Introduction

“Dreams are extremely important, you can’t do unless you imagine”

~George Lucas
CHAPTER - 1

INTRODUCTION

Forestry is the second largest land-use in India after agriculture, and an estimated 345 million people in rural areas depend on forests for at least part of their livelihood. Forest is under intense pressure, mainly from human activities, with the current consumption of timber and fuel wood well above sustainable harvest levels. There appears to be a great potential for increasing production to meet this demand-supply gap, especially from forests managed by communities and farm forestry. Afforestation is recognized as the tool for establishing more productive forests and a vehicle for extending tree cultivation outside the forest area, especially in the country like India where demand outstrips the production. Forests have the potential to improve the livelihood of forest dwelling people, particularly tribal people, who are among the most disadvantaged group in Indian society. In Kumaon hills, there are a number of indigenous multipurpose tree species which provide fuel, fodder, timber, medicines etc; but very little is known about the propagation of most of these species and, therefore, they are not being included in afforestation/ reforestation or social forestry programmes of the foot hills.

Demand of the petroleum products in India is expected to grow by a factor of 2.2 upto the year 2030. With the number of vehicles doubling between 2002-2020, the demand of diesel will make up a substantial part of this increase (The Energy Research Institute, 2002). The Indian Government’s Vision 2020 document states that cultivating
ten million hectares with tree borne oilseeds (TBOs) would generate 7.5 million tonnes of fuel a year, creating year-round job for five million people (Lele, 2007).

In the present scenario, when most of the cultivable area has been occupied by conventional/cultivated crops, tree species which can come up on wastelands under less favourable environmental conditions need to be promoted. In this context, promotion of plantation of oilseeds of tree origin is a good alternative. Thus there is need to identify superior clones/ genotypes of important species, which can produce better quality of oil, besides being high yielding. This calls for initiating work on technology development and its refinement for important TBOs. Besides, the studies on value addition of TBOs also need to be pursued to promote the use of their oil for confectionery purpose. (Kureel et al., 2008) In order to exploit the enormous challenges and possibilities, National Oilseeds and Vegetable Oils Development (NOVOD) Board has constituted National Network on Cheura by involving the institutes of ICAR and CSIR to address various researchable issues, which in turn could contribute towards development of high yielding varieties and improved cultural and seed production practices. The participating institutes have collected germplasm and identified about 50 CPTs/ superior genotypes of Cheura having high yield and oil content.

*Diploknema butyacea* (Roxburgh) H.J. Lam, belongs to family Sapotaceae, many of whose species produce edible and other economic fruits, is a medium sized deciduous tree, locally known as *Cheura* and popularly known as butter tree. This fast growing multipurpose tree is a native of Nepal and is almost localized in Pithoragarh district found mainly along steep slopes. It is a deciduous tree with a straight trunk. Flowers are white / yellow coloured with a fragrance. The fruit is berry, oval in shape with three seeds. Cheura is generally propagated through
seeds. Cheura starts flowering in the month of October-November and fruits start ripening in June-July. The seed contains considerable amount of fat, known as *Phulwara butter*. The potential use of Cheura products is found in different fields such as confectionary, pharmaceuticals, vegetable ghee production, candle manufacturing and soap making. It has been found effective for rheumatism. The flowers are used as a source of alcohol. The defatted seed contains protein and saponins which are toxic. The cake produced after processing Cheura is used as manure.

Vegetative propagation is an irreplaceable tool for tree domestication and breeding, and its advantages and implications have been widely treated in literature (Wright, 1976; Zobel and Talbert, 1984; Park et al., 1989). Although in forest research most of the efforts were traditionally focused on propagation of timber species, a scenario of rapid climate changes (IPCC 2008), with increasing land degradation and genetic diversity loss, makes it necessary to focus on species that are important for other functions, such as supply of non-timber products. Programmes involving indigenous species and impoverished communities have become important in the last decades (Leakey et al., 2005) and the development of low cost vegetative propagation technologies is one of its most relevant aspects (Tchoundjeu et al., 2004; Atangana et al., 2006). Despite the advances in tissue culture, for many conservation, domestication and breeding programmes, low cost macro-propagation methods continue to be the most convenient approaches even when human and financial resources are not scarce.

Though vegetative propagation is not a breeding method, but it is a way to rapidly multiply, disseminate the desired clonal material, according to its genetic potentials. In vegetative propagation, the genetic potential of a species, including the non-additive variance, is
automatically transferred to the new plant (Libby and Rauter, 1984; Chaperon, 1987; Puri and Khara, 1992). However, in nature the tree populations are highly heterozygous and the vegetative propagation helps to utilize maximum genetic gains in the shortest possible time. The success of vegetative propagation depends upon proper environment, the genetic components and the physiological status of cuttings, etc. (Brix and Barker, 1973; Foster et al., 1987; Cunningham, 2001).

Vegetative propagation is widely used to multiply elite plants selected from natural population and makes investment in forestry more attractive by improving yield and quality, shortening rotation age and allowing some of the biological problems hindering reforestation to be circumvented (Leakey et al., 1990; Arya et al., 1993). The role of vegetative propagation is also important in respect of species which do not produce fertile seeds or species like Diploknema butyracea in which the seeds remain viable only for a short period. Reproduction of this nature is also important where seeds have high economic value as in Cheura. Though there are several methods of vegetative propagation of trees, rooting of branch cuttings is the most convenient and cost effective method and, in many cases, it has already proved to be successful in mass multiplication of selected trees. Many economic crops, deciduous and evergreen fruits, ornamentals and vegetables are now being propagated by vegetative methods. The method is practised even for raising true-to-type plants for commercial exploitation. Many times, vegetative propagation is practised for rapid multiplication of plants. While it will take many years to get a mature plant from the seed, it can be grown to maturity from cutting in a much shorter time.

The ability of cuttings to regenerate varies with the plant species. While some regenerate easily, others regenerate with difficulty and still others do not regenerate at all and are thus, obstinate. The regeneration
through cuttings is affected by both internal and external factors. Thus, cuttings of some plant species regenerate throughout the year, while of others are seasonal in their ability to regenerate, spring or early summer and rainy season being more suitable for propagating plants from cuttings. Changes in light, temperature and humidity conditions also play a determinative role in propagation. Seasonal changes are also affected by micro-climate of particular area, which increase the chance of growth variation from one place to another. Many synthetic substances affect the regeneration of plants through cuttings. Auxins in general, promote rooting of branch cuttings. Their effectiveness, however, varies not only with the nature and concentration of the auxin and the plant species but also with season.

Variability studies provide the basic information required for genetic improvement of species under any agro-climatic situation. This can be exploited through research to increase yields in the future. Selection is an important tool in any tree improvement programme which determines the magnitude of genetic gain that can be obtained and it provides the basis for subsequent recurrent selections in succeeding generations.

Geographic variation exists in all plant species. The variability within a species occurs through many types of mutations and gene exchange among divergent genotypes over a long period of time. This forms the genetic base for geographical variation which gets established in the population over time through isolation. Sub-population of species, after geographical isolation from other populations, can result in genetic differentiation. Most widespread species appear to be composed of geographic lines of moderately distinct geographic ecotypes (Wright et al., 1958). Species improvement programme is a multi-step process and begins with the study of variation present in important economic
characters in the particular species. This range of species variation can be assessed for the selection of provenance. Advanced tree improvement programmes are also based on exploitation of the natural variations present in improvement trials of the species over a wide range of geographical areas, resulting from genotype-environment interactions. If a particular character is heritable, it will certainly attract the breeders. Variation can also be studied within a provenance for determination of superior individuals.

There is a huge scope for the improvement of *D. butyracea*. Study of genetic variation pattern in this species is important as there could be variation existing in oil content, growth and yield among different locations. Healthy and vigorous seedlings are necessary for good establishment and growth of trees. Differences in the propagation behaviour of different populations within a species have been reported by some workers (Cavers and Harper, 1966; McNaughton, 1966).

Having such a great economic and medicinal value, *D. butyracea* is facing threat as the exploitation levels have reached all time high, because of relentless anthropogenic pressure (Biswas et al., 2003). The species is failing to regenerate in spite of reasonable seed production. In recent years, there have been reports of large scale exploitation of *Diploknema butyracea* (Sundriyal, 1999). Therefore, in order to counteract the continuous degradation of this natural asset and augment the natural regeneration, special attention needs to be given for its propagation and conservation (Tewari and Dhar, 1997). Systematic propagation will go a long way in achieving the goal, it is desirable to apply simple methods of propagation which would be easy to perform in the field and are cost effective. Thus, vegetative propagation is a better option, as it ensures purity of clonal or true-to-type propagation of elite
tree. The present investigation was conducted on *Diploknema butyracea* with the following objectives:

1. To develop vegetative propagation technique for *D. butyracea*.

2. To study variation in rooting and growth behaviour of plants of different sources.

3. To evaluate the variation in oil content in natural populations of *D. butyracea*