Salt tolerance of subterranean clover cultivars

M.C. Shannon[1], C.L. Noble[2] and D.W. West[2]

[2] Institute for Irrigation and Salinity Research, DARA, Tatura, Vic. 3616
[1] U.S. Salinity Laboratories, USDA, Riverside, California.

Subterranean clover (Trifolium subterraneum L.) is important forage in Australia but is moderately sensitive to salt. Genetic variation within species and specific mechanisms for salt tolerance are important aspects of any program designed to improve salt tolerance in a crop. We conducted the following experiment to determine the variation in salt tolerance and ion uptake patterns among six cultivars of subterranean clover which had shown promise in germination and seedling tests for salt tolerance (1).

Methods

Seed of six cultivars (Clare, Bacchus Marsh, Meteora, Tallarook, Trikkala, and Wenigup) were planted into randomized rows in 20 greenhouse sand tanks (1.66 x 0.76 x 0.15 m). The tanks were irrigated with a modified one-half strength Hoagland solution containing 4mM Ca. After 18 days, the plants were thinned by clipping to 8 plants/replication and salinity treatments were imposed by adding NaCl to the irrigation medium at a rate of 20 mM/day until the required concentration was reached. Final treatments consisted of 0, 20, 40, 60, and 80 mM NaC1 with 4 replications/treatment. Plants were harvested 24 days after the first application of NaCl.

Results and discussion

Increasing concentrations of NaC1 decreased growth and K levels in the roots and shoots in all cultivars. Shoot and root Na and Cl concentrations increased as salinity increased. Mean shoot Na increased from about 0.2% to around 5% as salinity increased. Corresponding concentrations of shoot Cl rose from 1.3% to 6%. Shoot K decreased as Na increased so that total (Na+K) remained relatively constant. No significant changes due to salinity were noted in shoot and root concentrations of Ca and Mg.

Meteora was the highest-yielding cultivar across all salinities and averaged 4.1 gdw/plant under nonsaline conditions. Clare had among the lowest yield (1.9 gdw/plant for controls) but was the most salt tolerant (i.e. had a low relative yield decline with increasing salinity). Relative yield reduction at 80 mM NaCl was 45% for Meteora and 31% for Clare. Tallarook and Wenigup were the most salt-sensitive cultivars, averaging 63% reduction at 80 mM NaC1 concentration.

Maintenance of low Na and Cl in the shoot correlated well with high shoot growth. Meteora had lower shoot Na and Cl concentrations than Clare but the latter had lower concentrations of Na and Cl in the roots. Root dry weight was not significantly reduced by salinity in Clare; however, root dry weight in Meteora was reduced 43% by 80 mM NaCl in the irrigation medium. Differences in the distribution of inorganic solutes between root and shoot may be a major factor determining growth rates in these plant parts.

1. West, D. W. and Taylor, J. A. 1981. Plant Soil 62 221-30.