**Terroir and rootstock effects on leaf shape in California Central Valley vineyards**

**Figure 1: Experimental design.** A) A map of bonded California winery locations (black points) projected onto Köppen-Geiger climate classifications (see legend). B) Sampling design of Cabernet Sauvignon (purple) and Chardonnay (dark green) scions across vineyards in San Joaquin (orange), Merced (light green), and Madera (magenta) counties and Teleki 5C (yellow), 1103 Paulsen (brown), and Freedom (charcoal) rootstocks. 20 contrasts that evaluate effects of pairs of rootstocks (solid, horizontal arrows) or locations (dotted, vertical arrows) are indicated by number.

**Figure 2: Morphospace.** **A)** Principal Component Analysis (PCA) on Procrustes-adjusted landmarks. Left: Superimposed landmarks of all leaves and the Generalized Procrustes Analysis (GPA) mean leaf (blade points in orange, vein points in magenta). Right: eigenleaf representations across the PCA morphospace. Points are colored by the ratio of vein-to-blade area (inferno palette). Similar to (A), panels **(B)**, **(C)**, and **(D)** show superimpositions of GPA mean leaves (left) and projections onto the PCA morphospace (right) for scion, rootstock, and locations factors, respectively (see legends).

**Figure 3: Comparisons of rootstock effects**. For each significant rootstock comparison, visualizations of differences between GPA mean leaf shapes are visualized as a reference leaf (solid outline) to a comparison leaf (dotted outline), in which the difference to the reference has been multiplied by x4. The differences of each rootstock to the other are visualized in turn. Rootstock pairs are arranged by column and the locations the samples arise from by row. The identification number of each contrast and the scion that was sampled are indicated.

**Figure 4: Comparisons of location effects**. For each significant location comparison, visualizations of differences between GPA mean leaf shapes are visualized as a reference leaf (solid outline) to a comparison leaf (dotted outline), in which the difference to the reference has been multiplied by x4. The differences of each location to the other are visualized in turn. Location pairs are arranged by column and the rootstocks the samples arise from by row. The identification number of each contrast and the scion that was sampled are indicated.

**Figure 5: Water use efficiency (WUE) models. A)** For all samples, photosynthetic rate (A, umol m-2 s-1) plotted against transpiration rate (E, mol m-2 s-1). A fitted curve modeling photosynthetic rate as a function of transpiration rate, A = m\*ln(E) – b, is shown. Similar to (A), panels **(B)**, **(C)**, and **(D)** show plots and fitted curves by scion, rootstock, and location factors, respectively (see legends).

**Figure 6: Morphospace of rootstock and location effects on leaf shape.** For each significant contrast, divided by Cabernet Sauvignon **(A)** and Chardonnay **(B)** scions, the magnified differences (x4) in leaf shape were used to construct a morphospace. Each pair of contrasted leaf shapes is connected by a line segment indicating the type of comparison, either rootstock (solid) or location (dotted). Points are colored by identity (see legends). Eigenleaf representations are provided to visualize the morphospace. **C)** The modeled vein-to-blade ratio values for eigenleaves across PC1 values for the Cabernet Sauvignon (purple) and Chardonnay (green) PCA morphospaces.

**Table 1: Contrasts by rootstock and location and associated p values for differences in leaaf shape and instantaneous water use efficiency (WUEi)**