

How nitrogen is fixed in a tree.

How Biological Nitrogen Fixation Works in Legumes

Working with a group of bacteria called rhizobia, legumes are able to pull nitrogen out of the air and accumulate it biologically. The bacteria, which are normally free-living in the soil in the native range of a particular legume, infect (inoculate) the root hairs of the plant and are housed in small root structures called nodules. Energy is provided by the plant to feed the bacteria and fuel the nitrogen fixation process. In return, the plant receives nitrogen for growth.

There are thousands of strains of rhizobia. Certain of these will infect many hosts, certain hosts will accept many different strains of rhizobia. Certain hosts may be nodulated by several strains of rhizobia, but growth may be enhanced only by particular strains. Therefore, when introducing hosts to a new area it is extremely important to also introduce a known effective symbiotic rhizobia strain. Such effective strains have been identified for thousands of the important nitrogen fixing legumes, and can be purchased at low cost for the value returned. The best method for ensuring effective nitrogen fixation is introduce a known effective strain of *Rhizobium* to the potting medium at the time of sowing. Large, healthy nodules may also be used to inoculate seeds. To determine if the nodule is effective, it may be cut open. Effective nodules will have a pink to dark red pigment inside.

In conventional cropping systems it is estimated that 50-800 kg of nitrogen per hectare per year are accumulated by nitrogen fixing plants, depending on species, soil and climate, *Rhizobium* efficiency, and management. Equivalent quantities of manufactured nitrogen is produced using an energy intensive process, and the end product is high-priced nitrogen in a form which can be detrimental to soil ecology.

from ***Permaculture Institute of the US: Nitrogen Fixing Trees - The Multipurpose Pioneers***, by Craig Elevation, September 29, 2008
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