Methods

The winegrape cuttings used in this experiment were taken from the UC Davis Robert Mondavi Institute vineyard in December 2015. They were potted in 26 cm diameter pots and began growing in January 2016. On 27 May they were placed in growth chambers with day/night temperatures of 6/4 °C and an 8-hour photoperiod to induce dormancy, though the plants did not appear visibly dormant until 20 June.

On 15 August, the 351 potted cuttings were moved out of dormancy and into a greenhouse where the initial day temperature was 18.5 ± 1.5 °C and night temperature was 16.75 ± 1.25 °C. After the first week, the temperatures were slowly raised to 25.5 ± 2.5 °C during the day and lowered to 10 °C at night. The cuttings were pruned the day they were removed from dormancy so that each cutting had two spurs and each spur had two nodes. Then, the diameter of each spur and node and the distance between the two nodes on each spur were measured with calipers.

Twice a week, beginning 22 August, each plant’s development was recorded using the modified Eichorn-Lorenz scale (REFERENCE) and soil moisture was measured with a probe in three locations in each pot. Each spur was kept at two shoots, but only the dominant shoot on each spur had observations recorded. Each shoot was trained up a stake for support. When an inflorescence had developed (EL stage 12), the plant was randomly assigned to one of five growth chambers if it was a part of the heat tolerance experiment. Otherwise, observations on it continued in the greenhouse. The varieties chosen for inclusion in the experiment expressed a diversity of phenology and had enough reps for at least one plant per chamber.

The five chambers all had a 12-hour photoperiod with 800 m-2s-1 of fluorescent light, but Chamber 1 was set at 17/23 °C, Chamber 2 was set at 23/29 °C, Chamber 3 was set at 27/33 °C, Chamber 4 was set at 31/37 °C, and Chamber 5 was set at 34/40 °C. Initially, CO2 levels were set at 400 ppm during the day and 600 ppm at night, because plants respire at night, increasing CO2 levels (REFERENCE). Each inflorescence was contained in a paper bag to collect the flower caps as they fell.

Observations on the percent flowering, leaf number, stem length, and number of fallen flower caps along with soil moisture readings were made three times a week. On 19 September, it was noted that some inflorescence bags also contained aborted buds that had yet to flower, and so those numbers were also recorded. Once a plant had reached 100% flowering, or, in the case of plants where the entire inflorescence had died and fallen off, the plant spent a minimum 14 days in the chamber, it was returned to the greenhouse.

All analysis, including analysis of variation (ANOVA) to test for trends between the treatments, was performed in R version 3.3.3 (R Core Team).

Results

The plants underwent budbreak between 17 August and 6 September (mean=29 August) and leafout between 22 August and 22 September (mean=4 September). All plants had least one bud burst, but two plants never leafed out. The first inflorescence formed on DATE, and 51 plants eventually reached this stage (EL 12), though only 26 were of the varieties selected for the experiment.