Subject: New England Grape Notes – May 14, 20018
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New England Grape Notes – May 14, 2018

UMass Extension
CENTER FOR AGRICULTURE

Grapevine Bud Break 101

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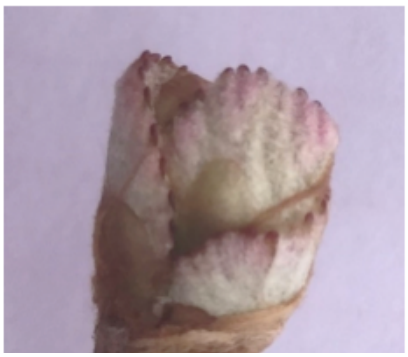
Grape growers across Pennsylvania would agree that grapevines are breaking bud later this spring compared to the past few years. Some of you might be relieved and are hoping that a late bud break will reduce the likelihood of spring frost injury, particularly for those cultivars that tend to break buds early, while others might wonder if a late bud break will mean a shorter growing season and what impact this might have on fruit and wine chemistry.

This might be a good opportunity for a short review on bud break (or bud burst if you prefer) and some of the major factors that influence it.

What is bud break?

Bud break is one of the grapevine's key growth or phenological stages. Phenology is defined as "*the study of the timing of natural phenomena that take place periodically in plants and animals*[1]." Many vineyard operations related to canopy, nutrient, disease and insect management are conducted at specific phenological stages, so it is important for growers to record dates for bud break and other important growth stages.

Bud break is commonly described as "the appearance of green tissue through the bud scales[2]" or "the emergence of a new shoot from a bud during the spring[3]." There are several systems used to precisely identify bud break and other key phenological stages. One of the systems most widely used today is the **modified Eichhorn Lorenz (E-L) system**, which was developed by Eichhorn and Lorenz in 1977, modified by Coombe in 1995[4], and later revised by Coombe and Dry in 2004[3]. A primary reason why the E-L system was revised multiple times was that the visual characteristics during the early stages of bud growth might vary among cultivars. For example, in some cultivars buds "emerge as hair-covered cone from between the scale without any sign of green tissues" while in other cultivars buds can have "green tips visible early through the hairs[1]." To avoid, or at least reduce confusion, the latest E-L system modification (2004) defines grapevine bud break when **leaf tips are visible** (Figure 1).



Although there might be slight differences in how growers or scientists define bud break, using a consistent method across years and cultivars is important in order to make comparisons. Photos of the modified E-L system and information on how to use grapevine phenology to improve vineyard management can be found by clicking on these hyperlinks: modified E-L system by The Australian Wine Research Institute and Grapevine Phenology Revisitedby Fritz Westover[5].

Why was bud break late this year in Pennsylvania?

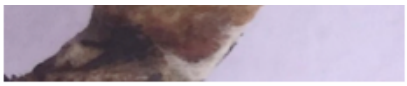


Figure 1. Lemberger bud at bud break

Grapevine phenology is strongly tied to **air temperature**. Once buds fulfill their chilling requirements they are in a state of eco-dormancy, which means they are dormant only because of cool or cold weather. In temperate regions, buds tend to reach this state by early winter, therefore, warm weather in late winter or early spring might result in early bud break and consequently increase the risk of spring frost injury.

An air temperature of 10 °C (50 °F) has traditionally been used as the base temperature for grapevines, as it is the temperature threshold below which grapevines will not grow. Hence, mean daily temperatures above approximately 50 °F (or, more specifically, 46 to 50 °F) induce bud break and shoot growth[6]. Grapevine base temperature is higher than that reported for fruit trees, such as apple, peach, cherry, and apricot (the base temperature ranges from approximately 39 to 41 °F)[7]. Base temperature for bud development varies between grapevine species and cultivars, and the physiological basis of this thresholds is still unclear[2].

Over the years, many models have tried to use temperature data to predict bud break and other key phenological stages. Some models are based on the accumulation of temperatures above the mean daily temperature of 50 °F, for example, Growing Degree Days (GDD), while others use temperature averages rather than summations[8]. However, **there is not**(at least to my knowledge) a solid and simple formula that we can use to predict when bud break will happen.

GDD calculated from January 1 to bud break may not be a very good way to answer the question: Are we going to have an early bud break? Hans Walter-Peterson, Finger Lakes Grape Program, Cornell University, used data collected over many years in the Lake Erie region to show that the date of bud break for Concord was not well correlated with GDD (base 50 °F) accumulated from January 1 to bud break. Using the total GDD for this period, however, does not take into consideration when GDD accumulates. For example, having seven consecutive days with mean temperature above 50 °F might not be the same of having seven days with the same temperature but interspaced by a long period of cool/cold weather with mean temperatures below 50 °F.

Although further studies are needed to clarify the relationship between bud break and temperature, **air temperature still remains the dominating factor affecting bud break**. The number of GDD accumulated from January 1 through April 30 in 2018 across Pennsylvania was definitely lower than the accumulated GDD during the same months in 2017 (Table 1). This indeed had an influence on grapevine bud break occurring later in 2018 compared to 2017.

Table 1. Growing degree days accumulated from January 1 through April 30 in 2017 and 2018 at several locations across Pennsylvania. Weather data were collected by NEWA (Network for Environment and Weather Applications) weather stations (http://newa.cornell.edu/).

	GDD (base 50 °F) January 1 to April 30	
	2017	**2018**
Rock Springs (North Central)	246	72
Northeast (Northwest)	167	41
Biglerville (South Central)	371	136
New Paris (Southeast)	313	106
New Tripoli (Southeast)	226	88
Scott Township (Northeast)	164	42
Logan, NJ[a]	396	182
Pittstown, NJ[b]	251	92

[a]near the southeast PA border, Delaware County
[b]near the southeast PA border, Bucks County

Time versus rate of bud break

While the number of GDD accumulated from January 1 through April 30, 2018, was lower than the same period in 2017, the

number of GDD accumulated during the first week of May 2018 was, however, much higher than the number accumulated during the same period in 2017 (Table 2). Although bud development started later this year, you might have noticed a greater **rate of bud break** or higher speed of bud development due to consecutive days of high, above average daily temperatures at the beginning of May. The rate of bud break increases as the air temperature rises above 50 °F up to approximately 86 °F (30 °C). However, at higher temperatures, the rate of bud break might start to decline[6].

Table 2. Growing degree days accumulated during the first week of May (May 1 through May 7) in 2017 and 2018 at several locations across Pennsylvania. Weather data were collected by NEWA weather stations (http://newa.cornell.edu/).

	GDD (base 50 °F) May 1 to May 7	
	2017	2018
Rock Springs (North Central)	31	83
Northeast (Northwest)	8	86
Biglerville (South Central)	60	111
New Paris (Southeast)	37	127
New Tripoli (Southeast)	43	111
Scott Township (Northeast)	19	94
Logan, NJ[a]	80	136
Pittstown, NJ[b]	46	114

Other factors to consider:

Species and cultivars: The base temperature requirements vary amongst grape species (e.g., V. berlandieri > V. rupestris > V. vinifera > V. riparia) and cultivars (for example, Riesling > Chardonnay)[6]. Regardless of the seasonal weather conditions, the order of bud break across different species and cultivars tends to be consistent. Those with a lower base temperature threshold will break buds earlier than those with a higher base temperature. For example, Chardonnay always bursts earlier than Cabernet Sauvignon.

Soil and root temperature: There is contradictory evidence about the role of soil and root temperature on the timing of bud break. Studies conducted in California[9,10]found that Cabernet Sauvignon bud break was positively correlated with soil temperature: bud break occurred several days earlier when soil temperature increased from 52 °F to approximately 77 °F. In a more recent study, however, soil temperature did not influence the timing of Shiraz bud break[11].

Number of buds left at pruning: The number of buds (or nodes) retained at pruning (24 to 72 per vine) had little influence on bud break and other phenological stages of Sauvignon Blanc vines up to veraison[12].

Bud position along the cane: When dormant canes are left upright, the more distal buds generally tend to break first and suppress the growth of the buds at the base of the cane (closer to the cordon) (Figure 2). This phenomenon is called apical dominance or, more precisely, correlative inhibition. In frost prone areas, to delay bud break of cordon trained vines, canes can be pruned back to 2-bud spurs when the distal buds reach bud break. For more information please refer to a past blog post: How does delaying spur pruning to the onset or after bud burst impact vine performance?

In some cultivars, for example, Cabernet Franc, correlative inhibition may cause inconsistent bud break in cane-pruned vines. Meaning that buds located in the central part of the cane might not open or they might develop shorter, weaker shoots than those positioned at the beginning or at the end of the cane. There are, however, practices that can be used to promote uniform bud break along the canes, these include bending or arching (Figure 3), and partial cracking of

Figure 2. Delay winter spur-pruning on Lemberger vines (front row). Note the reduced shoot development at lower node positions.

canes[6].

Figure 3. Arching of canes to promote uniform bud break along the cane.

Age of the vine: Within the same cultivar, the timing of bud break and other key phenological stages may vary between young vines that are not in full production yet (3rd leaf or younger) and mature, established vines (4th leaf or older)[5].

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