INIS-XA--609

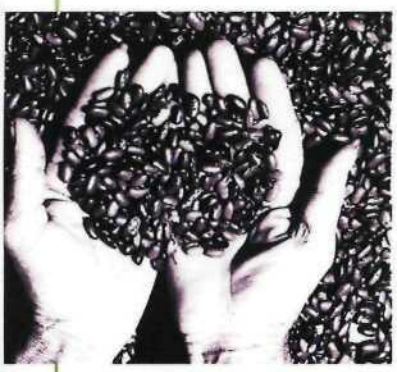
Biofertilizer for food legumes: Bangladesh

In Bangladesh grain legumes are the protein meat substitute of the poor, and an integral part of the daily diet. Yet present yields cannot meet demand and every year about 25% of the country's grain legumes' requirements have to be imported at a cost of about US $23 million in hard-earned foreign exchange. This money could easily be saved by increasing production in the country. The Department of Technical Co-operation is sponsoring a programme, with technical support from the Joint FAO/IAEA Division, in Bangladesh to find ways of increasing yields of grain legumes using efficient strains of biofertilizers.

Need for protein

As one of the heavily populated countries in the Indian sub-continent, Bangladesh is traditionally dependent on grain legumes for a source of proteins. Being rich in protein, legumes provide nutritious body-building food for people and animals and in addition provide bone-building minerals and vitamins essential to good health.

The current production of grain legumes amounts to about 520,000 metric tons per year which falls short by about 70,000 metric tons on the national demand. In a country where arable land is already limited and where there is an equally high demand for rice, there is no room to increase the acreage of legumes. The only option is to increase yield per unit of land area.



The grain legumes in greatest demand in Bangladesh are:

- *lentils*
- *chickpea*
- *groundnut*
- *mungbean*
- *soybean*

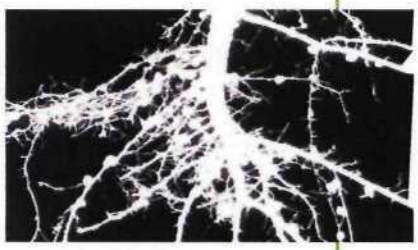
Grain legumes, the 'poor man's meat' in South Asia

Nitrogen fixing legumes

Nitrogen is the nutrient that most frequently limits agricultural production. Commercial nitrogen fertilizers are most frequently petroleum-based products, vulnerable to fluctuations in the oil markets. At farmer level, these fertilizers are often too costly or are unavailable. Fortunately, leguminous plants are capable of fixing atmospheric nitrogen into forms usable by the plants by working symbiotically with a bacterium called *Rhizobium* that lives in the soil. The nitrogen fixing capacity of legumes is one of nature's gifts to agricultural sustainability and is most needed in developing nations like Bangladesh. Under natural conditions, legumes often do not find the best bacterial companion in the soil to fix high quantities of nitrogen needed to produce high yields. However, the appropriate bacterial strain, if known, can be cultured in the laboratory and added into the field as a biofertilizer (inoculum), a process known as inoculation.

Meeting the needs

In 1988, the Bangladesh Institute of Nuclear Agriculture (BINA), through assistance from the IAEA, initiated a programme of research to find ways of increasing yields of grain legumes by enhancing their capacity for biological nitrogen fixation. Initial studies demonstrated that biological nitrogen fixation in chickpea and groundnut could be doubled if inoculated with the appropriate strain of *Rhizobium*. More importantly, grain yields in the inoculated plants increased by 20–50%.



Bacteria gather atmospheric nitrogen into nodules and transform it into organic compounds. This is called symbiotic nitrogen fixation.

A 100-tonne capacity pilot plant for biofertilizer production will help establish the capability to create a successful biofertilizer industry in Bangladesh. It will also establish the R&D capability needed to instruct and further develop this dynamic industry.

Field demonstrations of the application of this technology will establish a market for the industry, increasing legume production by about 25% through biofertilizer use. This will lead to savings of about US$23 million on imported legumes and about US$6 million on chemical fertilizers. The use of biofertilizers instead of chemical fertilizers will eliminate chemical pollution of soil and water resources. The establishment of a biofertilizer industry based on sound cost-benefit analysis will create employment opportunities and contribute to sustainable development in Bangladesh as well as contributing significantly to sustainable agriculture.

'Grain legumes can supplement much needed dietary proteins for the less privileged masses'

K. S. Kumarasinghe
FAO/IAEA

M. PICKSTOCK/IAEA

Biofertilizer for food legumes: Bangladesh

The model project: Bangladesh

The model project is designed to build on the promising results already obtained in the biofertilizer programme for increasing grain legume production. The primary objectives of the project are to:

- Establish a demonstration plant for the large scale production of *Rhizobium* biofertilizer as a technological base for development of a biofertilizer industry in Bangladesh.
- Conduct large-scale field trials to demonstrate to farmers the effectiveness of biofertilizers in increasing grain yields.
- Continue greenhouse and field trials using the isotope ^{15}N for screening of elite strains of *Rhizobium* and identifying superior nitrogen fixing legume cultivars. The strains of *Rhizobium* and cultivars of legumes tested include local as well as exotic types so as to widen the spectrum of germplasm base.
- Elite strains of rhizobia will be multiplied at the BINA laboratories for storage and large-scale production of biofertilizer.
- Assist in large-scale production of biofertilizers at BINA with a view to expanding the industry at national level.
- High quality biofertilizers are a prerequisite for producing high yields of legumes in Bangladesh. BINA and the Department of Agricultural Extension will ensure a supply of high quality biofertilizers to farmers.
- Farmers' assessment: twenty district level officers and 60 subject matter officers of the Department of Agricultural Extension have been trained at BINA. These trainers will in turn train farmers in the different districts who will conduct the field trials on their farms.

'With a yield increase of 20%, Bangladeshi farmers can earn US$16 million more in one growing season, improving the quality of life for the individual farmer, and society as a whole'

K. S. Kumarasinghe
FAO/IAEA

How nuclear techniques help

The Joint FAO/IAEA Division has developed a technique using the isotope ^{15}N which has proved to be a unique tool to estimate the amount of nitrogen derived from the atmosphere compared with that derived from the soil and applied fertilizer. The technique is relatively simple and requires that a nitrogen fixing crop be grown together with a non-fixing crop in soil labelled with ^{15}N.

A major advantage of this method is that it provides an integrated measure of nitrogen fixed for desired periods of time.

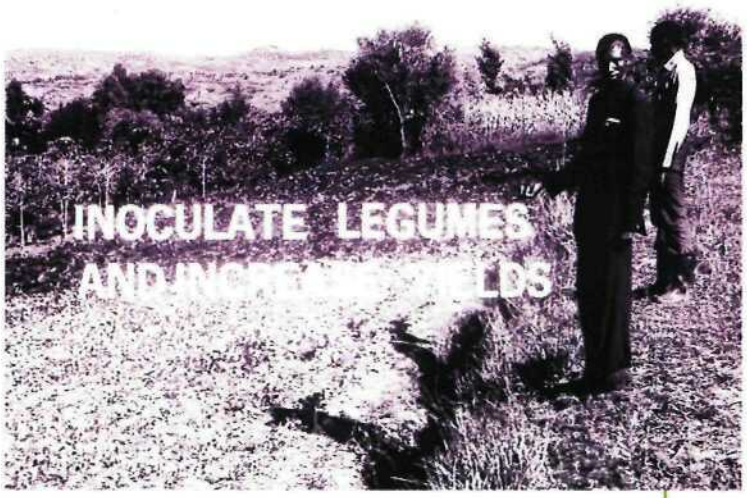
The potential for increasing yields of lentil, chickpea, groundnut and mungbean, through greater contribution of nitrogen from the atmosphere, can be conveniently scanned by means of ^{15}N as a tracer. In this project, ^{15}N will be used as a tool to identify strains of rhizobia efficient in nitrogen fixation and cultivars of grain legumes capable of producing high yields.

National commitment

The Government is committed to introduce a biofertilizer industry in Bangladesh. In view of its good infrastructure, BINA, in Mymensingh, is the most appropriate institute to implement the project.

BINA and the Department of Agricultural Extension, with the help of the Agency, will conduct demonstration trials in 1500 fields of 400 square metres each in the first year and a similar number in the second year. This will demonstrate to a large number of farmers the effectiveness of biofertilizer to increase the yield of grain legumes.

BINA will be responsible for the establishment of the pilot plant and, in co-operation with the Ministry of Agriculture and farmers (the end users), will undertake large scale field trials. It is hoped to attract private investors in setting up a manufacturing plant for production of biofertilizer with technical and scientific support from BINA.



BIOFERTILIZERS are already being produced in Thailand and there is a programme to develop such an industry in Myanmar (Burma). There are also possibilities for such production, in the Philippines and Sri Lanka where there is a considerable interest among national agricultural scientists.

In Africa the technique has been established in Zambia and Zimbabwe and a good foundation has been laid through a regional project for Africa for developing biological nitrogen fixation capacity over the next 5–6 years in Ethiopia, Ghana, Nigeria, Senegal and Zaire.

Impact and benefits in Bangladesh

Application of this technology will establish a market for biofertilizers:

- increasing grain legume production by about 25%
- saving costs on imported grain legumes of about US $23 million
- saving on chemical fertilizer costing about US $6 million

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