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Research Note

Berry abscission is related to berry growth in *Vitis labruscana* 'Concord' and *Vitis vinifera* 'Riesling'

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K e y w o r d s : abscission, flowering, fruit set, sink-source relationship.

Introduction: The utilization of energy by the grapevine in the form of carbohydrates is critical to vine performance, and the balance of vegetative growth to cropping (*i.e.* "crop load") affects fruit yield and quality. A key factor in this balance is fruit abscission or retention that occurs shortly after bloom. This establishes the number of berries which overwhelmingly determines the amount of crop, and which in turn affects the distribution of carbon to crop and vegetative growth for the rest of the season.

In the vineyard fruit retention is known to be very variable. For example, a 25-year study of flowers and berries per cluster conducted in Concord in New York has shown that fruit set (% of flowers that become final fruit) varied from 20 to 56 % from year-to-year (R. Pool and R. Dunst, unpublished data). Environmental conditions, carbon balance, hormonal balance, nutrition and water relation are among some of the factors known to affect fruit set (May 2004), but their effects and complex interactions are poorly understood. We hypothesize that berry growth rate integrates all these factors and a reduction of berry growth rate will lead to abscission.

A reduction in fruit growth has been reported as the first evidence of its abscission in peach (Zucconi 1981) and citrus (Zucconi *et al*. 1978). The same relationship has been quantified with apple (Lakso *et al*. 2001). In *Vitis* species however, to the best of our knowledge, this relationship has not been studied. Our objective was to test, in two *Vitis* species, the hypothesis that berry abscission during the immediate post bloom period is related to its growth rate. In vines in the field under standard conditions individual berry growth was monitored during their early season growth and related to subsequent berry retention or abscission.

Material and Methods: The experiment was carried out during 2007 in two vineyards at Cornell University's New York State Agricultural Experiment Station in Geneva, NY, USA (42N, 77W). The Concord study was conducted in an own rooted 'Concord' (*Vitis labruscana*) vineyard planted in 1997 at a row by vine spacing of 2.74 by 2.44 m. Vines were trained to a high (1.6 m) bilateral cordon with single pendant curtain pruned during the winter to retain about 80 nodes. The 'Riesling' experiment was conducted in a vineyard (*Vitis vinifera L.*) planted in 2005 on 101-14 rootstock at a row x vine spacing of 2.74 and 2.1 m, respectively. Vines were cane pruned by leaving 2 canes with an average of 24 shoots per vine, and were trained by vertical shoot positioning. In both vineyards cultural practices of irrigation, fertilization and pest management were appropriate to maintain healthy vines with minimal stress.

To monitor grape berry drop in relation to growth rate, 16 vines per specie were selected and shortly after bloom 3 berries were tagged in each of 10 clusters per vine (a total of 480 berries per specie). Berries were identified with pieces of colored dental floss tied loosely around the peduncle following the method of Friend *et al*. (2003). The equatorial diameter of each berry was then measured with a digital caliper every 1-3 d up to 2 weeks after flowering and every 4-5 d afterwards. At every measurement, berries that abscised was recorded.

During the first 25 d after flowering, when most berry abscission occurs, the berry growth rate of each individual berry was related to the fastest growing berry located in the same vine. Since Concord drop occurred rapidly, berry growth 0-14 d after bloom was used to calculate growth rates. 'Riesling' berries abscised over about 20 d, so berry growth 0-25 d was used to calculate growth rates. The berry growth rates of each specie were ordered, then divided in categories of 10 % increments and expressed relative to the group with the highest growth rates. The populations of relative berry growth rates were then related to the percentage of berries within each category abscising later. At harvest 10 clusters per specie were randomly selected from the experimental vines to measure the weights of all berries to analyze the variability in berry fresh weight.

Results and Discussion: In 'Concord', almost the entire fruit drop occurred during the first 10 d after flowering with little occurring later (Fig. 1). These results are in agreement with previous findings obtained by Pratt (1973) that also showed that berry drop was complete within 12 d after bloom. In contrast, in 'Riesling', there was little drop immediately after bloom, but drop occurred in waves with some fruit drop as late as 30 d after flowering. Similarly Candolfi-Vasconcelos and Koblet (1990) also observed in 'Pinot noir' some fruit drop as late as 6 weeks after bloom. It is not clear if the patterns are inherent or if they are induced by the responses of vine growth and development to environmental variations.

In both species fruit abscission could be related to its berry growth rate (Fig. 2). In 'Concord', the relationship was very steep with all berries growing at a rate lower than about 80 % than the maximum showing some abscission with essentially complete abscission if growth rates fell below about 60 % of maximum. In 'Riesling', the relationship between berry abscission and growth was similar in shape

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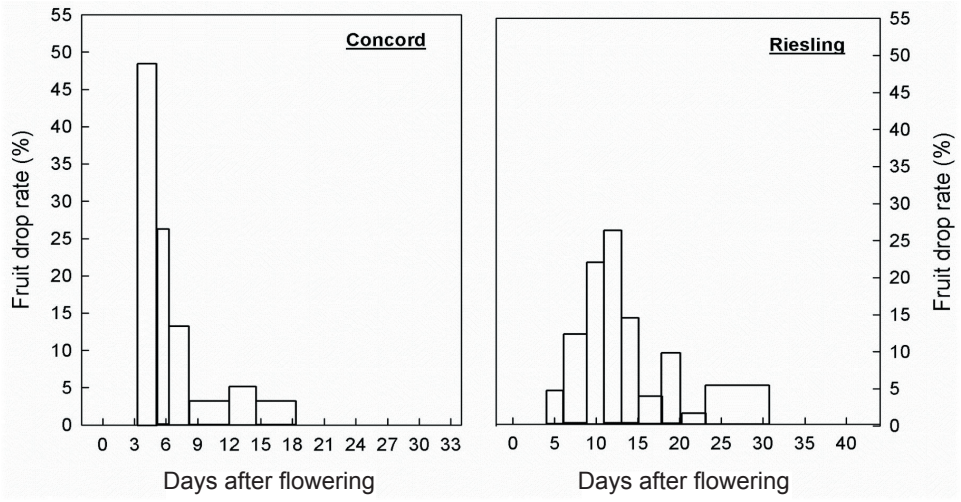

Fig. 1: Seasonal variation of fruit drop in 'Concord' and 'Riesling' vines. Values reported are relative to the total amount of berries that abscised.

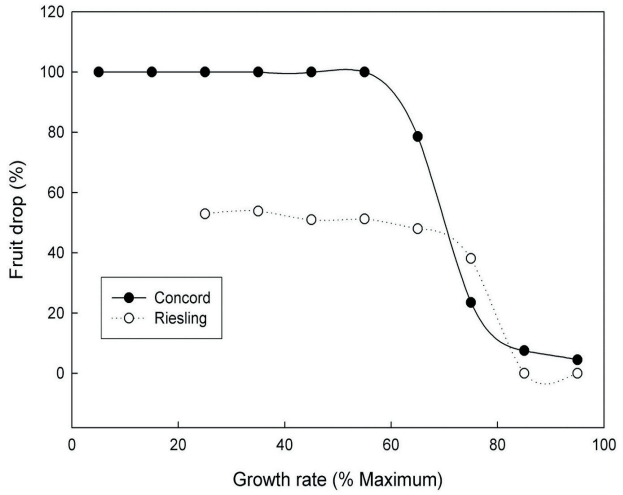

Fig. 2: Relationship between berry growth rates, expressed as the maximum of the fastest growing berry of a vine, and the percentage of berries that abscised. Data are separated for 'Riesling' (growth period 0-25 d from bloom) and 'Concord' (growth period 0-14 d from bloom).

but with much less abscission at the lower growth rates. Even at a growth rate as low as 20 % of the maximum, only 50 % of the berries abscised.

At harvest the coefficient of variation of berry fresh weight in a cluster was 42 % in 'Riesling' but only 12 % in 'Concord'. The lack of abscission of slow-growing 'Riesling' berries during the cell division might explain why the variability in the individual berry size was much larger in 'Riesling' than in 'Concord'. 'Concord' grapes are often observed to be relatively consistent berry size compared to *vinifera* wine grapes.

Overall these results appear to be the first evidence that in grapevine, berry abscission can be related to the berry growth rate relative to fastest growing berries in a vine. The relationship obtained may allow modeling fruit set based on the berry growth rate simulated from a carbon balance model such as the "VitiSim" (Lakso and Poni 2005). The shape of the relationship is essentially the same as found in apple (Lakso *et al*. 2001) except that apple fruits were retained at somewhat lower growth rates. The underlying mechanism of growth-related abscission is not understood, but it appears that it may be a fairly fundamental response of fruit as different as citrus, peach, apple and grape.

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