CHAPTER - I

INTRODUCTION
The need for an increased rate of tree planting is being continuously emphasised by practically all sections of the society. Massive wastelands afforestation schemes have come to be launched in all the states as a very important component of developmental programmes for the general prosperity of the people. These are in pursuance of the then Prime Minister's declaration in December 1984 that about 5 million hectares of wastelands would be developed every year to arrest further ecological degradation on the one hand and to provide the basic requirements of man and his animals in respect of fuelwood and fodder. This has necessitated large scale afforestation throughout the country to achieve the desired goals in shortest possible time.

Afforestation on a large scale requires large amount of seeds of good quality. Seed quality has a critical effect on the economics of planting trees and their quality. This is true in all cases be it a large scale commercial plantation, a village level social forestry plantation, a small scale diffused farm wood lot or even an isolated tree.

Carefully selected good seeds leads to the successful establishment of a plantation, but the seed may be of little value if the tree is slow growing, ill adapted to the site or produces the wrong kind of bole or timber, just for the reason that the provenance or genotype was incorrectly chosen (Prasad and Kandya, 1992).
It normally happens that foresters get enhanced plantation targets just a few months before the actual planting. Being unaware of the type and extent of planting and the species to be planted they rush to procure the required quantities of seeds from the open market. The seed suppliers care little for provenance, collect seeds from different sources and from different edapho-climatic regions. The quality of the seeds their source and other details are also not known to them (Prasad and Kandya, 1992).

Multiplication through seeds even when collected from elite trees will continue to maintain heterozygous behaviour. Though with continuous breeding and selection some improvement is possible, the immediate genetic gains may not be much. Also, improvement through sexual means involves several generations. It is also a fact that the generation by seed sources would be difficult for the control of quality due to collection and participation of both inferior and superior phenotypes during cross pollination. Moreover, the selection and stabilization of superior characters sought by horticulturists and foresters is very slow (Abbott, 1977).

The biological problems limit the use of seeds in many species. Moreover, use of inferior and diseased seeds yield poor tree crops, which could be detected only after a long time.

Unlike agriculture, in forestry the availability of quality seed is not assured on account of various factors.
Alternative seeding cycle in some species, poor viability and undesirable mixing of seeds collected from forest floor are some of the key problems in obtaining quality seed material for raising vigorous planting stock.

In Central India, most of the tropical deciduous tree species flower and fruit during summer season. In this part of the country, the best sowing period is also during summer season. Many tree species also have 'afterripening dormancy' and therefore freshly collected seeds refuse to germinate without a rest of 2-3 months after collection. This requires maintaining of nursery stock at least for a year or so, till they become plantable in the field. In other words seeds harvested in February-March even if sown in the nursery immediately thereafter, may not attain plantable size by July and therefore need to be nursed for 12-15 months.

In order to obviate the inherent biological problems connected with seeds, vegetative propagation could be tried as potential means of production of quality material of planting stock. Multiplication of elite tree through vegetative means after the advantage of greater genetic uniformity and immediate availability of superior clones for plantations. Plants with desired characters as high fruit/seed yield, resistance to diseases and pests, good branching and stem form, fast rate of growth and quality production can be multiplied at mill and made available in the shortest possible time. By vegetative propagation, the potential of greater genetic gain and greater
uniformity can be achieved which is not possible by sexual propagation. Another advantage of vegetative propagation is the rapidity with which the selected tree can be multiplied for establishing plantation and seed orchards.

Vegetative propagation is generally considered as an important part of the tree improvement activity in regeneration programme. The goal is to get the best planting stock with highest genetic quality (Hartmann and Kester, 1968; Nanda, 1970; Wright, 1976). Therefore, the field foresters and forestry scientists are constantly trying to improve the techniques of vegetative propagation for forest trees to meet the increasing demand of quality seedlings for planting. Use of latest methods of vegetative propagation by rooting of cuttings and through tissue culture assumes greater importance. While production of large scale planting material to be capable of withstanding inhospitable conditions in field is being experimented, methods of rooting of stem cuttings under mist conditions has assumed greater importance steckling (rooted stem cuttings) as they are called, could be prepared throughout the year. This type of clonal propagation is capable of meeting the growing demand of genetically improved planting material.

Amongst the accepted methods of vegetative propagation methods like grafting, budding, air layering and rooting of cuttings the last one is the cheapest one provided suitable means are devised for easy rooting of cuttings. Such methods are already in use for propagation of ornamental plants and fruit
trees (Randhawa et al., 1972) but a great deal has to be done in
forestry (Prasad and Kulkarni, 1988a). Foresters have now
realised that once an individual tree of a species with
desirable characters is obtained by hybridization, it can be
multiplied fast by vegetative propagation. In case of poplars,
willows, mulberry etc. this has already been achieved and clonal
propagation is now the rule.

Rooting of branch cuttings of elite trees under
intermittent mist has been found to be the best method to obtain
quality planting material in shortest possible time in several
species (Prasad and Kulkarni, 1988). Good genetic material is
obtained round the year through this technique by using branch
cuttings.

Rooting of branch cuttings of Morus alba, Dombusa
vulgaris, Adhatoda vasica, Gmelina arborea, Rauwolfia
serpentina, Dalbergia sissoo and Pongamia pinnata using various
auxin treatments and under mist conditions were tried and
reported from State Forest Research Institute, Jabalpur (Prasad
and Kulkarni, 1986; Dhuria and Tiwari, 1989,1991; Dhuria and
Chadhar, 1990; Dhuria, 1990,1991). The work on these species were
taken on for lack of quality seeds in adequate amount and
another for their importance in practically all afforestation
schemes.

In India Nanda (1970) carried out very detailed
investigations on use of auxins in rooting of stem cuttings.
Recently Aracruz group in Brazil in 1984 achieved great success
from intensive management and use of genetically improved rooted cuttings of *Eucalyptus* species. Earlier, the unimproved *Eucalyptus* forests were reportedly yielding a mean annual increment of 33 M$^3$/ha/year. But the improved forest developed by planting rooted cuttings of selected trees enhanced the yield of *Eucalyptus* forest to 70 M$^3$/ha/yr. Other pulpwood characteristics such as basic density and pulp percentage were also observed to have improved.

In view of the importance of the subject and taking into consideration the work already carried out, the present investigations was taken up. The objectives of the study were:

(1) To test the rooting response of some important forestry species through exogenous application of different auxins in a mist chamber.

(2) To study the optimum concentration of three auxins, IBA, NAA and IAA on *D.sissoo*, *P.pinnata*, *A.indica*, *L.leucocephala*, *L.flos-reginae*, *T.grandis*, *D.latifolia* and *Eucalyptus* hybrid.

(3) To find out the most appropriate season for getting best rooting in the cuttings of different species taken up in this study.

(4) To standardise rooting technique.

(5) To compare the field performance of rooted cuttings (stecklings) versus seedlings.
(6) To develop standard methods for micro propagation of some forestry species through the use of tissue culture technique.

(7) To study the field performance of Tissue Culture Plants (TCP) with those of Seed Origin Plants (SOP).

Although a lot of work has been done on rooting response of various tree species on account of exogenous application of auxins, type of cuttings and seasonal variation etc., literatures on the aspects of field performance of stocklings versus seedlings are lacking. In the present investigation two types of planting stocks have been compared for their survival and growth on most hospitable sites.

Application of tissue culture technique for mass multiplication of three species is still in the experimental stage. Comparative performance of TCP (Tissue Culture Plants) and SOP (Seed Origin Plants) formed part of this study.

The results of this investigation are likely to be useful to nurserymen and foresters who in the absence of quality seeds resort to vegetative propagation.
Madhya Pradesh has been raising plantation over an area of about 2,00000 hectares every year (Prasad and Kandya, 1992). The number of trees planted under various programmes has been increasing year after year. These forestry species are generally propagated by seeds. Invariably, the seeds used for massive afforestation programme are not of desired quality. Moreover, due to various reasons quality seeds in desired quantities are not always available for large scale afforestation programme.

Seed quality has a key role in the success of plantations and future site productivity. Good seed implies seed which is both of high viability and vigour and is genetically well suited to site and for the purpose for which it is used. Physiologically good seed may lead to successful establishment of a plantation. However, little is likely to be achieved if seed is of poor quality, ill adapted to the site or produces poor quality of wood, mostly because the provenance or genotype was wrong (Prasad and Date 1987).

Apart from the facts that the use of poor quality seeds produces inferior generation of plants, many a time the plantations fail and those which survive, are of low productivity. India's annual average increment per hectare, therefore compares unfavourably with the world average mostly because the quality of seeds has not been of desired provenance (Anon, 1989).

In order to overcome the difficulties in procuring
seeds of desirable quality and quantity alternative methods of quick and large scale multiplication of plantlets is urgently needed. Cloning has the major advantage of transferring the entire genetic potential of the mother tree to the new plants (Prasad 1988). The developed clones when grows in similar environment reduces, interaction between genotype and environment, thus saving the way for successful plantation. For this purpose bio-technological tool such as vegetative micropropagation which has already shown promises in respect of forestry species may be relied upon.

Role of Tissue Culture: For large scale afforestation programmes and limitation to those forestry species in which the conventional methods like cuttings, grafting, air layering and through seeds are the limiting factors, then the alternative bio-technological approaches, such as tree tissue culture may be an alternative method.

Through this technique a number of plants can be produced from a very small plant parts of desired quality from the selected clones, in lesser space and time the ease of international exchange of germplasm in avoiding quarantine controls (Henshaw and O’hara 1983).

Presently a number of forestry species have been successfully cultured through plant tissue culture technology. However, tissue culture in forestry has not been very successful because presently some important forestry species such as
Sal (*Shorea robusta*), Teak, Khamer (*Gmelina arborea*) etc. have not been propagated successfully through tissue culture.

These are very few reports on micropropagation of forestry species in Madhya Pradesh (Prasad and Tiwari, 1990; Tiwari and Dhuria, 1989; Prasad *et al.*, 1991).

Keeping in view the vast potential of plant tissue culture in the area of propagation and *ex situ* conservation the present work focussed on clonal micropropagation of most important forestry species viz. *Dalbergia sissoo*, *Eucalyptus* hybrid and *Tectona grandis*.

The present study focussed on the following aspects:

1. Selection of plus trees for the source of explants.

2. Establishment of aseptic culture using different type of explants: Nodal and apical explants.

3. Cloning of plant through tissue culture.