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Factors Influencing the Rate of Senescence of Clover Roots Following Permanent Excision of the Shoot

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ABSTRACT

Clover roots can survive for periods in excess of 6 weeks after permanent excision of the shoot when grown in sand culture and left undisturbed. Experiments were conducted to investigate whether the rate of root senescence is affected by soil and crop management factors. Cutting roots to simulate mechanical damage and shading the shoot prior to excision resulted in an earlier loss of root cell viability. Viability was also lost much sooner when roots were grown in soil rather than sand culture. The results suggest that in the field, clover roots may be relatively short-lived following soil cultivation, especially if the clover is grown as an understory in a crop mixture.

KEYWORDS: Red clover, root senescence, shading, mechanical damage

INTRODUCTION

Legumes grown as sole crops or in mixture with non-legumes are key components of organic rotations since they have the capacity to fix N_2. An important goal in managing these systems is to ensure that the N is made available to the companion or following crop when demand from the non-legume crop is at its greatest. A better understanding of the mechanisms that control the release of N from clover roots and nodules, and the factors that affect it, would facilitate the development of more effective crop management strategies. Previous research has shown that clover roots grown in sand culture can survive for remarkably long periods of time (> 6 weeks) after permanent excision of the shoot and major release of N only occurred after the loss of membrane integrity (Bingham and Rees, 2008). The objective of experiments reported here was to determine the effects of selected management and soil factors on the rate of root senescence following shoot excision.

MATERIALS & METHODS

Red clover plants (*Trifolium pratense* L cv Merviot) were grown in either sand culture or sandy loam soil in controlled environment conditions for 6-8 weeks as described previously (Bingham and Rees, 2008), after which shoots were excised at the crown to prevent re-growth. Depending on the treatment (Table 1), roots were then either left *in situ* or transferred to incubation vessels containing moist sand and the progress of root senescence determined by weekly measurements of the presence and absence of cell turgor (Bingham and Rees, 2008). The presence/absence of cell turgor was used here as an indicator of cell viability.

RESULTS & DISCUSSION

The results confirm that if left undisturbed in sand culture, clover roots can survive for long periods of time after complete and permanent excision of the shoot (Fig. 1b & c). However, the roots lost viability sooner when the root system was mechanically damaged and when the shoots

were shaded prior to excision to reduce the root’s soluble sugar reserves. Viability was also lost much sooner when roots were grown in soil rather than sand culture. These results suggest that clover roots in the field may be relatively short-lived after soil cultivation, especially if the clover was grown as an understory in a crop mixture where the clover would be shaded.

Table 1. Experimental treatments

Treatment	**Pre shoot excision**	**Post shoot excision**
Mechanical damage	Sand culture	Roots transferred to culture vessel & left intact or cut into 10 mm sections
Shading	Sand culture; 84% shading applied 14 days before excision; controls 525 µmol m^{-2} s^{-1} PAR	Roots left *in situ*
Substrate	Sand culture or soil	Roots left *in situ*

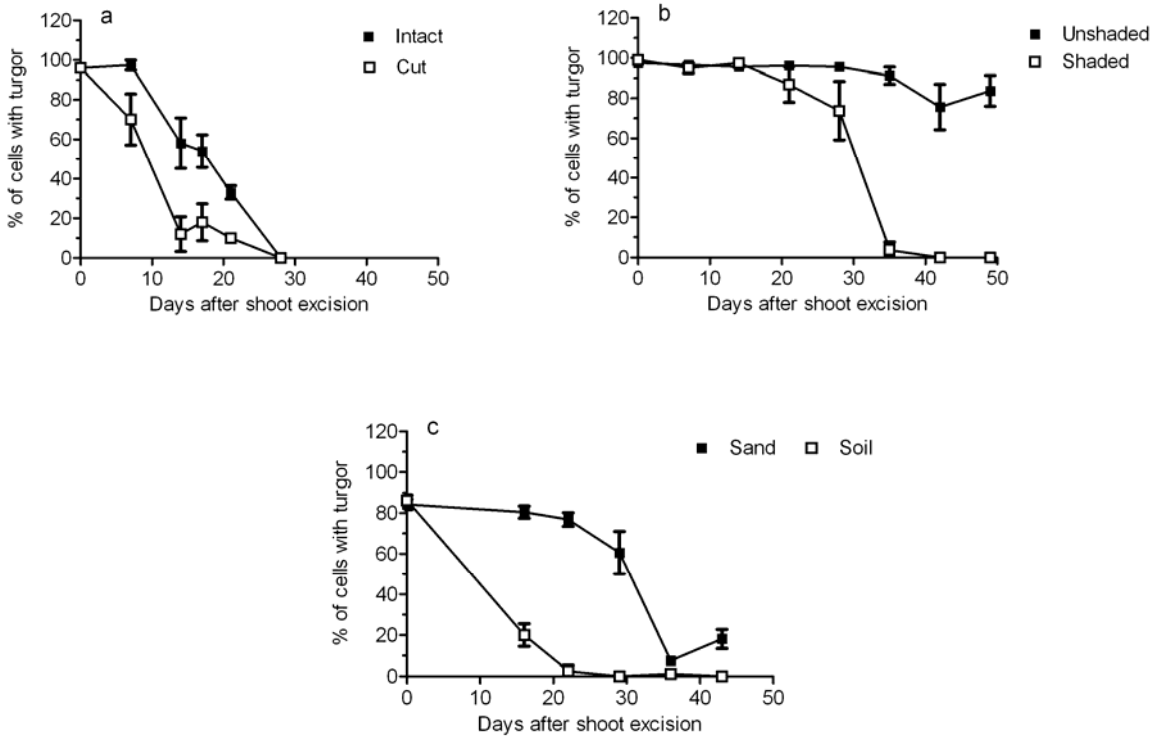

Figure 1. Effects of a) mechanical damage, b) shading, c) root substrate on root cell viability with time after shoot excision.

REFERENCES

Bingham, I.J. and Rees, R.M. 2008. Senescence and N release from clover roots following permanent excision of the shoot. *Plant and Soil* 303: 229-240.

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