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Studies of rhizobia nodulating *Lotus* species

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During the last five years there has been increasing interest in New Zealand in the use of *Lotus* species as alternative pasture legumes. For example "Grasslands Maku" (*L. pedunculatus* Cav.) has been found to grow well in moist, hill country soils of low fertility and low pH, while the drought resistance characteristics of *L. corniculatus* make it well suited for dryland pastures. Accompanying this interest, studies of the rhizobia nodulating *Lotus* species have been initiated at the Applied Biochemistry Division, DSIR, Palmerston North.

From the *Rhizobium* point of view *Lotus* is a very interesting legume. This is because many species eg. *L. pedunculatus* and a number of the annual *Lotus spp.* are able to form nodules that fix nitrogen with both fast- and slow-growing *Rhizobium* strains i.e. with representatives of the two groups of organisms (the fast and the slow-growing) currently recognized within the genus *Rhizobium*. This is an unusual property as generally speaking legumes nodulate exclusively with either fast or slow-growing *Rhizobium* strains, and rarely both. Furthermore the distinction between fast and slow-growing rhizobia goes beyond simply growth rate. For example they show very little DNA homology, they differ greatly in the type of extracellular slime they produce, and they differ greatly in their antigenic

composition, their susceptibility to bacteriophages and in their sensitivity to antibiotics.

Recently, evidence has been obtained in several laboratories that suggests that genes for nodulation may be carried on small pieces of extrachromosomal DNA (plasmids) in Rhizobium. Work in our laboratory has confirmed that both fast and slow-growing Lotus rhizobia contain plasmids but we have not yet demonstrated that these carry genes for nodulation. However, in view of the very different phenotypes of these two types of rhizobia it would seem likely that the infomation for nodule forming ability is contained within a small part of the genome in these rhizobia and is probably on a plasmid. The Lotus rhizobia may therefore prove to be of great value in studying the genetics of nodule initiation and simplfy identification of phenotypic and genotypic properties of the Rhizobium cell essentially involved in this process.

Another interesting feature of Lotus from the Rhizobium point of view is the high concentration (2 to 3 mg per gm dry weight) of condensed tannins and other phenolics found in the roots of this legume. Research in our laboratory has shown that some fast-growing strains of Lotus rhizobia are particularly sensitive to the condensed tannins and that this sensitivity is correlated with their ability to nodulate and fix nitrogen with certain species. This work has been recently reported in J. Expt. Bot. (see Pankhurst et al., 1979 a, b, c in the list of recent publications).

Interest in our laboratory is also centered on the nodulation properties of hybrids developed between L. pedunculatus (tetraploid) and L. tenuis (tetraploid) using embryo culture

techniques. These hybrids include both F1 and F2 plants obtained from reciprocal crosses between these two species. Results obtained so far indicate some degree of maternal inheritance of nodulation.