

# Spotlight on Agriculture

Ministry of Agriculture, Water and Rural Development • Directorate of Agricultural Research and Training • Private Bag 13184 • Windhoek

No 61 November 2002

## Cereal-Legume Intercropping

### INTRODUCTION

Nitrogen and Phosphorus deficiencies are the most pronounced nutrient constraints to crop production in the Northern Communal Areas (NCA). It has been suggested that legumes offer the most promising alternative to alleviating nitrogen deficiency due to the ability of legumes to freely establish active symbiosis with *Rhizobium* bacteria. The nitrogen fixed in this way can support growth of the host legume and be available to associated crops. Cereal-legume intercropping has the potential to supply much of the nitrogen demand of cereals.

Pearl millet-cowpea intercropping is a common practice in the NCA, however work done by (Hillyer, 2001) suggested that for cowpea to make any significant contribution to the system and N<sub>2</sub>-fixation, certain management practices need to be adopted. These are application of phosphorus fertilizers, increasing cowpea densities in the intercrop and retaining residues in the field.

### WHAT IS INTERCROPPING?

Intercropping is a farming system that involves growing two or more crops together on the same land. The crops need not be planted at exactly the same time and their harvest times might be quite different, but they occupy the same land area together for a significant part of the growing season. The crops are usually harvested and kept separate.

### BIOLOGICAL NITROGEN FIXATION

The process by which nitrogen from the atmosphere is fixed and converted to an organic form is termed biological nitrogen fixation. Roots of legume plants form nodules, in which symbiotic bacteria live and fix atmospheric nitrogen. The bacteria reduce atmospheric N<sub>2</sub> to ammonia, by using sugars and other compounds produced by the legume host as a source of energy; they can convert atmospheric nitrogen into the form usable by plants only in the protected environment of the legume's root nodule.

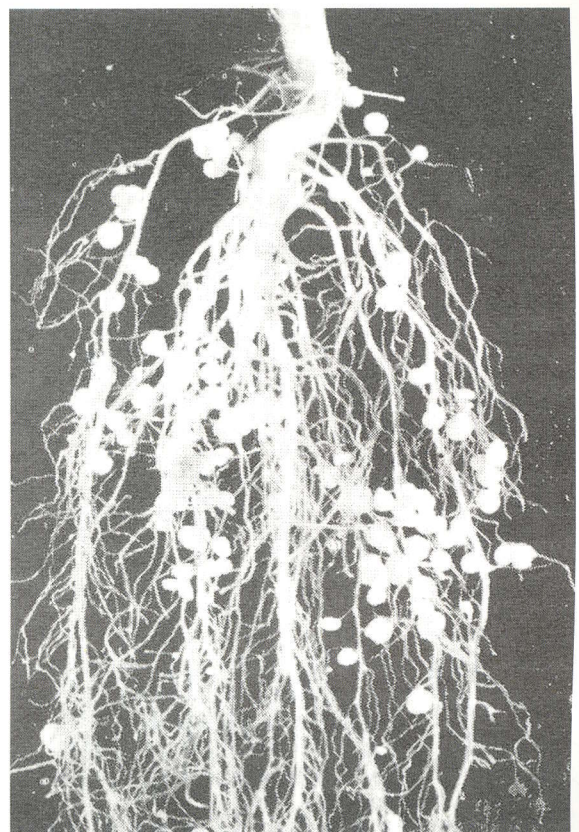
Although some research workers have reported evidence of direct transfer of nitrogen in a cereal-legume intercrop, it is believed that most nitrogen transfer is residual.

#### Nitrogen-transfer can be:

**Direct:** Via vesicular arbuscular mycorrhizal tripartite symbiosis.

**Indirect** (mineralization of legume residues during the current growing season): Indirect transfer can occur when an early season legume is intercropped with longer duration cereal.

**Residue** (mineralization after the current growing season): The nitrogen benefits are mainly for subsequent crops after roots and nodules have rotted away and fallen leaves decomposed.



*Nodulated roots of a legume* (From K. Mengel & E. A. Kirby, 1987, *Principals of Plant Nutrition*, p 353).

## BENEFITS OF INTERCROPPING

- Intercropping provides greater total yield from a given land area than does a proportional allocation of sole crops to that area. Yield advantage is due to maximized use of growth resources such as, soil moisture and plant nutrients. Different plants, e.g. pearl millet and cowpeas have different requirements and different root systems.  
Increased production has been associated also with greater evapotranspiration (ET) efficiency (Grema and Hess, 1994) probably due to greater effective Leaf Area Index (LAI) achieved through complimentary phenologies and canopy architecture.
- Spread of pests and diseases can be reduced in an intercropping since neighbouring plants are not hosts for the same pest or disease. Insect pest reduction can occur due to two general mechanisms:
  - Enemies' mechanism: Greater biological control in intercrops.
  - Resource concentration mechanisms: Host plants harder to find (less apparent) in intercrops.
- Suppression of weeds at later stages of plant growth is achieved through competition by established crops. Weed suppression also via increased shading or allelopathy.
- Risk of crop failure due, for example, to drought is minimized because farmers mix varieties and species with different maturation periods and moisture requirements. Intercropping therefore provides a measure of stability, if one crop fails or grows poorly the other component crops can compensate for the failure.

Overall intercropping offers for a range of combinations to match individual needs and preferences, local conditions and changing circumstances within each season and from season to season.



*Traditional millet-cowpea intercropping at Omhakoya (February 2002).*



*Traditional millet-cowpea intercropping at Onaanda (February 2002).*

## PRACTICAL CONSIDERATIONS

Legume biological nitrogen fixation (BNF) depends largely on the availability of P. In Phosphorus deficient soils P fertilization can substantially increase biomass production and N accumulation by legumes to make a significant contribution to N supply.

The amount of legume residue produced is generally low because cowpea intercrop densities in farmers' fields are low. Increasing cowpea density is believed to be the best way of increasing biomass. Hillyer & McDonagh, (1999) suggested that cowpea densities could be doubled to 20 000 hills/ha with no great risk of competition with millet.

Biologically fixed nitrogen from the host legume is usually available to associated crops after decomposition and mineralization of the host legume. That means the highest benefit would be obtained if the legume plant residues were returned to the soil after harvesting. However in the NCA these residues are commonly utilized by livestock leaving perhaps only the roots to decompose and contribute to soil N, and deposits of in situ animal manure.

Pictures courtesy of Klaus Fleissner, Directorate of Agricultural Research and Training, P. O. Box 272, Tsumeb, Namibia, saromahe@iway.na  
References: Grema, A. K. & Hess, T.M. (1994). Water balance and water use of pearl millet-cowpea intercrops in northeast Nigeria. *Agric. Water Manage.* 26:169-185.  
Hillyer, A. & McDonagh, J. F. (1999). On station soil fertility research. In the Proceedings of the Namibian National Agricultural Research Planning and Reporting Conference (1999), Ministry of Agriculture, Water and Rural Development, Swakopmund, Namibia.

Author: Agnes R. K. Ngolwe, Directorate of Agricultural Research and Training, P.O. Box 272, Tsumeb, Namibia, ngolwea@tsu.namib.com  
Editor: A. van Niekerk, Directorate of Agricultural Research and Training, Private Bag 13184, Windhoek, Namibia.