

# A shot in the seed for landcare

Ecologists have identified elite strains of nitrogen-fixing microbes that boost the growth of native shrubs used in revegetation projects. They are preparing to trial their application in a range of environments in southern Australia.

Dr Jeremy Burdon, of the Centre for Plant Biodiversity Research at CSIRO Plant Industry, says little known native rhizobia form mutually beneficial associations with native legumes throughout Australia. Living in nodules on the host plant's roots, they manage to convert or 'fix' nitrogen gas from the air into other forms of nitrogen that can be used by plants.

'This symbiosis is a useful adaptation to the infertile soils of our continent,' Burdon says. 'We have found that whereas familiar crop and pasture legumes, such as soybeans and clover, form associations with nitrogen fixers of the genus *Rhizobium*, native legumes, such as acacias, form associations with microbes of the genus *Bradyrhizobium*.' On bare and degraded farmland, however, these native bradyrhizobia are few and far between.

Burdon and his colleague Dr Peter Thrall, building on earlier work by the division, have found that these bacteria can all but disappear from soils within two to three years of removal of their plant hosts, especially in acidic soils. Their soil sampling showed huge differences between bradyrhizobia densities in undisturbed vegetated areas and adjacent land used for grazing or pine plantations.

Burdon and Thrall believe that by bringing together the best lines of bradyrhizobia and a range of native shrubby legume species – in genera such as *Acacia*, *Daviesia*, *Dillwynia*, *Oxylobium*, *Hovea* and *Pultenea* – revegetation projects throughout the country will be given a significant boost.

They and their colleagues have collected hundreds of native isolates of rhizobia from plant communities in south-eastern Australia and have found that some of these are much more effective than others at promoting legume growth by providing that crucial supply of nitrogen.



Peter Thrall, assisted by a student, checks the progress of an inoculation experiment.

For example, when the researchers compared growth and survival of silver wattle (*Acacia dealbata*) seedlings in the presence of elite, as opposed to ineffective (virtually parasitic) strains of native rhizobia in glasshouse experiments, the differences were dramatic. After 12 weeks, the poorly nodulated seedlings looked small and stunted compared to plants having the benefit of elite inoculation.

'This rapid early growth really improves the odds for seedlings in the field,' Thrall says. 'In our drought-prone environments and in situations where soil fertility is low, this quick growth reduces the time that the plant spends as a seedling, when competition from pasture and weeds, and depredations of livestock, rabbits and hares are a concern.'

This was shown in an experiment conducted by the division's John Brockwell. When he out-planted acacia seedlings from the nursery to a paddock near Eden, NSW, survival of well-nodulated seedlings after 12 months easily exceeded that of poorly nodulated seedlings, even though the latter received applications of nitrogen fertiliser.

Burdon and Thrall have also investigated the host-specificity, or 'fussiness', of bradyrhizobia strains as this has implications for the success of revegetation programs. There is no point inoculating legume seedlings with strains that don't effectively nodulate with that species.

The experiments have shown combinations or 'soups' of elite nitrogen-fixing strains to be the most practical method of seed inoculation. 'High-performing strains of bradyrhizobia can be used in pelleted seeds of native legumes before direct drilling or aerial sowing, improving the prospects for seedlings after germination,' Thrall says.

With funding from the Australian Centre for International Agricultural Research, CSIRO scientists have worked with colleagues in China on a revegetation project using Australian legumes and rhizobia. Encouraged by the project's success, the CSIRO group is seeking funding for 8-10 revegetation field trials in NSW and Victoria, in cooperation with community and Landcare groups.

Different experimental treatments will throw light on the biology and cost-effectiveness of incorporating bradyrhizobia into revegetation projects, practical low-cost establishment techniques, the value of mixed legume-eucalypt stands, and more effective vegetation management by landowners.

## More about rhizobia

Thrall PH Burdon JJ and Woods MJ (2000) Variation in the effectiveness of symbiotic associations between native rhizobia and temperate Australian legumes: interactions within and between genera. *Journal of Applied Ecology* 37:52-65.

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