

Water Use Efficiency (WUE) and Drought Tolerance Traits of Fava Bean in Relation to the Plant ¹³C Isotope Composition.

Fava bean (*Vicia faba*) is grown in winter cover crop mixes in California. In this study, we compared agronomic performance and physiological traits related to WUE and drought tolerance of several fava bean lines in the field and a pot study. A panel of 63 fava bean lines was evaluated for their ¹³C composition in four environments. Seven lines with extreme ¹³C values were selected and studied for their drought tolerance and WUE traits under full-irrigation and drought treatments in a pot study. The fava bean lines produced a range of 16.8 to 28.7 g plant⁻¹ grain, and 34.9 to 55.8 g plant⁻¹ dry biomass (with grain) in the drought treatment group. Lines in the fully-watered condition produced a range of 18.4 to 49.8 plant⁻¹ grain, and 50.2 to 72.7 g plant⁻¹ dry biomass (with grain). On average, fully watered plants transpired a range of 19.3 to 29.0 L water plant⁻¹ and stressed plants had a range of 7.4 to 15.8 L plant⁻¹ transpiration during the growing season, as measured by the cumulative daily loss of soil moisture weight over time. The WUE_{grain} of the fava bean lines ranged from 0.179 to 0.350 gL⁻¹ in fully-watered conditions, and 0.207 to 0.304 gL⁻¹ in drought stressed conditions.

In a second experiment, the performance of 7 fava bean lines with high WUE were selected for testing in a field study comprised of 4 replications under rainfed and additional irrigation. From these lines, Ziyad Brothers Import and V4-Derived produced the highest grain yield under irrigation and non-irrigation, respectively. PF17339-342 had the lowest grain yield reduction in response drought conditions. Boccli displayed the most drought stress resilience as measured by physiological metrics (leaf temperature, photosynthetic gas exchange). Fava bean δ¹³C was moderately correlated with leaf temperature and WUE_{biomass}. (R² = .5501, R² = .4271 respectively).