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Effect of Different Local Nutrient Levels on the Growth and Development of *Potentilla reptans* L.

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Abstract: In this study, the response of ramet 4 (a young, newly rooted ramet) to rooting in media of different nutrient levels, and the effect of such local treatment on the growth of older and younger parts of the clone was investigated under green-house conditions. The response was also compared to clones where R4 remained unrooted. The results clearly indicated that there was a very localized response to nutrient supply, where the growth response was largely restricted to the ramet supplied with nutrients.

Key words: Ramets, clone, nutrient levels, *P. reptans*.

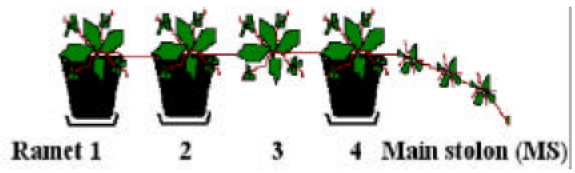
Introduction

Potentilla reptans (Rosaceae) is a perennial, stoloniferous herb. It is commonly found in fields, pastures and road-side verges and also regularly flooded riverbanks and lake shores. Clonal growth may be defined as the horizontal extension of a plant by the addition of ramets that develop their own roots (Silvertown, 1987). Ramets are the vegetatively produced growth modules with root and shoot components that are capable of independent existence, if they are separated from the main plant (Harper, 1977). Each ramet has a shoot and the potential to develop a root system. The established clonal plant is thus a population of interconnected ramets of various ages and origins where different groups of ramets by their spatial separation may experience different edaphic and climatic conditions. As long as the connection between ramets persist clonal plants may function as physiologically integrated system in which carbohydrates, mineral nutrients and water are freely transported from one part of the clone to another; alternatively they may function as an assemblage of interconnected but independently functioning units, i.e., with intra-ramet rather than inter-ramet patterns of resource allocation (Marshall, 1990). The experiment described in this paper was designed to investigate the functional organization of the stoloniferous plant, *Potentilla reptans* L., by examining its growth response to localized supplies of nutrient levels.

Materials and Methods

The experiment was conducted in the Pen-y-ffridd field station at University of Wales Bangor, (UK) during June 1995. In greenhouse having a minimum temperature 14°C under natural lighting but with a minimum photoperiod of 14h, provided with 400W high-pressure sodium lamps. Sixteen main stolons (MS) were selected from a population of *P. reptans* and the second youngest node from the apex was rooted by pinning to the surface of 3.5cm diameter pots containing John Innes No.1 compost. This unit was classed as ramet 1 (R1). Three weeks later when each MS had produced five to six fully extended nodes, ramet 2 (R2) and (R4) were rooted with ramet 2 in compost as for ramet 1 but with ramet 4 (R4) rooted in a range of nutrient rich substrates R3 remained unrooted .

All MS were severed from mother plants after one week. There were four treatments (T1–T4) and each treatment had four replicates. With respect to R4, in T1 it remained unrooted, in T2 it was rooted in 100% sand, in T3 it was rooted in a mixture with 66% sand and 33% compost, and in T4 it was rooted in 100% compost (given below). Saucers were placed under all pots to contain the nutrient treatments. Water was supplied to all pots as required throughout the duration of the experiment. Experimental treatment T1 where R1 and R2 are rooted in compost and R4 is unrooted; R1 is the oldest ramet. Treatments T2-T4 where R4 is rooted in media with increasing nutrient supply.



Treatments				
T1	:	Compost	Compost	Unrooted
T2	:	Compost	Compost	Sand
T3	:	Compost	Compost	66% Sand + 33% Compost
T4	:	Compost	Compost	Compost

Measurements were made (at 4-day intervals over a 16-days period) on mean branch length of the two longest ramet stolon branches and the number of ramets on these branches for each of the ramet R1-R4, and the length and ramet number of the MS. Plants were harvested at 16 days and separated into component parts for biomass determination. These components were dried at 70°C for 4 days before weighing. The statistical analysis was performed using ANOVA (Anonymous, 1993), the comparison of means was made by Tukey's honestly significance difference (HSD) test. The results described as significant are statistically different at $p \leq 0.05$ critical level of probability.

Results and Discussion

The mean branch length and the production of ramets of R1 and R2 increased with time and showed no significant difference between the treatments (T1-T4) (Fig. 1a-d). In contrast, R3 which was unrooted, showed very little growth with time and again there was no difference between the treatments (Fig. 1e & f). In R4 there was a significant difference in branch extension and ramet production between T4 and T1-T3 (Fig. 1g & h), with the latter showing a far less increase with time as compared to T4. MS length

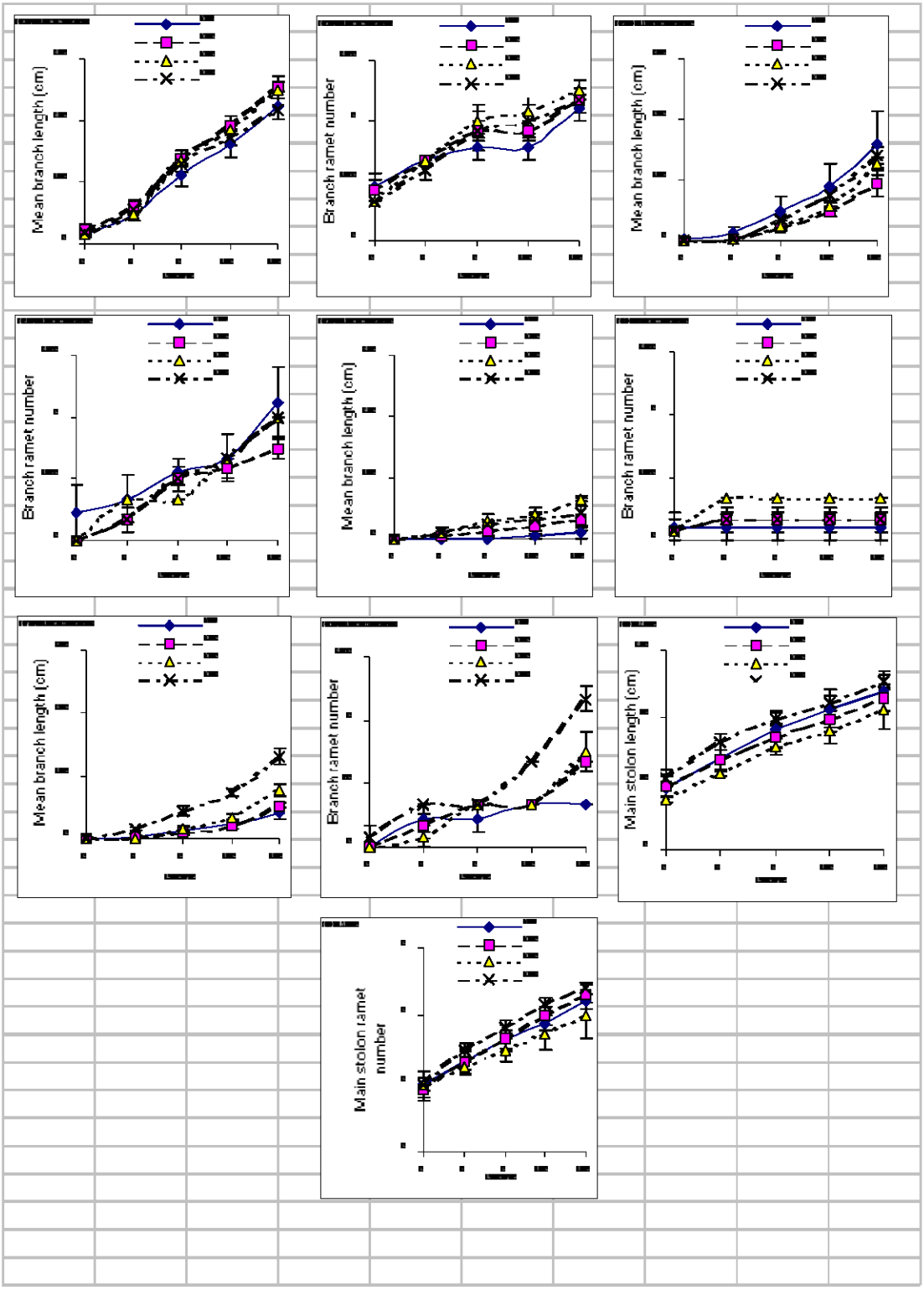


Fig. 1: The effect of local nutrient supply on mean branch length and MS length (a,c,e,g and I) and branch and MS ramet number (b,d,f,h and j) with time in R1, R2, R3, R4 and MS. Bars represents ±S.E.

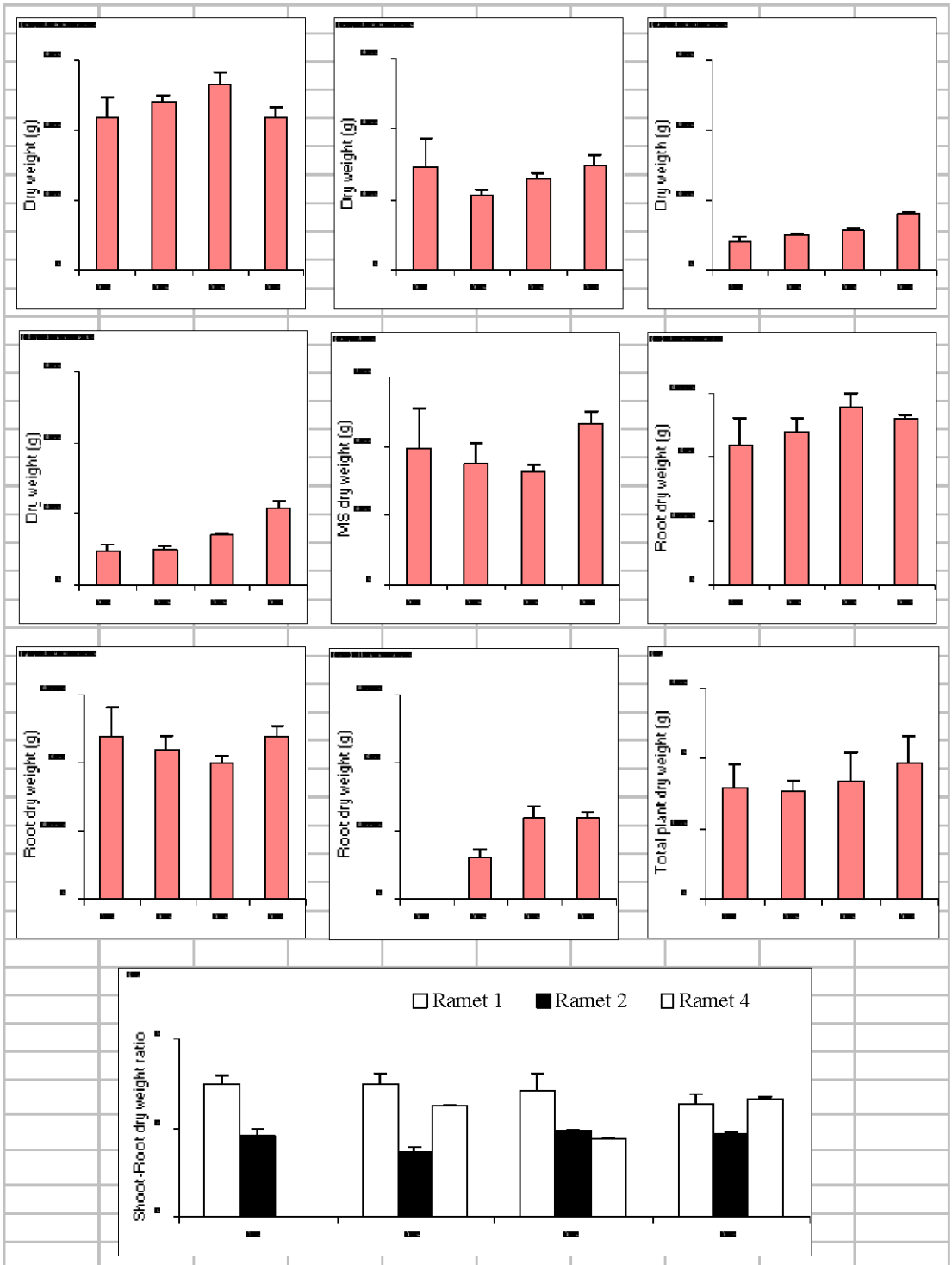


Fig 2. The effect of local nutrient supply on the shoot biomass of (a) R1, (b) R2, (c) R3, (d) R4, (e) MS and root biomass of (f) R1, (g) R2, (h) R4and on total plant dry weight(i) and (j) ramet shoot-root dry weight ratio respectively (. Bars represent ± S.E).

and ramet production increased greatly with time but there was no difference between T1-T4 (Fig. 1i & j).

In case of biomass production of individual ramets plus their branches, R1 showed a significantly greater dry weight in T3 than T4 (Fig. 2a). R2 had significantly less dry weight in T2 as compared to all other treatments (Fig. 2b). R3 and R4 had significantly greater dry weight production in T4 than other treatments (Fig. 2c & d). MS had significantly greater dry weight production in T4 as compared to T2 and T3 (Fig. 2e). The root biomass of R1 was not significantly affected by the treatments, but in the case of R2 T4 resulted in a significantly greater dry weight than T3 (Fig. 2f & g). The R4 root in T3 and T4 was significantly greater than that in T2 (Fig. 2h). There was no significant difference in total plant dry weight production, but a greater response was observed in T4 than other treatments (Fig. 2i). No significant effect of the treatments on ramet shoot-root dry weight ratio was observed for R1 and R2 but for R4 both T2 and T4 showed significantly greater values than T3 (Fig. 2j).

The results clearly indicate that there is a very localized response to nutrient supply, i.e. the growth response is largely restricted to the ramet supplied with nutrients. Similarly (Slade and Huchings, 1987a,b) were found the rooted stolons of *G. hederacea* (L.) nutritionally independent in terms of both their mineral nutrient and carbon economies. The growth of tiller ramets of *A. stolonifera* deprived of nutrient was also very restricted and they responded to nutrient shortage by increasing the proportional allocation of biomass to the roots (Marshall and Anderson – Taylor, 1992). The later response is a well-recorded characteristic of plant grown in conditions of low nutrient status (Noble and Marshall, 1983; Fitter and Hay, 1987) and suggests the lack of significant nutrient transfer from parts of the clone supplied with nutrients to elevate the shortage of nutrients in parts given only water. It was also evident that the growth of the unrooted, extending portion of the stolon was reduced to far lesser degree than that of established ramets. This indicates that nutrient resources of the stolon were translocated from older to younger parts to establish the growth of stolon, as well as increasing the number of new ramets.

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