Constraining parameter uncertainty for predicting oxygen and hydrogen isotope values in fruit

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Understanding delta O-18 and delta H-2 values of agricultural products like fruit is of particular scientific interest in plant physiology, ecology, and forensic studies. Applications of mechanistic stable isotope models to predict delta O-18 and delta H-2 values of water and organic compounds in fruit, however, are hindered by a lack of empirical parameterizations and validations. We addressed this lack of data by experimentally evaluating model parameter values required to model delta O-18 and delta H-2 values of water and organic compounds in berries and leaves from strawberry and raspberry plants grown at different relative humidities. Our study revealed substantial differences between leaf and berry isotope values, consistent across the different relative humidity treatments. We demonstrated that existing isotope models can reproduce water and organic delta O-18 and delta H-2 values for leaves and berries. Yet, these simulations require organ-specific model parameterization to accurately predict delta O-18 and delta H-2 values of leaf and berry tissue and water pools. We quantified these organ-specific model parameters for both species and relative humidity conditions. Depending on the required model accuracy, species- and environment-specific model parameters may be justified. The parameter values determined in this study thus facilitate applications of stable isotope models where understanding delta O-18 and delta H-2 values of fruit is of scientific interest.
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