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IS THE DISCRIMINATION AGAINST 13C IN LEAFLETS AND TUBERS AN APPROPRIATE TRAIT TO DETERMINE GENOTYPIC DIFFERENCES RELATED TO DROUGHT TOLERANCE IN POTATO?

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Drought tolerance selection through phenotyping entails prioritizing plant traits that synthesize and integrate critical physiological processes occurring during the crop's growth. Potato studies where discrimination against ^{13}C (Δ) in leaflets ($\Delta_{leaflet}$) and tubers (Δ_{tuber}) were monitored, concluded that $\Delta_{leaflet}$ is not an appropriate trait for screening tolerance to mild water stress [1], and that Δ_{tuber} differences do not reflect final yield [2]. The present study was designed to revisit these findings, comparing the $\Delta_{leaflet}$ and Δ_{tuber} throughout the phenology of two advanced varieties with acceptable yield under water limiting conditions (UNICA, CIP N°392797.22 and Sarnav, CIP N°397077.16) and contrasted with a cultivar commonly tested in carbon isotope studies (Désirée). The drought treatment consisted of a deficit irrigation with 50% of field capacity, which was established after tuber initiation onset (TIO). The control plants were watered until the soil reached field capacity. Six sequential harvests were carried out to assess Δ in dry biomass of leaflets and tubers. Prior to each harvest, gas exchange was measured in leaflets. The variety Sarnav showed the higher final tuber dry biomass (75.96±1.96 g plant^{-1}) under drought as well as the maximum tuber bulking (1.65±0.05 g day^{-1}) under control conditions. The average difference control-drought, for both $\Delta_{leaflet}$ and Δ_{tuber}, was positively correlated with the drought tolerance index (DTI) [3]. DTI ranking among genotypes was Sarnav > Unica > Désirée. Despite Sarnav's higher average stomatal conductance (242.4±15.4 mmol H_2O m^{-2} s^{-1}) and lower intrinsic water use efficiency (A/g_s; 79.3±5.4 µmol/mol), low $\Delta_{leaflet}$ (20.3±0.17‰) was evidenced under control treatment, attributed to a larger photosynthetic capacity [4]. Sarnav showed the lowest Δ_{tuber} (15.8±0.17‰) of the three varieties under drought conditions, suggesting a more extensive use of carbon products synthesized in leaves for drought tolerant mechanism, thus confirming previous findings for this variety [5]. Due to the strong negative correlation found between Δ and A/g_s ($r_{Pearson}$ between -0.77 and -0.89), the use of Δ as a method for screening drought tolerance in advanced potato genotypes seems warranted. We recommend sampling for Δ analyses before senescence i.e. between 30 and 60 days after TIO, or 350 and 700 ºC days of accumulated thermal time after TIO.

References

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