CHAPTER VI

GENERAL DISCUSSION
Trees within a species show wide variability in several characters. Vegetative propagation is one of the methods to transfer some of the desired characters to their progeny. The trees as seen growing in any area show phenotypic characters. After vegetative multiplication field testing, it is possible to select clone that transmit the desired characters.

Invariably seeds used for afforestation are not of desired quality. Good quality seeds implies seed which is both of high variability and vigour is genetically well suited, to site and to the purpose for which it is used. Use of good seed may lead to the successful plantation, however, when the seed is of poor quality it produces inferior planting stock. As a result many times the plantations fail and those which survive are of low productivity. This happens because such seeds are not adopted to the site and produce poor quality of wood because the provenance or geno-type was wrong (Prasad and Date, 1987).

There is an increasing need to grow planting material in shortest time and round the year for large scale afforestation programme. Generally plants are propagated by seeds in a limited period of year. Some forestry species have short viability and long dormancy period (Shorea robusta, Lagerstroemia parviflora, Anogeissis latifolia and A. pendula etc.). In such cases other method of plant propagation become a very handy. Vegetative propagation, macro and micro after good alternative to using seeds of desired quality (Prasad, 1988). Vegetative propagation technique have already shown promising in
many species. In creating forest plantation of very high productivity. Yield improvement using vegetative propagules to the extent of 64 m³/ha⁻¹/hr⁻¹ has been achieved with *Eucalyptus grandis* on 6th year rotation in Brazil (Zobel and Ikemori, 1983; Gurumurti and Dhandari, 1987 and Chaturvedi et al., 1992).

Conventional method of plant propagation for example by cuttings, grafts etc. have however their limitations especially where large amount of propagules are required. Cutting from various heavy hard wood trees have not rooted inspite of repeated experiment under various growth conditions using a wide variety of root induction hormones. Tissue culture method in such cases offers an alternate novel possibility and technique has been successfully applied to many Tropical hard wood species (Mascarenhas et al., 1987).

In the present study both types of vegetative propagation viz. rooting of stem cuttings in mist chamber and micro propagation using tissue culture techniques have been investigated in respect of a few important forestry species of this region. Plants raised by these methods were painted out in the field to compare their adoption to the site and growth pattern with the plants of seed origin.

6.1 ROOTING OF STEM CUTTINGS

The rooting success of stem cutting depends upon proper environmental treatment. Brix and Barker (1975) and Puri and Shamet (1986) have stress the importance of environment,
particularly that of high humidity for proper rooting of cuttings. Although many species root under normal climatic conditions, still a large number of species require controlled temperature, humidity and light conditions for rooting. This requirement of optimum conditions for rooting is more or less available in the mist chamber. Use of certain auxin in different concentrations are reported to give good rooting in many species. Auxin, such as IBA, NAA, IAA, 2,4-D, Boric acid and Keradex have been used for inducing root development in cuttings planted in sand or vermiculite media in mist chamber.

Mist spray schedule of 1-2 minutes per half hourly intervals in a day which on an average gives 0.05-0.1 mm per hour mist regime. Heavy intermittent mist has been found to cause rooting in cuttings while less misting causes drying and wilting of leaves. Such rooted cuttings have been called as stocklings which are ready for planting in a short period of 60-90 days.

In the present study rooting in mist chamber in cuttings of 8 species were tried (D. sissoo, P. pinnata, A. indica, L. floe-reginae, L. leucocephala, Eucalyptus hybrid, D. latifolia and T. grandis) using different concentration of 3 auxins (IBA, NAA and IAA). In order to study the effect of seasonality rooting was observed during summer, winter and rains. Among the species tried in this investigation two species viz. (L. leucocephala and D. latifolia) did not root during summer, two
species (A. indica and T. grandis) did not reported to rooting in winter and one species T. grandis was not found rooting in rains. On the other hand D. sissoo, P. pinnata, L. flos-reginae and Eucalyptus hybrid were found rooting present in all seasons. Summer season has invariably given better rooting present in all species except L. leucocephala and D. latifolia where did not at all) followed by rains. Winter season on the other hand has invariably found unfavourable to most of the species. Such seasonalty have been reported by many other workers (Nanda et al., 1968; Pandey and Vaish, 1990; Bhatt and Todaria, 1990; Nautiyal et al., 1991).

Among the 3 auxins tried IBA was found to be most effective in all most all the species. It gave very good rooting response as compared to others.

In some cases the better results were found to be achieved by IBA and in some cases IAA (Mc Veigh, 1951), reviewed the literature on comparative effectiveness of various auxins and reported IBA and NAA as best suited for sprouting and rooting in comparison to IAA. Bhatt and Todaria (1990) on the other hand reported much better sprouting by use of lower concentration of IAA. Similarly NAA also produced much better respectively at lower concentration and IBA was found to be more effective at higher concentration. Similar results were reported by Shamet and Puri (1988).

In the present investigation earlier part of summer which is also happens to be the spring season, gave better
rooting response in most of the species. This period (February to March) is the generally growing period in most of the tropical species. Early sprouting depends on available food reserve in the cuttings and this is followed by root formation which enables the plant to absorb mineral nutrients from growing medium (Wright, 1975). It indicated that better sprouting at February planted cuttings was the result of sufficient reserve food material in them.

Cuttings of tree species are extremely variable in their ability to root, while some root easily, other are difficult to root and still others do not root at all. Considerable evidence is available in literature to show that rooting of cuttings is influenced by a number of external and internal factors (Allen and McComb, 1955; Nienstaedt et al., 1958; Dore, 1965). In the present case also while species like *D. sissoo*, *P. pinnata* and *L. flos-reginae* when treated with 3 auxins, rooted easily during summer and rains, rooting in winter was somewhat difficult. *Eucalyptus* hybrid and *L. luecocaphala* also gave low rooting percent compared to other species. On the other hand *D. latifolia* and *T. grandis* were found extremely difficult to root.

The results of this experiment showed that the season, auxins and their concentrations and type of wood. At a paramount importance in rooting the chief factor responsible for this difference in results appear to lie in physiological condition of stock plants (endogenous level of auxins).
Juvenility factor type of wood selected for cutting, time of year in which the cutting taken temperature (growing, humidity) and rooting medium. The specific region for stem cuttings are not able to understand. Although some species root better at lower temperature (Hartmann and Kester, 1959), (D. sissoo, P. pinnata, L. flos-reginae, Eucalyptus hybrid, L. leucocephala and D. latifolia), there are some species (A. indica and T. grandis) which root only at higher temperature (summer season). Such reports are also available in other species (Hartmann and Kester, 1959; Siddiqui, 1973; Pandey and Vaish, 1990). Garner and Hatcher (1962) pointed out that the stock plants should be showing active vegetative growth in order to have the highest regenerative capacity. The low nitrogen-high carbohydrate balance in stock plants in many cases seem to favour rooting. In some species cuttings were noted with callus formation (D. latifolia and T. grandis) but roots were not produced which might be due to non-availability of auxin in the cuttings. Van Overbeck and Gregory (1945) and Van Overbeck et al. (1946) concluded that in rooting Hibiscus cuttings, some substance (or substances) in addition to auxin, is definitely necessary for initiation of roots which was shown to come from the leaves to adventitious root formation (Hartmann and Kester, 1959).

6.2 FIELD PERFORMANCE

Five species viz. (D. sissoo, P. pinnata, A. indica, L. leucocephala and Eucalyptus hybrid) rooted through vegetative propagation were trial planted for comparison with seedlings. At
the end of 3.5 years Eucalyptus hybrid, L.leucocephala and D.sissoo have shown greater promises in respect of plant growth, fruiting and seeding than their seedlings. However, growth performance of stecklings of P.pinnata and A.indica were not very good, when compared to their seedling. These plants tended to grow in a bushy form. Since the material obtained from the plants are based on the branches particularly the Juvenile apical portion it quite likely that growth of stecklings tends to be bushy.

As has been demonstrated in Aracruz a part from elite trees from which the cuttings are taken and their successful rooting in mist chamber, favourable site condition and high level of inputs application is necessary to get better results (Campinhos and Ikemori,1980; Zobel and Ikemori,1983).

In the present case the plantation were raised on very difficult site and practically little was given to boost the plant growth. Another factor could be that the period of 3.5 year is too early for A.indica and P.pinnata.

6.3 TISSUE CULTURE TECHNIQUE

Clonal micropropagation of using tissue culture technique was tried in D.sissoo, Eucalyptus hybrid and T.grandis. MS media containing macro nutrient and micro nutrient, organic supplement and Agar-Agar was used to culture nodal and apical explants. From the result it was seen that in
T. grandis only leaf explant resulted in moderate callus formation, however, nodal and apical explants did not give any response. In case of Eucalyptus hybrid profused callus and shoot proliferation was observed. However, the various concentration and combination of auxins and cytokinin fail to induce rooting. However, in case of D. sissoo nodal explant when cultured with Kn+auxin it resulted into callusing, shoot formation and root development, however the plantlets produced showed very high degree of callusing.

A number of workers (Gupta et al., 1980, Mascarenhas et al., 1982a; Sitalakshmi et al., 1980; Bapat and Rao, 1979) have used various concentrations and combinations of auxins and cytokinin in promoting shoot and root development. However, the results in all cases have been very variable and as a result is very difficult to get the reported results from the same media and auxin and cytokinin. This necessitate further intensive investigation to standardise the media, solution and explant for better results.

6.4 FIELD PERFORMANCE

Tissue culture plants of teak have given better result than seed origin plants, however the differences were found to be not significant in many cases. One important thing recorded from tissue culture plant is in respect of early flowering and fruiting than seedling origin plants. Such results have also been reported by Mascarenhas et al. (1987). Although a large
number of tissue culture plants have been raised by National Chemical Laboratory (NCL) Pune, not many plantations of tissue culture plants have been raised. Even where the plantation like the one reported in this thesis have been raised the superiority of tissue culture plants over seedling origin plants has not been proved. The picture so far emerging out from these investigation indicate that the technique of tissue culture is still not perfect for mass multiplication of forestry plants. Comparison on field performance of tissue culture plants and seedling origin plants could also depend upon many factors.

If the material for the seedling origin plants and tissue culture plants are same this comparison would be very scientific. However, the plantations of bamboos, Eucalyptus and teak raised at Jabalpur, Chandrapur, Tirupati and NCL, Pune have to different sources for plants of TCP and SOP. The difference in growth, flowering and fruiting reported in this case would, therefore depend on the factor of again plant material for tissue culture and for raising nursery stock.