Phenological Development of Different *Vitis* Cultivars[1]

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The expansion of grape buds into shoots in the early portion of the growing season is an important series of events. Empirical observations have suggested that some cultivars begin growth earlier than others, and some grow at different rates. In most areas where grapevines are grown commercially there is an economic problem resulting from spring freeze damage. The stage of phenological development can have a direct influence on the level of low temperature stress that the developing shoot may tolerate, and still survive (3). In Concord (*Vitis labruscana* Bailey), tolerance of young shoots to cold stress declined with increasing growth and elongation. This study has been undertaken to gain a better understanding of the factors leading to the early onset of growth, and loss resulting from subsequent spring freezes.

Materials and Methods

An effort was made to categorize the stage of bud growth. The system used was primarily that of Baggiolini (2) as modified by Johnson (3) to include a more useful expanded number of stages during early growth.

The following notation will be used:

D —dormant; showing no growth or swell.

SC—Scale crack; showing a break in the bud scales, but no visible shoot.

S_1 —swell-one; the earliest swell stage, and is nearly globular.

S_2 —swell-two; a later swell stage, and is more elongated than S_1, length exceeding breadth by approximately 1.5 times.

B —burst; stage with an exposed flat leaf away from the surface of the bud.

A retrospective evaluation of damage due to 1976 spring freezes was made at the Sodus Horticultural Research Station (S.H.R.S.), Sodus, Michigan. The vines evaluated were in the test planting at least six years, were healthy and vigorous, and were being balance-pruned (30 + 10 for Concord and Baco noir, 10 + 10 for all others). Vines were trained to a bilateral cordon at the top wire (1.8 M), and canes retained were 8-nodes in length. Certain large cluster cultivars (DeChaunac, Seyval, Vidal blanc, and S. 10868), were flower cluster thinned to retain a single, basal cluster. In 1978, additional cultivars were included, and bud phenology was evaluated on May 11, 19, and June 1. These vines were at least six years old, and were pruned by means of a 10 + 10 pruning severity.

Weather data collected at the S.H.R.S. were used to build mathematical models to predict the stage of bud development based on temperatures. Models were evaluated graphically using 1976 and 1978 data of the percentage of buds at burst or beyond versus the following models:

1. The number of days the maximum temperature was greater than 45°F.
2. The number of days the maximum temperature was greater than 40°F.
3. The summation of heat degree days, base 45°F (1, 4).
4. The summation of heat units (S.H.U.), base 40°F. We calcu-

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lated this by subtracting the base temperature from the maximum temperature for that day. The remainder was that day's heat units. The units were summed from March 1 through June 1.

5. The S.H.U., base 45°F.

Of these models, the S.H.U. base 45°F appeared the most satisfactory.

Results and Discussion

In Table 1, the data show a ranking of primary bud development. On May 11, Foch and Baco noir appeared to be early developers with Rougeon not far behind. Aurore and Vidal blanc had grown the least. About one week later, there are some shifts in the relative rankings. While Foch and Rougeon remained among the most developed, Concord and De Chaunac made sufficient growth during the eight day hiatus to surpass Baco noir. The relative ranking of the more slowly developing cultivars changed little. The spring of 1978 was very cool compared with the spring of 1976. De Chaunac, Foch, and Baco noir were early or fast developers just as they were in 1978.

The cultivars were categorized into early, mid or late starters based on S.H.U., base 45°F. required for onset of growth (Table 2). The change in S.H.U. to bring a cultivar from onset to 50% burst have also designated slow, medium, and fast growth rate categories. Looking at the cultivars Rougeon and Foch, the independence of growth onset and growth rate can be seen (Fig. 1). Both started early, but Foch grew slowly, while Rougeon

Table 1. Ranking of cultivars at the Sodus Horticultural Research Station in 1976 and 1978 based on stage of primary bud development from most developed to least developed.

May 4, 1976	May 11, 1978	May 19, 1978
De Chaunac	Foch	Rougeon
Foch	Baco noir	Foch
Baco noir	Rougeon	Concord
Concord	Ventura	De Chaunac
Aurore	Concord	Baco noir
Seyval	Seyval	Vignoles
Vignoles	De Chaunac	Ventura
Vidal blanc	Vignoles	Seyval
	Cayuga White	Cayuga White
	S. 10868	S. 10868
	Chelois	Aurore
	Aurore	Vidal blanc
	Vidal blanc	Chelois

Table 2. Classification of growth onset and rate in 1978 among cultivars at the Sodus Horticultural Research Station.

Cultivar	S.H.U., base 45°F. of growth	S.H.U. 50% burst	S.H.U. from 0 to 50% burst	Category Onset	Rate
Foch	290	580	290	early	slow
Baco noir	360	640	280	early	slow
Rougeon	440	550	110	early	fast
Concord	445	700	255	mid	mid
De Chaunac	460	660	200	mid	fast
Seyval	460	700	240	mid	mid
Vignoles	460	640	180	mid	fast
Chelois	700	880	180	late	fast
Aurore	640	880	240	late	mid
Vidal blanc	640	870	230	late	mid

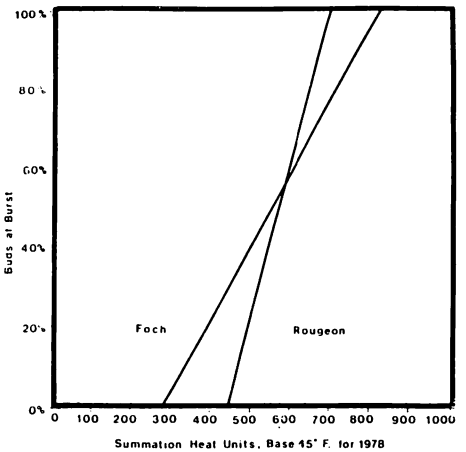

Fig. 1. Foch is an early, slow developer while Rougeon is an early, fast developer.

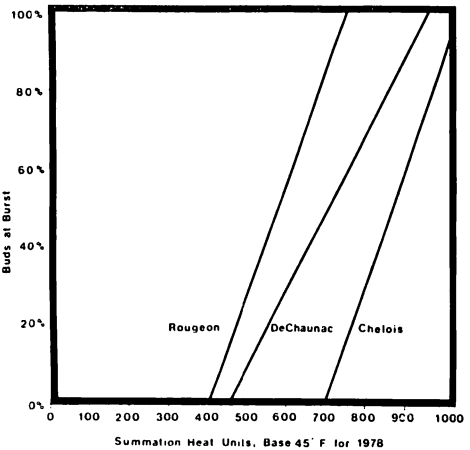

Fig. 2. Rougeon, De Chaunac, and Chelois are fast developers but have early, mid, and late onsets, respectively.

developed quickly. Figure 2 shows three fast developers, Rougeon, De Chaunac, and Chelois, but all have different times of onset.

Further research efforts to more closely study the onset and rate of growth may find many other parameters contributing to differential development. Although rainfall, humidity, soil type, and fertility state may contribute to development we predict temperature to be the primary stimulus. Controlled growth chamber experiments as well as more years of field observation will help in predicting bud development more accurately.

Advanced phenological development is an important factor contributing to spring freeze losses in Michigan. Independence of growth onset and growth rate could be put to use in future breeding endeavors to combine the desirable characteristics of late onset with rapid growth. High quality cultivars of that type would reduce grower loss resulting from spring freeze damage.

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