

Carbon isotope discrimination as an indicator of pastoral water use efficiency

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New Zealand pasture systems depend on year-round growth for profitability. Extended late summer and early autumn soil moisture deficits restrict pasture growth in many regions and consequently threaten profitability. A potential mitigation strategy is the use of pastures with more diversity, including more drought tolerant species. Increasing dry season growth will benefit farmers directly, through increased pasture production, and also indirectly through improved soil physical and chemical properties (increased carbon inputs) leading to more sustainable land use. We require a fast and cost effective method to screen for productive drought tolerant pasture species and mixes over multiple sites with variation in climate and soils. One solution maybe to use natural carbon isotope discrimination ($\delta^{13}\text{C}$) signals in leaves where the ratio of ^{13}C to ^{12}C provides information on both water stress and the efficiency with which pasture plants are controlling the trade-off between carbon gain and water loss (i.e. WUE). Using $\delta^{13}\text{C}$ is attractive because the method does not modify the measurement environment, integrates over useful time scales, and is a quick, simple, and cost effective procedure. To test this method we harvested biomass samples in sequence with the grazing rotation on a commercial dairy farm where we were measuring WUE at the paddock scale using the eddy covariance (EC) technique. The biomass samples were dried, ground, and analysed for $\delta^{13}\text{C}$. Preliminary data showed that $\delta^{13}\text{C}$ WUE and EC WUE were positively correlated. Furthermore, we also observed a negative correlation between the $\delta^{13}\text{C}$ and soil moisture suggesting a relationship between $\delta^{13}\text{C}$ and water stress. This method is simple and relatively inexpensive. Ultimately farm advisers might be able to use $\delta^{13}\text{C}$ measurements to assess pasture species and mixes best suited to individual climate and soil type combinations maximising above and below ground productivity, especially during dry periods.