SUPPLEMENT

Natural abundance labelling

In a preliminary experiment, the continuous introduction of fresh air into the growth cabinets was suppressed over the entire growing period resulting in a ^{13}C enrichment of cabinet CO_2 due to the highly productive plants growing within them, discriminating against ^{13}C. High photosynthetic rates changed cabinet air conditions to *c.* 100 ppm [CO_2] and $\delta^{13}C_{air}$ to *c.* -1‰ which subsequently also changed $\delta^{13}C$ values of respiration. Labelling was achieved by re-starting fresh air supply resulting in near-ambient air conditions inside the cabinets with [CO_2] of 400 ppm and $\delta^{13}C_{air}$ of *c.* -9‰.

Labelling started at the same time as the random allocation of plants to one of two cabinets – one with a warm treatment (25°C; equal to the daytime growing conditions; control) and one with a cold treatment (10°C).

Results

The $\delta^{13}C$ of pre-label leaf-respired CO_2 was around -11‰ which is much less depleted than usual C_3 plant respiration (of around -27‰). Further, $\delta^{13}C_{SR}$ was stable during the diurnal cycle of the pre-label day (data not shown) with only small variations between replicates. However, $\delta^{13}C_{SR}$ was very responsive to the labelling. Immediately after introducing ambient fresh air, shoot respiration was already much more depleted in ^{13}C (change of *c.* 3.5‰) compared to the average values during pre-labelling (Fig S1, upper panel). This indicates a very fast utilization of recent photo-assimilates for shoot respiration. Within about 7 h, $\delta^{13}C_{SR}$ had changed by the full magnitude of the treatment (*c.* 8‰). There was no difference in the response of $\delta^{13}C_{SR}$ between warm and cold treatments. However, after 8 h post-labelling, $\delta^{13}C_{SR}$ of the warm treatment increased again by *c.* 3‰, whereas the cold treatment continued to decline, levelling out at 10.5 h post-labelling. The change of $\delta^{13}C_{SR}$ by the full magnitude of the label might indicate that all recent photo-assimilates are quickly invested in respiration or export (to roots) rather than storage and/or growth within leaves.

The $\delta^{13}C$ signal of root respiration ($\delta^{13}C_{RR}$) on the other hand, showed a time-lagged response to the label application with a faster response in the warm (after *c.* 2 h) compared to the cold treatment (after *c.* 5 h; Fig S1, lower panel). Unlike $\delta^{13}C_{SR}$, $\delta^{13}C_{RR}$ of both treatments did not change by the full magnitude of the label, shifting only by 5‰.

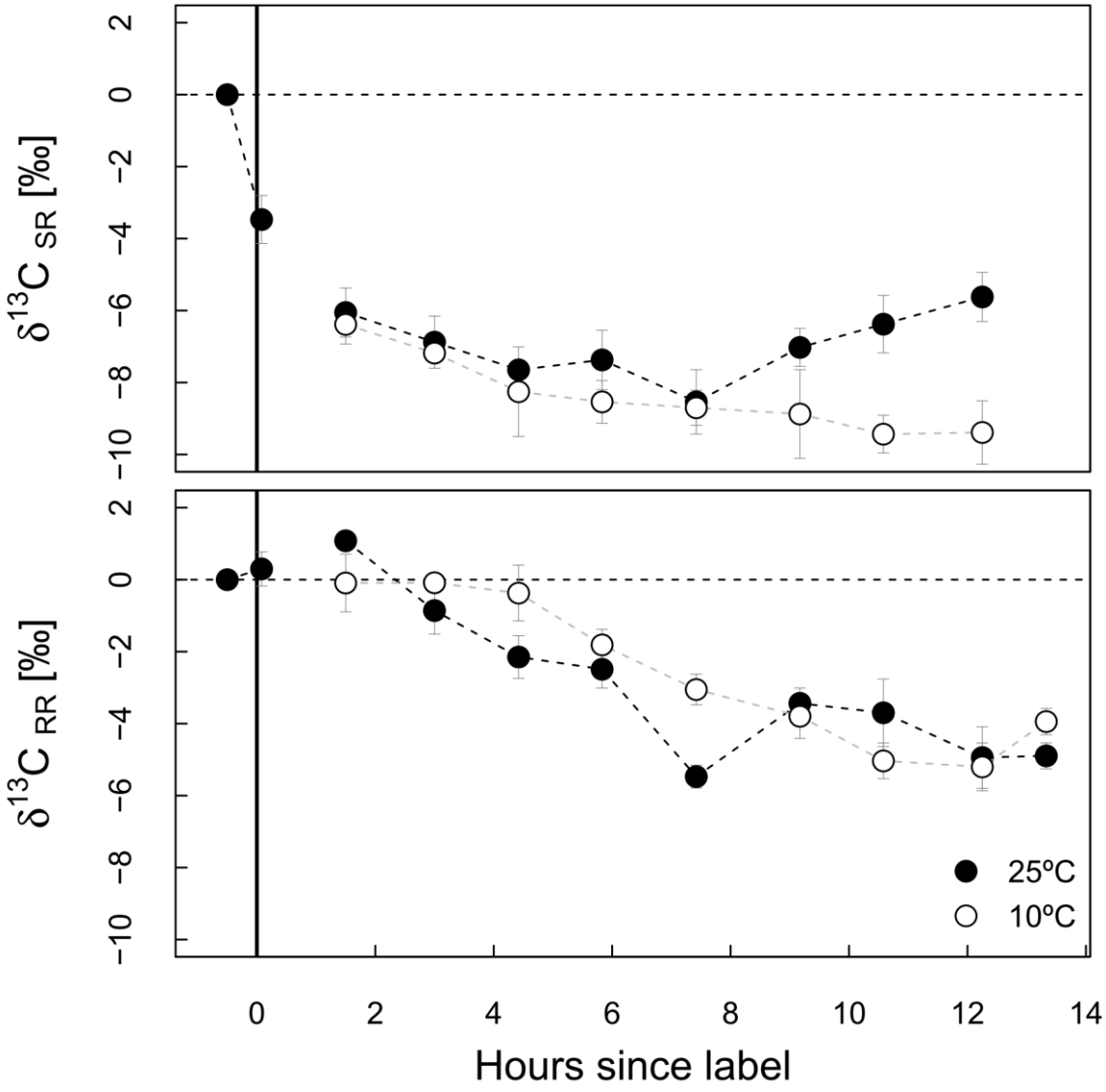

Figure S1: Time course of relative change of $\delta^{13}C$ in shoot ($\delta^{13}C_{SR}$; *upper panel*) and root ($\delta^{13}C_{RR}$; *lower panel*) respired CO_2 during continuous label; control treatment (25 ºC, *closed symbols*); cold treatment (10 ºC; *open symbols*); sample allocation to warm and cold cabinets and label start (*vertical line*). The data shown are means ± standard error (n = 3)