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Grapevine yield elaboration highly relies on plant carbon status. Whether global warming may cause an imbalance between plant carbon gain and carbon loss, and promote in return the failure of early phases of reproductive development, is a major issue for wine growers. The present study was aimed to address the role of grapevine carbon status on yield elaboration under elevated temperatures. It was conducted on Microvine, a grapevine model characterized by a dwarf stature and continuous flowering, thus facilitating experiments under fully controlled environment.

Two experiments were performed in growth chambers on Microvine plants, characterized by contrasted initial vigor. High day/night temperatures treatments (+3°C to +8°C increases compared to a control) were applied over a one- to two-month period in each experiment. Plant phenology, vegetative development and yield components were assessed before and after the temperature treatments. In addition, the biomass growth and sugar contents of all individual above-ground organs and of roots were determined at the end of experiments.

High temperatures caused the abscission of young inflorescences, before they reached the flowering stage. The abortion occurred instantly after the temperature increase on plants with a low vigor, while it was concomitant with the onset of ripening of oldest bunches on plants with a high vigor. Although the number of flowers and the rate of fruitset on the remaining bunches were unchanged under warm temperatures, the onsets of flowering and of ripening were both delayed on a thermal time basis. In contrast, the phyllochron remained constant, and the biomass allocations toward the leaves and the internodes even increased under elevated temperatures. However, carbon statuses in perennial vegetative organs (internodes and roots) were altered under high temperatures, and they were also lower when the vigor was low, thus indicating that carbon gain was impaired with the sink demand. These results suggest that the dynamics of carbohydrate pool within perennial organs act as an adjusting variable to buffer the changes in carbon balance. This study provides the first basis for a modeling approach of yield responses to carbon balance under temperature changes.