

An integrated approach to breeding acid aluminium tolerant lucerne

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The intolerance of lucerne to acidic soils is a major problem in Australia and around the world. Constraints to production are related to the concentration of hydrogen ions in soil, aluminium toxicity, nutrient deficiency, the performance of the host-rhizobia symbiosis and rhizobia survival.

A national project in Australia, funded by the CRC for Plant-Based Management of Dryland Salinity, focuses on using an integrated approach to develop lucerne that is tolerant to acidic soils containing aluminium. This short report focuses on recent South Australian activities.

A solution culture technique (developed through ACIAR/GRDC funded projects) was used for rapid assessment of large populations. It measures the root elongation trait, and enables selection of tolerant individuals that are able to maintain growth rates after exposure to aluminium. The method is based on digital imaging of individual root growth rates before and after the addition of aluminium. Seedling vigour is taken into account by measuring the growth rate of each individual seedling before aluminium is added. A diverse range of alfalfa germplasm was tested, including accessions from South America and the USSR in regions with potential adaptation to acidic soils. Small but significant differences were found between populations, but these were much less than the level of intra-population variation detected. Recurrent mass selection was employed to develop improved lines with 2 cycles of selection, with a significant improvement made during each cycle of selection (Figure 1).

Nodulation capacity is also being assessed in solution culture. In combination with the commercial inoculant strain, the percentage of lucerne seedlings nodulated was around 10% at pH 5.4. However, this characteristic was significantly affected by rhizobial strain. The best strain identified thus far, is able to nodulate 35% of lucerne seedlings at pH 5.4 (Figure 2). Significant intra-population variation for nodulation in lucerne has also been measured (not shown). Plant selections have been made and are being used to develop breeding lines that when combined with the improved rhizobia will offer greater nodulation potential.

Figure 1: Root growth of lucerne at pH4.5, 3.5 uM Al

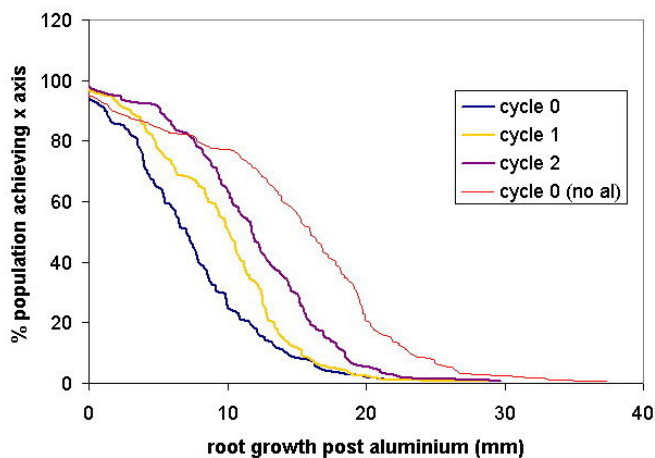


Figure 2: Percentage of nodulated in solution culture at pH 5.4 by rhizobial strains RRI128 & SRDI434

