



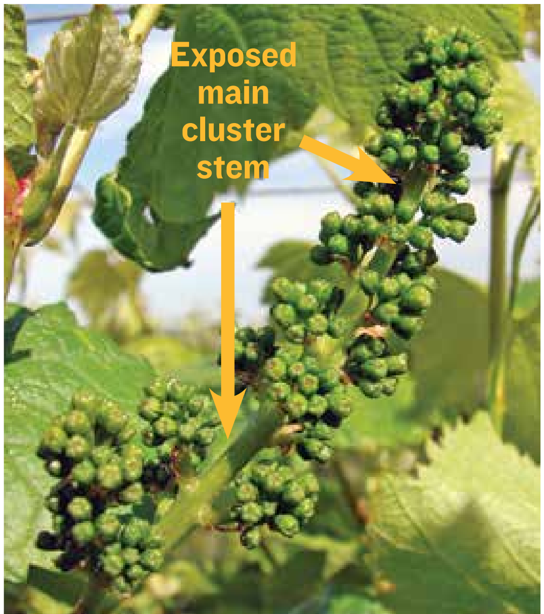


Figure 2. Early cluster elongation (left). Figure 3. Late-cluster elongation (right).

Figure 4. Flowers separated.

Regulated deficit irrigation schedules, particularly when they cause early season moderate water stress in vines, limit berry size, loosen clusters and diminish humidity in canopies. Still, the extent that plant material selection and water management can mitigate disease is limited, and although they may somewhat reduce bunch rot, most tight-cluster varieties remain susceptible.

Gibberellin

Gibberellins are a group of plant hormones. In agriculture, the names gibber-

Figure 5. Gibberellin-treated Zinfandel is ready for harvest.

ellin, gibberellic acid and gibb commonly refer to the GA_3 gibberellin compound. It is the most active of the gibberellins and is synthesized in roots, young leaves, shoot tips, embryos, seeds and young berries.[7,15]

Gibberellin is involved in dormancy, differentiation of vascular tissues and elongation and growth of roots, stems and leaves. Its promotional effects on tissue growth involve increased cell wall plasticity, elongation and division.

In addition, parts of a vine treated with a spray application of gibberellin tend to accumulate sugars at higher than normal levels. Along with cytokinins, another group of plant hormones, gibberellin influences flowering in grapevines; external applications during flowering induce floral abscission and/or increased shot berries.[13] Foliar applications near or during flowering may reduce bud fruitfulness and fruit yield the following year by encouraging formation of tendrils and inhibiting the formation of inflorescences.

Short history: gibberellin for bunch rot control

During the late 1950s and early 1960s, foliar applications of gibberellin to elongate the clusters of rot-prone grape varieties were studied in France, Germany, New York and California.[29,21]

University of California (UC) research indicated the best timing for cluster elongation, especially lengthening of the pedicels of seeded winegrape varieties, coincides with a cluster length of 3 to 4 inches. (At this time, the total range of cluster lengths may vary between 2 and 5 inches.) During the same period, shoots are between 15 and 20 inches long. These developmental stages occur about two to three weeks prior to bloom.

UC research also showed that, as with all bunch rot control methods, application of gibberellin provides benefits only during years of high disease incidence. In this regard, it is a preventive treatment.

Based on these research findings, many California winegrape vineyards were treated with gibberellin for bunch rot control. Widespread application, however, ceased around 1977 due to gibberellin misuse by a few growers, associated yield loss, litigation and the manufacturer rescinding the label.

Nevertheless, some vineyard owners in the Sacramento River Delta acquired Special Local Need Registrations and have treated Chenin Blanc, Petite Sirah and Zinfandel with gibberellin since the 1960s without ill effect.

Gibberellin must be applied at the proper time and in the proper concentration to avoid undesirable side effects related to fruit yield, both during the year of application and the following year.

During the 1980s and early 1990s, Special Local Need Registrations also were issued for vineyards in San Joaquin, Stanislaus and Merced counties. About 2002 a gibberellin manufacturer reinstated a label for winegrapes and during the past decade, and the number of treated acres in the Delta and Lodi has steadily increased.

Scheduling foliar gibberellin applications

Experience has shown the degree of elongation of the main cluster (rachis) stem—rather than cluster length or shoot length—is a more precise determinant for scheduling gibberellin application.[2,3] Deciding when to apply gibberellin requires that growers focus on the lateral stems, which are attached along the length of the central or main stem of the cluster. The lateral stems have flowers attached to them and they appear as clumps of flowers at this time of year.

As the main stem begins to elongate, the lateral branches near the base of the cluster begin to separate from one another and, as they do, the main cluster stem becomes clearly visible between them (Figure 2). These events mark the onset of the period of rapid cluster elongation, during which the clusters are receiving an influx of gibberellin from inside the vine.

During the next few days after the onset of cluster elongation, the cluster tip will continue to distance itself from the cluster base as the main stem of the cluster continues to elongate. During the same time, more of the main cluster stem becomes exposed (Figure 3). (Shoots are normally 6 to 12 inches long during the period of rapid cluster elongation.)

Foliar applications of gibberellin during the cluster elongation period accentuate the internal gibberellin supply and have negligible effects on yield.[8,19] There is no effect on wine quality.[19]

It is too late to apply gibberellin after cluster stems have elongated so far that flowers on lateral braches have separated, due to the risk of excessive flower abscission and yield reduction (Figure 4).[19] With very late applications, gibberellin causes very little cluster elongation.[3] Late gibberellin applications may also induce primary bud death.[4]

Table I. Bunch rot susceptibility of selected wine grapes

Negligibly Susceptible
Alicante Bouschet, Muscat of Alexandra, Petit Verdot, Rubired, Ruby Cabernet, Tempranillo, Thompson Seedless

Slightly Susceptible
Cabernet Franc, Cabernet Sauvignon, Merlot, Mourvedre, Muscat Blanc, Muscat Hamburg, Roussanne, Sylvaner, Syrah, Viognier

Moderately Susceptible
Barbera, Burger, Carignane, Colombard, Grenache, Malbec, Malvasia Bianca, Meunier, Sangiovese, Semillon, Trousseau Gris (Gr. Rslg.)

Highly Susceptible
Chardonnay, Chenin Blanc, Gewurztraminer, Petite Sirah (Durif), Pinot Blanc, Pinot Grigio (Gris), Pinot Noir, Riesling, Sauvignon Blanc, Zinfandel

Sources: Marois, et. al; Vail and Marois; Grant (personal experience)

Table II. PROGIBB 4% Application rates for varying quantities of water per acre

Targeted Gibb Concentration (ppm)	Water Per Acre (gal)	PROGIBB 4% Per Acre (fluid ounces)	Varietal Recommendation[1]
2.5	50	0.5	Sauvignon Blanc
2.5	75	0.7	
2.5	100	0.9	
7.5	50	1.4	Barbera, Carignane, Chardonnay, Chenin Blanc, Colombard, Pinot Noir, Petite Sirah, Tempranillo, Zinfandel
7.5	75	2.1	
7.5	100	2.8	
20.0	50	3.8	Grenache
20.0	75	5.7	
20.0	100	7.6	

1. Source: Pro-Gibb 4% label, Valent BioSciences Corp., 2011.

Gibberellin application concentration

The quantity applied is as important as timing of application. For gibberellin, grape clusters respond to the concentration of active ingredient in the solution rather than the active ingredient per acre.[2] Varieties differ in their sensitivity to gibberellin, and as a result the appropriate application concentration varies accordingly.

Due to the presence of seeds, all wine grape varieties are highly sensitive to gibberellin, especially compared with some other crops like seedless table grapes, citrus and cherries.

At low concentrations (2.5 to 20 ppm depending on variety), gibberellin induces moderate cluster elongation and minimizes bunch rot in wine grapes. At high concentrations, however, gibberellin causes clusters to stretch excessively and creates cluster deformation including twisting.[3] They also decrease bud fruitfulness of seeded grape varieties.[13,21] At very high concentrations (50 ppm), gibberellin will prematurely defoliate grapevines.[3]

Other gibberellin considerations

Gibberellin is registered with the Organic Materials Review Institute (OMRI) and therefore is suitable for organic-management programs. The risks associated with this material are the viticultural risks described above.

The legal use of gibberellin, like all registered growth-enhancing chemicals, requires the written recommendation of a licensed pest control advisor. With their guidance you can avoid the risks and achieve the benefits of this material.

Labeled application concentrations for specific winegrape varieties and sprayer tank volumes are given in Table II. These solutions will elongate clusters and minimize bunch rot with negligible undesirable side effects when applied during the cluster elongation period. For consistent results, thoroughly wet the entire foliage with the specified solution.

Gibberellin is only one component of a comprehensive bunch rot-management program for tight-cluster wine grape varieties. To ensure minimum bunch rot, use gibberellin with additional practices and materials that effectively address the other components of the disease triangle.

Conclusion

Gibberellin application is a low-cost, efficacious method to minimize bunch rot in compact clusters, especially when used in conjunction with vineyard management practices that optimize air movement in the fruit zone and reduce bunch rot inoculum.

Gibberellin must be applied at the proper time and in the proper concentration to avoid undesirable side effects related to fruit yield both during the year of application and the following year. Application concentration is variety-specific because varieties differ in their sensitivity to gibberellin.

Properly applied foliar applications of gibberellin will enhance normal physiological processes during rapid cluster elongation. Apply gibberellin only with the assistance and written recommendation of a pest control advisor. PWV

Acknowledgements

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Dedication

This article is dedicated to the memory of Mike Vail, one of California's finest viticulturists.

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