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From the Director's Desk

Trees have always played a pivotal role in securing livelihoods of the people. This issue highlights one such tree species, neem, which is a common household name. The issue also highlights the need for integrating trees in agricultural fields to enhance organic carbon through a case study. The IFGTB ENVIS *Van Vigyan* aims to increase awareness among its readers about different forest tree species. We believe that this will enable their active participation in conservation of these valuable genetic resources. We seek your comments and feedback to help us in our endeavour.

R.S. Prashanth
Director

Know Your Trees - *Neem*

Distribution and Habitat

Azadirachta is a genus that comprises of two tree species namely *A. indica* and *A. excelsa* belonging to the family Meliaceae. Though both the species are native to the Indomalaysian region, *A. indica* is also widely cultivated and naturalized outside its native range. The species *Azadirachta excelsa* (Jack) Jacobs is confined to Philippines, Sumatra, Borneo, Malaysia and Papua New

Guinea. On the other hand, *Azadirachta indica* A. Juss. occurs throught the Indian sub-continent and Southeast Asia. *A. indica* is an ideal multipurpose tree species, popular among the farmers in India because of its multifarious uses. The tree exhibits different patterns of variation because of its wide distribution and adaptation to different climatic conditions. The chromosome number of *A.indica* has been reported as 2n= 28 (Deshmukh, 1959). Well known by its common name, Neem, it occurs widely in India, Pakistan, Nepal, Sri Lanka, Bangladesh and Myanmar, and it is also found in Laos and Vietnam. It is believed that during the reign of Asoka in the third century B.C., extensive roadside plantings were carried out with neem to provide shade for travellers. Through the Buddhist missionaries he despatched it to neighbouring countries. Neem grows well in Southern Peninsular India. Dispersal of seeds, mostly by birds, has resulted in establishment of neem trees in the farmsteads as a semi-domesticated species.

The species is adapted to dry and harsh sites. It is used since time immemorial, in the Indian system of medicine to cure many ailments. It provides a range of valuable products and services including wood, medicines, natural pesticides, shade and protection from wind. Neem has attained global importance because of azadirachtin, a chemical present in the seed, effective in controlling more than 200 insect pests (National Research Council, 1992).

Botanical description

- Kingdom: Plantae
- Division: Magnoliophyta
- Class: Magnoliopsida
- Order: Sapindales
- Family: Meliaceae,
- Genus: *Azadirachta*
- Species: *indica*
- Scientific/Botanical Name: *Azadirachta indica*

Azadirachta indica is a small to medium-sized tree, that grows up to 15-30 m tall with a dense, round, large crown up to 10-20 m in diameter; branches spreading; bark moderately thick, with small, scattered tubercles, deeply fissured and flaking in old trees, dark grey outside and reddish inside, with colourless, sticky foetid sap. Leaves alternate, crowded near the end of branches, simply pinnate, 20- 40 cm long, exstipulate, light green, with 2 pairs of glands at the base, otherwise glabrous; petiole 2-7 cm long, subglabrous; rachis channelled above; leaflets 8-19, very short petioluled, alternate proximally and more or less opposite distally, ovate to lanceolate, sometimes falcate 3.5-10 x 1.2-4 cm, glossy, serrate; apex acuminate; base unequal. Inflorescence an axillary, many-flowered thyrsus, up to 30 cm long; bracts minute and caducous; flowers bisexual or male on same tree, actinomorphic, small, pentamerous, white or pale yellow, slightly sweet scented; calyx lobes imbricate, broadly ovate and thin, puberulous inside; petals free, imbricate, spathulate, spreading, ciliolate inside.

Phenology of flowering and fruiting

Neem plants flower normally in the month of March/April. Each panicle has 12-15 small branches and a total of at least 100 flowers. The flowers are frequented by bees, flies, ants, butterflies and thrips. Each flower possesses 5 sepals, 5 petals and 10 stamens. The anthers are placed on the inner side of staminal tube towards apex close to stigma. Anthers dehisce vertically towards inside and release pollen grains. The anthesis time is 4 pm to 6 pm (Dayanandan *et al.,* 1993). After pollination, the petals curve back and the staminal tube turn brown. Ovary is tricarpellary with 2-ovules in each carpel; usually only one develops into seed.

The fruits will be ready for harvesting by the end of June and July and in some places they will be available till August. The fruit is a fleshy drupe, yellow when ripe. The fruit wall is three layered - outer thin epicarp, middle fleshy mesocarp and inner fibrous endocarp. The endocarp contains usually a single seed within. After processing, the endocarp with seeds in it is sown. This endocarp with seeds is generally termed as "stone".

A matured fruiting branch

Leaf flushing	-	February-March
Flowering	-	March-May
Fruiting	-	June-August

Though normal flowering in neem is during March-May, there are some genotypes which come into flower in September. These trees are intermixed with normal flowering populations. The trees produce fruits in the month of December, as a consequence of self pollination which is inevitable (Shanthi *et al,* 1991). Studies conducted on one such tree which produces fruits both in the month of July and December is presented below:

Month	Germination Percent	Percentage of abnormal seedling
December	87	12
July	83	2

Though seeds may be available for raising seedlings in off season, collection of such fruits is not advisable because of the production of abnormal seedlings. However, these genotypes form excellent base for breeding programmes. Assemblage of such genotypes is of immense importance, more so in a species like *A. indica*.

Neem is said to be self compatible and therefore may be self pollinated (Jindal and Satya Vir, 1999). The structure of the flower indicates the condition conducive for self pollination, but, further intensive research is required.

Collection of fruits

The optimum stage for collection of fruits is when the greenish fruits start turning to yellow. Ripe yellow fruits can also be collected directly from the trees by climbing and/or shaking the fruiting branches using poles. Before the collection operation, the ground should be cleared off the already fallen fruits and/or a tarpaulin should be spread under the tree. Care should be taken to collect only the freshly fallen fruits. When ripe yellow fruits are collected action should be taken to depulp them immediately to avoid fermentation and heating. Generally the quantity of fruits available in this condition is very low.

Our experience of collecting the fallen fruits from the ground yield seeds of poor quality. It is observed that the fallen fruits are attacked by soil borne fungus. The fungus is carried along with the pulpy fruit resulting in the deterioration of seeds. The fungus starts attacking the fruits within a few hours of their fall, as they are pulpy and rich in carbohydrates Even if the fallen fruits look apparently healthy, there is a danger of fungal infection. The micro-climate under the tree, particularly in the months of June and July is very conducive for the fungal growth because of the monsoon showers and humid conditions.

The other best way of collecting the fruits is when the fruits are greenish yellow. The clipped greenish yellow fruits are spread on a tarpaulin inside the seed processing room. The green fruits start ripening in a day or two; then they are depulped and seeds extracted.

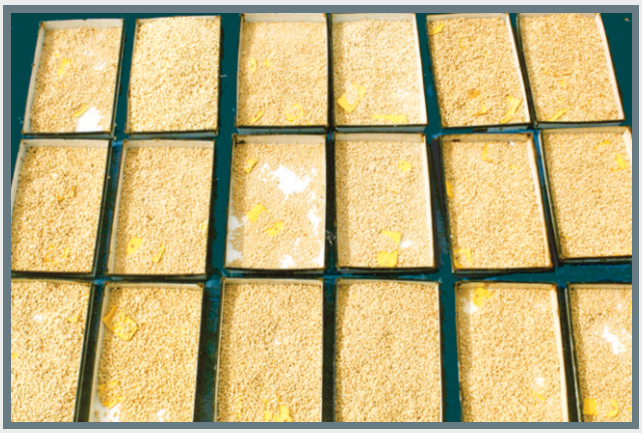
Neem trees start flowering from 4th year onwards, but commercial seed collection can be done from 7th year onwards.

Seed processing and storage

As only fruits are collected in neem, appropriate seed processing techniques are followed for achieving high physical and physiological quality of seeds. The fruits should be processed soon after harvest. The time gap between harvest and processing should not exceed 48 hours.

1. Pre-cleaning: The impurities like twigs, bark, foliage etc. should be removed before any other operation to reduce fungal attack.

2. Pre-curing: It is a deliberate storage and slow air-drying of fruits containing the seeds in order to render them more suitable for subsequent operations like extraction and storage. The greenish yellow fruits are put in a well ventilated place in shade for one or two days, when the fruits become yellow and ready for extraction.



Drying of seeds after depulping

3. Extraction of seeds by depulping: The fruits are depulped by macerating them in a bucket of water. When water is poured into the bucket containing macerated fruits, the skin of the fruit floats on the water, which can be easily removed. The stones with adhered pulp are transferred to bamboo baskets and are rubbed on the surface of the basket. They are then washed thoroughly in running water. Rubbing and washing in running water are repeated until all the pulp is removed. Care should be taken to completely remove the pulp, as even small quantity of the pulp adhered to the stones will invite fungal infection affecting the seed quality.

4. Drying: The surface moisture of neem seeds is removed immediately after depulping by drying them under a fan for a day. Ezumah (1986) has found that the neem seeds can be conveniently dried under sun for eight days. Initial moisture content of the neem seeds was found to around 35%. The reduction in moisture content of the seeds (even up to about 6%) does not affect the germination percentage.

5. Storage: Neem seeds do not store well. The germination percentage decline sharply after 12 weeks. Storing seeds with high moisture content in deep freeze conditions had deleterious effect on the viability. Storing seeds with low moisture content in ambient and refrigerated conditions up to 0°C is recommended.

Germination

No pretreatment is required for germination of seeds. Fresh seeds start germinating from 7 days of sowing and germination is complete in 24 days. Over 80% germination was observed in fresh seeds.

For production of seedlings, seeds are sown in mother beds of size 10 x 1 m containing the soil mixture of sand, red earth and Farm Yard Manure (FYM) in the ratio of 2:2:1 or 1:1:1. The bed is not directly exposed to sunlight and only partial light is allowed. The mother bed is watered daily with fine spray, particularly when seedlings are small. The seedlings should be kept free from weed competition at all stages of development by manual weeding. The emerged seedlings are transplanted to polybags of size 13 x 25 cm with soil mixture after 20-25 days of sowing. It is advisable to prune the roots to avoid coiling. The seedlings are protected from damping off and root rot with fungicides if necessary. Either Blitox or Dithane M-45 can serve the purpose. Similarly spraying of pesticides (Nuvacron) is effective against defoliators. Using root trainers in nursery helps in the production of quality seedlings with higher biomass and better survival potential.

Silviculture

Neem is a strong light-demander but can tolerate fairly heavy shade during early growth years. However it cannot withstand extreme cold and frost particularly during juvenile stages. It grows in a wide range of soils including clay, saline and alkaline soils. The tree has the ability to exhibit better growth on dry, stony calcareous and shallow soils where most other species would find very difficult to get establish. It possesses extraordinary root system that can absorb moisture and mineral nutrients from even highly leached or sandy soils. The suitable pH value is 6.2 and above for better growth, however the tree can also sustain well at pH 5.0. Radwanski and Wickens (1981) provide clear evidences that Neem can alter the acidic soils and bring them to neutral pH through its leaf litter. Because of these reasons, Neem is a highly preferred genetic resource for improving the productivity of wastelands and other dry farmlands.

Regeneration: Natural regeneration occurs mainly through seeds. Reports from southern India suggest that

Germination trial in controlled conditions

Neem also regenerates well by coppice and root-suckers. Fruit maturation coincides with monsoon rains. Seed dispersal to a greater extent is effected by birds that feed

on fruits. Fully ripen fruits that are left unharvested fall beneath the crown and eventually germinate within a fortnight.

Nursery techniques: Neem seeds are viable for a shorter period and hence should be sown within 2 to 3 weeks after collection. Seeds are sown in nursery beds with loose soil at a depth of 2.5 cm. This depth for seeds is recommended to prevent the radicle being eaten by birds or insects during germination. Germination starts after one or two weeks and may extend up to 6-7 weeks. The beds should be watered regularly but not in excess. When the seedlings are about 5-7 cm in height, are transferred to polybags. Alternately, seeds can also be sown directly in polybags to avoid root damage while transferring from nursery beds. Seedlings maintained in nursery are sometimes pulled out for preparing stumps. Each stump may have 5-6 cm shoot, 20 cm root and 1-2 cm collar thickness.

Planting and management: Once the seedlings reach a height of 25-30 cm (6-12 months old), they are ready for planting. The pit sizes for dry and moist localities are 45 cm^3 and 30 cm^3 respectively in a spacing of 5 X 5 m. Neem is normally planted in an espacement of 5 X 5 m or 10 X 10 m. However in case of agroforestry practices, a wider spacing is recommended. Pits can be filled with native soil along with 5 kg of FYM and 25-50 g of DAP at the time of planting. Planting is generally done during rainy season. Application of Bursbon in pits will prevent the plant from the attack of termite or other insects during extreme drought periods. Neem stumps are prepared from 12-13 months grown seedlings. The shoot portion of stump measures 2.5 cm long while the root portion measures around 20-23 cm. The stumps are planted in crow bar holes and their success depends on the amount of rainfall.

Though the tree requires less attention during early growth phases, in dry localities, watering and weeding should be ensured during the first two years for providing enhanced growth conditions. Weeding should be done during early establishment and growth as it helps to retain soil moisture and nutrients. Another important purpose of weeding is to loosen the soil to prevent caking and promote soil aeration. Thinning is generally done at the age of 2-3 years and in well managed plantation at the end of the first year.

Growth and Yield

Neem is a fast-growing species and reaches two third of its actual height within 3-5 years (von Maydell, 1990). The trees put on an average yearly girth increment of 2.3-3.0 cm. The annual rings are sometimes not distinct. Growth of plantations generally depends on the soil quality and is fairly rapid during first 5 years and then slows down. Tewari (1992) stated that naturally grown Neem trees stood at 6.5 m with a girth of 68 cm after ten years. A mean diameter of 5.14 cm was observed after four years of planting in Nigeria with more than 75% of survival rate (Verinumbe, 1991). Under favourable conditions, the annual leaf biomass production reaches nearly 10 tons/ha. Reports from dry areas suggest that each tree yields about 24 kg of fuel wood at the age of 23 years (Kalla *et al.,* 1978). There are also reports indicating a height of 10 m in two years old coppice shoots. In Nigeria and Ghana, the tree is harvested on a eight-year rotation basis (von Maydell, 1990), however, the best yield is achieved after 20 years (Kalla *et al.,* 1978).

Neem prefers a wide range of soils, even a more alkaline pH (8-10). Unlike other species it is not attacked by Loranthus spp. and exhibits much better growth with VAM inoculation. The tree usually starts bearing fruits 3-5 years after planting. It attains full bearing capacity at the age of 10-12 years. During initial years, an individual tree produces around 10-20 kg of fruits annually, whereas in maturity it yields about 30-100 kg of fruits per year. Mehta (1989) reported that a rice/wheat rotation practised in agroforestry model with Neem for a period of 4-5 years yielded good tree growth due to soil enrichment. Thus Neem can be rightly considered as one of the most suitable tree species for arid zones.

Insect Pests and Diseases

Though *A. indica* has strong antifeedant and growth inhibitory properties, the tree also gets affected by nearly 60 insect pests, mostly represented from Asia and Africa. In India, 38 species are recorded including 13 defoliators, 15 sap suckers, 2 root feeders and 1 stem/shoot borer and 5 species that attack seed and flower. Most of the insect pests are polyphagous. *Araecerus sutularis* (beetle), *Erythrothrips asiaticus* (thrips) and *Othries fullonica* (moth) are the prominent insects that feed on seed, flower and fruit respectively. The moth *Endoclita undulifer* with annual lifecycle is the only reported stem or shoot borer of Neem. Ahmed (1992) recommended spraying of 0.2% Rogor along with 0.05% Blitox and Vipul@2 ml/litre for controlling the shoot borer.

Defoliators do not cause serious injury to Neem and nearly 13 defoliators are reported so far. The most common defoliators are *Ascotis selenaria, Cryptocephalus ovulum, Cleora cornaria, Eurema* sp. and *Boarmia variegate.* Spraying 0.1-0.2% of folithion in water will be effective against defoliators. Among the insect pests, sap suckers cause considerable damage to Neem in nurseries, young and grown plantations. Both nymphs and adults suck foliage sap of growing shoots, causing die back. The most common Neem sap suckers are *Pulvinaria maxima,*

Aonidiella orientalis and *Helopeltis antonii.* All these sap suckers can be controlled by the application of monocrotophos or dimethoate (0.01-0.02%) in water. In case of root feeders, two major pests namely *Holotrichia consanguinea* and *Odontotermes obesus* are reported to attack Neem.

Starting from the nursery stage to mature tree, most of the Neem diseases are caused by fungi. 'Damping off' is a destructive disease that affects Neem seedlings and blocks their emergence from ground. The fungus *Fusarium oxysporum* is invariably found associated with this disease. Hence seeds must be treated with fungicide before sowing.

Rhizoctonia leaf web blight is another major damaging disease caused by *Rhizoctonia solani.* The disease can easily be identified by greyish brown blotches on leafblade which increases with growth of fungal hyphae. Epidemiological investigations reveal that the disease appears after rain and gets concentrated during July-September (Mehrotra, 1990). The fungus being a soil pathogen gets activated during rains and enters the stem. The initial infestation occurs in leaves at the lower branches and later it engulfs the entire foliage. The disease is about 100% in highly humid areas with heavy rains and defoliation varies between 30-100%. The disease can be controlled by maintaining better sanitation and cultural practices. Seedlings can be directly raised in polybags instead of sowing in beds. The former method also facilitates easy segregation of affected seedlings.

Another infection known as Colletotrichum leaf spot and blight was reported from Dehradun (Mehrotra and Pandey, 1991). The disease usually outbreaks in nurseries during the period of September end to first week of October. Initial leaf spots by the fungus increases in size over a period, eventually causing leaf shedding. Application of Blitox fungicide (0.2%) twice a week was found to be effective in controlling the fungus. Two other fungal pathogens namely *Alternaria alternata* and *Pseudocercospora subsessilis* were also known to cause leaf spot and blight disease. Apart from leaf spots, powdery mildew disease that appears as white patches is caused by *Oidium azadirachtae.* Spraying 0.1% of fungicide Bavistin in affected leaves is suggested as the control measure.

Uses

The uses of Neem are known for centuries and almost every part of the tree has its own importance. The drought tolerant tree has rich ecological, environmental and economic values. In the world of Ayurveda, Neem is used as a potential ingredient in medicines in curing traditional remedies dating back to centuries. It has been used as a bio-pesticide in control of a wide range of insect pests. The tree is also successfully used as a windbreak and source of shade for human and cattle.

Wood: Neem wood is moderately heavy, stable and its durability makes it a good choice for using as construction material and also furniture making in rural areas. However, due to lack of grain and poor retention capacity of polishes, the wood has been limited to general utility furniture. Despite its characteristics, it has been widely used for making carts, axles, boards and panels, cabinets, toys, drums, and farming implements.

Bark: Neem has a rough bark in dark grey or brown colour. The bark has a plenty of medicinal properties and traditionally employed in Ayurveda, Unani, etc. It has its largest application as a multi utility natural product without side effects especially in skin and personal hygiene products. The bark extract was found to be effective against certain strains of watermelon mosaic virus. It is also reported to possess anti-protozoal, anti-allergic, anti-dermatitic and anti-fungal properties. Kurokawn *et al.* (1988) extracted two water soluble polysaccharides from bark, which exhibited anti-tumour activity. The bark along with other herbs is found to be effective in controlling jaundice (Rao, 1981).

Foliage: Estimation of chemical and nutritional value of Neem leaves (Shukla and Desai, 1988) has revealed that they have a good source of protein, calcium and trace minerals. Reports also suggest that leaves have comparatively less fibre content over other tree species. In some parts of India, cattle and goats are fed with Neem leaves to increase milk secretion after parturition. They are also used as mulch and manure. Leaves also possess numerous medicinal properties. A strong decoction of leaves functions as mild antiseptic and hot infusion is used as anodyne for fomenting swollen glands, bruises and sprains. Young leaves when administered orally along with pepper are found to cure intestinal helminthiasis. Kharkongar and Joseph (1981) reported that few tribes of Meghalaya use the leaves to cure diarrhoea, tuberculosis and heart diseases.

Seeds: A Neem tree on average yields 30-50 kg of seeds in a year. Each seed has around 45% of kernel and 55% of shell. The most active ingredient Azadirachtin is isolated from Neem seeds. Von Maydell (1990) observed that the insecticidal effect of azadirachtin is similar to DDT and also not toxic to human. Due to the presence of compounds like triterpenoids and salanin, Azadirachtin exhibits a strong antifeedant activity. These compounds are similar in structure to insect hormone ecdysones and alter the

lifecycle of insects during metamorphosis. Relative humidity and temperature play a crucial role in deciding the azadirachtin content. Kernel forms the inner part of Neem seed and is the richest source of oil. The kernels are dehulled initially and grinded for extraction either aqueously or with a solvent depending on the required compound. Kernel in various forms such as powder, suspension, aqueous extract, solvent extract is found effective against several crop devastating pests. The Neem oil extracted from kernel is greyish yellow to brown in colour and has a strong disagreeable garlic like odour. Besides its potential application as an ingredient in soap-making and toothpaste manufacturing, the oil is used in a plenty of other products.

Neem cake, the most important by-product obtained in oil extraction has more sulphur content (1.07-1.36%) than any other cake. It has high protein content (25.4%) and various important plant nutrients such as Nitrogen (2-3%), Phosphorus (1%) and Potassium (1.4%). Hence, it has been widely used as organic manure resulting in high crop yield. Neem cake acts as a inhibitor of nitrification process and also found to enhance crop yield when applied along with urea.

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Benefits of Soil Organic Carbon and its Storage in different Land Uses

Soils are at the heart of the Earth's "critical zone", the thin outer veneer between the top of the tree canopy and the bottom of groundwater aquifers that humans rely on for most of their resources (US NRC 2001; Planet Earth 2005). They form and continually change over thousands of years, at different rates and along different pathways, as mineral material from the breakdown of rock is colonized by plants and soil biota. This colonization leads to the formation of soil organic matter (SOM) and soil structure, which controls carbon, nutrient and water cycling (Brantley, 2010). Soil organic carbon (SOC) is the main constituent of soil organic matter (SOM). Soil organic matter is the fraction of the soil that consists of decomposing plant and animal residues, also contains living and dead microbial cells, microbially synthesized compounds and a number of derivatives produced as a result of microbial activity.

Soil organic carbon (SOC) holds a very important role in global carbon cycle, as it is the largest terrestrial carbon pool. The amount of carbon stored in soil organic matter is one of the largest and most dynamic reservoirs of carbon in the global cycle. It has an important influence on the physical and chemical properties of the soils and it can release nutrients through mineralization in forms available to plants (Lal, 2004). Soil carbon pool to 1m depth is estimated at about 1550 Pg of organic carbon, and approximately 750 Pg of inorganic carbon (Batjes, 1996). This total soil carbon pool of 2300 Pg is three times the atmospheric pool of 770 Pg and 3.8 times the vegetation pool of 610 Pg; a reduction in soil carbon pool by 1Pg is equivalent to an atmospheric enrichment of CO_2 by 0.47 ppm (Lal, 2004). Thus, any change in soil carbon pool would have a significant effect on the global carbon budget. The Intergovernmental Panel on Climate Change (IPCC) identified creation and strengthening of carbon sinks in the soil as a clear option for increasing removal of CO_2 from the atmosphere and has recognized soil organic carbon pool as one of the five major carbon pools for the Land Use, Land Use Change in Forestry (LULUCF) sector. The type of land use system is an important factor controlling organic matter contents of soils since it affects the amount and quality of litter input, decomposition rates and the processes of organic matter stabilization in soils. Management practices and land use changes can strongly influence the concentration of soil organic carbon (Hai *et al.,* 2010; Srinivasan *et al.,* 2012).

Role of organic matter in soil fertility

1. Organic matter influence the soil colour. Due to presence of adequate amount of organic matter in soil, the colour will be brown to dark brown or black.

2. Organic matter binds soil particles (sand, silt and clay) into structural units called aggregates. These aggregates help to maintain porous, open and granular condition. Also, helps in maintaining favorable condition of aeration and permeability.

3. The rate of infiltration and percolation of water is enhanced by the application of organic matter in the soil.

4. Water holding capacity is increased by the application of organic matter.

5. Organic matter reduces plasticity, cohesion, stickiness in soils containing appreciable amounts of clay.

6. Organic matter increases the ability of the soil to resist erosion.

7. Organic matter reduces losses of surface soil by wind erosion by forming granules with soil particles.

8. Organic matter affects the densities of soil especially bulk density of soil which in turn influence the soil porosity favorably.

9. During decomposition of organic matter various organic acids and CO_2 liberate in the soil which help to reduce alkalinity of soil.

10. Organic matter has high cation adsorption capacity. It has two to thirty times more cation adsorption capacity than that of mineral soil colloids.

11. Organic matter acts as a buffering agent. Due to such buffering effect it reduces the likelihood of damage to plant roots from excessive acids, alkalies or salts.

12. Organic matter can be considered as a store house of various nutrients essential to plant growth. It is the source of 90-95 per cent of the nitrogen in unfertilized soils. In addition it also supplies available phosphorus, sulphur, micronutrients like Fe, Mn, Cu and Zn to the soil.

13. Organic matter serves as a source of energy for both macro and microorganisms and helps in performing various beneficial functions in soil.

14. Organic matter acts as a chelate. A chelate is any organic compound that can bound to a metal usually (Fe,Zn,Cu and Mn) by more than one bond and form a ring or cyclic structure by that bonding. The soluble chelates help mobilize these micronutrients, increasing their availability to plants and mobility in soils.

15. Organic matter temporarily absorb heavy metal pollutants (lead, cadmium) which are usually derived from waste waters used for irrigation.

Organic Matter Management

Farm practices that help to maintain or increase soil organic matter levels;

- Use of conservation tillage practices like zero tillage. Tillage exposes the organic matter to air and results in lowering of stable organic matter due to increased mineralization rates and erosion losses.

- Establishment of legume cover crops will enhance organic matter accumulation by providing the nitrogen needed for decomposition of freshly added organic materials, especially those with a high C:N ratio.

- Avoiding soil compaction which increases water logging, and maintaining proper pH to enhance microbial activity and decomposition of freshly added materials.

In a study conducted in Southern Agro-climatic zone of Tamil Nadu for assessment of soil organic carbon under different land uses, soil samples belonging to Padarnthapuli and Vayalogam soil series were collected from various land uses namely Agriculture, Agro-forestry and Plantation. Soil samples were collected from three plots and at two depths namely 0-30 and 30-50cm. The soil samples collected from respective locations were air-dried, mixed well and passed through a 0.2 mm sieve for the analysis of organic carbon. Organic carbon was determined by chromic acid wet oxidation method of

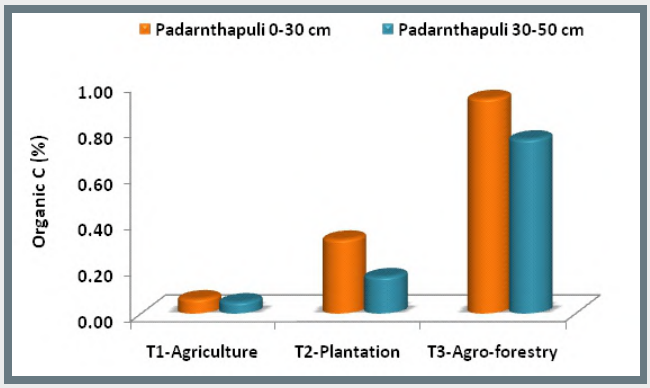

Figure 1: Effect of land use on Organic carbon (%) in Padarnthapuli Soil Series

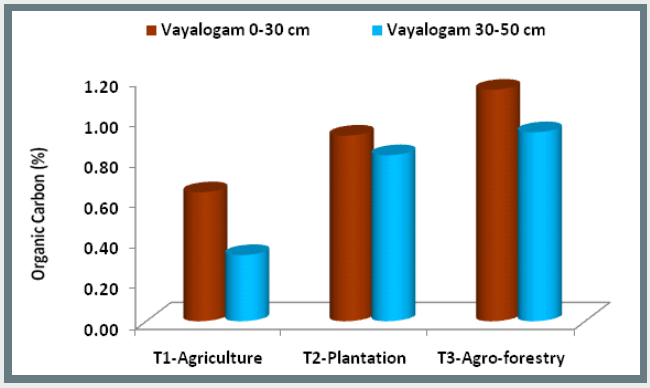

Figure 2:Effect of land use on Organic carbon (%) in Vayalogam Soil Series

Collection of Soil Samples and Estimation of Organic Carbon

Soil profile of Vayalogam series

Agriculture crop-Maize

Collection of soil samples

Gmelina plantation

Estimation of organic carbon

Walkley and Black, 1934. Soil organic carbon content was highest (0.94%) under the agro forestry land and lowest (0.06%) in the cultivated land in Padarnthapuli series (Fig. 1 and 2). Considering the two soil depths, the higher organic carbon was recorded in surface depth of 0-30 cm. Similar trend was observed in Vayalogam series also, where, highest organic carbon content was registered under agro forestry land (1.14 %) followed by plantation (0.92 %). The total amount of OC in the soil can be considered as a measure of stored OM. Less amount of organic carbon under cultivated land might be due to the effects of tillage practices coupled with reduced soil organic matter inputs and apparently complete removal of crop residues from cultivated fields (Adeboye *et al.,* 2011).Uncultivated soils have higher soil OM than in cultivated soils (Miller and Gardiner, 2001).

Conclusion

SOC is an indicator of both soil quality and environment stability. As sequestration of atmospheric CO_2 in soils is an option to reduce global warming, baseline data and information on SOC storage are essential for characterizing C dynamics. Soil fertility decline associated with wrong usage of land which has great implication on sustainable agricultural practices needs to be reduced. Therefore, careful selection of appropriate land use needs to be followed for enhancing or maintaining fertility status of soil

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ENVIS ACTIVITIES

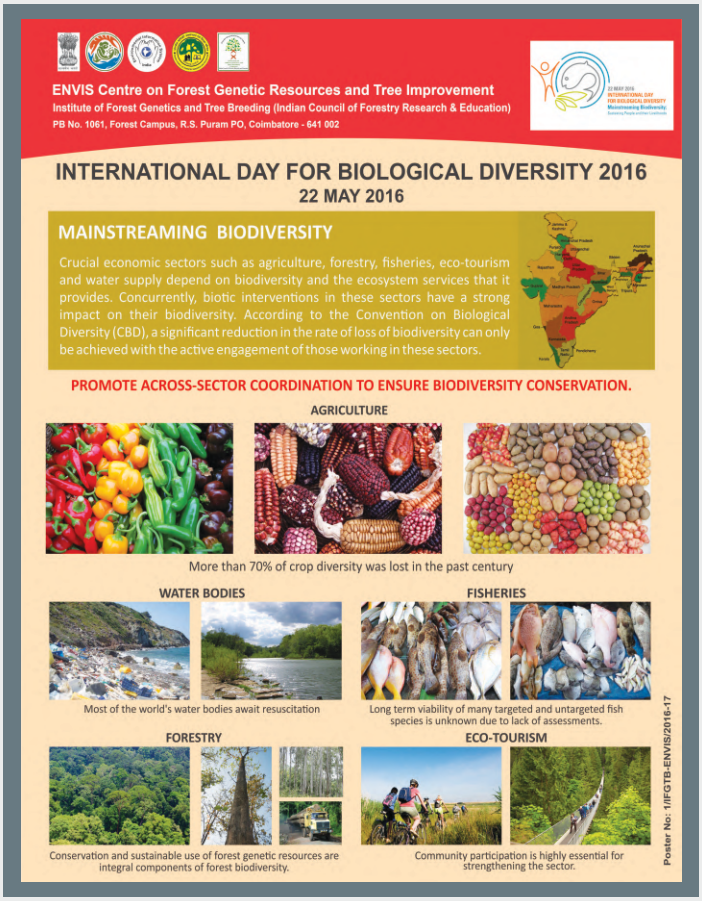
Exhibition on Flora and Fauna at PSG College of Technology, Coimbatore

In association with the Institute of Forest Genetics & Tree Breeding (IFGTB) and an Environment based NGO (OSAI, Coimbatore), the Nature Club of PSG College of Technology, Coimbatore had organised an 'Exhibition on Flora and Fauna' on 1st April 2016 in their College Campus. The ENVIS Centre on Forest Genetic Resources and Tree Improvement participated in the event and exhibited various awareness posters on conservation of tree genetic resources. Information about individual tree species was distributed to the public in the form of pamphlets/brouchers. Students were supplied with environmental quiz booklets.

AWARENESS POSTERS

The ENVIS Centre on FGR & TIP observed the International Day for Biological Diversity on 22nd May 2016. Based on this year's theme 'Mainstreaming Biodiversity', an awareness poster was released emphasizing the need to promote across-sector co-ordination to ensure biodiversity conservation. The poster highlights that the people working in major sectors involving biodiversity such as agriculture, fisheries, forestry, water bodies and ecotourism should actively co-ordinate between them for sustainable management of these resources apart from revenue generation.

The second awareness poster was released on 5th June observed as World Environment Day (WED) by the United Nations. The theme for WED – 2016 is 'Go Wild for Life', an initiative to ensure zero tolerance approach to wildlife crime and related illicit activities. The WED – 2016 poster released by IFGTB-ENVIS brings out the cash flow involved in illegal trade in wildlife across the world. Both the posters were widely circulated among students and other visitors while conducting outreach activities.



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Upcoming Events

Event	:	**Breaking dimensions and resolutions of forest remote sensing data: Third Workshop of the Special Interest Group on Forestry**
Venue	:	Krakow, Poland
Date	:	15-16 september 2016 Workshop
details	:	http://sigforestry2016.eu/#background
Event	:	**IUFRO International Conference on Somatic Embryogenesis and other Vegetative Propagation Technologies**
Venue	:	City of La Plata, Argentina
Date	:	19-23 September 2016
Conference website	:	http://www.iufro20902.org/registration.html
Event	:	Abies **2016: 15th International Conference on Ecology and Silviculture of Fir**
Venue	:	Sapporo, Japan
Date	:	21-24 September 2016
Conference website	:	http://www.uf.a.u-tokyo.ac.jp/hokuen/Abies2016/index.html
Event	:	**IUFRO International and Multi-disciplinary Scientific Conference: Forest policy and governance: Analyses in the environmental social sciences**
Venue	:	Bogor, Indonesia
Date	:	04-07 October 2016Registration details: (http://iufroforpolbogor2016.ipb.ac.id/registration-and-abstract-submission/)
Event	:	**International Conference on Conservation and Sustainable Use of Tropical Rainforests 2016**
Venue	:	Belum Rainforest Resort,Pulau Banding, Perak, Malaysia
Date	:	17-22 October 2016
Registration details	:	(http://www.belumrainforestsummit2016.com/index.php/general-international)
Event	:	**IUFRO Regional Congress for Asia and Oceania 2016' Forests for Sustainable Development: The Role of Research'**
Venue	:	Beijing, China
Date	:	24-27 October 2016
Registration deadline	:	Open now (http://www.iufro-ao2016.org/en/page.asp?hid=&pageid=84.html)
Event	:	International Conference on Forest Multi-functional Management
Venue	:	Beijing, China
Date	:	24-27 October 2016
Conference website	:	http://www.gfsf2010.org/dct/page/70002
Event	:	ForestSAT 2016
Venue	:	Santiago, Chile
Date	:	14-18 November 2016
Conference website	:	http://forests at 2016.com/

ABOUT IFGTB

Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore is a National Research Institute under the Indian Council of Forestry Research and Education. IFGTB envisions a wood secure society. The Institute primarily aims to carry out research to improve productivity of forest tree species through conventional breeding programmes and biotechnological interventions. The major areas of research include tree improvement, breeding, planting stock improvement, marker assisted selection, genomics, clonal propagation, agroforestry systems, climate change research, integrated disease and pest management, seed handling and testing, eco restoration and conservation.

ABOUT ENVIS

ENVIS established by the Government of India, in 1982 has been on providing environmental information to decision makers, policy planners, scientists and engineers, research workers, etc. all over the country. It is a comprehensive decentralized information system on environment involving effective participation of institutions / organisations in the country actively engaged in work relating to different subject areas of environment. A large number of nodes, known as ENVIS Centres, have been established in the network to cover the broad subject areas of environment with a Focal Point in the Ministry of Environment, Forest & Climate Change.

INSTRUCTIONS TO CONTRIBUTORS

Dear Author/ Subscriber/ Contributor,

We invite contributions to the ENVIS Newsletter issues! The ENVIS Centre at IFGTB focuses on Forest Genetic Resources and Tree Improvement. It aims to act as a window for quality scientific publications and a forum for presenting your thinking on the challenges in the fields of FGRs and tree improvement. The ENVIS Newsletter, Van Vigyan, a quarterly publication, publishes original research articles, reviews, reports, research highlights, news-scan etc., related to the thematic area of the ENVIS Centre. Original research and review articles, notes, research and meeting reports are invited for the newsletter. Details of forthcoming conferences / seminars / symposia /trainings / workshops also will be considered for publication in the newsletter. Articles may be sent in Times New Roman (with font size 12) in double spacing with a maximum of 5-6 typed pages. Photographs/line drawings and graphs need to be of good quality with clarity for reproduction in the newsletter. Only electronic submission will be accepted.

Details may be sent to: ifgtb@envis.nic.in.

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