FIELD PERFORMANCE OF SELECTED MUTANTS OF SORGHUM AND RICE (MLI/5/014) D2 New

CORE FINANCING

YEAR	Experts		Equipment	Fellowships		Scientific Visits		Training	Sub-contracts	Misc. Comp.	Total
	m/d	US $	US $	m/d	US $	m/d	US $	US $	US $	US $	US $
1995	2/ 0	22,800	110,000	6/ 0	19,800	-	-	-	10,000	-	162,600
1996	2/ 0	24,000	100,000	6/ 0	20,700	-	-	-	10,000	-	154,700
1997	1/ 0	12,600	90,000	6/ 0	21,600	-	-	-	10,000	-	134,200

First Year Approved: 95

OBJECTIVES: To contribute to the development of sustainable sorghum and African rice production through the selection of improved varieties, soil fertility and water management.

BACKGROUND: Agriculture is the mainstay of the Malian economy, absorbing approximately 70% of the national labour force and contributing to slightly less than half of all GDP, with the tertiary sector accounting for more than a third. Located in the sub-Sahara, Mali is mainly an arid country with only 4% of the total area devoted to rainfed crops. Mali imports an average $90 million worth of cereals per year which accounts for 6.5% of all GDP. Food production has increased at a slower rate than the population during the past 20 years. In 1993, agricultural production of the major crops was 691,000 t of millet, 694,384 t of sorghum, 274,753 t of maize, 388,483 t of rice and 21,945 t of fonio. Achieving food self-sufficiency remains the top national

priority. The strategy seeks to ensure that the population has access to food, increases the income of farmers and stimulates the rural economy. As climatic constraints seriously affect agricultural productivity, efforts are being directed towards "strategic" areas, characterized by quick returns in short lead time, e.g. by the use of selected varieties or, in the case of pest control, where speedy results can be expected in terms of yield and removing grain deficit. This has been recognized as a priority in Mali's Fourth National Development Plan (1987-1992) and is again a priority in the Fifth Plan now under implementation. The Agency has assisted (1985-88) two institutions in Mali for the improvement of sorghum and African rice under the joint FAO/IAEA/Italy CRP on improvement of basic food crops in Africa through plant breeding, including the use of induced mutations. Both crops are dependent upon rain and suffer from stress conditions which occur from time to time during the growth period of the crops. The project on the improvement of sorghum using radiation mutation techniques was initiated in *1986 by the Institut Polytechnique Rural de Katibougou, Koulikari (about 80 km from Bamako),* in order to obtain genetic variability by irradiating several local varieties of guinea type sorghum. This research has resulted in the production of several mutant lines in the M8 generation with improved characteristics, notably drought resistance, maturity, yield and nutritive value. Although none of these mutants had been tested in replicated field trials, some of the material was handed to the farmers for cultivation. Their response showed that some of the mutants performed better than the local cultivars, which gives strong justification for multi-location field trials. There is also new material from experiments initiated in 1988 and 1989, and it is now in M4/M5 generations. Three M8 lines of sorghum are being field tested in this season to produce sufficient seed for multi-site trials with mutants and the parent cultivars. There is a need to establish a basic tissue culture facility to initiate studies on the pre-selection of sorghum mutants for tolerance to heat and drought in the cell, tissue and plants cultured in vitro. It is well established that sorghum plants can be regenerated through shoot formation

and somatic embryogenesis from callus culture of most cultivars. In-vitro irradiation of cell and callus cultures allows handling of extremely large populations in a small space and around the year, independently of weather. In-vitro grown plants, subjected to stress, can be selected and later tested in the field to confirm their improved tolerance to heat and drought. The research work on African rice was initiated in 1988 by the Institut d'Economie Rurale (IER) at its regional Agronomic Research Station, Mopti, and yielded very useful mutants which have white grain instead of red kernel. Seven such mutants have been advanced to M5 generation and have been tested in small plot trials. All of them have white kernel which carries a premium market price as it is the preferred colour by the consumer. Two high yielding mutants, which have given an increased yield of 18% in small plot trials, mature very early, and in 1993 trials ripened before the parent had initiated even the seed set. Ongoing activities include tests of

the mutants in multi-site field trials in replicated plots, grown along with the parent and another cultivar as controls. For sorghum and African rice, a large number of field trials and experiments have been conducted which led to mutants with improved yield. High yielding plant varieties usually have high requirements for other inputs, especially nutrients, which have to be met if the yield potential is to be realized. It is therefore essential to obtain information at this stage on the nutrient and water requirements of the promising mutants and optimal fertilizer and water management strategies. If the breeding efforts are now complemented with studies on fertilizer/nutrient and water management for about two years, there is a high probability of practical pay-off, i.e. of reaching the stage where the outputs (desired varieties, practical methods for efficient cropping, fertilizer and water management strategies) could be handed to the Ministry of Agriculture and farmers. The required assistance will demonstrate the field performance of economically valuable mutants of sorghum and African rice, develop new cropping patterns and management practices with efficient fertilizer/nutrient and water use, and optimize biological nitrogen fixation. This will include the appropriate use of local rock phosphate and incorporation of legumes in crop rotation as a source of biological nitrogen which represent affordable alternative means of fertilizing these crops.

PROJECT PLAN: Phase I (1995) will concentrate on the implementation of field plot trials at six locations involving selected mutants of sorghum and African rice. Two staff members will be trained in plant tissue culture technique. The training of an agronomist on the use of isotpes in soil/plant studies, and a technician on N-15 analysis using emission spectrometry will be followed by the establishment of N-15 laboratory facilities and the initiation of experiments on nutrients, nitrogen, phosphorus and potassium requirements, and fertilizer use on the selected sorghum and African rice varieties. The seeds to be harvested from field plot trials will be analysed and multiplied in sufficient quantity for trials in the second and third year for multi-location trials. Phase II (1996) will focus on the validation of the results obtained from Phase I and on the assessment of the effectiveness of locally available natural rock phosphate for sorghum and African rice production. Associated studies on nitrogen turnover in a sustainable sorghum/African rice-legume cropping system will also be carried out and the establishment of a basic facility for tissue culture completed. The last year of the project will be devoted to the preparation and distribution of protocols on recommended agronomic practices based on the results obtained from the studies on mutation breeding and on soil/plant/fertilizer ralationship. Large scale seed multiplication of the mutants of sorghum and African rice selected during Phases I and II will be undertaken in collaboration with the Ministry of Agriculture and its extension services. The project will ensure that enough seeds are released to farmers together with the related agronomic practices. The final evaluation of all project activities will also be completed during the last year. The National Technical Committee that will be established at the beginning of the project will be transformed into a permanent entity to look after the dissemination of the project's results and to ensure that the agronomic practices are followed by farmers.

NATIONAL COMMITMENT: The institutions involved will make available adequate land parcels for field trials, scientists (plant breeders, geneticists and soil scientists) as well as premises to house the tissue culture, N-15 and P-32 laboratory facilities. The Government, through the Ministry of Agriculture, will ensure that sufficient seeds of the promising mutants of sorghum and African rice are multiplied and reasonably priced.

AGENCY INPUT: For 1995-96, equipment for a tissue culture laboratory, N-15 emission spectrometer and accessories, a liquid scintillation counter, equipment for P-32 injection; expert services in soil sciences, fertilizers, mutation breeding and tissue culture in both years; fellowship training. In 1997 it is envisaged to provide further assistance to help interpret the results obtained, validate the promising mutants of sorghum and African rice and multiply sufficient seeds for release to farmers. Follow-up expert services and additional fellowships are also foreseen.

IMPACT: This project will enhance the capability of integrating nuclear techniques in agronomic research in two institutes in Mali. The field performance of selected mutants of sorghum and African rice will be tested, optimal agronomic practices will be defined, and sufficient seeds will be multiplied for release to the farmers, who are the end users. The Ministry of Agriculture will undertake distribution of seeds to the farmers through the extension services. The primary impact of the project is therefore the increased production of sorghum and African rice which will contribute towards food self-sufficiency in Mali.