PLANT PROTOPLASTS:
A New Tool in Plant Biotechnology*

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At the Plant Biotechnology Section of the Bio-Organic Division, plant cell, tissue and protoplast cultures of a number of economically important plants are being investigated. In two plant systems namely *Santalum album* (sandalwood tree) and *Tylophora indica* (a medicinally important plant), protoplasts have been successfully cultured and plants have been regenerated.

Sandalwood trees are conventionally propagated by seeds and vegetative multiplication through cuttings has not been possible. Using tissue and cell culture approach, a protocol has been developed to obtain a number of sandalwood plants. This is of great advantage in large scale clonal multiplication of elite trees. Recently, protoplast work has been carried out on this commercially important tree species. From small stem segments of a 30 year old sandalwood tree, rapidly proliferating callus tissues were obtained on a nutrient medium. The tissues were treated with an enzyme solution for 4–5 hours. Following the enzyme treatment, a substantial number of protoplasts were released. Isolated protoplasts were cultured as liquid droplets in a nutrient medium and under appropriate conditons, they reformed a cell wall and underwent rapid and successive divisions resulting in cell colonies. Such cell colonies multiplied and developed into callus tissues. Varying of hormonal conditions of the growth medium lead to the formation of a large number of embryos (resembling the embryos occurring in seeds) some of which could be grown into complete plants. This is the first successful report of development of plants from protoplasts of a tree. Protoplast technology developed in sandalwood might be useful in breeding and improvement programmes. A somewhat similar protocol was followed in case of another plant *Tylophora indica* and a number of plants could be obtained from tissues of protoplast-origin. In case of groundnut (*Arachis hypogaea*), protoplasts were isolated by treating the leaf cells with the enzyme solution. Isolated protopasts formed a new cell wall and divided frequently resulting in callus tissues. Plant regeneration is yet to be achieved.

Somatic hybridization

Plant breeders use the familiar technique of hybridisation involving crossing of sexually compatible species in order to obtain a hybrid of desired characters. Since protoplasts are cell wall-less, why not fuse protoplasts from two different plants and obtain a hybrid? Such a fusion is called somatic hybridisation. The eminent biologist J. B. S. Haldane described somatic hybridisation as an "alternative to sex". A great advantage of somatic hybridisation is that it can be used to bypass incompatibilities that may exist between plant species.

Fusion of protoplasts is brought about by treating them with fusion agents such as salts of sodium or polyethylene glycol. It provides opportunities to develop novel hybrids which can be between (a) two varieties of the same plant or (b) two species or (c) two plant genera. In recent years, somatic hybrid plants have been produced in a number of instances namely tobacco, datura, petunia, cabbage, carrot and tomato + potato etc., through protoplast fusion. However, regeneration of protoplasts to plants is still restricted to a few plant genera, often those of lesser economic value. Protoplasts of crop plants have shown a general inability to develop into complete plants and this has impeded the application of somatic hybridisation to plant breeding programmes. When techniques are perfected for efficient production of plants from protoplasts of agriculturally important crops, it would pave the way for developing novel hybrids of crop plants and specially those which cannot be crossed through sexual methods. Protoplast fusion is receiving considerable attention in BARC and various plant species are being examined as to their suitability for fusion. Preliminary experiments with two species of *Physalis*, a plant of medicinal value, have shown that protoplasts could be fused. Our eventual goal is to extent protoplast technology to crop plants in which

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we have already established cell cultures capable of plant regeneration.

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Plant biotechnology includes not only techniques related to recombinant DNA but also the many *in vitro* manipulations of plant cells, tissues and protoplasts which, together, is often referred to as genetic engineering. Crop improvement using genetic engineering requires the execution of several procedures that as yet are difficult to accomplish in the required sequence in any economic species. However, given the rapid advances that are being made, it is reasonable to expect that all the critical procedures will be accomplished in the foreseeable future. Plant protoplasts would undoubtedly play an important role in the rapidly emerging plant biotechnology for crop improvement.

NEWS

UK LAUNCHES SOLID STATE BATTERY PROGRAMME

London (LPS): A major programme to develop the materials and technology for all-solid-state rechargeable batteries has been launched at the UK Atomic Energy Authority's Harwell research laboratory.

The research and development programme is being sponsored by an industrial "Club" of battery users, manufacturers, and materials specialists. It will provide the basic technology for the manufacture of all-solid-state lithium batteries based on polymeric electrolytes. Rechargeable, all-solid-state, lithium systems constitute a radical new concept in battery technology. They will have major advantages over conventional battery systems and hold out exciting and new battery application areas.

Harwell's Applied Electrochemistry Centre has already demonstrated experimental cells. These incorporate thin-foil anode and current collectors, and thick-film polymer electrolyte and composite cathode components which may be produced by continuous casting. A complete cell is currently only 250 microns thick, and there are prospects for reducing this still further.

Using such fabrication techniques it should be possible to produce large area cells for configuration into batteries of any size or geometry. Batteries based on his technology will have a very high energy density as well as being rugged and safe. Major applications envisaged include consumer products, electronic systems and communications equipment and satellite power sources BIS. (Science and Technology News, British High Commission, Chanakyapuri, New Delhi 110 021.)