SALINITY RESPONSES IN SOME FORAGE LEGUME SPECIES

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ABSTRACT

The salt tolerances of more than 70 lines and species of forage legumes were evaluated in a series of greenhouse experiments, with the aim of identifying plant material that is more salt tolerant than some of the more traditionally-grown, temperate, forage legume species. Several species or lines showed potential as salt tolerant germplasm including sweet clover (*Melilotus albus*), berseem clover (*T. alexandrinum*) cvv. Mescani and Wardan, woolly clover (*T. tomentosum*), birdsfoot treefoil (*L. Corniculatus*), slender birdsfoot treefoil (*Lotus tenuis*) and *Trifolium squamosum*. However, further selection and field evaluation is required in order to fully assess the potential of this material under saline soil conditions.

KEYWORDS

Forage, legumes, salt tolerance, salinity, clover, NaCl

INTRODUCTION

Forage legumes are major species in many irrigation areas of the world (e.g. the Murray Darling Basin of south eastern Australia) where soil salinity and rising saline watertables affect large areas of grazing land. Most forage legume species, such as lucerne, white clover, red clover and subterranean clover, are more salt sensitive than their companion forage grasses (Lauchli, 1984) and therefore it is important to accurately assess individual plant salt tolerance to identify alternative species or cultivars that may be grown productively, with companion grass species, in saline areas.

This paper outlines some greenhouse research that has been undertaken at ISIA, Tatura, Australia to evaluate the salt tolerance of over 70 different forage legumes. Species and lines that have shown potential in the greenhouse are being further evaluated in more detailed greenhouse or field studies.

MATERIAL AND METHODS

The salt tolerances of over 70 species or lines of forage legumes (Table 1) were assessed in a number of greenhouse experiments at Tatura in northern Victoria, Australia (temperature ranges 25°C ± 3°C day to 10°C ± 3°C night). All experiments followed a general procedure with some individual experimental differences.

Seeds of the particular species were first germinated under non-saline conditions in vermiculite in seedling trays. At the second trifoliate leaf stage, seedlings were transplanted into polystyrene trays that were floating on solution in stainless steel tanks. The solution consisted of half-strength Hoagland solution modified after Karmoker and Van Steveninck (1978) to contain 4 mM Ca. The salinity treatments were selected to represent a realistic soil or groundwater salinity level that may occur in the Murray-Darling Basin in Australia, and covered the range from low to moderate NaCl concentrations - generally from 0 to 100 mM NaCl. The solution culture was continuously recirculating and the solutions were completely aerated. The experimental design was generally a randomised block-split-plot, usually with four replicates. The main plots were the five salinity treatments and the subplots were the tanks containing the different legume species. Each species or line was represented in each tank by a row of plants (the experimental unit), which usually consisted of 10 plants but may have contained five plants if there was a limited amount of seed.

Generally the plants were harvested about 20 days after the salinity treatment had been imposed. At harvest, the rows of plants were cut to 2 cm above the solution level and shoot fresh weight and dry weight (dried at 70° C for 48h) were measured on the bulked row sample.

More detailed information on materials and methods for some individual experiments has been described in Rogers and Noble (1991) and Rogers et al. (1993).

RESULTS AND DISCUSSION

These greenhouse studies have identified a number of species and lines of forage legumes that have shown potential for saline areas. For example, within *T. alexandrinum*, cultivars Mescani and Wardan were found to be considerably more productive under saline conditions ($P<0.05$) than six other cultivars of this species. *T. squamosum*, a species that is not grown agriculturally in Australia, was significantly more productive and salt tolerant than *T. subterraneum* cv. Clare - a finding that confirms an earlier observation by Maranon et al. (1989) in the Guadalquivir delta in Spain. *T. tomentosum* was also found to have potential as salt tolerant germplasm. Table 2 lists the species and lines of material that have performed well under the experimental saline conditions either in terms of salt tolerance (the rate of decline in dry matter with increasing NaCl concentration), or absolute dry matter production, and which may warrant further selection and/or field studies.

Finding replacement species for productive, traditional pasture legumes such as white clover, subterranean clover and lucerne is difficult. The domestication and subsequent improvement of these species from their wild relatives has occurred over many years and therefore it is difficult to adequately assess the potential, as well as compare the production, of unselected, unimproved material such as the species *T. tomentosum*, *T. angustifolium* and *T. squamosum*, with the more widely or commonly used agricultural species like subterranean clover. Nevertheless, these series of experiments have shown that forage legume germplasm exists that may provide useful alternatives to the more traditional forage legumes under saline conditions but which may also require further research to fully assess their potential for Australian field conditions.

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Table 1
Forage legume germplasm evaluated for salt tolerance in the greenhouse

Species or line evaluated	Common name (if available)	Cultivars evaluated
I. Trifolium species		
T. alexandrinum	berseem clover	Kastalia, Wardan, Matameer, BigBee, Mescani, Lito
T. alexandrinum	berseem clover	2 accessions (origin unknown)
T. arvense	rabbit foot clover	1 accession
T. tomentosum	woolly clover	1 accession
T. squamosum		5 accessions
T. angustifolium		1 accession
T. repens	white clover	Haifa, Irrigation, Tamar, Aran, Kopu, Zapican, Huia, Pitau, Ladino, Tahora
T. repens	white clover	5 accessions (collected from Mediterranean region)
T. repens	white clover	7 accessions (collected from northern Victoria, Australia
T. fragiferum	strawberry clover	Palestine, Princep Park
T. subterraneum	subterranean clover	Clare
T. michelianum	balansa clover	Paradana

Table 2
Forage legume material that showed potential as salt tolerant germplasm

Plant species or line	Recommended further research
T. alexandrinum cvv Mescani, Wardan	salt tolerance at various growth stages, regeneration
T. tomentosum	plant vigour and productivity
T. squamosum	plant vigour and productivity
T. isthmocarpum	seedling vigour
T. fragiferum	plant vigour
M. albus	plant vigour and productivity
L. tenuis	plant vigour
L. corniculatus	plant vigour