ABOUT ICFRE - IFGTB

ICFRE - Institute of Forest Genetics and Tree Breeding (ICFRE - IFGTB), Coimbatore is a National Research Institute under the Indian Council of Forestry Research and Education. ICFRE - 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 EIACP

EIACP (erstwhile 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 EIACP PC RP (erstwhile 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 and Climate Change.

INSTRUCTIONS TO CONTRIBUTORS

Dear Author/ Subscriber/ Contributor,

We invite contributions to the EIACP Newsletter issues! The EIACP Resource Partner at ICFRE-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 EIACP Newsletter, Van Vigyan, a quarterly publication, publishes original research articles, reviews, reports, research highlights, news-scan etc., related to the thematic area of the EIACP Resource Partner. 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.

EIACP Team

Dr C. Kunhikannan
Director

Dr Kannan C.S. Warrier
Scientist F and Coordinator, ENVIS

Dr T. Vamadevan
Information Officer

Dr Rekha R. Warrier
Scientist F and Editor

V. Thangavel
IT Officer

Dr S. Vigneswaran
Programme Officer

G.V. Subha Shree
DEO

ICFRE - INSTITUTE OF FOREST GENETICS AND TREE BREEDING

Forest Campus, P.B. No. 1061, RS Puram HPO, Coimbatore - 641 002
Phone : 91 422 2484100; Fax : 91 422 2430549
Email: ifgtb@envis.nic.in, kannan@icfre.org; Web : www.ifgtbenvis.in, ifgtb.icfre.gov.in

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From the
Director's Desk

In this issue

The present issue of Van Vigyan, the Newsletter of the EIACP on Forest Genetics and Tree Improvement, gives a detailed account of a tree-borne oil seed, *Simarouba glauca*. Tree-borne oilseeds have the potential to provide a sustainable source of vegetable oils, as they can be grown in agroforestry systems that provide additional benefits such as soil conservation, carbon sequestration, and biodiversity conservation. Simarouba trees are fast-growing and adaptable to various soil types and climatic conditions. They have been widely planted in agroforestry systems in tropical regions for their multiple uses, including timber and oil production, erosion control, and carbon sequestration. The EIACP team sincerely looks forward to your suggestions and feedback and seeks your support and cooperation.

Dr C. Kunhikannan
Director, ICFRE - IFGTB

Know Your Trees - *Simarouba glauca* Dc.

Know Your Trees - *Simarouba glauca* Dc.

Introduction

Simarouba glauca DC. is a multipurpose tree which belongs to the family Simaroubaceae. *S. glauca*. is commonly known by a variety of names depending on the region and country where it is found. Some of the common names for *Simarouba glauca are* Aceituno (Central America); Simarouba (Brazil); Tree of Heaven (USA); Bitter Ash (USA); Paradise Tree (USA); Acajou blanc (French Guiana); Daguillo gavilan (Dominican Republic) Olivio (Venezuela); Palo amargo (Mexico); Bwa fwenn (Haiti) ; Doliv fwenn (Haiti); Bois amer (Haiti); Quinquina (Peru); Mountain Damson (Guyana); Dysentrybark (Guyana) and Acituno (Colombia). These names reflect the wide distribution of *S. glauca* different regions, where it has been used for various purposes such as timber, fuelwood, medicinal properties, and biodiesel production. (Siva Selvi *et al.,* 2020).

Taxonomic classification

Kingdom : Plantae
Order : Sapindales
Family : Simaroubaceae
Genus : *Simarouba*
Species : *glauca*

Distribution and habitat

Simarouba glauca DC is native to tropical and subtropical regions of the USA, including the southern United States, Mexico, Central America, the Caribbean, and northern South America (Santhosh *et al.,* 2016). *S. glauca* was introduced to India in 1960s and cultivated in including Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, and Kerala in India. Its cultivation depend on rainfall, soil water holding capacity, and sub-soil moisture, as it requires adequate moisture for proper growth and development. It is also known for its tolerance to drought, making it a potentially valuable crop in areas with limited water resources. In addition, to its ornamental value due to its beautiful flowers, *S. glauca* is also valued for its oil-rich seeds, which can be used for biodiesel production and medicinal applications. (Sala *et al.,* 2002). It can grow in temperatures ranging from 10 to 50°C, and at elevations from sea level to 1,000 m (3,300 ft). When fully mature, it can reach a height of 40 to 50 ft (12 to 15 m) with a spread of 25 to 30 ft (7.6 to 9.1 m). This makes it important for reforestation and agroforestry projects, as well as for landscaping and ornamental gardens. (Santhosh *et al.,* 2016).

Botanical description

It has a taproot system and a cylindrical stem, and the crown is dense and rounded, forming in 6 to 8 years. The leaves are alternate, imparipinnate, and compound, with 13-23 shiny glaucous leaflets. The plants are polygamodioecious, meaning that some individuals produce exclusively male flowers (staminate), some produce mainly male flowers with a few bisexual flowers (andromonoecious), and others produce only female flowers (pistillate). Its polygamodioecious nature, with a mixture of male, female, and bisexual flowers, is quite uncommon in the plant kingdom.The staminate flowers are larger and more numerous than the pistillate flowers. The sepals are united at the base, and there are 5 petals and 10 stamens, which are appended at the base. In the pistillate flowers, the stamens are much reduced or absent, and there are 5 carpels borne on a short broad gynophore or disk. The carpels are weakly united, with a short common style and divergent stigmas. The staminate flowers have a gynophore present but no carpels. Each carpel contains one ovule, and the fruit is made up of several distinct drupes. Its protandrous flowering habit (male flowers mature before the female flowers), reduces the chance of self-fertilization and increases the chances of cross-fertilization with other individuals. The fruit is an ellipsoid drupe, 2-2.5 cm long, with a thin hard cuticle and juicy fruit pulp. The two distinct forms, with pink or whitish yellow fruit found. It has a thin, brittle endocarp and oily kernel.

Reproductive biology and breeding system

S. glauca starts fruiting at about 4-6 years of age. Flowering is annual, beginning in December and continuing up to February. The drupes (blackish purple in pink and brownish yellow in green) are ready for harvest by March/April. The season and duration of reproductive phenophases vary according to location and climate. Individual fruits have a development and ripening period of 1-2 months. Both male and bisexual plants are required for proper fruiting of female plants. Wind and honeybees, specifically *Apis cerana, Apis* indica, acts as pollinating agent for the flowers. The flowers start opening around 6:30 AM and complete by about 9:30 AM. Anther dehiscence takes place around 4:00 PM with maximum receptivity at 10:00 PM. The ripening of fruits takes 80-90 days from anthesis and they are typically harvested in April-May.

Fruit collection and processing

Fruits an usually harvested when fully ripe, which is typically around March to April. The optimal time for fruit collection is when the color of the fruits turns from greenish-yellow to blackish-purple. It is best to collect fruits from the tree since fallen fruits are often attacked by soil-borne fungi that deteriorate the seeds. Fallen fruits are attacked by the fungus within a few hours since they are pulpy and rich in carbohydrates. The easiest way to collect the fruits is to spread a tarpaulin under the trees and collect the fruits after manually stripping them from the branches or shaking them down. To ensure maximum seed quality, the fruits should be graded to separate undeveloped, immature, damaged, and decayed fruits, and also grade them for color groups: fully green, greenish-yellow, and dark purple. Discard green fruits, which account for poor quality. After collection, transport the fruits to the processing place in gunny bags. Avoid plastic bags or plastic containers for collection and transportation of fruits. The fruit pulp must be removed immediately after collection, either by hand or in a depulper. Depulping is done by macerating the fruits. The seeds with some pulp still adhered to them are transferred to a bamboo basket. They are then thoroughly washed under running water. Immediately after extraction, the seeds must be dried in the shade for a few hours,

followed by sun drying to reduce the moisture content. The surface moisture of the seeds should be removed immediately after depulping and washing by drying them. The seeds should always be spread in a single layer and not heaped for uniform drying. The initial moisture level of the seed is 12-15%.

Germination

The seeds of *S. glauca* have a hard seed coat that imposes physical dormancy, resulting in low seed emergence and germination rates. The germination rate of fresh *S. glauca* seeds is 70 to 80%. However, the seeds have a short viability of 2-3 months (Patil Manasi and Gaikwad 2011). To retain high viability for several years, seeds should be stored in paper or cloth bags at low temperature. They can be stored at room temperature for 9-12 months, but this may reduce their viability. To break dormancy, various mechanical and chemical treatments can apply, such as scarification or soaking seeds in 100 ppm of plant growth regulators like GA (Gibberellic acid), CCC (Chlormequat chloride), SA (Salicylic acid), 6-BA (6-Benzylaminopurine), and by applying different priming techniques (Kumar *et al.,* 2016). To grow seedlings, a raised nursery bed of 10 m x 1 m is prepared, and seeds are sown in lines with a distance of 10-15 cm apart and 3-5 cm apart within lines. The depth of sowing should be 2-4 times the diameter of seeds. When the seedlings reach 7-10 cm in height and have a taproot of about 15 cm (usually 40-50 days after sowing), they are ready for transplant. Seedlings are pricked out into polythene bags with a size of 10-22 cm or 15-22 cm and 200 gauge thickness. The soil mixture used to fill the bags consists of garden soil, sand, and compost in a 1:1:1 ratio. The bags are watered twice a day, and frequent shifting of the seedlings should be done to prevent roots from striking the ground. After six months, the seedlings are ready for out planting.

For the nursery method, seeds can be sown directly in containers or in a bed. Freshly collected seeds can be sown directly in the container, and the germination rate is typically between 60 to 80% depending on the locality factors. To improve germination capacity, the seeds can be presoaked in cold water for 24 hours and the endocarp can be removed. The recommended soil mixture for container seedlings is soil:sand:FYM in the ratio of 3:1:1. The seeds typically germinate on the 15th day after sowing and take 25 days to complete germination. Regular and efficient weeding is essential for successful production of good planting stock. Weeding should be a continuous process to keep the plants free from weed competition. Combining weeding operations with shifting can help reduce the cost of seedling production. Application of biofertilizers may enhance the quality of seedlings and reduce the nursery period.

Vegetative propagation

S. glauca can be propagated vegetatively using various methods such as stem cuttings, air layering, and grafting. Stem cuttings are the most commonly used method for vegetative propagation of Simarouba glauca (Kumar and Jha 2018). In this method, young, healthy, and disease-free shoots of about 20-25 cm long and 1-2 cm in diameter are selected as planting materials. The basal end of the cutting is treated with a rooting hormone and planted in a rooting medium consisting of a mixture of sand and soil or sand and vermiculite. The cuttings are then kept in a warm and humid environment until they develop roots, which usually takes about 2-3 weeks.

Air layering is another method used for vegetative propagation of *S. glauca*. In this method, a branch is selected, and a section of the bark is removed to expose the cambium layer. The exposed section is then treated with a rooting hormone and wrapped with moist sphagnum moss or a rooting medium. The wrapped section is then covered with a plastic sheet and tied securely with twine. After several weeks, roots will emerge from the exposed cambium layer, and the branch can be cut and planted in a suitable medium.

Grafting is also a viable method of vegetative propagation of *S. glauca*. It involves joining a scion of the desired cultivar with a rootstock of a related species. The scion and the rootstock are joined together using a grafting technique such as cleft grafting or whip grafting. The grafted plant is then grown in a suitable medium until it establishes itself. This method is commonly used to propagate specific cultivars with desirable traits.

***In vitro* propagation**

The process of in-vitro regeneration for *S. glauca* involves using shoot tips and axillary buds as explants. The explants are surface sterilized using mercuric chloride for a specific duration. For shoot tip explants, treatment with 0.1% mercuric chloride for 4 minutes resulted in 80% aseptic culture establishment, while for axillary buds, treatment with 0.1% mercuric chloride for 5 minutes resulted in 80% aseptic culture establishment. For callus induction, MS + 2,4-D (5 mg/L) was found to be the best medium. The callus changed color from white to yellow and maintained a compact texture. The optimal medium for shoot regeneration was found to be MS + BAP 4 mg/L + IAA 0.5 mg/L, which required the least amount of time for establishment (36.80+0.23 days) and resulted in good growth of shoot tip explants. To manage the absorption and oxidation of phenolic substances, charcoal and ascorbic acid were found to be effective. During primary hardening, soil rite was found to be superior to pot mix 1:1:1 (fine sand: clay: FYM) with a survival rate of 62.96%. During secondary hardening, 72.00% survival rate was achieved with fair growth of plantlets (Dudhare *et al.,* 2014).

Insect pests and diseases

Generally, cattle and goats do not browse *S. glauca*, and no major pests and diseases are recorded in its native and Indian conditions (Armour, 1959). However, the almond moth *Ephestia cautella* is a pest on stored decorticated seeds (Cucker *et al.,* 1958). Mites (*Eutetranychus* sp.) may attack *S. glauca*, seedlings, and the bark feeder *Inderbela* sp. has been observed on some plants. In the nursery, seedlings may be affected by damping off caused by *Pythium* sp. and wilt caused by *Fusarium* sp. These diseases can be controlled with commercial fungicides (Joshi and Hiremath 2000). Sooty mold Capnodium species has been reported on the "honey" deposited by scale insects and aphids, with several species of scale insects attacking young growth, most commonly *Tolumeyella* sp. This pest can be controlled by using a mixture of 50% malathion at the rate of 1% in water. The larva of threadworm (*Atteva ergatica* walshm) can feed on growing tips and

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particularly among panicles of male flowers, weaving intricate webs. These insects can be controlled using a 5% DDT spray or Toxaphene at 20%. Scale insects, such as Chianapsis species and Ceroplastes species, may also attack young trees, and the mites (*Brevipalpus phoenicus* Geijskes) may induce the proliferation of apical buds, causing a "witch's broom" effect on terminal shoots, which seriously reduces fruiting. Control measures using common miticides have not yet proved effective.

Planting techniques and post planting operation

S. glauca seedlings aged between 30-45 days are ideal for transplanting, and early planting during mid-June with the onset of monsoon ensures better post-monsoon growth in the field. Late planting can inhibit growth due to the short rain season or aberrant weather conditions. *S. glauca* is mostly planted in wasteland and degraded forest land with poor soil conditions for soil conservation and afforestation programs. It prefers well-drained soils with a pH range of 5.5 to 7.5. Although it can be grown on a wide range of soils, growth and yield are better on fertile soils. The best time for planting *S. glauca* is at the beginning of the rainy season. Seedlings can be raised in a nursery and transplanted in the field or directly seeded in the field. In general, seedlings are preferred over direct seeding for better survival rates.

The recommended spacing for *S. glauca* varies depending on the planting objective. For timber production, a spacing of 3 x 3 or 4 x 4 m is recommended, while for oil production, wider spacing of 6 x 6 m or 7 x 7 m is preferred. In the case of *S. glauca*, stumps prepared from 10-12 months old plants with 2.5 cm of shoot and 20 cm of root have been found to give good establishment. This method is particularly recommended for moist localities, as it helps to conserve soil moisture and reduce water stress on the young plants. Weeding is an essential operation during the first few years after planting to ensure that young trees have access to sufficient light, water, and nutrients. Weeds can be controlled mechanically or chemically. *S. glauca* responds well to fertilization with nitrogen, phosphorus, and potassium. The fertilizer application rate and timing depend on soil fertility, tree age, and growth rate. Pruning can help shape the tree, improve wood quality, and increase timber yield. Pruning is usually done in the early years of the tree's growth.

Agroforestry practices

In the first 3-4 years, during the pre-bearing period, traditional crops of the area may be grown as intercrops. Intercropping with suitable systems can make *S. glauca* cultivation less risky for growers and provide some income until the main crop starts bearing. Short-term annual crops such as soybean, sunflower, groundnut, and pulses are suitable as intercrops.

Tree improvement

Tree improvement programs for *S. glauca* have been conducted in various countries, including India. The Central Research Institute for Dryland Agriculture (CRIDA) has been working on the genetic improvement of *S. glauca* since the 1990s. CRIDA has developed and released several high-yielding varieties of Simarouba glauca, including CRIDA 1, CRIDA 2, CRIDA 3, and CRIDA 4. These varieties have been shown to have higher oil content and yield than the local landraces, making them more suitable for commercial cultivation. In addition to breeding for higher productivity, CRIDA has identified sources of resistance to stem borer (*Atractomorpha crenulata*) in Simarouba glauca germplasm and developed breeding strategies for incorporating this resistance into high-yielding varieties (Thakur et al., 2013). This research could help to reduce the use of chemical pesticides and make *S. glauca* cultivation more sustainable (Bhadane and Wadikar 2015). Study conducted by researchers at the Indian Council of Agricultural Research (ICAR) evaluated the genetic diversity of *S. glauca* populations from different regions of India using molecular markers. The results of this study indicated that the populations had moderate levels of genetic diversity, suggesting that there is potential for further genetic improvement through breeding programs (Kumar and Singh 2019).

Several studies have been conducted to assess the potential of *S. glauca* for biofuel production. A study by Subramanian *et al.* (2014). Sureaded that *S. glauca* cultivation could generate higher net returns than traditional crops such as sugarcane and cotton. Another study by Shukla *et al.* (2017) investigated the potential of *S. glauca* oil as a biodiesel feedstock. The study found that *S. glauca* oil has a high cetane number and good oxidative stability, indicating its potential as a biodiesel feedstock. In addition, a study by Bhatnagar *et al.* (2016) evaluated the use of *S. glauca* oil as a blend with diesel fuel in a diesel engine. The study found that the blend of *S. glauca* oil and diesel fuel resulted in lower emissions and improved engine performance. These studies demonstrate the potential of *S. glauca* as a biofuel feedstock and highlight the importance of further research in this area.

Utilization

S. glauca is known for producing edible oils from its seeds, and various parts of the tree are used to treat different ailments. The plant contains several essential phytoconstituents of major pharmacological significance. Pharmacological reviews have shown its medicinal value, and demonstrated therapeutic qualities such as analgesic, antimalarial, antimicrobial, antitumor, antiulcer, hypoglycemic, insecticidal, stomachic, and vermifuge properties. Several medically active compounds have been found in the plant, with the group of triterpenes called quassinoids being the most active compound. Further research on these plants can conclude that these new pharmacophores can be beneficial for improving human health and combating several other disorders (Hussain *et al.,* 2021).

Chemical Constituents

S. glauca contains alkaloids with elevated cytotoxicity and quassinoids with influential antifungal properties. Triterpenes, useful in the cure of amoebiasis, diarrhea, and malaria, are present in the bark and leaves of SG. Quassinoids have demonstrated positive anti-tumor activities and are the bitter values of the plant family of Simaroubaceae (Mathew *et al.,* 2019). *S. glauca* contains 11 therapeutically essential quassinoids and other active ingredients such as alkaloids, cardenolides, flavonoids, fixed oil, glycosides, phenolic compounds, and saponins. Tirucalla, sitosterol, simarubolide, simarolide, simaroubidine, melianone, holacanthone, glaucarubolone, glaucarubinone, dehydroglaucarubinone,

canthin, benzoquinone, and ailanthinone are major active components in the *S. glauca* (Jach *et al.,* 2000).

Nutritive value

S. glauca is indeed a good source of carbohydrates, fatty acids, lipids, and proteins. The seeds of *S. glauca* have been found to contain up to 55% oil, which is a rich source of oleic, palmitic, and stearic acids. The kernels of the seeds are also a good source of essential amino acids such as leucine, lysine, and valine, with an average protein content of 51.8g/100g. (Jose *et al.,* 2019). However th oil is not edible.

Pharmacological activity

In vitro studies have shown that *S. glauca* contains crystalline glycosides that exhibit amoebicidal properties against *Entamoeba histolytica* (van Assendelft *et al.,* 1956). The leaves of *S. glauca* also exhibit potential antibacterial properties against both Gram-positive and Gram-negative bacteria, including *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*, as indicated by fresh and dried extract studies (Rajurkar, 2011). *S. glauca* also shows significant anticancer activity, with several species within the Simaroubaceae family exhibiting tumor-suppressive properties. Additionally, *S. glauca* exhibits antifungal properties against several fungi, with extracts from this plant being more effective than *Fusarium oxysporum* against *Aspergillus parasiticus*. Notably, ethanolic extracts from fresh leaves exhibit higher efficacy against fungal growth compared to methanol extracts from fresh leaves, as determined by the agar well diffusion process (Mikawlrawng *et al.,* 2014).

Biodiesel

A two-stage esterification process was used to produce the oil, using concentrated sulphuric acid and sodium hydroxide as catalysts. The resulting biodiesel was then blended with diesel in various proportions, and its thermo-physical properties were characterized using chromatographic and spectroscopic techniques. The performance and emission characteristics of the biodiesel were evaluated in a single-cylinder direct injection diesel engine. The free fatty acid content of the oil was reduced from 3.5% to 0.2%, indicating good potential for use as a diesel substitute. The performance and emission characteristics of Simarouba seed oil were found to be comparable to diesel, and met the limits prescribed in the ASTM D6751, BIS, and European standards.

All parts of this plant are useful in one way or another. The seeds are especially important, as they contain 60-70% oil (Joshi and Hiremath). Each well-grown tree can yield 15-30 kg of nutlets, which is equivalent to 2.5 to 5.0 kg of oil, and about the same quantity of oil cake (Kaul et al., 2003). The annual returns in kg/ha from a moderately well-managed 10-year-old plantation of Simarouba is as follows: oil (1000-2000), oil cake (1000-2000), fruit pulp (8000-10000), leaf litter (10000-15000), and shell (4500-9000) (Joshi and Joshi, 2002).

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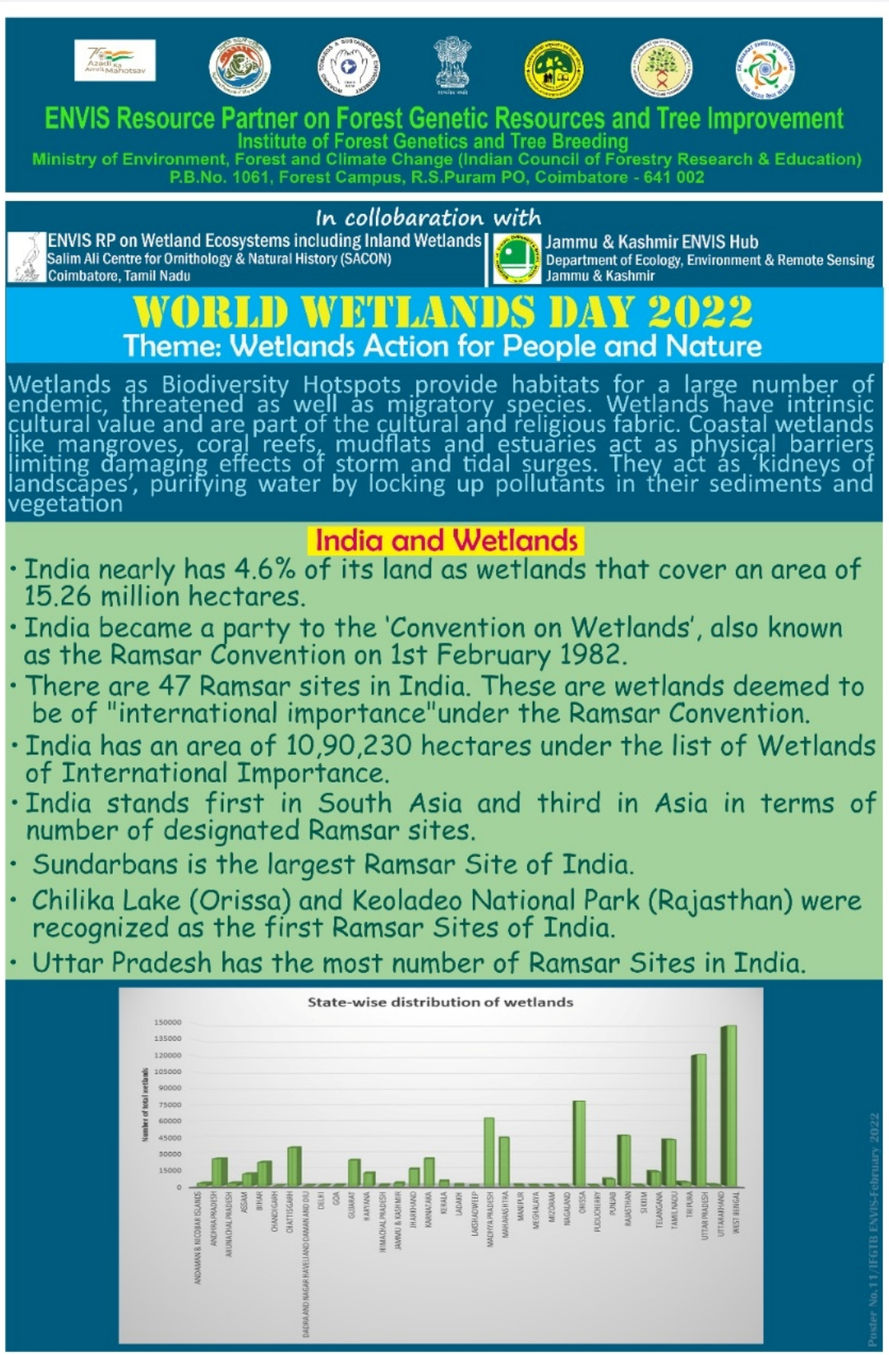
World Wetlands Day 2023 Celebrations

As a part of AzadiKa Amrit Mahotsav (AKAM), Ek Bharat Shreshtha Bharat (EBSB) and Mission LiFE, EIACP (Environmental Information, Awareness, Capacity Building and Livelihood Programme) Programme Centre (erstwhile IFGTB ENVIS) RP at the ICFRE - Institute of Forest Genetics and Tree Breeding, Coimbatore commemorated World Wetlands Day 2023 by organizing an awareness campaign. The campaign's primary goal is to raise awareness of the importance of wetlands among students and the general public. As a part of this commemoration, an online awareness quiz was also conducted to peoples of all walks of life from 18.01.2023 to 02.02.2023. Both the events were registered in the worldwide events organized by World Wetlands Authority (www.Ramsar.org). Dr C Kunhikannan, Director, ICFRE -IFGTB inaugurated the campaign and released the awareness poster. Participants from different walks of life participated in the online awareness quiz and E Certificate awarded to all the participants. An awareness poster highlighting the significance of wetland restoration was released during the occasion and were shared with all the stakeholders. Awareness handouts were disseminated to school children and the general public.

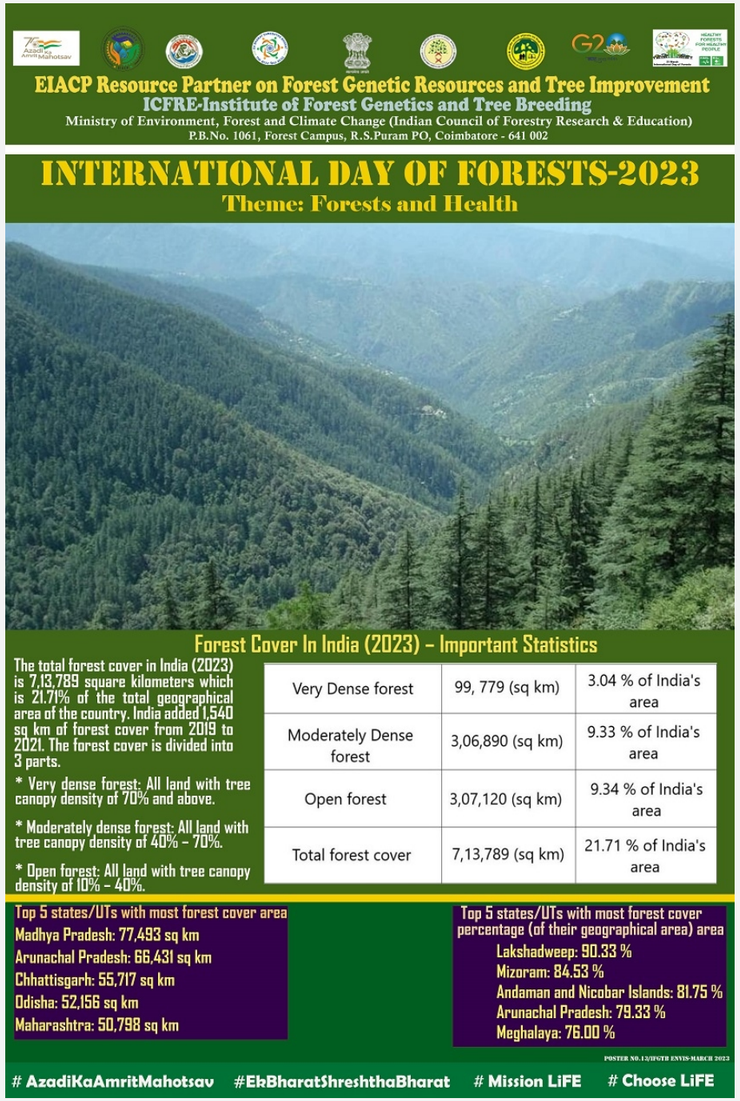
T. Vamadevan, S. Vigneswaran
and Rekha R. Warrier
ICFRE - Institute of Forest Genetics
and Tree Breeding, Coimbatore



International Day of Forests 2023 Celebrations

As a part of AzadiKaAmritMahotsav (AKAM), Ek Bharat Shreshtha Bharat (EBSB) and Mission LiFE, EIACP (Environmental Information, Awareness, Capacity Building and Livelihood Programme) Programme Centre (erstwhile IFGTB ENVIS) RP at the ICFRE - Institute of Forest Genetics and Tree Breeding, Coimbatore commemorated the International Day of Forests 2023 by organizing a tree sapling planting programme. The main aim of this event was to create and spread awareness about the importance of tree planting and role of individuals in protecting the environment from degrading by planting indigenous trees. Dr C Kunhikannan, Director, ICFRE -IFGTB inaugurated the programme. Saplings of various indigenous medicinal and timber tree species like *Ficus racemosa* (Athi), *Terminalia arjuna* (Neermaruthu), *Magnolia champaca* (Senbagam), *Mimusops elengi* (Magilam), *Calophyllum inophyllum* (Punai), *Bischofia javanica* (Shola vengai), *Syzygium cumini* (Naval), , *Simarouba glauca* (Sorgamaram) and *Atrocarpus hirsutus* (Pala) etc. were planted in the Botanical Garden by officers, staff members, scholars and interns of ICFRE-IFGTB.

An awareness poster highlighting the significance of forests was released during the occasion and were shared with all the stakeholders. Awareness handouts were disseminated to school children and the general public.



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1.	Clones of Casuarina Hybrids (CH-1, CH-2 & CH-5)	Rs. 4.50 per plant		**Smt. K. Shanthi, CTO,** Division of Plant Biotechnology, Phone : 0422 2484122 E-mail : shanthik@icfre.org
	Eucalyptus clones (EC-4, EC-6, EC-9 & EC-11)	Rs. 4.00 per plant		
2.	Tissue Culture Teak Plants Bomboo Plants	Rs. 55.00 per plant Rs. 25.00 per plant		**Dr Rekha R. Warrier,** Scientist - F & Head, Division of Chemistry & Bioprospecting Phone : 0422 2484167
3.	Windbreak Clones (WBC-1, WBC-2, WBC-3 & WBC-4)	Rs. 4 per plant		**Dr. C. Buvaneswaran,** Scientist - G, Sliviculture & Forest Management Division, Phone : 0422 2484198, 94422 45047 E-mail : buvanesc@icfre.org
4.	ArborEasy® DNA Isolation Kit **Pack Size**	**Price Rs.**	**Packaging & Transportation Rs.**	**Dr. Modhumita Dasgupta,** Scientist - G, Division of Plant Biotechnology Phone : 0422 2484115 E-mail : ghoshm@icfre.org gmodhumita@gmail.com
	10 Reactions	950.00	150.00	
	20 Reactions	1900.00	200.00	
	50 Reactions	4750.00	300.00	
5.	Soil Testing (pH, EC, OC, Micro and Macro Nutrients)	Rs. 4750.00		**Dr. A.C. Surya Prabha,** Scientist - D, Sliviculture & Forest Management Division, Phone : 0422 2484150 E-mail : acsuryaprabha@icfre.org
6.	Phytosanitary Certificate	Rs. 100.00 + Tax per application		**Dr. John Prasanth Jacob,** Scientist - G, Forest Protection Division, Phone : 0422 2484157 E-mail : jacob@icfre.org
Products of IFGTB: For Sale & Booking				
7.	Hy-Act (Natural and Seed Oil Based Biopesticide)	Rs. 80.00 per bottle		**Dr. N. Senthilkumar,** Scientist - F Phone : 0422 2484193 Mobile : 9629160703 E-mail : senthilnk@icfre.org (or) **Smt. R. Sumathi,** CTO Division of Chemistry & Bioprospecting, Phone : 0422 2484144 Mobile : 9942245542 E-mail : sumathir@icfre.org
	Tree PALH (Natural and Seed Oil Based Biopesticide)	Rs. 80.00 per bottle		
	Crawl clean (Plant Based Green Insecticide)	Rs. 25.00 per packet		
	Tree Rich Biobooster (Instant Organic potting mixture for home garden, terrace and kitchen garden)	Rs. 50.00 per packet		
	Tara Red Jam (with natural fruit colorant)	Rs. 60.00 per bottle		