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Growth Regulators

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A growth regulator for raisins is a natural or synthetic chemical compound that enhances or alters the fruit characteristics of raisin grapes. The two registered compounds available for raisin grapes at the time of this publication are gibberellic acid (GA) and ethephon. Gibberellic acid is used at bloom to thin and size berries and ethephon is used at berry softening (veraison) to enhance fruit ripening. Not all vineyards will benefit from the use of a growth regulator; it is an added tool that growers can consider using to supplement other cultural practices with the object of improving raisin quality.

GIBBERELLIC ACID

Gibberellic acid (GA_3 formulation) sprays are used at bloom to thin berries and increase berry size. The main goal is to improve grape maturity and raisin grades. Studies conducted by University of California Cooperative Extension researchers have demonstrated the following effects from bloom treatment with GA in 'Thompson Seedless' raisin vineyards:

- increased fresh berry and raisin weights, mostly ranging between 8 and 11 percent
- increased total soluble solids per berry, but only occasional increases in percent soluble solids concentration (°Brix)
- improved airstream sorter raisin grades for percentage B and better and percentage substandard in some vineyards
- increased length of berries
- measurable thinning of berries only occasionally found
- no increased cluster length at harvest in any trial
- no experimentally documented reductions in incidence of bunch rot
- no effect on raisin yield

The most consistent effects measured in these studies have been increased berry weight and increased total soluble solids per berry. Increases in percentage soluble solids, airstream sorter grades, and berry thinning have been less consistent; they occur in only some vineyard situations. It is also important to know that raisin yield differences, incidence of bunch rot, and cluster lengthening have never been reported in these studies. The berry thinning effect appears to be minimal, or at least too small to be consistently measured. It is possible that the berry lengthening effects also increase the apparent looseness of clusters. Also, it is possible that bunch rot is reduced in some situations where it would have been encouraged by excessively tight clusters, but this has not been reported in these studies.

Whether to Use GA

Your decision whether or not to use GA should be based on your vineyard's history of raisin production and quality, the current season's crop progress and potential at bloom, and your consultations with a packer representative. Some growers prefer to try GA first on a few rows or acres to determine possible benefits in their vineyards.

Gibberellic acid probably is most beneficial in vineyards with a history of heavy crop loads, late fruit maturity, or poor raisin quality (particularly in years when bunch counts are high). GA treatment should also be considered in years when cool spring weather creates the potential for a late season. Conversely, GA would be of questionable value in vineyards with a his-

tory of good raisin quality or in years when the bloom is early and the cluster count is moderate or low. You should also consult your raisin packer: marketing constraints for large raisin sizes may prompt some to object to the larger berries produced with GA.

Overall, GA's greatest potential benefit is to improve berry size without reducing soluble solids. This increases the total soluble solids per berry and can result in better raisin grades.

Application of GA

Follow label directions for bloom thinning sprays only. Applications before bloom for the so-called "stretch" effect are not warranted. The idea of the stretch treatment is to loosen clusters by lengthening their stem framework. However, University of California studies have shown that untreated clusters will catch up with the lengthening of GA-accelerated clusters. No harvest time benefits in cluster or berry characteristics or raisin quality have ever been shown to justify the use of stretch sprays. Also, stretch sprays have been shown to reduce bud fruitfulness of canes the following year. This is because they are applied early in the spring when flower primordia in the buds are being initiated.

Bloom sprays are most effective during the 30 to 80 percent bloom stage ("percent bloom stage" refers to the percentage of flower caps that have fallen or are cracked at their base). The bloom stage is an overall average; some clusters may have completed bloom and others may just be beginning. Base your judgment of the current percentage on the appearance of a majority of well-developed, normal clusters on both sides of the vine canopy. Never apply GA at fruit set: it will increase berry size with no possibility of thinning. The larger berries may delay maturity and increase cluster compactness for slower raisin drying. A 10 ppm application of GA at fruit set has also been shown to increase stem retention during processing. However, no stem retention problems have been documented to be associated with properly timed bloom sprays.

Direct GA sprays toward the blooming flower clusters, making sure to contact all of the cluster parts. Diluted and concentrated spray applications are equally effective, provided coverage is comparable. Added wetting agents, acidifiers, buffers, and nutrients such as urea in the spray solution have not improved GA's efficacy.

Follow label directions for per-acre application rates. Most bloom sprays are applied in the range of 3 to 6 grams of GA per acre (7.5 to 15 g/ha) for 'Thompson Seedless.' This has been shown to be sufficient to achieve the desired effects on raisin quality. Higher rates will increase berry size, which may be an undesirable effect from the packer's standpoint.

GA for Other Raisin Varieties

'Zante Currant' ('Black Corinth'). Because its berries are naturally tiny, this variety requires GA application if it is being grown for raisins. Growers used to girdle the vines at bloom to improve fruit set and increase berry size. This practice was replaced with a growth regulator spray of parachlorophenoxyacetic acid (4-CPA or "Grape Fix") during the 1950s. GA replaced 4-CPA in the 1960s because it did not delay fruit maturation and it eliminated the potential for vine damage experienced with 4-CPA (4-CPA is no longer registered for use on grapes).

Follow GA label directions. Typically, GA is applied at 4 to 6 grams per acre (10 to 15 g/ha) 3 to 5 days after full bloom (full bloom is at about 75 percent cap fall). This stage is thought to provide a compromise between berry thinning and sizing by moderating the effects of each response. Its main effect is probably to stimulate berry cell division and elongation. Preliminary studies have indicated that 8 grams of GA applied at full bloom may further reduce the occasional hard-seeded berries found in 'Zante Currant' clusters. However, further study is needed, and the timing is not within label guidelines.

'Fiesta.' The 'Fiesta' variety is not specifically labeled for GA use. It is particularly sensitive to GA, and this is one reason this variety is not used as a table grape. Preliminary studies demonstrated that there is too little room for error when applying GA to 'Fiesta.' 'Fiesta' will berry-thin satisfactorily at 1 ppm GA, but rates of 2 to 3 ppm will produce shot berries. Rates above 10 ppm will reduce vine fruitfulness the following year.

ETHEPHON

Ethephon (2-chloroethyl phosphonic acid) is a compound that decomposes to release the natural plant hormone ethylene. Its main use in fruit production is to enhance fruit ripening. Vineyard trials have shown that ethephon can advance 'Thompson Seedless' raisin grape maturity by about 1.0 °Brix or the equivalent of one week. Overall, University of California Cooperative Extension 'Thompson Seedless' vineyard trials have demonstrated the following effects:

- improvement in berry soluble solids ranging from 0.6 to 1.3 °Brix in seven out of eight trials
- lower titratable acidity in four out of six trials where measured
- no change in fresh berry weights

- improved airstream sorter grades (higher percentage B and better and lower percentage substandard) in four out of five trials
- no measured raisin yield effects
- no adverse effects on vine growth or cane maturity

Whether to Use Ethephon

Growers can use ethephon to accelerate fruit maturation in either of two ways. First, they can use it to permit harvest about one week earlier but at the same maturity, in order to take advantage of better drying conditions. Second, they can use it to permit harvest at a more conventional later date, but at higher maturity.

Ethephon application would be of questionable value in vineyards with a history of good raisin quality or in years with light to moderate crops and normal crop development. It should be considered in situations where the advancement of crop maturity is economically warranted. This is the case for DOV vineyards, where earlier cane cutting with advanced fruit maturity is always an advantage.

Ethephon should not be used in vineyards that are weak, stressed for water, or partially defoliated. Such vineyards will not respond with improved fruit ripening, and applications may prompt further loss of leaves. In a few cases ethephon has been observed to hasten the development of waterberry or berry shatter (looseness) in years or vineyards prone to these problems. However, so far as is known, this is a temporary hastening effect; the overall incidence of these problems at harvest appears to be similar whether the vines are treated or not. In any case, it is always a good idea to leave a few rows unsprayed. That way you can measure the response against an untreated "control," and verify the extent of any perceived adverse effects.

Ethephon can also be considered in vineyards where GA was applied at bloom. The responses to each growth regulator are independent of one another, and can be additive for fruit ripening. Trials have demonstrated that the greatest airstream sorter raisin grade improvement can sometimes be achieved when a GA application at bloom has been followed by an ethephon treatment at veraison.

Application of Ethephon

Follow label directions. Time of application is at berry softening (veraison). Timing studies have shown that comparable response can be obtained with a range of 1 to 95 percent of the berries in the berry softening stage. Applications at the end of berry softening (98 percent or more of the berries soft) become less responsive. Most growers prefer to apply ethephon before berry softening is nearing completion to ensure that they apply within the optimum response period.

A rate of 1 pint per acre (1.2 L/ha) (2 pounds/gallon [0.24 kg/L] formulated product) has been found to be optimal for most situations. A higher rate of 1½ pints per acre (1.8 L/ha) might be justified in large or heavy-canopy vines to adjust for coverage differences. Response is similar with diluted or concentrated application, provided that coverage is comparable. The spray should be directed so as to thoroughly cover the fruit and the surrounding leaves.

Response varies with grape variety, and published data are limited. A 'Muscat of Alexandria' trial that compared four rates and three dates of ethephon application showed no fruit response. Ethephon increased fruit soluble solids by 0.8 and 0.9 °Brix in two separate 'Black Corinth' trials. However, this response may be of limited value because of the early ripening characteristics of 'Black Corinth.' 'Fiesta' responds similarly to 'Thompson Seedless,' and the practice is common in 'Fiesta' DOV vineyards.

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