BNF APPLICATIONS FOR POVERTY ALLEVIATION

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The causes of poverty worldwide are very complex, but solutions to poverty can be found. Although it is possible to easily identify many roles for biological nitrogen fixation (BNF) in poverty alleviation, it can be difficult for subsistence farmers to achieve sustainable change incorporating new developments that involve BNF. Moderate and extreme poverty occur in many countries located predominantly in a band both north and south of the equator in the tropics and sub-tropics across North and South America, Africa, and Asia. Significantly, many of these countries, in which more than 25% of the population lives on less than US$2 per day, have negative economic growth. The most important determinant in the declining economic growth of these countries is their poor food productivity. The poverty trap for individuals and communities in these countries is mainly a rural phenomenon of peasant farmers caught in a spiral of rising populations and stagnant or decreasing food production per person. Important factors in the poverty-trap situation that these farmers are unable to escape include the poor infrastructure for distribution and communication, the expense of products, such as essential fertilizers, which results in very little use of fertilizers, and under-funded scientific research and extension.

The clear role for BNF scientists to contribute to on-the-ground solutions for overcoming poverty is to expand the use and benefits of biologically-fixed nitrogen in agricultural systems and to increase use of legumes as secondary crops in fallows and rotations, as green manures and cover crops in fields, as well as to improve opportunities for training. But there are a range of identifiable constraints to adoption of BNF in agriculture for poverty alleviation. As recently outlined by Herridge (2006), these constraints include: a decline in many countries in the land areas being planted to legumes; the widespread use of N-fertilizers on legumes; lack of farmer knowledge about inoculation; difficulties in developing markets for inoculants in low-input systems; lack of expertise to make inoculants; lack of private sector involvement in inoculants; and a significant lack of support for research on BNF.

With an understanding of these constraints, Herridge (2006) identified the following critical research gaps and investment options for increasing broad-scale adoption of *Rhizobium*-based technology. These were: to increase legume plantings and inoculant

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demand; to develop simple rapid "need to inoculate" tests; to enhance farmer knowledge of inoculation, inoculant manufacture, quality control, and distribution; to support *Rhizobium* R&D capacity; and to improve understanding of the role of legume- in farming systems.

The Centre for *Rhizobium* Studies (CRS) at Murdoch University, through ACIAR, aims to introduce legumes and their inoculants into the abandoned arable lands of the Eastern Cape of South Africa (acronym ECCAL). The project will address two of the major limitations to improving livestock production in the region; these are the quality and quantity of forages, and effective communal management of feed resources (from a social, economic and biological sense). To achieve success, two key elements have been identified. Firstly, the need for a "social incentive", i.e., a system of resource management that needs community ownership and secondly, a "financial incentive", i.e., the outcome must be an income-generating enterprise for the community. Strong in-country support comes from ARC and the ECDA. A key component is researching the microbiology of herbaceous legumes native to the southern and western parts of South Africa. Root-nodule bacteria from species of *Lotononis* and *Lessertia* have proven to be diverse and unusual nodule occupants, both taxonomically and physiologically. The Department of Agriculture and Food, Western Australia, is also evaluating species from these legume genera for their potential in Australian agriculture.

The scientific challenges for improving the application of BNF for poverty alleviation are often rudimentary. These can often be to do with determining which legumes will grow and overcoming constraints to adoption. It is clear that for N_2-fixing forages and pastures, the rhizobiology must be addressed first, so that plant selection and breeding can be undertaken using effective N_2-fixing symbiotic plants. In addition, it is important that simple-to-use robust inoculation technologies are available for subsistence-level farmers to adopt. By contrast, the social and cultural challenges for achieving sustainable use of BNF can be significant. In essence, community ownership and management is essential for poverty alleviation to be successful. One important aspect is that often an investment of funding is required to implement change, such as the need to introduce a new technique or a new crop, the need to provide necessary P and K fertilizers, or the need to overcome loss of a planting season. Implementation of programs aimed at alleviating poverty by application of BNF in subsistence-level agricultural systems requires a multi-faceted approach that must be built on foundations where the rhizobiology of effective symbioses is integrated with plant selection, breeding and evaluation.

Reference

Herridge (2006) Report on a review of ACIAR-funded projects on *Rhizobium* during 1983–2004. ACIAR Working Paper, No. 62.