# OLM 8.6. Division of labour in clonal plants

As described in Ch8.3 the relative abundance of soil resources and light is an important factor shaping basic plant strategies and this ratio of the two types of resources determines the biomass ratio of above- and below-ground parts in plants. Classical allocation theory states that plants allocate more into organs specializing in the uptake of the most limiting resource (Grime 1979, Bloom et al. 1985). Nevertheless, if individual ramets of clonal plants stay interconnected after vegetative propagation they may share resources (assimilates or nutrients). This opens up the possibility for the spatial division of labour between ramets (Stuefer et al. 1996): each ramet specializes in taking up the resource that is locally abundant and shares it with other, connected ramets. We shall discuss this phenomenon in this OLM.

The most enlightening experiment presenting this phenomenon (Figure 8.6.1) is that of Stuefer et al. (1996). Clonal fragments of the stoloniferous herb *Trifolium repens* were

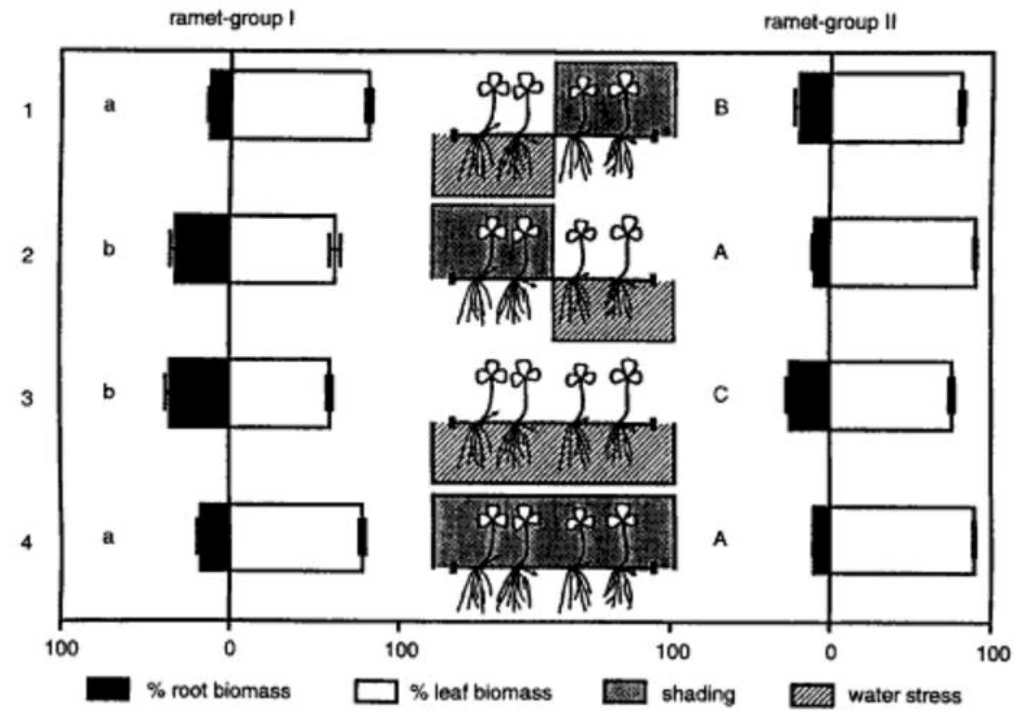


Figure 8.6.1: Experimental evidence for division of labour in clonal plants

Central part of the figure: drawing of the four experimental treatments with *Trifolium repens*, bars: mean ± SE percentage biomass allocation to leaves (white) and roots (black) for the two interconnected ramet-groups (left: ramet-group I; right: ramet-group II). Different letters indicate statistically significant differences (at $\alpha$=0.05) in root-shoot ratios among treatments separately for the two ramet-groups: lower and upper case for ramet group I and II, respectively (Stuefer et al. 1996). Reprinted by permission of John Wiley & Sons.

exposed to two levels of light intensity and water supply. Two interconnected groups of ramets (the older ramet group I and the younger ramet group II) experienced either homogeneous conditions (Figure 8.6.1, treatment 3 and 4) or contrasting environments (Figure 8.6.1, treatment 1 and 2). Treatment 1 and 2 differed only in that the developmentally older (proximal) part of each plant was exposed to which environment. This made possible the detection of age effects if there were any. After four weeks of growth plants were harvested and dry mass of leaves, petioles, stolons and roots determined.

Ramet groups under high light and low water conditions allocated more biomass to leaves, and less to roots when they were connected to a shaded and well-watered counterpart than when entire plants grew under high light, low water supply conditions (compare treatment 1 and 3 for ramet group I, and 2 and 3 for ramet-group II). On the contrary, shaded and well-watered ramets allocated less to leaves and more to roots when they were connected to an unshaded and water-stressed ramet-group (compare treatment 2 and 4 for ramet group I, and 1 and 4 for ramet-group II). Thus, interconnected ramet-groups growing in contrasting patches specialized morphologically in the uptake of the locally most abundant resource and supported each other by reciprocal translocation of water and assimilates between sites of high supply and high demand. This division of labour significantly increased the performance of the entire plant in terms of biomass and clonal offspring production in heterogeneous compared to spatially uniform environments (Stuefer et al. 1996).

Magyar et al. (2007) investigated the costs and benefits of plasticity in a wide range of spatio-temporally heterogeneous environments via a spatially explicit simulation model including two resources. The amount of resources taken up by a ramet depended on both the local environment and on the degree of ramet specialization. The uptake of the two resources was traded-off. Three plant strategies were investigated in pairwise competition. The nonplastic strategy was unable to specialize. The autonomous plastic strategy responded only to external signals of local resource availability, disregarding the internal resource balance in the clonal fragment; while in the coordinated plastic strategy localized responses could be modified by internal demand signals from connected modules, specializing only if there was an internal demand for the locally abundant resource. Plasticity in resource uptake proved beneficial in a broad range of environments. Modular coordination was beneficial under virtually all realistic conditions, especially if supply of the two resources did not closely match resource needs (Magyar et al. 2007).

## References

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