Teak Plantation:-

Plantation management

A suitable land with good soil and rainfall of > 1200 mm ma y be selected for raising teak plantation. The land should be ploughed thoroughly and prepare pits ( 45 x 45 x 45 cm) in 2 x 2 m or 3 x 3 m or 3 x 4 m spacing before rainy season. Farm yard manure with soil mixture has to be prepared and filled in the pits. Seedlings are planted in the pits during rainy season. For stump planting crowbar may be used and pitting is not required. In the initial stage the plants have to be watered weekly, and regular weeding and pruning have to be done. The branches have to be removed periodically without affecting the main stem. Drip irrigation is beneficial in farm lands. Irrigation reduce the rotation period and also enhance the productivity. Application of 50 g of urea and 30 g of super phosphate after six months and 75 g of urea and 60 g of super phosphate after 24 months of planting increases the growth rates. The fertilizers are effective for enhancement of growth in young teak trees than mature trees. Thinning (removing alternate rows) is done 5 years and 10 years after planting in plantation raised with closer spacing (2 x 2m). Mechanical thinning is also needed. The interval of thinning cycle is at age of 5, 10, 15, 20 and 30 for 60 year rotation, in Kerala. Teak can also be planted in bunds in south and north direction in such way the agricultural crops get sufficient light. It was found that there was no significant variation in wood properties of young (25 to 30 years old) and mature teak (50 to 60 years old). Therefore teak plantation raised with good quality planting material or clones in good soil with limited irrigation and dry period with silivicultural practices can be harvested within 20 to 25 years. In Brazil and Malaysia teak is harvested at the age of 15 to 20 years. The teak growing in the canal areas in Thanjavur and Tiruvarur (Tamil Nadu) showed fast growth with good girth (> 150 cm) within 20 years and canal teak is harvested at the age of 30 years.

Agroforestry practices

Teak is one of the favoured silvicultural species by the farmers. It is planted in different models, combinations as well as in different spacements. IFGTB has developed agroforestry models like, Agri-silvicultural models (Teak + casuarinas with agricultural crops maize, cotton, turmeric, tomato and chilly), Agri-silvi-horticulture model (Teak + coconut with agricultural crops plantain, turmeric, vegetables, maize and cotton) and Silvi-horticulture model (Teak-Gauva, Annona) (George, 2000). Under irrigated lands, silvipasture model was developed with Teak and Casuarina as tree component and Napier and Guinea as pasture components.

Yield

The average productivity of teak in Nilambur teak plantations was 2.85 m3 ha-1 year-1 in 53 years rotation period. In Indonesia the MAI at the harvest age (40 to 90 years) was 2.91 m3 ha -1 year-1 (FAO, 1986). The productivity in moist semi deciduous forest in Ghana was 8-10 m3 ha- 1 year-1 (Oteng-Amoako and Sarfo, 2005) while in Central America it was 8 to 12 m3 ha -1year -1(Arias, 2005). Recent studies conducted on teak growing in farmlands with irrigation, fertilizer application and management revealed the possibility of reducing the rotation period to 25 years with increase in productivity. The trees grow in farm lands grow f aster and produce more biomass when compared to plantations in the forest areas. The quality of teak timber in farmland at 12 years was found to be similar to that of 20 years in forest land.

Important insect pest and diseases

Teak defoliator, *Hyblaea puera* and leaf skeletonizer , *Eutectona machaeralis*are considered to be the major pests in teak. These insects are known to occur on seedlings in nurseries and also in grown up trees in plantations. *H. puera*feeds on tender foliages during the early part of the growth season and *E. machaeralis* feeds on older foliage towards the end of the season. Making regular pest surveillance in nurseries and young plantations, particularly during rainy season when there is a new flush formation to detect the occurrence of the pest and removal and destruction of larvae if the population is less. If the pest attack is severe it can be controlled by spraying of the foliage with the chemicals like monocrotophos or endosulfan 0.05-0.075% or neem based formulations (Neemazal 1%) at 10-12 days intervals can give good control. A virus (NPV) based formulation (biocide) is also available for management of the defoliator *H. puera*.

Uses

It has been extensively used for decking, deck houses, rails, bulwarks, hatches, weather doors and planking. The traders and timber users recognized several varieties of teak suitable for different end uses. The huge teak trees from Western Ghats region (high rainfall range) are used for structural needs like ship and boat building, construction and bridge building. Teak from Central Indian region is known for colour, texture and grains preferred for furniture and aesthetic needs. Teak wood of Godavari valley in Andhra Pradesh is used for furniture and cabinet making for its ornamental figuring. Teak wood markets and depots are available in all teak growing states in India.

Planting  
With the pre-monsoon showers, stump planting is done in crowbar holes during April-May (four to six weeks before the onset of regular monsoons). The site must be cleared of stubble or other competing vegetation, if any. If containerized planting stock (polybags, root trainer) is used, then optimal time of planting may be after the onset of southwest monsoon in June-July. They are usually planted in pits of size 30 cm x 30 cm x 30 cm. Spacing recommended for monospecific woodlot is 2 m x 2 m. However, if intercrops are proposed to be raised, then row-to-row distance can be altered. For one or two row strip plantings at farm boundaries, a closer plant-to-plant spacing of 1 m could be employed.  
  
Weeding and fertilization  
Six or seven weeding may be necessary during the first two years. Teak is very susceptible to weed competition. Fertilizers may be applied @ 30-40 g N, 15-20 g P2O5 and 15-20 g K2O per plant per year from the second year to the fifth year and thereafter once in three to four years for 10-12 years. In agroforestry situations, if the intercrops are fertilized, the quantities of chemical fertilizers applied to teak can be proportionately reduced or even skipped. Providing life-saving irrigation during the summer season favours teak growth.  
  
Thinning  
For a fifty-year rotation, monospecific teak plantation on a good site (initial spacing 2 m x 2 m), thinning may be carried out at 4, 8, 12, 18, 26 and 36 years after planting. Thinning in short rotation (25-30 years) high input plantations can be at 4, 8, 12 and 16 years. The thumb rule governing thinning is that trees should not be allowed to compete with each other for site resources, as intense competition may depress teak growth. Therefore, considering the site characteristics, tree growth rate and merchantability of the thinned out materials, a flexible thinning schedule can be adopted. A teak density management diagram can be used for this purpose. In general thinning is delayed on poor sites.  
  
Mixed plantations  
Fruit/spice/medicinal trees also can be successfully intercropped with teak throughout its growth. Additionally, inclusion of nitrogen fixing trees such as Gliricidia or Leucaena (subabul) either in alternate rows or every third row not only improves teak growth but also saves chemical nitrogenous fertilizers. However, manage (by lopping or pruning) the nitrogen fixing tree component in such a way that it does not compete with teak for light.  
  
Pests, diseases and their control  
White grubs feed on roots in the nursery. Apply phorate 10 G or carbofuran 3G @ two teaspoon full mixed with fine sand. Vascular wilt disease (Burkholderia solanacearum) is noticed in nursery and young plantations. As preventive measures against this disease, maintain proper drainage and avoid root injury. Leaf spot disease (Phomopsis sp. and Colletotrichum gloeosporioides) in nursery and young plantations can be controlled by mancozeb 0.05% or carbendazim 0.05% application. Against pink disease (Corticium salmonicolor) in young plants, apply Bordeaux paste.  
  
Defoliators (Hyblaea purea) and skeletonisers (Eutectona machaeralis) can be controlled by quinalphos 25 EC 0.05% spray. However, only in small plantations / woodlots chemical control through insecticide spray is advocated. For controlling stem borer (Sahyadrassus malabaricus) apply 0.2% quinalphos at the site of infection after removing the frass. Avoid injury to root and collar to prevent bud rot and heart rot occurrence. Cut and remove the parasitic plants (Dendrophthoe falcata var. pubescens) before fruiting.

Teak can be planted at 2m x 2m, 2.5m x 2.5m or 3m x 3m espacement. It can also be raised along with agricultural crops at a spacing of 4m x 4m or 5m x 1m.  
• Plough lands thoroughly and level it of. Mark the areas for pit digging by alignment and staking.  
• Dig pits of 35 x 35 x 35 cm sizes. Refill the soil after seasoning and mixing with Farm Yard Manure and insecticides. On poor gravely sites, replace the pit soil by good soil.  
• Use pre sprouted stumps for planting.  
• Best planting season is frm feb – sep or in winter.  
• Firm up the soil after planting and apply irrigation wherever necessary.  
• Apply 50 g of fertiliser in pit at the time of planting and thereafter in split doses or as per the fertility status of soil.  
• Carry out weeding operations regularly. Weeding may be carried out @ 3 operations in the first year, 2 operations in second year and one operation in the third year.  
• Carry out soil working periodically for better growth of plants. One working in the Ist year and two workings in 2nd and 3rd year may be adequate.  
• Debudding in the initial years may be done to improve the quality of timber.  
• Undertake prophylactic and control measures for protection of plants from insects/pests and diseases to ensure good health of the crop.  
Irrigation:  
Study has revealed that, irrigation during stress period boosts the growth of the plants. Irrigation should be followed by weeding (3,2,1) and adequate soil working. Two doses of fertiliser (in the month of August & September) @ 50 gm per plant of NPK (15:15:15) may be provided every year upto two years. By increasing the inputs of irrigation and frequent thinning, it is possible to increase the rate of diameter growth. The increase in diameter growth is, however, dependent on increasing the size of the crown i.e.. decrease in the number of trees per acre. In other words, one can have either lesser no. of trees of higher girth or larger number of trees of lower girth. It has been observed that teak trees grown under irrigated condition grew faster but the sapwood content of trees increased, the wood became weak and wind damage became quite serious. A phenomenon of water blisters may also develop in teak trees grown under irrigated conditions.  
Many people claim that, teak grown with fertiliser and irrigation give excellent result. Drip irrigation will induce surface roots and epicormic branching. Nitrogen fertilisers will increase the nitrogen content of leaves. Initially larger leaves will increase photosynthesis and faster growth.  
Harvesting, yield  
The highest growth under plantation condition in India was seen in the Indo-Gangetic belt of Haldwani Division  
Insects, Pest and Diseases :  
Teak defoliator & skeletoniser (Hyblaea puera and Eutectona machaeralis) cause extensive damage to young plantations. Root rot due to Polyporous zonalis is also common in plantation. Pink disease fungus causes cankers and bark flaking. Powdery mildew caused by Olivea tectonae & Uncinula tectonae leads to premature defoliation. It is thus necessary to undertake prophylactic and control measures to ensure good health of the crops. This method is of immense importance in the insect, pest control considering its harmless and pollution free implications on the environment further avoiding the operational and residual hazards that involve in the use of organic and inorganic insecticides  
Irrigation:  
irrigation during stress period boosts the growth of the plants. Irrigation should be followed by weeding (3,2,1) and adequate soil working. Two doses of fertiliser (in the month of August & September) @ 50 gm per plant of NPK (15:15:15) may be provided every year upto three years. By increasing the inputs of irrigation and frequent thinning, it is possible to increase the rate of diameter growth. The increase in diameter growth is, however, dependent on increasing the size of the crown i.e.. decrease in the number of trees per acre. In other words, one can have either lesser no. of trees of higher girth or larger number of trees of lower girth. It has been observed that teak trees grown under irrigated condition grew faster. A phenomenon of water blisters may also develop in teak trees grown under irrigated conditions. Such trees may appear quite healthy from outside but the inner heartwood may develop rot due to storage of excess water that increases the spread of fungi which may further damage the tree.  
Many people claim that, teak grown with fertiliser and irrigation give excellent result. Drip irrigation will induce surface roots and epicormic branching. Nitrogen fertilisers will increase the nitrogen content of leaves.. The control through insecticides is not, therefore, possible. Once the trees are established they generally donot respond significantly to irrigation and fertilisers.