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Adaptation of carbon allocation under light and nutrient reduction

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The allocation of recently assimilated carbon (C) by plants depends on developmental stage and on environmental factors, but the underlying mechanisms are still a matter of debate. Whereas shifts in the allocation of photosynthates induced by reduced water availability, enhanced temperature and CO_2 concentration were recently investigated in various studies, less is known about the response to light and nutrient reduction. We induced different allocation patterns in the Mediterranean shrub *Halimium halimifolium* L. by a reduction of light (*Low L* treatment) and nutrient availability (*Low N* treatment) and analysed allocation parameters as well as morphological and physiological traits for 15 months. Finally, we conducted a $^{13}CO_2$ pulse-labelling and followed the fate of recently assimilated carbon to eight different classes of plant tissues and respiration for 13 days. The results revealed a high intraspecific variability in C distribution to tissues and in respiration. Allocation changes even varied within leaf and stem tissue classes (e.g. more C in main stems, less in lateral stems). These results show that the common separation of plant tissues in only three classes, i.e. root, shoot and leaf tissues, can result in missing information about allocation changes. The nutrient reduction enhanced the transport of recently assimilated C from leaves to roots in terms of quantity (c. 200%) and velocity compared to control plants. Interestingly, a 57% light reduction enhanced photosynthetic capacity and caused no change in final biomass after 15 months. Therefore, our results support the recently discussed sink regulation of photosynthesis.

Finally, our results indicate that growing heterotrophic tissues strongly reduce the C loss from storage and structural C pools and therefore enhance the fraction of recent assimilates used for respiration. We propose that this interruption of the C reflux from storage and structural C pools could be a control mechanism for C translocation in plants.