BERRY CRACKING IN TABLE GRAPES

Robert H. Beede
U.C. FARM ADVISOR
KINGS COUNTY

Introduction

In certain years, table grape growers report substantial amounts of berry cracking in sound clusters as harvest approaches. Personal observation indicates this cracking occurs most often on the fruit's blossom end and sides; splitting near the base of the stem is less common. Berry cracking jeopardizes profitability by increasing harvest costs and decreasing yield. Fruit quality and storage life both on the vine and in cold storage are also reduced due to the threat of bunch rot; flexibility in marketing is therefore lost.

Laboratory and field studies have attempted to understand the cause of berry cracking and provide growers with practical guidelines for its prevention. The complexity of the problem has limited significant advances thus far. Field researchers have been frustrated by being unable to predict years favorable for studying cracking.

This paper summarizes some of the important studies on grape berry cracking as well as the observations shared with the author by farm advisors, specialists and table grape growers.

Berry Growth and Development

The grape berry, like many other fruits, has three distinct growth stages. Stage I begins immediately after fruit set and involves a rapid increase in the number of cells that make the grape berry. This period lasts for about one month. Following this rapid cell division is a period of 10 to 14 days in which little or no growth occurs; this is referred to as Stage II. Berry softening and/or color break signals the beginning of Stage III. Like Stage I, Stage III is also a rapid growth period, but it is caused by an increase in cell size rather than cell number. The grape berry achieves maximum size during Stage III (6). Lasting for about 14 days; it is also the growth period in which berry cracking is most likely.

Although capable of describing the major events of berry growth, researchers do not understand what actually drives berry development, especially during the transition from Stage II to III when growth is resumed. One theory suggests a competitive relationship between fruit and seed development. This seems unlikely in grape because in late-maturing seeded varieties (such as Emperor) the seeds are mature long before the fruit. The opposite is true for early varieties; fruit maturity occurs before seed maturation. In addition, seedless grapes exhibit the same growth pattern as seeded grapes.

Another common belief about fruit growth is that cell expansion is driven by turgor (pressure created within the cell by water absorption). Recent research by Matthews et. al. (4) on Cardinal table grapes clearly showed that berry enlargement was independent of turgor and therefore could not, by itself, regulate growth. Hopefully future discoveries into what controls fruit growth will provide important information for understanding its role in table grape cracking.

Berry Skin Changes During Fruit Growth

Critical to understanding the factors associated with berry cracking are the changes taking place in the grape skin during fruit development. Meynhardt (5) showed that the structure of the berry skin influenced the grape's ability to resist cracking. Considine et. al. (3) states that the cracking of sound berries in the field is evidence that the skin limits growth. He supported this with the observation that peeled grape berries absorbed twice as much water as unpeeled berries without showing any signs of splitting. Considine also demonstrated that skin fractures developed through cell walls rather than the simple separation of two cells whose walls were connected by adhesion (1).

Further understanding of the grape skin's role in berry cracking can be found in reviewing some of what is presently know about the physiological changes it undergoes during fruit growth. Important to this discussion are the concepts of elasticity and plasticity. Elasticity is the ability to recover from having been stretched. A balloon is a good example of elasticity when its air is released. Plasticity is the ability to retain a new shape. Together these terms describe the extensibility of the berry skin during growth.

Matthews et. al. (4) showed that skin extensibility remained relatively constant during Stage I of fruit growth when cell division is occurring. The same was also true for Stage II when growth is minimal. Observations by Considine et. al. (2) indicate the berry skin's cell walls are thickening at this time. Matthews further reported a marked increase in extensibility at the beginning of Stage III, the period of rapid cell enlargement. At this same time, Considine observed that the berry skin cell walls became thinner, perhaps as a result of enzyme activity. Towards the end of Stage III, (two to three weeks before harvest) a rapid decrease in berry skin extensibility was observed by Matthews et. al. (4). This "hardening-off" of the skin tissue may pre-dispose it to cracking should the berry experience a sudden change in water status.

Although the regulation of grape berry enlargement is not well understood, present evidence suggests that the berry skin limits growth and undergoes complex chemical changes during the course of fruit development. It is conceivable that environmental conditions could have a significant impact on these processes and affect the skin's ability to resist cracking near harvest.

The Role of Turgor, Berry Size and Sugar Content

Considine et. al. (3) also studied the amount of turgor needed to crack the skin of mature berries. For susceptible varieties, he observed that 50% of the berries cracked when the cell turgor was 15 atmospheres. Resistant varieties required 40 atmospheres turgor to achieve 50% cracking. He believed that mature fruit could contain sufficient sugar content to absorb enough water to crack the skin given the right environmental conditions. These were high soil moisture and a period of low water use by the vine. Cool, humid days with little wind, following an irrigation, would be ideal for cracking susceptible varieties having moderate sugar content.

Considine also reported reduced berry cracking with application of gibberellic acid.

Susceptibility to cracking was not necessarily related to berry size or seededness.

Farm Advisor, Specialist and Grower Observations

Among the table grape varieties grown in the San Joaquin Valley, Flame Seedless is considered quite sensitive to berry cracking. Exotic can crack if there is a heavy crop load and the bunches are not properly thinned. Ribier is also sensitive, particularly to blossom end cracking. Varieties considered moderately sensitive to cracking include Thompson Seedless, Ruby Seedless and Cardinal. Emperor would be considered resistant due to its thick skin.

Cultural practices mentioned as possible increasing cracking were dilute sprays after color break, ethrel, girdling and late irrigations if they coincided with a sudden cool period which resulted in moisture on the berry surface.

Peter Christensen, U.C. Viticulture Specialist at the Kearney Agricultural Center, emphasized the seasonal nature of berry cracking. While still a farm advisor in Fresno County, Peter recalled one year when berry cracking was severe on Thompson Seedless with sprinkler irrigation. In an effort to evaluate the effect of sprinklers on cracking, he conducted a replicated trial the next year at Kearney and examined different cropping levels on Thompsons under overhead sprinklers. That year there was no cracking in any of the treatments or complaints by growers.

Literature Cited

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