



Carbon isotope composition ($\delta^{13}\text{C}$) in *Dactylis glomerata* and its relationship with water use efficiency at plant and leaf level

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INTRODUCTION

Water use efficiency (WUE) of forage crops will be a main trait in the selection of new cultivars for Mediterranean areas. Regrettably, it is not easy to estimate accurately at field scale, and several attempts have been made to establish accurate and simple variables to estimate WUE in large selection field experiments.

The objective of the present work was to analyse the relationship between leaf carbon isotopic composition ($\delta^{13}\text{C}$) and WUE measured at plant and leaf level in three cultivars of *Dactylis glomerata*.

MATERIAL AND METHODS

•**Plant material:** *Dactylis glomerata* cultivars Jana (Mediterranean non summer dormant), Kasbah (Mediterranean summer dormant) and Porto (Oceanic non summer dormant).

•**Environmental conditions:** The experiment was carried out in a growth chamber, 25°C and 12h-photoperiod. 5 L pots (2 seedlings per pot) were filled with a mix of horticultural substrate and a clay calcareous soil.

•Two irrigation treatments were considered:

•a) 100% of field capacity and

•b) progressive drought, imposed by a combination of deficit irrigation (80% of water lost) and no irrigation until a minimum of 30% of field capacity

•The following **parameters** were considered:

•Water use efficiency (WUE) at plant level: produced total biomass (g) / consumed water (L)

•Intrinsic water use efficiency (at leaf level): net photosynthesis/stomatal conductance (A/g)

•Carbon isotope composition ($\delta^{13}\text{C}$) of the leaf upper (older) half, the leaf bottom (younger) half, and also of the total final leaf biomass of each pot.

RESULTS AND DISCUSSION

•Carbon isotope composition ($\delta^{13}\text{C}$) showed little differences between treatments and its values were lower than expected in drought plants (Fig. 1), suggesting that in spite of low soil water content under drought, plants underwent a mild drought stress. This could be due to relatively low vapour pressure deficit (VPD, between 1.6-2.1 KPa).

•WUE at plant level and $\delta^{13}\text{C}$ were not highly correlated (Fig. 1) despite it was significant ($p < 0.05$), since irrigated Kasbah plants were out of this regression.

•The younger section of the leaves presented a slightly higher $\delta^{13}\text{C}$ than the older section (Fig. 2), which could be a consequence of the higher CO_2 demand of former.

•Both, the younger and the older section of the leaves showed similar regression coefficient between $\delta^{13}\text{C}$ and A/g (Fig. 2), but both showed no relation between $\delta^{13}\text{C}$ and WUE.

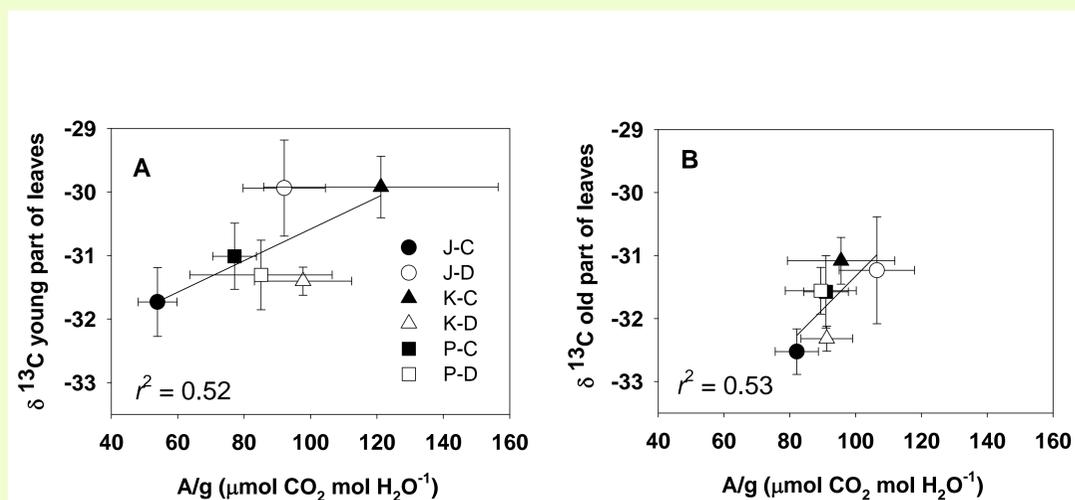


Figure 2. Relationship between A) isotopic composition of ^{13}C ($\delta^{13}\text{C}$) in the younger part of leaves and intrinsic water use efficiency (A/g) measured 27 days after treatments imposition; B) $\delta^{13}\text{C}$ in the older part of marked leaves and A/g measured 47 days after treatments imposition. Values are means of 4 replicates \pm standard error. Acronyms are like in Fig. 1.

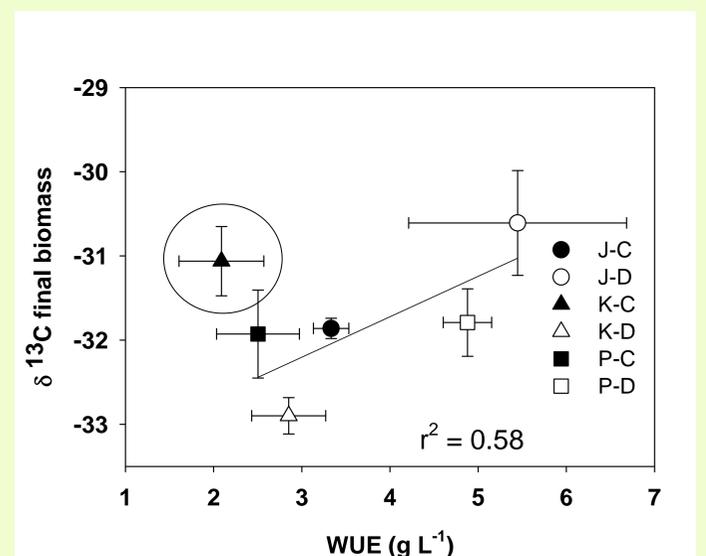


Figure 1. Relationship between isotopic composition of ^{13}C ($\delta^{13}\text{C}$) in leaf final dry biomass and plant water use efficiency (WUE). Values are means of 4 replicates \pm standard error. First letter is referred to cv: J: Jana, K: Kasbah, P: Porto. Second letter is referred to irrigation treatment: C: control, D: drought. The encircled point is out of the regression.

CONCLUSIONS

•Carbon isotope composition ($\delta^{13}\text{C}$) did not appear to be a clear parameter to estimate neither WUE nor intrinsic WUE in the studied range of *Dactylis glomerata* genotypes.

•The precise sampling, i.e. only old parts or young parts, did not show any advantage in relation to the 'coarse' sampling, i.e. considering the whole leaf biomass, in order to estimate crop WUE.

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