Improving the tolerance of alfalfa to acidic soils

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The poor adaptation of alfalfa to acidic soils is a major limitation to its adoption around the world. The combined stresses of low pH and aluminum toxicity impact on the growth of the plant, its rhizobia and the processes of nodulation. An attempt to improve the tolerance of alfalfa to soil acidity is being made by selecting plants in solution culture with improved root growth in the presence of toxic levels of aluminium, and the capacity to form functional nodules with rhizobia added to the low pH solutions. A half sib family with 4 cycles of selection for tolerance to aluminum toxicity has now had 3 further cycles of selection for nodulation capacity and root growth in a sequential screening system.

In solution culture, advanced breeders lines of alfalfa have improved nodulation (43% compared to 11% in control) and root growth (183 mm regrowth compared to 33mm in control) relative to an unselected parent line. Initial results from field experiments have also been positive with increases in nodulation, density and yield of acid tolerant alfalfa lines in the first 12 months.

The plant selection has been made in unison with the search to find a more acid tolerant strain of rhizobia. Nodulation by the strain (RRI128) currently used in commercial Australian lucerne inoculants is impaired below pH_{Ca} 4.8 and declines dramatically below this pH level. Over 250 strains were isolated from soils collected under mature alfalfa plants persisting on acidic soils. The rhizobia were evaluated in greenhouse and field trials, and three experimental strains have been shortlisted with improved levels of acidity tolerance.

The aim of the research is to integrate the two plant traits and combine this with an improved strain of rhizobia. Our ability to achieve this outcome may define the success of the program. That is, all three targets; aluminium tolerance, plant nodulation capacity and improved rhizobia may all need to be present to deliver success in the field.