

## BIOTECHNOLOGY IN AGRICULTURAL DEVELOPMENT

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Biotechnology by definition involves use of living organisms or subcellular components of living organisms to develop a technology. It is a vast field of science which brings together scientists of all disciplines. Most of the early progress was made by research workers who concentrated on microorganisms, but plant biotechnology has now developed sufficiently to be treated as a discipline in its own right. Despite the fact that there has been always a considerable interest in application of biotechnology to agriculture, until recently, research was mainly guided by the interests of the researchers than by market demand.

Tissue culture is one of the most applied areas in Biotechnology. Plant organ, tissue, cell and protoplast culture have developed rapidly in the past half century and micropropagation of crops is now routinely done on a commercial scale in many developing countries. Efforts have been made to link government institutes and industry in Latin American and South East Asian countries. Unfortunately, such links have not yet been established in Sri Lanka. I therefore wish to thank the organizers for having given us an opportunity to talk about the biotechnological research in the department.

Department of Agriculture realized the importance of tissue culture in early seventies when the cut flower industry was recognized as a means of earning foreign exchange to the country. In 1977, Orchids, especially Dendrobiums, were micropropagated and sold to growers who were registered with the Botanic Gardens, Peradeniya. However, due to various constraints including funds, laboratory facilities and insufficient trained personnel, the output of products were very limited although demand for planting material was very high. The first workshop on tissue culture was organized by the Export Development Board in collaboration with the Department of Agriculture and was held at the Botanic Gardens in 1981. Anthuriums, Crysanthemums, Geraniums, African violets and Ferns were also propagated but only on a scale sufficient for field trials. Subsequently, the Department of Agriculture extended the programme of micropropagation to horticultural crops and a laboratory was established in 1984 at the Central Agricultural Research Institute in Gannoruwa. The project was funded by the Food and Agricultural Organization of the United Nations to propagate banana, citrus, strawberry, pineapple, passion fruit, papaya. Pineapple, banana and strawberry were produced on a mass scale and field trials were carried out to study the field performance of micropropagated plants. Although *in vitro* propagation of papaya was successful through somatic embryogenesis, transfer of plants to soil was not successful. Viral elimination from infected passion fruit plants was attempted and the plants produced which did not show any symptoms as *in vitro* cultures began to show symptoms when transferred to pots under green house conditions, indicating meristem culture alone may not be sufficient to eliminate virus

in passion fruit plants. Micrografting of citrus shoot tips onto disease resistant root-stocks was successfully carried out.

At present, banana production is being continued to meet a target of producing 15000 plants for departmental needs. In addition, research is carried out to obtain disease free material from banana plants infected with bunchy top virus. Using media manipulations with gibberellic acid as the variable, elongated plants were produced which still showed diseased symptoms *in vitro*. Meristems were isolated from these plants and cultured on media supplemented with a cytokinin, benzylaminepurine, and allowed to proliferate. These plants were subjected to thermotherapy in an attempt to eradicate the virus. This experiment is in progress.

### Future Research

Tissue culture is clearly a mutagenic procedure. Although plants appear normal phenotypically most of them have detectable variations that are not present in the parent plant. An artificial tissue culture environment brings about disturbances in physiology of the cell resulting in DNA modifications. These variations can be detected as changes in the length of defined DNA fragments which result when a DNA sample is digested with restriction enzymes. Such variations are called Restriction Fragment Length Polymorphisms (RFLPs). Pineapple plants that were produced by tissue culture were found to have a high degree of somaclonal variation. Frequency of albino plants and plants with variegated leaves increased with more than four passages. A project proposal has been written to detect differences in native proteins and newly synthesized proteins by labelling the proteins followed by analyses of proteins using one dimensional and two dimensional gel electrophoresis. Combination of a probe and restriction enzymes has to be found to detect RFLPs. Although expertise in this area is available, local or foreign collaboration is needed regarding radioactive usage as the Department of Agriculture does not have facilities for safe use of radioactive elements. Public health and environmental aspects have to be considered especially when radioactive phosphorus is used. Therefore, as an alternative, non radioactive probes can be used, but trained personnel are not available in the Department. However, radioactive probes are much more sensitive and therefore many laboratories still prefer to use <sup>32</sup>P-labelled DNA probes. RFLP assays are expensive, especially if one opts to use radioactive elements.

It is also intended to work on isolating desirable genes for crop improvement programmes by transformation techniques at the Central Agricultural Research Institute. Again, the same problem of usage of radioactive elements will have to be considered. Nevertheless, it is strongly felt that emphasis has to be given to these programmes to expand the present approach of plant biotechnology in Sri Lanka. It must be mentioned that Sri Lanka has a rich scope for technological advance in biotechnology. We are blessed with a rich flora and a favourable climate, and commercialization of agricultural biotechnology should be expanded with available technologies such as tissue culture for increased productivity of fruits, vegetables and floricultural crops.

### **Biotechnological Research in Food Technology**

Food technology division at the Central Agricultural Research Institute is presently engaged in carrying out research on production of fruit and rice wine by fermentation and also on the production of natural enzymes.

### **Biotechnological Research at the Soya Bean Research Division**

The soya bean research division at the Central Agricultural Research Institute has isolated and screened under green house conditions nearly 450 *Rhizobium* strains for soyabean, green gram, ground nut and cowpea. Subsequent to field trials, immunological studies have been done to identify promising strains. Techniques have been developed to upgrade the quality of crude papain and to improve the drying characteristics of papaya latex.

### **Plans for Future Research**

It is intended to study the use of continuous and batch type commercial and pilot plant scale fermentors and to carry out research on isolation of food grade enzymes and their subsequent utilization to prepare value added products.

It is also intended to study the physiology of different strains of *Lactobacillus* and *Peadiococcus*, with the objective of isolating superior strains for fermentation.