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Consequences of Excessive Heat on Grape Yield

Seventeen days and counting, this is the number of days over 100°F the Central Valley has seen in July. Although passing the century mark in the valley is not unusual for July, critical heat waves, when the high temperature exceeds 107°F for 4 to 8 consecutive days and the very high temperatures (over 110°F) haven't been observed in the area for 25 years. Such heat waves can have an adverse impact on developing agricultural crops, including grapes. Excessive heat adversely affects grapevines in different ways depending on variety and vine growth stage. Excessively high temperatures are detrimental to grape development as it inhibits berry growth, delays sugar accumulation, impedes fruit coloration, causes fruit to shrivel and may cause abnormal pigmentation of white fruit.

The temperature and light environment play a critical role in fruit development. Temperature influences both cell division and elongation in individual berries, with temperatures for optimum berry growth ranging from 68 to 77°F. Studies have shown that if the temperature exceeds 95°F during the critical stage of rapid berry growth, which occurs just after bloom, cell division and elongation are reduced resulting in smaller berries and lower yields at harvest.

Another stage of development that is sensitive to excessively high temperatures is the period of veraison, or the ripening phase. This is the period when grape berries resume growth (through cell expansion), become soft, accumulate sugar, acids decline and color appears in red or purple fruit. Anthocyanins are the pigments responsible for the red and purple color of grapes and are influenced by temperature. The major anthocyanin pigments found in grape berries are named cyanidin, peonidin, delphinidin, petunidin and malvidin. The color and intensity of grape berries are determined by the amount and type of these anthocyanins present in the grape skins.

Furthermore, the synthesis and accumulation of anthocyanins are influenced by a number of factors including light, nutrition, crop load, plant hormones and temperature. For example, the red variety Tokay contains only the cyanidin pigment which is extremely sensitive to temperature and light. Tokay and other cyanidin dominant varieties, like Flame Seedless, require cool night temperatures to accumulate large amounts of the pigment. When exposed to very warm temperatures, the fruit remains green. Studies have documented that very high temperatures during the ripening phase reduce or completely inhibit key enzymes that are responsible for the synthesis of anthocyanins and thus results in poor coloration of fruit which reduces the amount of marketable fruit at harvest.

The abnormal coloration of white grapes often called “pink berry,” is related to the aforementioned discussion about anthocyanins. Pink berry is commonly observed in hot, tropical areas such as India, Brazil and Australia. The primary pigment found in affected varieties such as Thompson Seedless and Muscat is cyanidin, although others are present in much smaller amounts. It may seem unusual that a white variety would produce such pigments; however it is well known to researchers that the genes responsible for producing pigments are found in all grape varieties, even white ones. Furthermore, it is believed that this type of pigment accumulation in white varieties is triggered by heat stress.

Heat induced shriveling of grapes is often referred to as “sunburn” or heat injury. This type of damage generally occurs after a sudden rise in temperature and may occur at any time from fruit set to harvest. The type and extent of damage varies; single berries, parts or whole clusters may wilt, shrivel and dry. In some cases, damage occurs only to fruit that is directly exposed to sunlight. However, shaded fruit may also become damaged when temperatures exceed 104° F, but susceptibility to such heat damage is usually variety dependent.

It is difficult to predict the amount of damage to the grape crop resulting from the heat waves and excessive temperatures we have experienced this summer. There are some reports of poor coloration and delayed ripening of the Flame Seedless crop. In any event, everyone is looking forward to the predicted trough of low pressure that is due to move in over the weekend and give people and grapevines a well deserved break from the stifling heat.

