

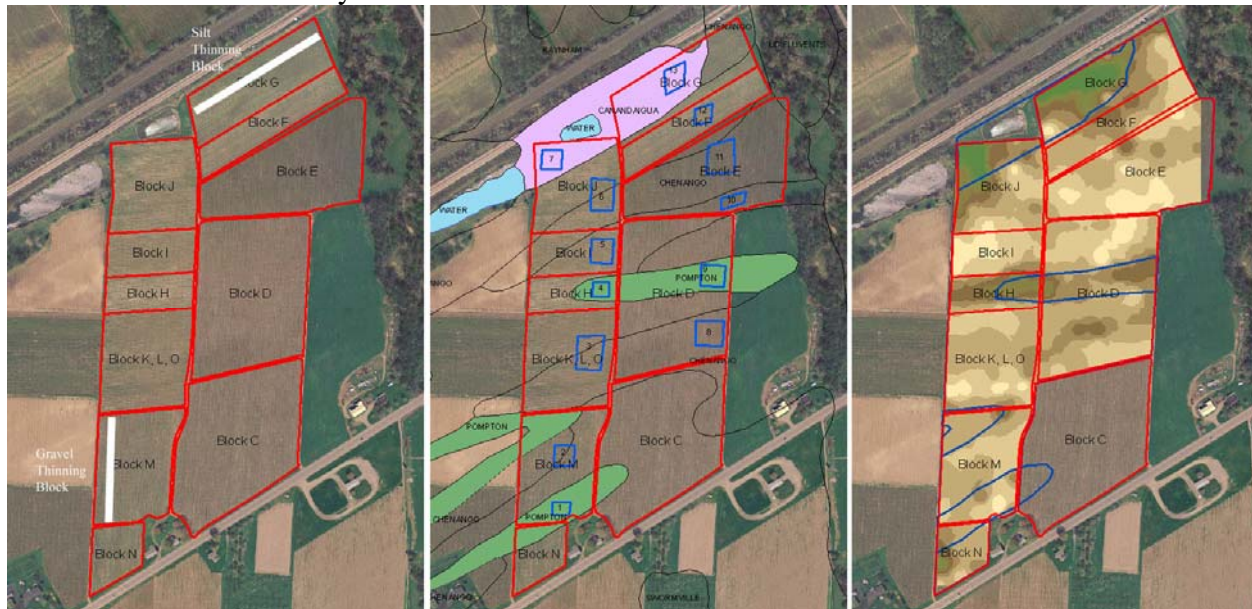
**Progress Report for 2007 Viticulture**  
**The Effect of Soil Type, Vine Size, and Crop Size on Concord**

Terence R. Bates, Cornell Dept. of Horticultural Sciences, 412 East Main St., Fredonia, NY 14063, Phone: 716-672-2175, email: trb7@cornell.edu

**Abstract:** Concord grapevine phenology, berry curve, and soluble solids accumulation rates are annually used by the industry to understand crop potential, chart seasonal characteristics, estimate crop, and predict harvest dates. To facilitate the transfer of data collection from the current Fredonia Vineyard Lab to the new lab site in Portland, NY, a phenology block and a crop load experiment were initiated in 2007. A 2 soil type x 2 vine size x 2 crop size factorial was established on mature 120 node pruned vines at the new Cornell Vineyard laboratory in Portland, NY. In conjunction, a new phenology block was established in Portland on two soil types to maintain and compare long-term data collection. Comparing the Fredonia and Portland sites (Chenango soil), there was no effect of location on vine phenology with respect to bud break, bloom, veraison, or berry weight. Fredonia vines had slightly higher juice soluble solids (jss) accumulation rates three weeks after veraison than Portland vines. Comparing Chenango (well drained gravel-loam) soil with Canandaigua (somewhat poorly drained silt-loam) soil at the Portland site, vines on both soils had similar phenology and berry weight. The silt soil vines had higher jss accumulation rates 2-3 weeks after veraison than the gravel vines. In general, vines on both soil types exhibited a similar response to thinning: removing 2.1 tons/acre increased jss by 1 °Brix in the range of 11-5 tons/acre (typical of a dry season). Below 5 tons/acre, there was no further brix increase. A more detailed analysis of jss accumulation from veraison to harvest showed that crop size had a larger effect on the gravel soil than on the silt soil. 2007 was a warmer and drier than average growing season. Soil moisture measurements and visual canopy observations indicated that the Portland Chenango gravelly-loam was relatively drier than the Portland Canandaigua silt-loam or Fredonia Chenango gravelly-loam during fruit ripening which led to decreased rates of jss accumulation 2-3 weeks after veraison and this response was exaggerated with crop size. Significant precipitation the 21 days after veraison returned all sites and soils to similar jss accumulation rates until harvest.

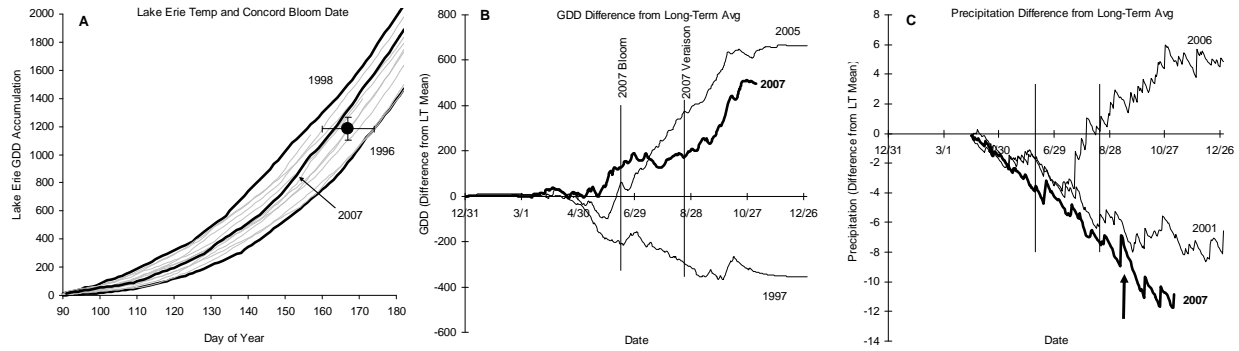
**Introduction:** Historical phenology data has been collected on the same set of Concord vines at the Fredonia site for 50 years with the past 27 years posted on the web: (<http://lergp.cce.cornell.edu/Phenology.htm>). Growers and processors can use the phenology information to compare vine development with other seasons, estimate crop potential, and predict harvest schedule. Similar to the phenology data, recent Concord research investigating the physiology of mid-season crop adjustment with follow-up research on mechanical crop estimation and thinning has been conducted on well drained gravel soils. This research has yielded information on the effect of crop load, vine size, thinning time, and growing season on the rate of Concord fruit maturation and the information has further been used to help producers in crop estimation and adjustment procedures. The objectives of this research project were to (1) establish a new historical Concord phenology block in Portland, NY on two soil types and compare the data with the current phenology block in Fredonia, NY and (2) study the interaction of soil type, vine size, and crop size on Concord growth and productivity.

**Methods:** The Portland lab was characterized with respect to soil type, chemistry, and water holding capacity (Figure 1). The site and soil information was used to establish gravel and silt soil thinning/phenology blocks. Medium and large vines (1.5-2.0 pounds and 2.5-3.0 pounds, respectively) were pruned to 120 nodes and adjusted to 100% crop and 50% crop at 30 days after bloom. Vines were measured for vine and fruit development in 2007 and compared to similar vines at the Fredonia vineyard lab.



**Figure 1:** The Portland Vineyard Lab: (Left) Aerial photo of the Portland site with designated vineyard blocks and the locations of the two thinning/phenology experiments. (Middle) Digital county soil overlay. Chenango soils are not shaded while Pompton and Canandaigua soils are shaded green and pink, respectively. The blue boxes indicate where soil samples were collected in 2007. Soil sampling was directed based on vineyard soil type and topography. In general, the Chenango blocks had low soil pH (4.1-5.0), low soil organic matter (1.7-2.4 %), with associated low nutrient content in Mg, Ca, and K. Pompton and Canandaigua soils had higher soil pH, organic matter, and mineral nutrient content. (Right) Relative soil moisture content measured on 8/29/2007. 285 TDR measurements were taken and recorded on a GPS field computer. Data were processed in ESRI ArcMap using Inverse Distance Weighted Interpolation to give the shaded vineyard map. The light sand color represents soil moisture values low enough to reduce Concord leaf photosynthesis on the measurement date (less than 6% SM). Brown regions had adequate soil moisture and green had adequate to excessive moisture. Therefore, thinning vines in M-block and G-block were under different soil chemical and moisture conditions.

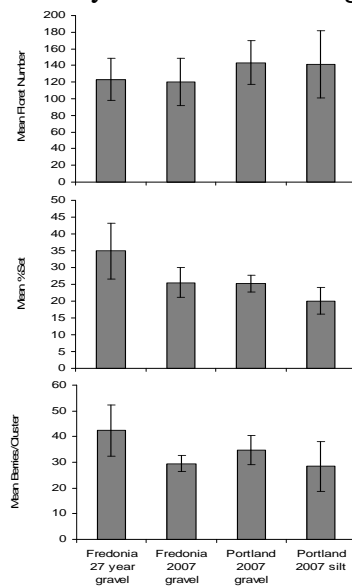
**Results:** In 2007, Concord vines developed close to the long-term average with respect to initial vine growth and bud break. However, warmer than average temperatures in 2007 led to earlier bloom and veraison dates than the 27-year average (Figure 2 and Table 1).



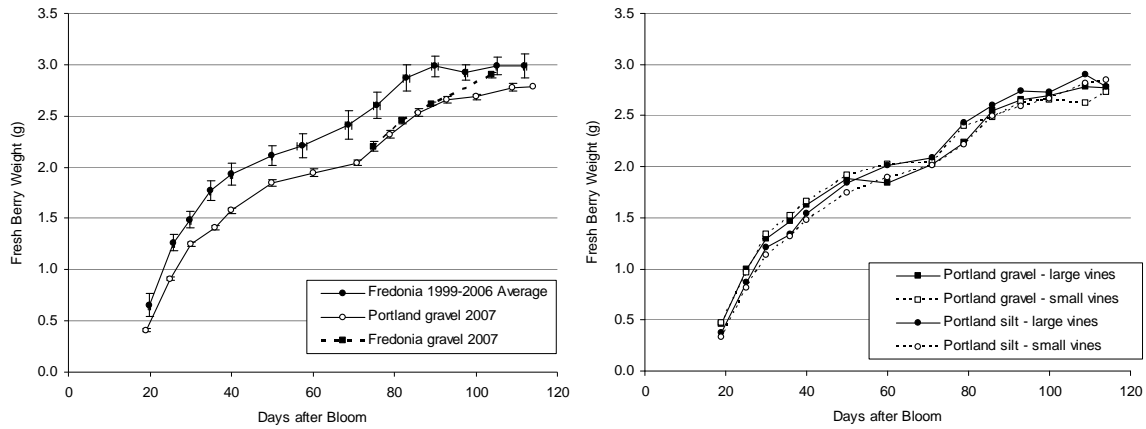
**Figure 2:** Lake Erie spring water heat accumulation (A), Air GDD accumulation (B), and Precipitation (C) in relationship to 2007 bloom and veraison dates. There is a direct correlation between Lake Erie heat accumulation and Concord bloom date in the Lake Erie grape production region. The dot in (A) is the average Concord bloom date  $\pm$  st. dev. In 2007, lake temp accumulation and bloom date were both slightly ahead of the long-term average. GDD and Precipitation accumulation is presented as the difference from the long-term average. 2007 was characterized as warmer and drier than average, especially in late summer. Note the spike in 2007 precipitation three weeks after veraison (arrow in C) because its impact on juice soluble solids is discussed.

Concord Phenology Dates				
	Fredonia LT Avg	Fredonia Gravel 2007	Portland Gravel 2007	Portland Silt 2007
10% pink	4/28	4/29	4/29	4/29
Bud Break	5/5	5/8	5/9	5/8
Bloom	6/15	6/10	6/10	6/10
Veraison	8/24	8/18	8/18	8/18

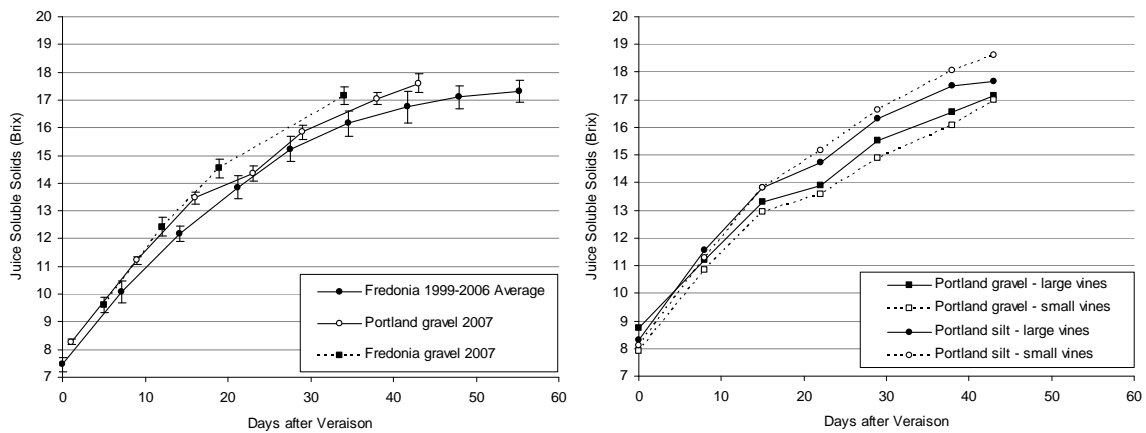
**Table 1:** Phenology dates of Concord comparing the Fredonia and Portland sites in 2007 with the 27-year Fredonia average.



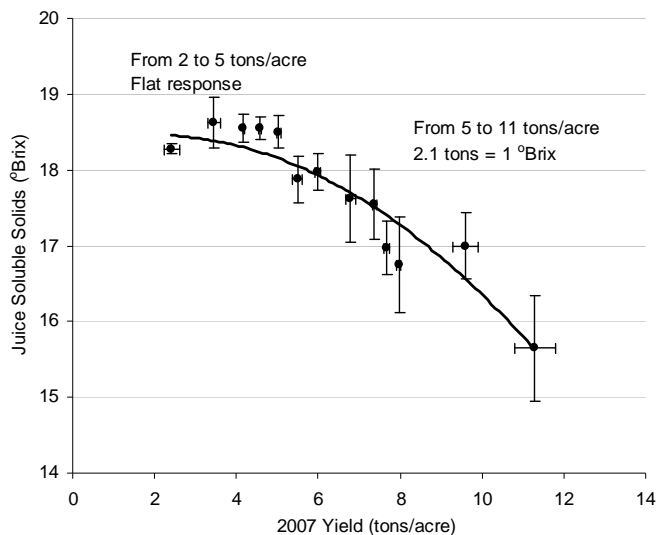
**Figure 3:** Floret number, % fruit set, and berries per cluster on Concord vines in Fredonia and Portland compared to the 27-year average. (The error bar on the 27-year average is standard deviation,  $n=27$ . The error bars on the 2007 data is standard deviation,  $n=4$  count phenology vines at each location). There was no statistical difference between any of the fruit set components measured. Neumerically, the Portland site tended to have higher floret number but lower %set leading to similar berries/cluster. 2007 tended to have slightly lower berries/cluster than the long term average.



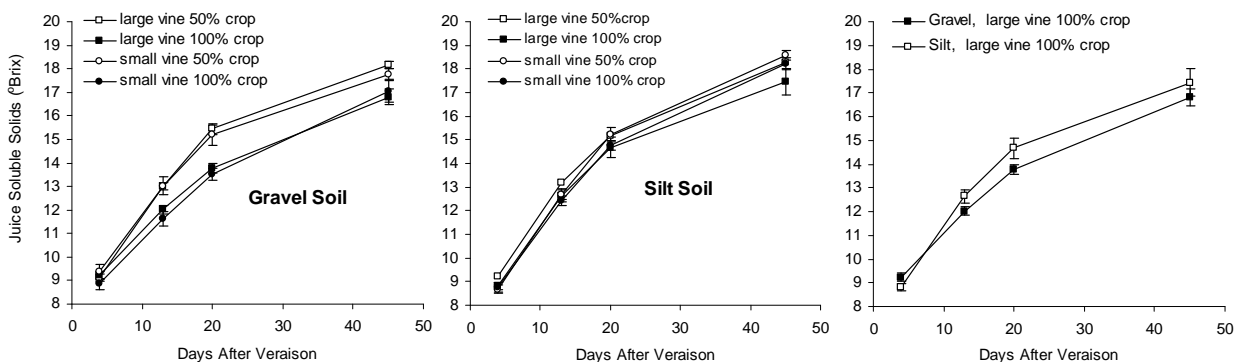
**Figure 4:** 120 node pruned Concord berry curve in 2007 compared to the 7-year average (left) and the berry curve at Portland comparing soil type and vine size (right). (For 2007 data, each point is the mean of five vines and all vines had 100% crop). Both the Fredonia and Portland berry weights were smaller than the 7-year average. This was a result of the warmer and drier than average 2007 growing season. Fredonia gravel and Portland gravel berry curves were similar with the exception of slightly higher harvest berry weight in Fredonia. The Portland gravel was under earlier and more severe water stress three-weeks post veraison which would explain the deviation in the two curves at that time. There was no effect of vine size or soil type on the Concord berry curve at Portland in 2007.



**Figure 5:** Juice soluble solids (jss) accumulation in 2007 compared to the 7-year average (left) and the jss accumulation at Portland comparing soil type and vine size (right). (For 2007 data, each point is the mean of five vines and all vines had 100% crop). Jss accumulation rate in 2007 was greater than the 7-year average because of the lower than average berry weight. The increased water stress in the Portland gravel three weeks post-veraison was measured as a decrease in the jss accumulation rate. Precipitation just after that point (arrow in Fig 2C) restored jss accumulation rates; however, the set-back delayed ripening by approximately one week. Similarly when comparing Portland gravel and silt, there was a jss accumulation delay three weeks after veraison on the dry gravel but not the relatively more wet silt.



**Figure 6:** Concord yield-brix relationship in Portland. From 11-5 tons/acre, removing 2.1 tons led to an increase in 1 °Brix. This relationship is typical of a warm and dry growing season with low berry weight where 2-2.5 tons = 1 °Brix. In cool and wet years with large berry weight, the relationship is typically 3-3.5 tons = 1 °Brix. Below 5 tons/acre, there was no response.



**Figure 7:** The effect of soil, crop, and vine size on Concord juice soluble solids accumulation in 2007. On the gravel soil, crop size had a negative effect on jss accumulation and vine size had no effect. On the silt soil, neither crop size nor vine size influenced jss accumulation rate. Between the gravel and silt soil, the drier gravel soil had a negative impact on jss accumulation in the second and third weeks after veraison (similar to the berry curve data in figure 5).

### Conclusions for 2007:

The Fredonia and Portland sites are located on the same gravel soil ridge approximately 10 miles apart in the Lake Erie grape region. Vine phenology measurements were nearly identical between the two sites in 2007. Although moving the site will always have an asterisk on in the historical data set, the similarity in the sites increases the value and continuity of long-term Concord phenology data collection.

Although there was little commercial crop thinning done in 2007 because of the early bloom and good growing season, the response of crop adjustment was measured in the experiment vineyard. Vine water status appears to have an effect on the thinning response. In drier years and/or drier soil there tends to be a stronger effect of thinning on jss than in wetter years and/or wetter soils.