CHAPTER - 1

INTRODUCTION

Afforestation criteria; Raising seedlings for afforestation and reclamation for inducing favorable micro-climate is influenced by exposure of the sapling under balanced nutrient filled potting media, partially encapsulated in appropriate container at nursery stage and during homologation process at the establishment stage in the main field on transplantation. Under intensive forestry management, sapling having fast-growing habit and well-fed with enriched nutrients, engineered through appropriate nursery and early establishment techniques, can encourage better as well as higher growth on transplantation in the main field from nursery. Successful tree planting activities hence depend on quality seedling production. Nursery therefore, occupies central stage in all plantation activities. Field performance, especially early period of establishment of the plant in the main field after transplantation from nursery is the second determinant towards success of raising a plant. These two are the important indices of performance of any plantation programme.

Regional perspective; The North East India including Assam is known for the vagaries of monsoon. Main field plantation is often to be delayed due to various unavoidable reasons. Standard method of nursery raising and early period of plant establishment in the main field can not be executed in orderly manner in vagaries prone North-East India. There is a need for evolving technique towards actual way of handling to solve problem of delayed planting, as nursery programme is often tuned locally without any systematic study to evolve techniques to synchronize delayed transplanting in the main field in North East India.

Growing stock of forest resource of the country as estimated by Forest Survey of India (2003) is about 0.83 million cum/Km². The forest cover of the seven North Eastern states (Plate-1.01) together comprises 17.70% of the total forest cover of India (6,78,333 Km²). The same in the state of Arunachal Pradesh accounts for 20.21% of total forests of the North Eastern Region (Plate-1.01) followed by
Assam (10.59%), Manipur (6.83%), Mizoram (6.55%), Meghalaya (3.72%), Nagaland (3.38%) and Tripura (2.47%). Major groups of forest types occurring in North Eastern region are northern tropical wet-evergreen forests, northern tropical semi-evergreen forests, tropical moist deciduous forests, tropical seasonal swamp forests, sub-tropical broad leaved hill forests, sub-tropical pine forests, northern montane wet temperate forests, Himalayan moist temperate forests, Himalayan dry temperate forests and sub-alpine forests (Champion and Seth, 1968) (Plate-1.02). The North Eastern region is characterized by conducive environmental conditions for luxuriant growth of vegetation. Different ethnic groups and nomadic tribes who are dependent on forests to a great extent practice their traditional shifting cultivation (*jhum*). The practice of shifting cultivation with long *Jhum* cycle can attain ecological perpetuity and would shun imbalances of vegetative cover. But this is not happening. Due to the pressure of increasing population, on limited land resources, the *Jhum* cycle has been continuously decreasing. Hence unless dedicated and consistent afforestation efforts are not made, it is difficult to compensate the rate and quantum of cumulative deforestation.

**National mandate:** The National Forest Policy, 1988 envisages bringing one-third of the geographic area of the country under forest/tree cover (agro-forestry, farm forestry, social forestry and other plantations) for maintaining ecological balance and environmental stability. The roadmap for Tenth Five Year Plan (2002-07) therefore, envisages increasing forest and tree cover to 25% by 2007 and 33% by 2012; to promote shelterbelt plantations to reduce adverse impact of natural calamities. The Forestry Research Priorities of India (NFRP 1998 : IRMDFR, 7-2000) has also focused for sustainable increment of bio-resources (Appendix-1.01).

The Ministry of Environment and Forests, Govt. of India, New Delhi has formulated and introduced a scheme titled “National Afforestation Programme (NAP) vide letter No. 35.1.1/2002–B–II dated 27.04.2001, to be implemented during Xth Plan period (2002-03 to 2006-07) through “Forest Development Agencies” (FDAs), to promote a decentralized approach to the development of degraded forests areas and adjoining lands of all Forest Division level in all the states of India for a period of five years (2002-03 to 2006-07).
Again, Govt. of India had created the Department of Wasteland Development during July, 1992 under the Ministry of Rural Development, which has been subsequently reorganised and renamed as Department of Land Resources, with a broader mandate to tackle the problem of degradation of lands, restoration of ecology and to meet the growing demands of fuel wood and fodder at the national level.

Further, the Ministry of Rural Development, Govt. of India has initiated Centrally Sponsored Scheme under “Hariyali Guidelines” from 1st April 2003, one project in each block throughout the country, for empowering the village community through Panchayati Raj Institutions (PRIs), to undertake the area development programmes on watershed basis with financial and technical support from the Government. Under Hariyali programme the Ministry has attempted all wastelands to bring under green cover with an objective of Restoring ecological balance by harnessing, conserving and developing natural resources i.e. land, water, vegetative cover especially plantations. The Funding Pattern and the present cost norm is Rs. 6000 per Hectare. Thus, fund and land resources for plantation avenues can’t be the constraints, while non-availability of short duration and cost effective nursery technology to commensurate the demand for plantable seedlings for common end users are the prevalent bottleneck.

**Gmelina arborea a wonder tree**; Gmelina arborea a moderate to large deciduous tree which occupies well with vigorous growth in most of the soils of North East is known for its timber, and is a substitute of teak in this region. It is often used as furniture, musical instruments, slate frames, Venetian-blinds, frames, artificial limbs, parts of looms and carts, bobbins, bridges, ship-building, plywood, match-industry and paper-making. Its leaf is considered a good fodder for cattle (crude protein 11.9%). Leaves are also used as a feed for Eri-silkworm. Its bark, root, leaf, flower, fruits have got various ethno-medicinal value. The species is recommended for skeletal soils in medium to high rainfall areas, also recommended for block-planting on hills, field boundaries, gullies and ravines, grassy blanks and for agro-forestry and social forestry. Intercropping of Gmelina arborea with food crops reported to increase nitrogen and phosphorus in soil.
Keeping all these in mind, rotation of native species *Gmelina arborea* in a period of 15 years is considered to hold key to rural economics of scale under afforestation programme because of its demonstrated fast growth and good form. Therefore, under the “Green India Programme” it is proposed to cover 43.0 million ha of plantation area over a period of ten years with *Gmelina arborea* as one of the target species. Thus, requirement of superior planting material of *Gmelina arborea* over the next ten years would be a massive of 1,07,500 million seedlings with an annual requirement of 10,750 million.

**Holistic quest ;** Currently, planters in North Eastern region of India are growing native species only. Due to poor substrates, plant growth in nursery is slow, extending to twelve odd months of two nursery seasons. As on date, the level of knowledge is inadequate in relation to planning out of nursery operations, especially when the span of nursery period is intended to be reduced from twelve months to three months to reduce the cost of operation without sacrificing the outcome and juvenility of the seedlings produced. Raising seedlings in a short span of three months instead of traditional twelve months is a challenging job for the forest managers, especially under delayed planting schedule.

Normally freshly harvested seeds of the desired species (*G. arborea*) are obtained in the month of May-June. As fresh seeds being the best, it is required to pass one full year extending the duration of nursery period up to next monsoon season to attain thumb size, ideal for root-shoot cutting (stump). On the other hand freshly harvested seeds generally require 10-21 days for germination. Thus a year-round cycle is required for raising the seedlings in the nursery under traditional management system. Alternately, if the seeds are allowed to be nurtured under intensive nutrient and environment package, there is a chance of transplanting the seedling during the fag end of the same monsoon season on being sown in the month of June-July, thereby restricting the span of nursery period for three or four months instead of traditional one year, apart from minimizing the cost of production in the mother bed during nursery period. As growth become sluggish during dry winter months, the intended package can also edge out one complete growing season. It is also expected to provide quality merchantable timber in higher numbers, as the percentage of crooked timber generally increases under stump planting due to
non-synchronized growth of ground-level lateral dormant bud after removal of active apical shoot.

**Nutrient efficacy**; Frequencies of plants suffering from malnutrition are widespread problems which forest manager has to tackle meticulously through appropriate nutrient management. The tropical soils have a low potential for holding nutrients and also low capacity for supplying nutrients through mineral weathering. These soils often have poor structure and are low in plant nutrients. Due to poor substrates, plant growth is slow, often extends to two nursery seasons, accelerating cost of nursery and inevitably reducing plant growth in the field, when the seedlings are planted on difficult sites devoid of rich soil and moisture and often in extremely inhospitable climatic conditions. Highly nourished quality seedlings can show substantial height growth in the first year of planting expressing their full genetic potential. They may capture the site quicker with improvement in micro-climate, thereby allowing fuller expression of site potential.

Again, under traditional open mother-bed condition, nutrients get lost due to sub-surface dispersion of the ground media. The production of seedling in closed or containerized growing media restricts the lateral movement of nutrients and often facilitates better availability of nutrients than seedling grown under open field condition. Plastic bags are obviously being the first option because they are inexpensive and readily available.

**Container variability**; Seedlings kept for long durations in polybags may suffer root coiling, as well as spiral growth of roots along the smooth sides and bottom of the bag. This root deformation can cause toppling or basal sweep several years after planting, thus greatly lowering the value of the plantation. (Mason 1985; Liegel and Venator 1987; Josiah and Jones 1992). The containment of root deformation and to produce developed well-planned root system in the nursery stage, suitability of root trainer for production of quality seedlings has been advocated from many quarters. Apart from long run cost effectiveness and ease of handling, instead of deformed root system either in the form of coiled tap root, bifurcated tap root, development of laterals like tap root etc., or one straight tap root, several bifurcated anchor roots going in different layers of the soil along with a good network of feeding roots as available in 150
cc root trainer is said to provide succor to plants under arid and semi-arid condition. But under humid condition as available in northeast India including Assam, such study was not available.

Also under dry condition, polytube, an alternative to root trainers, is said to be more than six times cheaper. On the other hand, comparatively large size polybags seedlings have been reported to produce prominent anchor and feeding roots under dry and semi-arid condition. Saxena (1997) had reported that biomass, penetration and spreading under large size poly bag system had marginal differences over root trainer seedlings.

**Potting media considerations**; Next to containers, growing media as a nursery parameter has been found to influence the production of quality planting materials. Potting mixture comprising soil : sand : compost in the proportion of 2:3:1 or 1:1:1 had been found to produce higher percentage of straight taproots as well as hairy roots. The incidence of root coiling could be avoided significantly. On the other hand, there are reports that under acidic soil condition, nursery soils are moderately low in available nitrogen, phosphorus and medium in exchangeable potassium. Nutrient application is required to supplement with optimum doses of nitrogen fertilizer to set the best of crop growth. Germination of *Gmelina arborea* was improved with higher dose of nitrogen treatment. Maximum growth was with higher dose of nitrogen and without any application of phosphorus and potash. Growth (height and girth) and biomass production were found to be greater with nitrogen and potash application. Organic manure was to be applied to improve the availability of inorganic nutrients besides supplementing.

**Cheaper and better criterion**; The criteria of cost effectiveness of seedling production in nursery have got direct relationship with the objectives involved in production and management process. Temporary or permanent nature of nursery, type and capacity of containers used, quantity of balanced potting media, organic and inorganic fertilizers etc. affect the cost effectiveness in the nursery. With judicious application of factors part/parts thereof can provide cost-effectiveness without exerting undue stress to growth vectors.

Adoption of package of practices depends on user friendly, time and cost effective, handy, less cumbersome, productive and sustainable technologies.
Expensive sophistication in technology though apparently productive, may not get wider acceptability among common users; so far as the rural and suburban forestry planters are concerned. The parameters of nursery technology, if could be standardised, can be passed on to the forest service trainees, forest officers of seven northeastern states, NGO’s, farmers, periodically visiting the RFRI nursery.

**Performance validation**; to satisfy quest on field performance of plants, especially at the initial years in the main field after transplantation, another area of concern to investigate the minimum possible time in nursery stage for optimum growth performance of plants, raised from aforesaid selected standardised nursery technology, under the impact of seasonal variation of climate as well as ascertaining the cost effectivity with respect to higher biological and economic productivity.

**Objectives of investigation**; Considering the above scenario, investigation titled “Standardisation of cost effective Nursery technique with N, P, K and other parameters of Gmelina arborea Linn.” was carried out to ensure production of quality-planting material of *Gmelina arborea* through economic and short duration nursery techniques that can meet the enormous requirement of seedlings under “Green India Programme” with the following objectives:

1. To determine the optimum doses of nitrogen, phosphorus and potassium on growth and vigour of *Gmelina arborea* seedlings.
2. To identify ideal potting media and seedling container for the production of healthy planting stock.
3. To obtain healthy, vigorous, transplantable planting stock within a minimum possible time.
4. To minimize cost of production of plantable seedlings.
5. To transfer the developed nursery package and practices.
Plates: Projection of Forest resources of North Eastern region.

Plate-1.01: Forest cover of Northeast region of India (Source: FSI-2003).

Plate-1.02: Forest types of North East region of India (Champion and Seth 1968).