

## Neem - A Versatile Tree



### Introduction

Neem (*Azadirachta indica*) belonging to meliaceae family is one of the most suitable and valuable tree species found in India. It can grow on wide range of soils upto  $pH 10$  which makes it one of the most versatile and important trees in Indian sub-continent. Due to its multifarious uses, it has been cultivated by Indian farmers since vedic period and it has now become part of Indian culture. In India, it occurs throughout the country and can grow well in every agro-climatic zones except in high and cold regions and dam sites. In fact in India, *Neem* trees are often found growing scattered in the farmers fields and on the boundaries of fields without affecting the crops. Farmers practice this system just to meet the local demand for timber, fodder, fuelwood and also for various medicinal properties. Due to its deep tap root system, it does not compete with annual crops for scarce soil moisture. *Neem* tree can be labelled as wonder tree for its multipurpose uses in real sense. This has been used as a medicinal plant for long time and provides almost all the requirements of rural areas - be the *timber, fuelwood, fodder, oil, fertilizers, pest repellent or the ubiquitous 'datun'*.

Today, it has been recognised as the most potential tree of India due to its evergreen nature (deciduous in drier areas) and ability to grow in even the most arid and nutrient deficient soils as well as for its many commercially exploitable by-products and environmentally beneficial characteristics (it has therefore been labelled as tree of the future). If plantation of this tree has to be taken up on large scale, it has to be integrated as an important component of agriculture under various agro-forestry systems. It has been estimated that India's *Neem* bear about 3.5 million tonnes of Kernels every year. From this about 7 lakh tonnes of oil might be recovered.

The annual production in the late 1980's was only around 1.5 lakhs tonnes.

To increase the amount of oil harvesting, *Khadi and Village Industries Commission* (KVIC) has pioneered various aspects of processing the fruit and seeds of neems over the past two decades. The major difficulty as observed in most of the tree borne oil seeds including neem is that neem fruits must be harvested during the wet season. Without locally available drying facilities the fruit and seeds rapidly deteriorate and become contaminated with aflatoxin. Ideally, the fruits should be depulped without delay and the seeds have to be thoroughly dried. KVIC has popularised simple methods for depulping, drying and decorticating neem products even in the rearmost villages of the country. The sales and turnover of neem seeds in India has been estimated by various agencies. Based on random survey at major neem seeds market by independent agencies the quantity of neem seed sold during 1996 was 5.5 lakh tonnes with turnover of Rs.137 crores.

## **2.Distribution**

It is grown from the southern tip of Kerala to the Himalayan hills in the tropical to sub tropical and semi arid to wet tropical regions and from the sea level to about 700 m elevation. It has been widely cultivated in India and African countries. In India, it occurs throughout the larger parts of the country in the states of *Uttar Pradesh, Bihar, West Bengal, Orissa, Delhi, Maharashtra, Gujarat, Andhra Pradesh, Tamil Nadu*. The tree is mostly evergreen except in dry localities where it becomes almost leafless for a short period during February - March and the new leaf appears immediately. Flowering spread over January - March in the southern parts of the country and later towards the north. *Neem* is a light demander and in the young stage it grows very fast. It is hardy but frost susceptible and cannot withstand excessive cold especially during seedling and sapling stage. In the international and national provenance trials raised by Arid Forest Research Institute, Jodhpur it was observed that all neem trees had branches near the base because of frost damage. It coppices well and produces root suckers and withstands pollarding well.

## **3.Description of plant**

A large evergreen tree, 12 to 18 meter in height and 1.8 to 2.4 meter in girth with a straight bole and long spreading branches forming a broad crown as much as 20 metres across, commonly found throughout greater parts of India. Bark Grey or dark reddish brown with numerous and scattered tubercles. The bark exudes a gum known as East India gum. Leaves alternate 20 - 30 cm long, leaflets 8 - 19 alternate or opposite ovate glossy, bluntly serrate. Flowers : white or pale yellow, small, scented, numerous on long axillary panicles, have a honey like scent and attract many bees. Fruit : Fruit is a ovoid bluntly pointed, smooth drupe green when young and turns yellow with a very thin epicarp, mesocarp with scanty pulp and a hard bony endocarp, enclosing one seed. The timber is relatively heavy with a specific gravity varying from 0.56 to 0.85 (average 0.68) when freshly cut, it has a strong smell. The flowering season of neem varies from place to place. Generally it flowers from January to May and the ripening time of fruits is from May to August. The fruit pulp is edible.

#### **4. Uses**

Neem extracts are used as insecticides, pesticides and fungicides. Neem oil has antibacterial, antiviral properties and used in skin and dental problems. *Neem* products are being used for malaria, fever, pain and also as contraceptive. Neem is also being used in cosmetics, lubricants and fertilisers. Neem bark is used in villages for rope making. Neem oil is used in soap manufacture.

#### **5. Agro-climatic Requirements**

It generally performs well on areas with annual rainfall varying from 400 - 1200 mm. It thrives under the hottest conditions where maximum day temperature reaches 50 degree Celsius. But it cannot withstand freezing or extended cold.

##### **5.1 Soil**

*Neem* grows on almost all kinds of soils including clayey, saline and alkaline soils but does well on black cotton soils. It thrives better than most other trees on dry stony saline soils with a waterless sub-soil or in places where there is a hard calcareous or clay pan near the surface. It does not tolerate inundation. It has a unique property of calcium mining which changes the acidic soil into neutral. *Neem* also grows well on some acidic soil. It is said that the fallen neem leaves which are slightly alkaline are good for neutralising acidity in the soil.

##### **5.2 Nursery Practices**

*Nursery Site :*

Nursery could be either a temporary or permanent one. Site in either case should have a perennial water source and located on a flat ground with well drained soil. On a hilly site, a moderate slope preferably on the northern aspect has to be chosen.

##### **5.3 Seed collection and storage**

Only fruits at the yellow green colour stage are pricked from the branches. The collected fruits are depulped immediately. Soaking in cold water for a few hours helps in removing pulp. Storing neem seed for 5 months at 40% natural moisture content at 16 degree centigrade is possible. For short storage the seeds are closed in polythene bags and exposed to air once in a week to keep them viable. Long term storage of *Neem* seeds for more than 10 years is done at 4% moisture content and -20 degree Centigrade temperature. Storage of seed in earthen pot containing wet sand (30% moisture) helps to retain viability upto 60% at the end of 3 months. On an average 5000 seeds weigh one kilogram.

##### **5.4 Sowing of Seeds**

Germination rate of *Neem* varies between 15% (stored seeds) and 85% (fresh seeds). Hence, to ensure higher viability of the seeds, their immediate sowing in nursery is recommended. Pre-soaking the seed for 24 hours in cold water and removal of the endocarp or cutting of the seed coat at the round end with a sharp knife also increase its germination capacity. Sowing of seeds

in nursery beds made up of fine river sand is done in drills 15 c/m apart. Seeds are sown 2.5 cms deep at distance of 2 to 5 cms in the lines and lightly covered with earth to safeguard against birds and insects which often eat radicles of the germinated seeds on the surface. The beds are sparingly watered to prevent caking. Alternatively seeds can be sown directly into pots. Germination occurs in 1/2 weeks time. Once the hypocotyl is erect the seedling is transplanted into the containers. Seeds are sown 3 / 4 months before planting date. Potting mix comprises of 50% sandy loam, 40% river sand and 10% compost by volume.

### **5.5 Pricking**

Seedlings are pricked out at 15 cms x 15 cms when about 2 months old. They do not require any shade. Soil working and weeding are very beneficial. In frosty localities plants are protected by means of screen. When the seedlings are 7 to 10 cm tall with tap root about 15 cm long, these are transplanted with balls of earth around them. In dry areas, it is necessary to plant larger seedlings of at least 45 cm height since smaller ones are unable to tide over the drought period. This is the reason why seedlings are kept in the nursery beds for another year before planting in the next range.

### **5.6 Planting Techniques**

*Neem* can be easily raised through direct sowing, entire / polypot seedlings or root-shoot cuttings. For degraded areas direct sowing is more successful. Entire / polypot seedlings or root-shoot cuttings are more relevant for agro-forestry / silvi pasture and road side avenue plantations. Direct sowing is done either by dibbling in bushes, broadcast sowing, line sowing, sowing on mounds or ridges, sowing in trenches in sunken beds in circular saucers or by aerial sowing. The choice varies with edaphic, climatic, biotic and economic conditions of the site. Planting in pits is carried out by using 20 to 45 cms tall seedlings. Taller ones promise better survival. Planting of stumps prepared from a year old seedlings in crowbar holes also gives good results.

#### **5.6.1 Entire / polypot planting**

Seedlings which have attained 20-25 cm height by the beginning of the rainy season are planted out in pits of 30 cu. cm at a spacing of 3x3 mtrs. or any other spacing depending on the purpose of plantation. Pruning of leaves except at the tip and roots has been proved successful in Nagpur district of Maharashtra. In Tamilnadu, plants of 45 cm height are used for this purpose, since smaller plants are found incapable of bearing the stress of drought period. Planting is, however, done during the rainy season.

#### **5.6.2 Planting Root-shoot cuttings**

The stumps are prepared from 12-13 months old seedlings, keeping 2.5 cm of shoot portion and 23 cm of root and are planted in crow bar holes at the break of rains. In Tamilnadu stumps from two years old plants have given higher survival and better height growth than one year old root

stock. 53% success from root-shoot cuttings has been reported from Maharashtra. The success of root-shoot cuttings depends upon rains, prolonged drought may affect survival to a great extent.

### **5.7 Farm forestry plantations**

For raising a block plantation under farm forestry a closer spacing of 5m x 5m accommodating 400 trees per ha may be followed. This may vary from field to field and also depending upon the objective. The wider spacing of 7m x 7m accommodating about 200 trees per hectare may be on the broader side where Agro-forestry can also be practised.

### **5.8 Viable unit for small farmers**

At least 100 trees should be raised by the farmers interested to avail of micro credit. For this about 1 acre land is required.

### **5.9 Care of Young Plantation**

Strip weeding of young plantations has a positive effect on health and survival. Two weedings are sufficient in the first year and one weeding during the second year. First mechanical thinning in the case of transplanted seedlings is done at the age of 5 years. In arid region *Neem* planted along the canals are watered for the first 5-7 years.

### **5.10 Plantation Growth**

The rate of growth of *Neem* in plantation varies with the quality of soil. It is fairly rapid upto the age of 5 years after which it slows down. The plant attains a height of 4 m at 5 years and 10 m at 25 years. The mean annual girth increment is 2.3-3.0 cm. More rapid growth is attained under favourable conditions. In Karnataka naturally grown *Neem* trees of 10 years age give an average height of 6.58 m and girth of 68.1 cm. In alkaline soils of U.P., *Neem* attains an average height of 170 cm at the end of first season and 264 cm at second season. Seven month old root suckers give the average height of 65.7 cm. Because of its international importance, there have been many provenance trials at several places. In 1993, the first international consultation on *Neem* was held in Bangkok where a panel was formed to aid and co-ordinate the work for genetic improvement of *Neem*.

At Arid Forest Research Institute, Jodhpur in 1992 a provenance trial of the Indian Provenances of *Neem* was established in the experimental fields. The provenance trial was supported with additional investigations like the seed characteristics and storage priorities of *Neem* seed. The trial which is established very well at Jodhpur, consists of 40 provenance representing 10 states of India wherein effort has been made to successfully represent other agro-climatic zones of India. Preliminary results on the trials have indicated that there is immense variation and hence, scope of selection and breeding for genetic improvement of *Neem*. The Institute hopes to utilise both sexual and asexual methods of selective propagation.

### 5.11 Plant Protection

Pests & Diseases: Tip borer (*Laspeyresia koenigiana*), Tea mosquito bug (*Heliopeltis antonii*) affect seedlings and young plants. *Pulvinaria maxima* is a scale insect now regarded as key pest & *Heliothrips haemorrhoidalis* a potential pest of *neem*. *Neem* seedlings get severely affected by damping off *Rhizoctonia* leaf web blight, leaf spot & blights induced by *Colletotrichum*, *Alternaria* & *Pseudocercospora*.

### 5.12 Environment

Considering the versatile nature, uses & growing global importance of *neem* the United Nations declared it as the "Tree of the twenty first century". Its large scale production promises to help alleviate several global environmental problems :*deforestation, desertification, soil erosion* & perhaps even global warming (If planted on a truly large scale). Its extensive, deep root seems to be remarkably effective at extracting nutrients from poor soils. Large scale *neem* plantations can help in rehabilitation of degraded forest lands & vast tracts of wastelands & greening the environment.

### 5.13 Neem in Agro-forestry

The tree component in the agro-forestry systems is preferred to be of local use, easily marketable with good economic value. Although *Neem* is not considered as the best tree species under agro-forestry systems nevertheless, in many parts of India it has been found to be suitable as agro-forestry species. In semi-arid conditions at Indian Grassland and Fodder Research Institute, Jhansi, *Neem* along with other tree species increased the productivity of a silvicultural system upto 8.5 tonne / hectare. It has been reported that the fodder production can be increased from 0.5 to 3.6 tonne / hectare in arid zone of Thar Desert by growing suitable grasses and legumes along with *Neem* and several other tree species.

### 5.14 Neem as a Timber Tree

*Neem* is a large ever green tree 15 to 20 M. high with semi-straight and straight trunk 30 to 80 cm in diameter and spreading branches forming a broad crown. It has a long life of 100 years. *Neem* tree has several economic advantages over other multi-purpose tree species grown in India. Although the main use of the tree is for production of seeds for extracting oil, the tree can be harvested for timber after 35 to 40 years of planting. The sap wood of *Neem* is greyish white and heart wood is red to reddish brown resembling *Mahogany*. The wood is aromatic moderately heavy with uneven grains, durable and not easily attacked by insects. Timber is medium refractory and seasons well even when sawn wet. It is easy to work with the timber but does not take good polish. Wood is used for building houses, as posts, beams, door / window frames, furniture, carts, axles, yokes, ship and boat building, helms & oars, oil mills, cigar boxes, carved images, toys and agricultural implements.

### **5.15 Harvesting, Yield & Returns**

*Neem* starts bearing fruits after 5 years and comes to full bearing at the age of 10-12 years. Fruit yield is 5-20 kg per tree per year in the initial years. A mature tree produces 35-50 kg fruit/year. Oil yield varies from 40-43% of seed on dry weight basis. Highest oil content has been reported from Banswara region of Rajasthan (43.2%), while the lowest oil yield of 32.4% has been reported from Jaisalmer region. It has been observed that as rainfall in an area increases oil content also increases. Among the International provenances tested, Bangladesh provenance has yielded maximum oil content (48.6%).

However we presume a conservative yield of 5,6,10,15, 20 kg/tree respectively from 5th year onwards. Yield generally stabilises from 9th year. Sale price of the seed may be considered @ Rs.5/kg. Irrigating the young stock, keeping the field clear from competing weeds & soil loosening have been reported to produce good results in neem. *Neem* seed price is projected to be Rs.10000 / ton in the near future. So, it is high time to exploit the potential of this hitherto neglected tree & to manage neem for higher economic returns to farmers. It has been estimated that 10 yr old tree can yield a timber of 5-6 c.ft / tree.

### **6. Export Potential**

Among the forest produce, *Neem* is perhaps the only tree that has potential of producing several items that can be exported, besides of course few medicinal plants obtained from forest. That is why many developed countries like *USA, Japan, Germany, France and Netherlands* which do not possess much *Neem* wealth have developed research laboratories exclusively for *Neem*. On the contrary, India has a very high resources of *Neem* wealth with millions of trees scattered throughout the country but we are yet to start *Neem* research systematically except that some sporadic research are being carried out in several laboratories.

Main active principle of *Neem* is Azadirachtin which is obtained from open column chromatography or pressure liquid chromatography. Maximum yield from *Neem* seeds is 3 gm. Azadirachtin per kg of *Neem* seeds. *Neem* is advocated to be a potential export item, yet not much attention has been paid to the tree for its improvement specially on per kg. yield of Azadirachtin and other components. In India, *Neem* cultivation is still in its infancy. Few plantations have been raised here and there. Whatever *Neem* seeds are available; those are collected from individual trees through unorganised sector. Hence, it is highly advocated that government organisations like *ICFRE, ICAR, Agricultural Universities and NGOs* must come forward to undertake coordinated research on all aspects of the tree and its products to reap the benefits from huge export market.

### **7. Economics of cultivation**

The cost of cultivation will depend upon the extent of the area to be planted. The cost of cultivation for one hectare at spacing of 5m x 5m i.e. 400 plants/ha has been worked out at Rs. 20700 / ha which is given in **Annexure – I**. The yield and income from *Neem* cultivation are given in **Annexure – II** along with techno-economic parameters.

## **8. Financial Analysis**

The financial analysis with the above parameters of the investment cost and techno-economic parameters, the IRR works out to 30.48 % which is given in **Annexure - III**.

## **9. Lending Terms and Conditions**

### **9.1 Margin Money**

NABARD stipulates beneficiaries' contribution to the project cost in order to ensure his stake in the involvement. Such margin money varies from 5% to 25% depending upon the type of investment and the class of borrowers. In the current model project margin money of 10 % has been considered.

### **9.2. Interest Rate**

The rate of interest to the ultimate borrowers will be decided by the financing banks which are subjected to revise by RBI / NABARD from time to time. In the present scheme, we have considered interest rate of 12 % per annum.

### **9.3. Repayment of Loan**

The loan would be repaid in an annual graded instalments with a moratorium / grace period of 5 years. The entire loan amount with interest can be repaid in 10years from planting. The repayment schedule has been worked out and given in **Annexure IV**.

[Neem Annexure](#)