Simarouba – A potential oilseed tree

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Simarouba glauca is a versatile multipurpose tree which can grow well even in the degraded soils. It can adapt to a wide range of temperatures (30–45°C) and altitudes (up to 1000 m above sea level). This tree has got the potentiality to produce 2000–2500 kg oil/ha/year. The oil contains about 63% unsaturated fatty acids and it is fit for human consumption. This oil is also used in the manufacture of soaps, lubricants, paints, cosmetics, etc. The nitrogen-rich oilcake is a good organic manure. The leaf and bark have got medicinal value. The wood is generally insect-resistant and is used for manufacturing light furniture, toys, paper pulp, etc. This evergreen tree can check soil erosion and helps in wasteland reclamation. For a long-term strategy, cultivation of Simarouba is advocated in the abundantly available marginal lands/wastelands to overcome the oil shortage and its implementation shall be economically viable and ecologically sustainable.

With the increase in the country’s population accompanied by the improvement in the general living standards, the demand for edible/industrial oils has eventually exceeded that of the supply. Since further horizontal expansion of oilseed cultivation in arable land (now it is in about 26.5 million hectares) is bound to adversely affect the production of essential food crops, presently efforts are made for vertical growth by improving the productivity of the existing potential oilseed crops like sunflower, oilpalm, etc. However, this approach has its own limitations. While the productivity of sunflower is stagnated at 700 kg oil/ha, the area under oilpalm (productivity 4000 kg oil/ha/year) cultivation could not be expanded much because of the specific requirements of the crop. As a progressive step in the direction of self-sufficiency, there is a need to identify alternative oilseed plants/trees, which can be grown in wastelands. The introduction of Simarouba glauca DC (a native of El Salvador first introduced in NBPGR station at Amravathi, Maharashtra in 1966) (refs 1, 2), a versatile oilseed tree3,4 with a productivity potential as high as 2000–2500 kg oil/ha/year and with an ability to establish well even in marginal lands/wastelands with degraded soils (India has got 33 million hectares of wasteland) has given new hope for alleviating the shortage of edible oil/fat.

Botanical features

Simarouba glauca DC (Family: Simaroubaceae), commonly known as aceituno, Simarouba or tree of heaven, is a medium-sized evergreen tree (height 7–15 m) with tap root system and somewhat warty cylindrical stem. The alternate imparipinnate compound leaves have 13–23 shiny glaucous leaflets. The plants are polygamo-dioecious5 with about 5% of the population producing exclusively male flowers (staminate) and 40–50% producing mainly male flowers and a few bisexual flowers (andromonoecious), the remaining 40–50% producing only the female flowers (pistilate). Inflorescence is a panicle with ultimate branches bearing dichasial cymes. The plants are protandrous, flowering is annual beginning in December and continuing up to the following February. The trees start bearing when they are 4–6 years old (grafts begin to do so in 3–4 years) and attain stability in production after another 4–5 years. The drupelets (blackish-purple in pink genotypes and greenish-yellow in green genotypes) are ready for harvest by April/May.

Uses of Simarouba

All the parts of Simarouba are useful in some way or the other. However, in the present context the seeds are considered economically important as they contain 60–75% edible oil6 (Box 1) which can be used in the manufacture of vanaspati and/or margarine. From 1950 onwards, in El Salvador and other Central American countries the oil is marketed for edible purposes under the trade name Manteca Vegetal 'Nieve' and demand for the product has steadily increased7. As an industrial oil it is well-suited for the manufacture of quality soaps, lubricants, paints, polishes, pharmaceuticals, etc.

The oilcake being rich in nitrogen (7.7–8.1%), phosphorus (1.07%) and potash (1.24%) is a valuable organic manure. The shells (endocarp) can be used in the cardboard industry. They can also be pulverized and added to enrich the compost since they contain about
1.2% potash. Pulp (about 20 kg/tree/year) constituting about 60% of the fresh fruitlet by weight, contains about 11% sugars and it can be used for juice making or in the fermentation industry. Leaf litter (about 20 kg/tree/year) is a good feed for earthworms and it makes good manure. The leaf and the bark contain the chemicals helpful in curing amoebiasis, diarrhoea and malaria. Wood is light and generally insect-resistant, and hence useful in making light furniture, toys, packing material, pulp (for the paper industry) and matches. It makes a good fuel too. This eco-friendly tree with well-developed root system and dense evergreen canopy can efficiently check the soil erosion and environmental degradation. Thus, it is well-suited for wasteland reclamation and is ideal for watershed development.

Cultivation aspects

This tropical tree grows well up to 1000 m above sea level in all types of well-drained soil with pH 5.5–8.0.

However, a minimum of 1.0 m deep soil is preferred for its growth. It has established in places with 250 mm to 2500 mm annual rainfall and mean maximum monthly temperature going up to 45°C.
Simarouba seedlings are raised during April–June in polybags filled with nursery mixture. Seedlings older than two months are ready for transplanting. The grafts of elite lines or the apomictic seedlings with known sex should be preferred for planting to get higher and earlier returns.

In rainfed marginal lands/wastelands transplanting is done in the beginning of monsoon so that the plants can establish well by the end of the rainy season. In places with irrigation facility, planting may be taken up at any time of the year. The saplings/grafts are planted at an interval of 6.0–8.0 m in pits of 45 x 45 x 45 cm size half filled with top soil and 3–5 kg compost. The plants grow well with a protective watering of 2–5 l/week during the first summer. Regular weeding in the first two years of growth is recommended.

For effective pollination and good bearing, planting of andromonoecious and female plants in a 1:20 ratio in the right geometry is advocated or some selected female plants may be grafted with a few branches of high-yielding andromonoecious scions. The low yielders can successfully be converted into high yielders by grafting them in situ with the scions of high-yielding elite genotypes. By top working and crown grafting the male plants can successfully be transformed into females.

For harvesting, the productive branches with ripe fruitlets are shaken or beaten mildly with a stick and the fallen fruitlets are gathered. The drupelets can be dried before or after depulping in direct sunlight. After decorticating, the oil is extracted from the kernels by expellers in the existing conventional oil mills. The extracted oil is refined (no hydrogenation required)\(^4\), packed and marketed.

Major pests on Simarouba have not been recorded\(^4\). The almond moth, Ephesia cautella occurs as a pest on stored decorticated seeds\(^7\). In conditions at Bangalore the mites (Eutetranychus sp.) attacking the Simarouba seedlings and the bark feeder (Inderbela sp.) are noticed on some plants. They can be easily managed by adopting regular control measures. There are no serious diseases of Simarouba plants. In the nursery the seedlings are affected by damping off (caused by Pythium sp.) and wilt (caused by Fusarium sp.) diseases which are generally controlled by effecting proper drainage and application of commercial fungicides. The sooty mold (Capnodium sp.) is reported to occur on the ‘honey’ deposited by scale insects and aphids\(^4\). The cattle generally do not prefer to browse on this plant.

**Future prospects**

The demand projection of oils by the National Commission on Agriculture (NCA), India, for the year 2000 is about 10.16 million tonnes for edible and non-edible purposes while the production has stagnated at the level of 6.5 million tonnes (cost of one million tonne oil is about 2000 crore rupees). Thus a wide gap between the demand and supply of edible oils already exists which is feared to grow wider in the future. Hence an immediate concerted effort by the government, scientists, farmers and industrialists is needed for developing a long-term strategy and adopting a suitable technology to increase oilseeds production in the country. As most of the cultivable area is already occupied by the conventional crops, plant species which can come up under less favourable environmental conditions can only be considered to solve the problem. Thus, Simarouba, the versatile tree finds an important place in the oil production strategy of our nation. Following are the steps suggested as research and development alternatives.

1. Developing location-specific high-yielding Simarouba genotypes (varieties) and sourcing the right kind of planting material have to be taken up by the Agricultural Universities whereas demonstration projects and distribution to the growers may be done by the State Departments of Forestry, Horticulture and Agriculture and some non-governmental organizations.

2. Based on the experience gained from these projects, plans may be drawn for large-scale cultivation of Simarouba on a pilot basis in each state in the readily available millions of hectares of wasteland and barren hillocks spread all over the country. This will enable to realize the yield potential of Simarouba when grown on a large scale.

3. The government may have to shoulder the responsibility of transfer of technology through bodies like National Oilseeds and Vegetable Oil Development Board (NOVOD) and State Oilseeds Federation by organizing training programmes, seminars, etc. bringing together researchers, farmers and industrialists.

4. The government and non-governmental organizations involved in watershed development and afforestation may include Simarouba, the multipurpose tree, as a component in their developmental programmes.

There is a clear indication that Simarouba cultivation can make a significant contribution to the edible oil/fat economy of the country by raising the production as well as the productivity of oil. It also encourages the development of several ancillary industries (juice, vanaspathi, margarine, bakery, fertilizers, paints, soaps, pharmaceuticals, value-added products, etc.), promotes better employment opportunities to the people and checks the migration of wealth out of India. Its cultivation can be lucrative to both the growers and the industrialists. This eco-friendly multipurpose tree with adaptability to a wide-range of agroclimatic situations and with an inbuilt genetic potential to give high oil yields, is poised to become one of the very important
Cutaneous wound healing: Significance of proteoglycans in scar formation

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Proteoglycans (PGs), components of extracellular matrix (ECM), play an important role in modulating the structure and regulating the functions of the skin. The timely turnover of PGs influence the development and differentiation of cells. Wound healing also depends on the level of PGs which if not adequate leads to abnormal scars. The role of PGs in different phases of wound healing and their implication in the formation of abnormal scars and several other skin disorders are discussed in the present review.

PROTEOGLYCANS (PGs) comprise a part of the extracellular matrix (ECM) which participates in the molecular events that regulate cell proliferation, migration and adhesion. These processes are regulated by the interaction of PGs with other components which are mediated through the glycosaminoglycan (GAG) chains or through protein–protein interactions within the core proteins of the PGs. The protein core functions as a scaffold for immobilization and spacing of GAG chains. GAGs are linear polysaccharides where the inherent structural feature is a repeating disaccharide unit composed of uronic acid and hexosamine. There are four main types of GAGs, heparin/heparan sulphate, chondroitin/dermatan sulphate, keratan sulphate and hyaluronic acid. While chondroitin and dermatan sulphates consist of N-acetyl galactosamine and uronic acid, the keratan sulphate consists of N-acetyl glucosamine and galactose. The sugars in GAGs are sulphated either at the 4th or 6th position to varying degrees; an exception is non-sulphated hyaluronic acid which exists as a free glycosaminoglycan. Due to the water absorbing capacity, PGs occupy a large space and may fill most of the intercellular spaces. PGs play a critical role as shock absorbers in the umbilical chord in the embryonic stage and at every stage of development in different ways throughout the life span. They also play a vital role in cell proliferation, migration and adhesion. Thus PGs are found to be prominent molecules during wound healing through their influential role in cell–cell and cell–matrix interactions (Figure 1).

An attempt has been made in the present review to explore the role of PGs during wound healing. Their role in tumour invasion, aging, etc. has also been discussed.

Distribution of PGs in different layers of skin

The skin is the most affected organ following an injury. To understand the role played by PGs during wound