Grain carbon isotope composition is a marker for allocation and harvest index in wheat

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Abstract

The natural ^{13}C abundance ($\delta^{13}\text{C}$) in plant leaves has been used for decades with great success in agronomy to monitor water use efficiency and select modern cultivars adapted to dry conditions. However, in wheat, breeding also implies looking for genotypes with high carbon allocation to spikes and grains, and thus with a high harvest index and/or low carbon losses via respiration. Finding isotope-based markers of optimal carbon partitioning to grains would be extremely useful since isotope analyses are inexpensive and can be performed routinely at high throughput. Here, we took advantage of a set of field trials made of more than 600 plots with several wheat cultivars and measured agronomic parameters as well as $\delta^{13}\text{C}$ values in leaves and grains. We find a linear relationship between the apparent isotope discrimination between leaves and grain (denoted as $\Delta\delta_{\text{corr}}$), and the respiration use efficiency-to-harvest index ratio. It means that overall, efficient carbon allocation to grains is associated with a small isotopic difference between leaves and grains. Our results show that ^{13}C natural abundance in grains has some potential to help finding genotypes with better carbon allocation properties and assisting current wheat breeding technologies

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