Tissue Culture of the Jack Tree

Division of Plant Physiology, Indian Institute of Horticultural Research, Bangalore 560 080, India

ABSTRACT

Shoot tips isolated from the juvenile shoots of jack (Artocarpus heterophyllus) cultured on MS basal medium containing an auxin and a cytokinin resulted in multiple shoot induction through stimulation of axillary buds. The shootlets grew only as shoots in culture. Rooting of isolated shootlets occurred rarely. This method, if copious rooting could be induced on a large scale, points to the possibility of clonal propagation supplementing the conventional methods.

INTRODUCTION

In the study of morphogenesis in vitro, most herbaceous forms of plants seem to present no problem to their being grown as de-differentiated tissue and in the manipulation of their callus to re-differentiated shoot buds, roots, or complete plants, which is now a routine. This has implications in the rapid clonal propagation, in larger numbers and in quicker time of many ornamental and other horticultural species. A survey of literature pertaining to the study of organ morphogenesis in aspecic culture of the tree species indicates that apart from members of the Coniferae and a few temperate woody angiosperms such as the aspen, elm, poplar, birches, etc., there have been no serious attempts at clonal propagation of the elite tropical fruit trees through tissue culture. This prompted us to investigate the culture conditions that influenced the growth of explanted organs of the jack (Artocarpus heterophyllus Lam.), a tree species belonging to the family Moraceae with particular emphasis on multiple shoot induction in vitro and rooting of the isolated shootlets to form whole plants. This report is based on such an attempt.

MATERIALS AND METHODS

Artocarpus sp. is a fairly large-sized tree originally native to India, but now cultivated in tropical Asia and Africa for its large edible fruits. Propagation is by seed, cuttings or patch budtings, Superior races of the jack tree are known and budtings in general, are difficult to transplant from the nursery row. One of the trees growing at the Indian Institute of Horticultural Research, Bangalore (India) was utilized as a source material for shoot buds and young inflorescence axes for experimentation in vitro. Shoot tips from germinating seeds as also slices of young inflorescence axes were used. Shoot tips, cotyledons and hypocotyl fragments were aseptically cultured on nutrient media after sterilization with mercuric chloride (0.2%) for 15 min followed by several rinses in autoclaved distilled water. Marashige and Skoog's basal medium (MS) supplemented with

---

indole acetic acid (IAA), indole butyric acid (IBA), naphthalene acetic acid (NAA), benzylaminopurine (BA), 6-(ɛ-7-dimethylallyl amino) purine (2iP) and gibberellic acid (GA$_3$) in different concentrations and combinations was used. Sucrose (2%) or glucose (3%) was used as the carbon source and FeEDTA as the source of iron. Autoclaving of media was done in the usual way for tissue culture. Twelve replicates were used for each treatment.

RESULTS

Cotyledons

Small fragments of cotyledons cultured on MS medium containing BA (2 ppm) and NAA (1 ppm) proliferated to form a callus from the cut ends. The callus could be subcultured and maintained for several months with no apparent sign of organ regeneration even under a wide range of cultural conditions.

Hypocotyl, Primary Root and Inflorescence

Organ segments (1 cm long) isolated from germinating seeds were cultured on MS medium to which BA (2 ppm) and NAA (2 ppm) had been added. Induction of callus occurred from the cut ends. On their transfer to fresh MS, basal medium containing NAA or IBA (1 ppm) and BA (2 ppm), multiple shoot induction was observed unaccompanied by rooting. Rooting, however, was observed only in a couple of instances out of 12 replicates on sequential withdrawal of BA and on prolonged incubation. Fragments of the primary root never calloused even on culture under a wide range of auxin-cytokinor combinations. Good callusing could be obtained from inflorescence primordia in culture originating from pith parenchyma of the axis. Apart from rooting no shoot bud regeneration was observed in the callus.

Shoot tips

Shoot tips, 1 cm long, isolated from fresh juvenile sprouts of a 50 year old tree and cultured on MS basal medium containing IAA (0.1 ppm) alone or with the addition of BA (2 ppm) caused the development of exuberant green callus. However, these failed to give rise to buds or roots. On the other hand, shoot tips excised from uniformly growing branches of the mature tree cultured on MS medium containing BA (20 ppm) + IAA (0.5 to 5 ppm) showed a better response. Callusing from the cut ends was profuse and prolonged incubation for 4-6 weeks, caused the stimulation of growth of buds from meristems axillary to the leaves in all the cultures. Multiple shoot induction unaccompanied by rooting was also characteristic of shoot tips cultured on MS + NAA (1 ppm) + 2 iP (10 ppm). Such regenerated shootlets, however, did not root in culture. On excision and culture of each of the regenerants to the same medium, callusing from basal ends followed by the development of fresh crop of accessory shoots from the nodal regions was observed (Figs. 1-3).

Rooting of the new shoots was, however, very rare and never copious on transfer to a root inducing medium containing IBA and NAA (0.1, 0.5, 1.0, 5.0 and 10 ppm). Addition of GA$_3$ (1 ppm) caused the abscission of the shoot tip.

DISCUSSION

Over the years, there appears to be no major breakthrough in investigations concerned with the woody
genera vis-à-vis clonal propagation through tissue culture. Tropical fruit trees still remain an unplumbed field and are difficult to propagate asexually by conventional methods. Elite trees of economical importance such as mahogany, gulmohur, mango, nutmeg, and others are not easily amenable to tissue culture. However, recent attempts at plantlet regeneration from seedling callus and terminal buds of elite 100 year old teak trees seem to be promising. A beginning has been made in the application of tissue culture methods to successful regeneration in sandalwood tree, Eucalyptus, and Tamarix, as also some deciduous trees.

Multiple shoot induction via callus, although a promising method, cannot guarantee the elite qualities of the parent plant, nor the one derived from a seedling. Great variations are observed among the different genotypes in their potential for morphogenesis as is evident from investigations on the Eucalyptus, ranging from species that are totally recalcitrant to those that are highly responsive to regeneration. Although jack tissue culture could successfully be raised and organ regeneration in the form of shoot buds could be manipulated with ease, rooting of the shootlets at will, still remains a problem for profitable use in plant propagation.

Acknowledgement

Authors are thankful to Dr. G. S. Randhawa, Director, Indian Institute of Horticultural Research, Bangalore, for facilities and encouragement.


INTERNATIONAL WORKSHOP ON THE PHYSICS OF SEMICONDUCTOR DEVICES, DELHI, INDIA

The International Workshop will be held at Solid State Physics Laboratory of the Ministry of Defence and the following is the tentative list of topics: (1) Recent advances in the physics of bipolar devices including heavy doping effects, high injection effects and switching; (2) Advances made in specific devices such as solar cells, CCD’s optoelectronic devices and semiconductor sensors; (3) Recent advances in the understanding of science and technology of semiconductors with emphasis on Si, GaAs and other similar materials; (4) Recent trends in CAD, LSI, VLSI and VHSIC.

Those interested in participating in the workshop may contact Dr. T. R. Reddy, Secretary, Organising and Programme Committee International Workshop on the Physics of Semiconductor Devices, Solid State Physics Laboratory, Lucknow Road, Delhi 110 007 (INDIA), before May 1, 1981.