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Hydrogen isotope composition of leaf wax n-alkanes in glaucous and non-glaucous varieties of wheat (Triticum spp.)

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The use of the 2H/1H composition of terrestrial plants in climate and ecology studies depends on fundamental understanding of the processes within the plant that control fractionation of these two isotopes. Little is currently known about the extent of 2H/1H fractionation at different steps of biosynthesis, after the initial H uptake following leaf water photolysis. Knowing this effect is particularly important when seeking to interpret the 2H/1H composition of leaf wax biomarkers from plants that differ in the amount and type of individual compound classes in their leaf waxes. The purpose of this study was to investigate the link between the quantity and distribution of n-alkyl lipids in leaf waxes and their isotopic composition.

We used a genetic approach to suppress glaucousness in 2 varieties of wheat (Alchemy and Malacca), which resulted in glaucous and non-glaucous phenotypes of both varieties. Both phenotypes were then grown outdoors under identical environmental conditions in central Norfolk, UK. At the end of the growing season, the plants were sampled for soil water, leaf water, and leaf wax isotopic measurements. Comparison of the leaf wax composition of the non-glaucous and glaucous phenotypes revealed that the non-glaucous varieties were characterised by the absence of diketones and a greater concentration of n-alkanes and primary alcohols..

Our results showed very small differences between glaucous and non-glaucous varieties with regard to soil (mean values, <2 per mil) and leaf (<1 per mil) water 2H/1H. Conversely, there was 15-20 and 10-15 per mil 2H-depletion in the C29 and C31 n-alkanes, respectively, from the non-glaucous phenotype. This 2H-depletion in the non-glaucous phenotype demonstrated that the suppression of diketone production and the increase in n-alkane and primary alcohol concentrations are linked with a shift in the 2H/1H composition of n-alkanes.

The initial results of this work suggest that plants using the same environmental water, subjected to the same effects of evapotranspiration, but which differ in the amount and composition of leaf wax compounds, can exhibit large variation in their n-alkane 2H/1H. Our current work on determining the 2H/1H composition of other n-alkyl lipids from these plants will provide further details regarding the role of biosynthesis in controlling 2H/1H fractionation within leaf waxes.