AUTECOLOGY OF WHITE CLOVER (*Trifolium repens* L.) WITH SPECIAL REFERENCE TO THE EFFECT OF STOLON BURIAL ON BRANCH FORMATION

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ABSTRACT

In moist temperate regions the persistence and productivity of white clover (*Trifolium repens* L.) in grazed pastures is dependent upon stolon growth, particularly stolon branching. However measurements of white clover in New Zealand pastures indicate that by the beginning of the growing season, generally 80% of stolon material is buried. The objective of this study was to investigate the effect of stolon burial on the branching of stolons and to utilize the findings to further the understanding of the autecology of white clover in grazed pastures.

Distinct seasonal patterns of maximal stolon burial in spring and minimal branching of stolons in spring (both on a population and plant basis) were measured in a field trial established for the monitoring of the autecology of white clover under sheep grazing. Measurements of individual axillary buds on stolons artificially buried, under a range of conditions in the field, consistently found that the major effect of burial was to reduce branching by increasing (up to threefold) the probability of mortality of axillary buds following initiation of outgrowth. Initiation of outgrowth of axillary buds on stolon tissue that had emerged from the stolon apex while on the soil surface before being buried was not, except perhaps for those buds at the two youngest nodes at the time of burial, influenced by burial.

Glasshouse experiments were performed in order to increase knowledge of factors controlling the initiation of outgrowth of axillary buds and to examine how stolon burial influenced outgrowth of axillary buds. Experiments involved measurements of the branching response of individual axillary buds on stolons subjected to differing burial/cultural treatments so that treatment responses could be separated from ontogenetic influences. Initiation of outgrowth of axillary buds was only severely lowered by burial when the node associated with a bud emerged from the stolon apex in soil and then remained in soil. This reduction in initiation of outgrowth was found to result from inhibition of bud activity rather than from loss of bud viability. As very few axillary buds in pastures are buried from emergence, it was concluded that stolon burial has little impact on the initiation of outgrowth of axillary buds in pastures. Severe deprivation of photosynthate or phosphorus within plants, induced by shading or low phosphorus supply, respectively, delayed the initiation of outgrowth of axillary buds until they were positioned six or more nodes from the stolon apex, and reduced node appearance rates which further

delayed initiation of outgrowth. However, such deprivations of resource did not change the proportion of buds that eventually initiated outgrowth. Thus together, these experiments showed that increases in apical dominance (delay in initiation of outgrowth of axillary buds) could be induced by either low levels of intraplant resource or in response to sensing of the environment. If the inhibition of axillary bud outgrowth was maintained until a bud was positioned more than eight nodes from the apex, that bud would not initiate outgrowth upon an improvement in plant growing conditions. It is suggested that there is a 'window of opportunity' for initiation of outgrowth of axillary buds limited to those nodal positions eight or less from the apex not subjected to inhibition through apical dominance.

Relationships between potentially available photosynthate within stolons and branching were further explored by measuring the starch, sucrose and hexose contents of individual internodes of stolons subjected to burial/defoliation treatments or differing seasonal growth periods and correlating these contents with branching activity of the distal axillary bud. There was no evidence to suggest that photosynthate supply was limiting branching in these pastures.

Starch content of stolons varied five-fold with season (minimal and maximal contents occurring in late spring and early autumn, respectively). This seasonal pattern in the availability of stored photosynthate within plants provided a physiological basis to underpin understanding of the very significant changes that occurred both within individual plants and populations of white clover in pastures during the early spring to mid-summer period. Such changes centre on a rapid increase in growth demand for photosynthate in early spring which decreases the starch content of stolons, whereupon stolon senescence increases markedly thereby fragmenting plants and thus reducing branching complexity and mean dry weight per plant.

The change in status of the white clover population in spring was considered to negatively influence the response of populations to cultural and environmental perturbations during late spring - early summer. It was concluded, in view of the large changes occurring within white clover populations in spring-early summer, that the greatest of the effects of stolon burial, which was an increase in the mortality of recently initiated branches during winter (a period of low growth rate), would not have major implications for the population dynamics of white clover in this environment. However if burial of a high proportion of stolon material occurred in summer it would have greater potential to significantly reduce branch establishment within populations.

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