BIOFERTILIZERS TO INCREASE SMALLHOLDER CROP PRODUCTION (RAF/5/045)

D1 New

MODEL PROJECT

CORE FINANCING

YEAR	Experts		Group Activity	Equipment	Fellowships		Scientific Visits		Group Training	Sub-Contracts	Misc. Comp.	TOTAL
	m/d	US $	US $	US $	m/d	US $	m/d	US $	US $	US $	US $	US $
1999	4/0	58,800	0	160,000	9/0	31,050	1/15	16,200	0	20,000	0	286,050
2000	6/0	92,700	0	120,000	18/0	64,800	2/0	22,800	0	0	0	300,300
2001	3/0	48,600	0	60,000	0/0	0	0/0	0	0	0	0	108,600

First Year Approved: 1999

OBJECTIVES: To increase food and pasture crop production and soil fertility through the use of legume and cereal biofertilizers. Specifically, to (i) validate the benefit of using biofertilizers on important legumes and cereals; (ii) undertake large scale on-farm demonstration trials on the use of biofertilizers for increasing crop yields; (ii) train extension personnel and farmers in biofertilizer use; (iii) produce popularizing publications on biofertilizer use for the extension services and farmers; (iv) produce biofertilizers for important legumes and cereal crops; (v) establish quality control mechanisms for biofertilizer production and use.

BACKGROUND: Nitrogen is the most limiting nutrient element for crop production in many soils, especially those in tropical regions. Required in large quantities by plants, it undergoes various transformations which result in its loss, and therefore non-availability to plants. Traditionally, nitrogen deficiency has been corrected through the application of nitrogenous fertilizers. Besides being expensive and out of the reach of most farmers in the developing world, chemical fertilizers are potentially hazardous to the environment. Legumes, such as soybean, groundnut and cowpea, are unique among plant species in that they are able to form, with bacteria of the genus Rhizobium/ Bradyrhizobium (root nodule bacteria), symbiotic associations that can utilize the otherwise unavailable and yet abundant nitrogen gas in the atmosphere for their nutrition - a process referred to as biological nitrogen fixation (BNF). Also, some cereals, such as rice, maize and wheat, are able to associate with bacteria of the genus Azospirillum and others and obtain nitrogen from the atmosphere through BNF. Hence nitrogen fixing legumes and cereals can grow very well and achieve maximum yields with little or no chemical nitrogen fertilizer inputs, provided they are associated with efficient bacteria. Nitrogen fixing legumes and cereals also leave substantial amounts of the fixed nitrogen in the soil, thus improving and sustaining its fertility. The Agency has long supported activities aimed at exploiting and improving nitrogen fixation in the soil. A major research activity has been to ascertain the benefit of inoculation, and to select bacterial strains and plant genotypes that support high levels of nitrogen fixation. The results have shown that nitrogen fixation can supply up to around 90% of legume nitrogen requirement, and significant fertilizer savings of over 200 kg N/ha, depending on crop species and environmental factors, can be made. For legumes, good nodulation can lead to grain yield increases averaging 20-40%. Availability of efficient nitrogen fixing bacteria to the plant can be ensured through the use of biofertilizers applied at sowing or planting. Biofertilizer production is a worldwide established technology attracting growing interest in developing countries. Biofertilizers are cheap and affordable for farmers. A packet of 100-200 gms, enough to inoculate seeds for one hectare, costs only a few dollars. Thus, the Agency attaches great importance to the use of biofertilizers as an effective, cheap, easy and environment friendly way of enhancing food production in Member States. Under Model Project ZIM/5/009, significant achievements have been made in Zimbabwe. Yield increases in soybean production of up to 500% have been obtained. The project outputs have enabled more than 2,000 smallholder farmers to increase their main source of food and income and have prompted the Government to expand the use of biofertilizer technology to small farmers throughout the country. After the success of this project and further to consultations with Government authorities, it was decided to expand the activities to other Sub-Saharan countries where a potential existed. The present regional project has been designed to support activities in Kenya, Senegal, Tanzania, Uganda and Zambia. One important feature of the present regional project will be the promotion, through TCDC, of biofertilizer technology through sharing experience and utilizing the capabilities in Zimbabwe. Special efforts will be made under the project to attract the interest of the private sector to promote sustainable biofertilizer production. An important issue which can be addressed through this project is malnutrition, which is the leading cause of death among children aged 1-10 years in Sub-Saharan Africa. Protein intake can be increased by the promotion of legumes such as soybeans as a food crop. In a number of Sub-Saharan countries, such as Kenya and Zambia, programmes exist for processing soybean into flour, soy milk, baby foods and other products. These programmes range from community based processing of soybean, mainly by women farmers, to small scale industries. The present undertaking has great relevance in this context and it will be integrated with other programmes dealing with the utilization of legumes. UNICEF and several NGOs are potential partners. Efforts will be directed towards collaborating with programmes related to the seed industry, such as those concerned with breeding improved varieties and distributing good seed, to ensure that farmers receive biofertilizers with other

agronomic packages. Apart from nitrogen biofertilizers for legumes, biofertilizers will be developed for rice, particularly in Senegal and Tanzania where rice is an important crop. In this respect, the regional project will benefit from the experience of Pakistan where biofertilizers containing both nitrogen fixing and growth promoting bacteria have been successfully used to increase rice production on farmers' fields.

PROJECT PLAN: The first year of the project will be devoted to inoculation trials for target crops and areas on farmers' fields to validate crop response to biofertilizer use, and to establish a QC protocol for the biofertilizers, both of which activities will require the use of N-15. During the second year, large on-farm demonstration trials will be set up in the target areas to show farmers the benefit of biofertilizers. Farmers will be trained in the proper use of biofertilizers, and "farmers' days" will be organized to facilitate interaction between researchers, extension specialists and the private sector. During the third year, demonstration trials will be continued; QC will also continue to be emphasized. Based on project results, simple extension materials on biofertilizer use will be published. The governments, with the assistance of the Agency where necessary, will carry out a socio-economic analysis of biofertilizer use to guide future activities. A key feature of the project will be the full involvement at all stages of stakeholders, notably the farmers, researchers, extensionists, private sector and policy markers.

NATIONAL COMMITMENT: The participating countries will provide the necessary scientific and support personnel, laboratory facilities, extension services demonstration and experimental fields and operational budgets. The national authorities will also undertake to promote the involvement of local communities, and potential partners, such as NGOs, and will encourage private sector participation.

AGENCY INPUT: Expert services in biological nitrogen fixation, inoculant production and use in legume and cereal cropping systems; laboratory equipment and supplies, including N-15 labelled fertilizers; training; support to on-farm demonstration trials with the involvement of extension services.

PROJECT IMPACT: Social : Legumes play an important role in meeting the protein needs of an expanding population base in developing countries. Low cost inoculation technologies increase the productivity of legumes, enhance economic returns on legume crops, and improve the nutritional quality of the grain. Increased production of soybean will lead to the development of ancillary industries - for processing soy milk, flour, and baby foods - that directly benefit consumers. Economic: There will be a large return on investment. At the farm level, the cost of inoculation is normally less than US $5 per hectare. The estimated return of investment in Zimbabwe and Zambia is 1:100 and 1:70 respectively. In contrast, the return on investment to the farmer of chemical nitrogen fertilizer in Zambia is estimated at 1:3. Thus, biofertilizers are much more cost effective than chemical fertilizers. Environmental: Nitrogen fixation through legumes and cereals is an environmentally benign, highly efficient and economical means to reduce farmer dependency on chemical fertilizers. The high replacement value for chemical nitrogen fertilizer will ensure that the hazardous environmental effects of the latter are avoided. This and their soil fertility improvement characteristics make inoculated legumes a key to agricultural sustainability of smallholder production systems.