

## PERSPECTIVES ON BIOTECHNOLOGY AND BIOSAFETY IN UGANDA

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### ABSTRACT

International efforts aimed at the application of biotechnology and biosafety are underway. Inevitably, Uganda is part of this effort. However, the country is constrained by inadequate financial and human resource capacity to foster her vision and strengthen institutional structures to fully benefit from the impact of biotechnology research and development. Uganda realises, however, that she has to apply science and technology in order to gain a competitive edge in trade, commerce and industry and an admirable standard of living in the region.

*Key Words:* Genetic resources, micropropagation, risk assessment, tissue culture

### RÉSUMÉ

Un effort international visant à l'application de la biotechnologie et de la biosécurité est en cours. Inévitablement, l'Ouganda fait partie de cet effort. Le pays est limité par une capacité inadéquate de ressources humaines et financières qui puisse favoriser la prévoyance et le renforcement des structures institutionnelles en vue de pouvoir bénéficier entièrement de l'impact de la recherche et du développement biotechnologiques. L'Ouganda comprend, toutefois, qu'il doit appliquer la science et la technologie pour être compétitif en affaires, commerce et industrie, et avoir dans le pays un niveau de vie admirable dans la région.

*Mots Clés:* Ressources génétiques, la micropropagation, évaluation de risque, la culture tissulaire

### INTRODUCTION

Biotechnology is a relatively recent and emerging area of science and technology in Uganda. It is, however, strategic in Uganda's national development objectives in that it has a potentially central role to play in her economic growth, food security, natural germplasm conservation and the provision of improved health services. Some of the techniques employed in biotechnology were applied as far back as 1960's in the development

of clonal coffee material in Uganda's agricultural research. However, this was not in the context of biotechnology as we know it today. With increased understanding of the application of biotechnology, its importance is increasingly being appreciated. Hence, in Uganda, it is quite apparent that agricultural biotechnology is of priority consideration, especially in micropropagation and production of disease free plant materials. Much of the concentration of biotechnology research is in the crop and livestock sectors.

It is apparent that the products of biotechnology will soon find their way into Uganda's production and service systems, if they have not yet done so. Consequently, risk assessment and biosafety issues are significant in the minds of the policy makers at the moment. In particular, it is essential to know what biotechnologies or techniques and processes of biotechnology research and application are of benefit to our systems, which ones pose risks, what kind of risks and how the impending risks may be avoided.

As far as the importance of biotechnology in Uganda is concerned, the focus is on acceleration of growth and processes, ridding material of diseases, improvement of quality, development of disease and pest resistant material, and diagnosis of diseases and increased livestock productivity. These foci are embraced in some of the research programmes at public research institutions and in universities.

### STATE OF THE ART OF BIOTECHNOLOGY RESEARCH

The national research system in Uganda comprises public funded research institutions; research and development (R&D) activities in training institutions, especially the universities; R&D by non-governmental organisations; and R&D activities by regional and international development agencies. Biotechnology research in Uganda is largely undertaken by the major national agricultural research institutes and university faculties. Some of the current biotechnology programmes in the national agricultural research institutions under the umbrella of the National Agricultural Research Organisation (NARO) are: (a) improvement through micropropagation and virus eradication of the sweet potato (*Ipomea batatas*) and Irish potato (*Solanum solanacearum*). This is carried out at Namulonge Agricultural Research Institute, 25 km northeast of Uganda's Capital City, Kampala; and (b) development of coffee clonal material by micropropagation at Kawanda Agricultural Research Institute, 15 km north of Kampala. Tissue culture laboratory facilities both at Namulonge and Kawanda Research Institutes can only be described as moderate, equipped

basically for preliminary and non-sophisticated biotechnology research.

At Serere Agricultural Research Institute, some 350 km east of Kampala, research work is concentrated on sorghum, cotton and livestock. However, no biotechnological research is undertaken at the institute; there are no facilities nor trained manpower in biotechnology research aspects.

At Uganda Trypanosomiasis Research Institute, which has now been transformed into a Livestock Research Centre, biotechnology research techniques are routinely applied in the diagnosis of livestock diseases using enzyme immunoabsorbent techniques (Nyira, 1993).

Research on biopesticides was also undertaken. *Bacillus thuringiensis* was tested for the control of bollworms on cotton, especially *Pectinophora gossypiella*, which occurs quite late in the cotton season and is quite difficult to control by conventional chemical pesticides; and for the control of *Heliothis* on tomatoes. Experimental results eliminated further efforts in that area.

Makerere University undertakes both research and training for biotechnology. With regard to research, the major area of concentration is the micropropagation and improvement of the banana (*Musa sapientum*) using non-conventional semiclinal radiation and chemical methods. Similar efforts at the university are being applied on improvement of coffee, Irish potato, cassava and horticultural crops. Mycorrhiza research is at the planning stage. Strategies and manpower requirements for its execution have been worked out but funding has not been secured. Biomanufacture of Rhizobia at Makerere University has reached commercial scale. Rhizobia are multiplied in commercial quantities and sold to farmers in Uganda and abroad.

Although much thought and planning have been given to molecular and genetic aspects of biotechnology in the University research programme and by the Uganda National Council for Science and Technology (UNCST), current facilities and trained manpower cannot handle the requirement. With regard to teaching, programmes have been worked out for postgraduate training in biotechnology, with options in microbiology, biochemistry and agriculture during their first

degree programmes. It is envisaged that postgraduate training in the area of biotechnology will contribute cost-effectively to biotechnology research.

In animal biotechnology, there has been little progress. Attempts have been made with success in the field of embryo transplant. There is sustained emphasis on diagnostic techniques. There is also a research programme on cultivation of naturally occurring bacteria for enhanced milk fermentation (Walsh, 1992). The strains have been identified and are being cultured at the university for large scale experimentation as part of the programme on modernisation of traditional technologies. There are plans to strengthen the area of animal biotechnology in Uganda once the East African Community institutional cooperation is revived. The vaccine production programme established in the Animal Health Research Institute stalled. It is now felt that the work should be undertaken by the private sector or even by the Uganda Farmers' Association.

Summing up the biotechnology research aspect, it is clear that current emphasis, in Uganda, is on tissue culture techniques. The effort is semi-commercial, except in the case of Rhizobia production. Plans are underway to establish a commercial biotechnology enterprise with Japanese investors. The products of the proposed bioreactor are still uncertain.

## **BIOSAFETY**

In 1993, an application was made to the UNCST to field test the hormone bovine somatotropin (BST) on cows. At the time, there was controversy surrounding BST in the USA. Uganda at that time was cautious about introduction of frenetically manipulated products either for evaluation or possible application, since little information was available to guide any form of decision making other than that provided by the commercial firms holding interest in the products. BST was ultimately cleared in the USA in November 1993 for wide scale application. Following these events, the issue of biosafety in the application of biotechnology became a critical consideration in Uganda. As an immediate measure, the UNCST advised government on tentative biosafety actions which included experimentation under contained

conditions on all uncertain biotechnological products such as transgenic material. Such contained conditions are available at the plant quarantine laboratories at Kawanda Agricultural Research Institute. Further, the government was advised to examine the existing legal framework which encompasses the Plant Protection Act and Phytosanitary Regulations, Animal Diseases Act, Food and Drugs Act, Forest Protection Act and the newly enacted Environment Protection Act. This framework is to be used to regulate research and application of genetically modified organisms and products of biotechnology bearing possible risks to human beings and the environment.

Attempts were made in 1994 to create a national biosafety committee and develop biosafety guidelines. The first meeting on biosafety was convened in March 1994. It was agreed to develop a framework for biosafety guidelines and regulations. However, because of lack of adequate information and expertise in this area, it was agreed to seek guidance from the guidelines developed by the regional biosafety committee of which Uganda is member. Meanwhile, Uganda participated in several meetings, including one convened in Amsterdam in May 1994 to consider draft international biosafety guidelines. Uganda has since received the refined draft of these guidelines which is considered as an excellent basis of a national biosafety guideline.

The UNCST convened during 1995, a national consultative forum on biotechnology and biosafety which will most likely be jointly organized with the National Agricultural Research Organisation.

In considering biosafety issues, Uganda is also considering the logistics of risk assessment. This is equally a new area where Uganda needs guidance and will very much benefit from external input with regard to methodologies.

## **HUMAN RESOURCE CAPACITY**

Although Uganda has a significant amount of trained manpower, it does not have adequate skilled manpower in the area of biotechnology. The agricultural research sector has many trained researchers at the second degree level. The training is largely in areas that form the pedestal for biotechnology research such as microbiology, virology, immunology, pest management, plant

breeding and biochemistry. The universities are equally short of manpower generally and particularly in the biotechnology field. The curriculum for postgraduate work has also not been well articulated to provide a solid foundation for biotechnology research and application.

### FACILITIES

The facilities both in the agricultural research institutes and at the universities can at most be described as moderate. They are not adequately equipped for advanced tissue culture work, let alone for preliminary work in molecular science and cell biology or cell chemistry. There is a moderately equipped plant quarantine laboratory at Kawanda Agricultural Research Institute with reasonable facilities for containment of objects of testing or experimental work. Again the laboratory lacks manpower. The UNCST suggested development of containerisation facilities at Makerere University as part of the biosafety measures. This suggestion has to date not been realised.

### FUTURE PLANS

Uganda needs international assistance to foster its biotechnology research in the form of expertise, training, technical assistance for development of biotechnology in agriculture, the universities and

the pharmaceutical industry, equipment, and the establishment of collaborative programmes which can ease the flow of finance and equipment in the biotechnology research area. There is much to achieve through international and inter-institutional cooperation and collaboration with international laboratories and centres of excellence as well as through an enhanced programme of technical cooperation which permits exchange of technical manpower and information.

Most important and perhaps quite urgent is the need for a national policy on biotechnology. The UNCST finalised and presented to government a national science and technology policy which spells out the broad framework within which the policy on biotechnology can be developed and implemented. The idea of convening the national biotechnology forum is to articulate what this policy should be and what form it should take.

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