Stability in cation concentrations during the development of two temperate pasture species

I.J. Sargeant[1] and C.A. Lamp[2]

[1] State Chemistry Laboratory, Department of Agriculture, Victoria

[2] LaTrobe University, Bundoora. Victoria

Little has been published on the relationship between the cation concentrations of tops and roots of nutrient solution grown plants and the time of harvesting. However, the literature abounds with cation concentration data from the analysis of plant material from a single sampling on which conclusions relating to cation interactions are generally based. Whether or not the same conclusions would have been reached if sampling had occurred at a different time is generally not questioned. This experiment was designed to investigate the changes in cation composition of Trifolium subterraneum (c.v. Bacchus Marsh) and Lolium perenne over time when grown in nutrient solution.

Methods

The plants were grown in a glasshouse in 40 litre plastic bins containing nutrient solution of relatively constant concentration. Two treatments, differing only in Ca and Mg concentrations but the same (Ca + Mg) concentration were used. The concentrations of all plant nutrients were non-limiting to growth. Each treatment was replicated 8 times but at harvest, only 4 plants of each species were taken from each treatment. Twelve harvests were made between 42 and 129 days after germination. Yield and cation concentrations in roots and tops were determined.

Results and Discussions

Individual cation concentrations In clover tops showed no significant changes over time but a slight drop in Mg, K and Na concentration in clover roots was observed after 90 days. The Ca, but not Na,, concentrations in ryegrass tops slightly decreased whereas Ca and Mg slightly increased, the net effect being that total cation concentrations remained constant. The Mg, Na and particularly G concentrations in ryegrass roots decreased whereas Ca concentrations increased, resulting in constant total divalent cation concentrations.

Ca and Mg uptake in generally believed to be restricted to root parts where the endodermis is unsuberized, whereas K and Na can be absorbed and translocated from most parts of the root (1). Thus, some variation in concentrations of individual cations in plants over the growing period is likely. However, this experiment supports the view (2) that such variation may be less than previously thought as little change in individual cation concentrations within the shoots of both species were found over the growing period. Equations describing the relationship between root and top growth, cation uptake and time, and root and top growth and time were derived from which growth rates and cation uptake rates could be determined. The rate of cation uptake of all cations per unit root weight showed little change in the early stage of growth but decreased with increasing age of the plant.

It is concluded that changes in cation composition that may occur in soil grown plants during vegetative growth are probably due more to edaphic factors, eg. soil temperature, soil water, oxygen concentration, mechanical resistance to roots and variations in ion concentrations in soil exploited by the root system, rather than changes mediated by the growth of the plant.

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