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Postharvest Decay of Late Season Table Grapes

by Bill Peacock and Joseph Smilanick

Gray mold (*Botrytis cinerea*) is the most destructive of the postharvest diseases of table grapes, especially for late season varieties that are subject to rain or high humidity. Other postharvest diseases such as Cladosporium, Alternaria, or Stemphylium can develop during storage but their importance is minor compared to Botrytis.

Berries with latent (hidden) Botrytis infections that end up in the box at harvest represent most of the initial infections of Botrytis leading to postharvest decay. In cold storage, latent infections continue to develop within the berry, despite fumigation with sulfur dioxide, and after a period of time the decay becomes apparent. Secondary infections occur with the spread of Botrytis to adjacent healthy berries ultimately creating a "nest" of decay.

Latent infections may arise when spores germinate and penetrate the berry surface, but then stop developing until the berry matures. Wounds near harvest caused by physiological cracking, tight cluster, insect or bird damage, or rough handling also provide opportunities for infections. No wound is required for infection when wet conditions occur.

Late season table grapes are particularly susceptible to Botrytis during periods of rainfall or high humidity and with mild temperatures (58° to 82 °F). Botrytis quickly develops under these conditions, and most, but not all, new infections become apparent after five to seven days. Delaying harvest five to seven days after wet weather allows thepacker to identify and trim infected berries; however, the level of infected berries packed usually increases after each storm along with the potential for decay during storage.

Various criteria are used to determine the storability of a specific lot of fruit. The storage history of the vineyard (some vineyards or varieties consistently have less decay problems than others), the general appearance of the fruit at harvest, and weather that occurred before harvest should all be considered. It is very important that all lots be inspected weekly for signs of decay during storage.

Predicting the storability of fruit is sometimes obvious. For example, grapes that have been subject to heavy rainfall for an extended period should be moved to market as quickly as possible or diverted to the winery under severe conditions. But, the effect that light rainfall or short periods of high humidity have on storability is often subtle and decisions on storage potential are difficult.

Harvey's Method of Forecasting Storage Decay

John Harvey, USDA plant pathologist, developed a forecasting method in the 1950's

that helps managers make decisions on the decay potential of specific lots of fruit at harvest (Harvey, 1984). The forecast method is fairly simple: five hundred berries are sampled from a specific lot, surface sterilized, incubated for ten days at room temperature and high humidity, and then evaluated for Botrytis decay. He found an excellent correlation between the level of decay forecasted at harvest and the level of decay developing in cold storage.

Sample Collection

The forecast requires collecting at least 500 berries from a specific lot. For the forecast to be accurate, the sample must truly represent the lot. Berries can be collected at packing stands by clipping single berries from packed fruit. The accuracy of the sample increases with the number of packages sampled (five berries from 100 packages should be adequate). Or, berries can be sampled directly from the vineyard during harvest. The 500 berries are collected in the vineyard by walking up and down rows clipping one or two berries from a single vine and sampling clusters located throughout the fruiting zone (high, low, inside, outside).

Carefully clip berries from the cluster to avoid injuring the fruit and choose only sound fruit. A minimum of time should elapse between taking the sample and running the forecast.

Sterilization

Surface sterilize the berry sample by fumigating with sulfur dioxide. The sample can be fumigated at the same time as the lot from which the sample was taken. Harvey used traditional initial fumigation (5000 ppm for 30 minutes). Rather than using sulfur dioxide, berries may also be surface sterilized by submersion in a solution of 0.5% NaOC1 (bleach) for one minute. A concentration of 0.5% NaOCl is achieved by diluting 1 part Clorox (5.25% NaOCl) with 9 parts water. After surface sterilization with either sulfur dioxide or bleach, be careful to keep the sample sterile and to prevent outside contamination from spores drifting in the air.

After surface sterilization, place berries in either glass jars (30 to 40 berries per jar) or petri dishes (six to eight berries per petri dish) or plexiglass sheets with holes drilled to support and separate individual berries (about 100 berries per square foot of plexiglass). Glass jars or petri dishes are placed on cafeteria trays so they can be more easily handled. Regardless of what container is used they must be sterilized to avoid contamination.

Incubation

The surface sterilized berries (either in glass jars or petri dishes or on plexiglass sheets) are placed inside a clear plastic bag along with a small dish of water (for humidity) and the bag is sealed. Containers, bags, water, etc. must all be aseptic to prevent recontamination of the surface sterilized fruit. The samples should be held at room temperature (about 70°F) for ten days.

Examination

Examine berries one by one after a 10-day incubation period. Most of the decay that develops will be Botrytis. However, some "Black Spot" from Cladosporium and Alternaria may also be present. They are easily distinguished. Botrytis causes the skin of the berry to separate from the underlying tissues, and when an infected berry is touched the skin slips away easily from the flesh. In the later

stages of decay the whole berry is covered by a velvety, gray growth of mold.

Cladosporium rot is a black, rather firm type of decay that usually affects only a small portion of the berry, forming a rather sharp margin between the affected and sound tissue. In the moist incubation forecast, an olive green growth of mold appears on the surface of affected areas. The color, the restricted growth, and the texture of the decay make it easy to distinguish Cladosporium from Botrytis.

Alternaria rot commonly develops in the area where the capstem is attached to the berry. Decay caused by this mold is rather soft in texture and brown in color. Alternaria rot may also affect other portions of the berry, causing decayed areas that are not as firm, as dark in color, or as well defined as those caused by Cladosporium rot. Mold growth on the surface of such areas is white to olive green and is more fluffy in texture than the Cladosporium fungus.

Interpretation

To meet the grade for U.S. No.1 table, the federal-state inspection service allows no more than 0.5% decay by weight (see table). Therefore, the forecast of decay should indicate less than 0.5% in order to grade U.S. No. 1 after long term storage and to account for some secondary spread of decay. For long term storage, the forecast should indicate no more than two berries with decay (Botrytis + "Black Spot") out of 500 berries incubated, and ideally, no berries should express decay in the forecast.

A forecast greater than 0.5% is a red flag indicating the fruit should be observed very carefully and frequently while in storage, and probably should not be stored for an extended period of time if a U.S. No. 1 table grade is desired. It should be noted, however, that the California Agricultural Code allows 5% decay by weight and this fruit is usually marketed locally. A 5% forecast of decay results when 25 berries express decay out of 500 berries incubated. A 0.4% forecast results when 2 berries express decay out of 500 berries incubated.

It is not uncommon to have a forecast greater than 5% immediately after a significant storm. The forecast will usually drop after 5 to 7 days of dry weather; however, when harvest resumes, the forecast of decay is usually higher than it was prior to the rain. Each storm or period of high humidity increases the level of latent Botrytis and reduces the opportunity for long term storage.

With late season table grapes, the length of storage has less effect on postharvest decay than the environment to which the fruit is exposed before harvest (Harvey, 1955). Late season grapes should be harvested when they reach maturity. Delaying the harvest increases the potential for the development of latent Botrytis and postharvest decay.

To meet the grade for U.S. No. 1 table, the federal-state inspection service allows no more than 0.5% decay by weight. The number of decayed berries allowed per 21 pounds of fruit will vary considerably depending on berry weight. For example, the typical range of berry weight for Ruby Seedless is 3.5 to 5.5 grams depending on cultural practices; subsequently, 8 to 14 decayed berries per 21 pounds of fruit would equal 0.5% decay by weight. Only 4 to 7 berries would be allowed for Red Globe with berries that range from 6.5 to 11.5 grams. The

table shows the maximum number of decayed berries allowed for U.S. No.1 table for different cultivars. Calculations are for 21 pounds of fruit adjusted to account for stem weight.

Summary

Predicting the storage quality of fruit is based on the level of exposure of fruit to rain or high humidity before harvest, knowledge of the storage history from a specific vineyard or variety, the general appearance of the fruit at harvest, and the ability of the crew to properly trim and pack the grapes. All these factors must be considered when determining the storage potential of a specific lot of fruit. John Harvey developed a laboratory technique to forecast latent Botrytis in fruit at harvest, and the forecast provides additional information for the manager to estimate the keeping quality of a specific lot of fruit. The forecast is not complicated and requires 10 days to complete.

Harvey's forecast does not eliminate the need for frequent examination of randomly selected boxes of fruit while in cold storage. While in storage, all fruit should be inspected for decay on a weekly basis, and fruit subject to decay (late harvest, rain or high humidity prior to harvest, susceptible variety, high forecast) should be given extra attention.

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Chart showing maximum number of decayed berries allowed for U.S> No. 1 table grade (0.5% decay)[1]

Table Grape Cultivars	Typical Range of Berry Weight (Grams)[2/]	Total No. Berries in 21 lbs of Fruit[2]	No. Berries Equaling 0.5% of 21 lbs of Fruit
Christmas Rose	4.5 to 6.5	1400 to 2000	7 to 10
Crimson Seedless	4.0 to 6.5	1400 to 2200	7 to 11
Emperor	4.5 to 6.5	1400 to 2000	7 to 10
Fantasy Seedless	5.0 to 7.5	1200 to 1800	6 to 9
Flame Seedless	4.0 to 6.5	1400 to 2200	7 to 11
Thompson Seedless	4.0 to 6.5	1400 to 2200	7 to 11
Red Globe	6.5 to 11.5	800 to 1400	4 to 7
Ribier	5 to 7.5	1200 to 1800	6 to 9
Ruby Seedless	3.5 to 5.5	1600 to 2800	8 to 14

[1] Based on 21 pounds of fruit.
[2] Adjusted to account for stem weight.

References:

Instructions for Forecasting Decay in Table Grapes for Storage. 1984. J. M. Harvey Publications ARS-7, United States Department of Agriculture, AGricultural Research Service, Fresno, CA.

A Method of Forecasting Decay in California Storage Grapes. 1955. J. M. Harvey. Phyto-pathology 45:229-232.

Reprints of the above references are available at the Tulare County Cooperative Extension Office, 2500 W. Burrel Ave., Visalia, CA 93291; phone (209) 733-6363.