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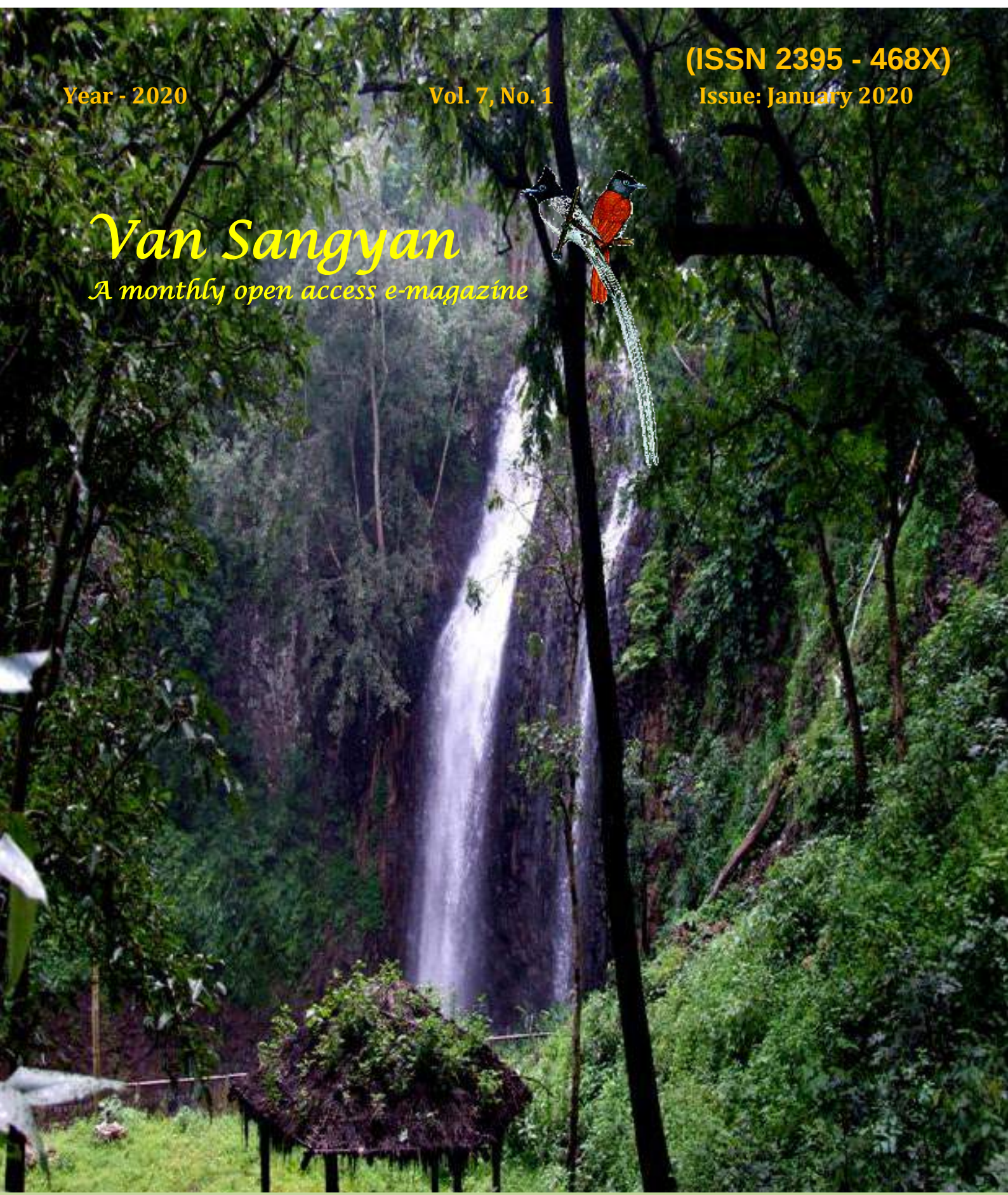

Van Sangyan

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Van Sangyan

Note to Authors:

We welcome the readers of Van Sangyan to write to us about their views and issues in forestry. Those who wish to share their knowledge and experiences can send them:

by e-mail to vansangyan_tfri@icfre.org

or, through post to The Editor, Van Sangyan,
Tropical Forest Research Institute,
PO-RFRC, Mandla Road,
Jabalpur (M.P.) - 482021.

The articles can be in English, Hindi, Marathi, Chhattisgarhi and Oriya, and should contain the writers name, designation and full postal address, including e-mail id and contact number. TFRI, Jabalpur houses experts from all fields of forestry who would be happy to answer reader's queries on various scientific issues. Your queries may be sent to The Editor, and the expert's reply to the same will be published in the next issue of Van Sangyan.

Cover Photo: Panoramic view of Achanakmar-Amarkantak Biosphere Reserve
Photo credit: Dr. N. Roychoudhury and Dr. Rajesh Kumar Mishra, TFRI, Jabalpur (M.P.)

From the Editor's desk

The ecology of the Himalayan region transforms as elevation increases. Tropical and subtropical broadleaf forests are found at the base of the mountains. Because of variation in topography, weather, soils, and rainfall, these forests range from dry tropical evergreen to northern wet tropical forests. This tropical region is also home to endemic wildlife, including Asian elephants, tigers, and hundreds of bird species. With further increases in elevation, tropical forests give way to temperate broadleaf mixed forests. Monsoons contribute substantial rainfall to these forests, supporting the growth of orchids, lichen, and ferns amidst a dominant canopy of oak (Quercus) and maple (Acer). Wildlife abounds within these forests, including golden langur monkeys and hundreds of bird species, many of which are endemic to the region.

Forests dominated by conifers such as pine (Pinus), hemlock (Tsuga), spruce (Picea) and fir (Abies) are found above the broadleaf forests. For coniferous species located within mountain valleys, surrounding peaks provide some protection from harsh conditions, albeit growing conditions remain difficult. Red pandas, takins and musk deer occupy this region. Once beyond the tree line there is incredible biodiversity within the montane grass and shrub lands. Montane grass and shrub lands generally occur at the highest livable plant zone, which is marked by intense winter temperatures but mild summer conditions. Alpine meadows with seasonally blooming flowers occupy the highest region above rhododendron and other comparable shrubs. Wildlife at this high elevation includes snow leopards, Himalayan tahr, musk deer and pikas.

Some of the most common natural disturbance regimes for the forest regions of the Himalayas include glacial activity (most recently glacial retreat), floods, avalanches, rock falls, and earthquakes. The Hindu Kush region of Afghanistan is especially active and prone to earthquakes. Steep slopes throughout the region amplify the results of tectonic activity and earthquakes, often producing landslides. A tragic history of devastating earthquakes pervades the region, such as one that killed an estimated 10,000 people in northeast India and Nepal in 1934. Human activity both mitigates, as well as exacerbates, some of the disturbance regimes and subsequent impacts.

The Himalayas are one of the most distinctive regions on the planet. From the tallest peaks and active tectonics to a variety of ecosystem and endemic species, the impressive geology of the region is coupled with remarkable biodiversity. The confluence of multiple nations in the Himalayas adds layers of social and cultural diversity. Visit our pages below as we explore the questions of how to meet growing population and resource needs within this highly unique region, specifically regarding the use, role, and importance of forests.

In line with the above this issue of Van Sangyan contains an article on Ficus auriculata: an important tree of Western Himalaya with high fodder value. There also useful articles viz.. राजस्थान के शुष्क भागो की प्रमुख वनस्पतियाँ. Eucalyptus and gall insect, Leptocybe INVASA, Wild Edible Mushrooms become invisible from Adivasi kitchens, DNA Profiling in Timber Forensics and Bamboo based Multipurpose Windbreak – An Effective Measure for Reduction of Wind Disaster in Tripura

I hope that readers would find maximum information in this issue relevant and valuable to the sustainable management of forests. Van Sangyan welcomes articles, views and queries on various such issues in the field of forest science.

Looking forward to meet you all through forthcoming issues

Dr. Pawan Rana
Scientist 'E' & Chief Editor

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Ficus auriculata: an important tree of Western Himalaya with high fodder value

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Introduction

Ficus auriculata Lour. (Synonym: *Ficus roxburghii* Wall.; Family: Moraceace) is an important indigenous fodder tree of Western Himalaya. It is an evergreen small tree with spreading crown and attains almost 12 m height. It is found growing right from foothills to mid & high hills of Himalaya between altitudes 900 to 2000 m amsl on moist, organic matter rich sandy loam soil (pH 5.5 to 6.5). It is locally called as timal, timbal, tiryamal, tremal etc. Mean annual temperature in its distribution zone ranges between 15 – 25 °C and mean annual rainfall ranges between 1,200 - 1,900 mm. Besides Indian Himalayan region, it also grows in Nepal, Bhutan, South China, Myanmar and Thailand. Its leaves are ovate –cordate, large sized (15–55 × 10–27 cm), thick, borne on 10–15 cm long thick petiole and are visible from long distance. Branches and leaves appear on upper portion of the stem and lower portion is devoid of branches and leaves. Trees are dioecious; bears reddish brown pear shaped fruits; flowering occurs in March to May and fruiting during June to July month. Stem of *F. auriculata* is grayish brown and rough textured. It is a multipurpose tree species as its leaves, wood, fruits and bark is utilized for various purposes in Western Himalaya and most importantly it is a highly nutritive tree fodder of Western Himalaya.

Utilization

In Western Himalaya *F. auriculata* is utilized in following ways:

Fruits as nutritionally rich food

Tasty and juicy fruits of *F. auriculata* are relished by local people as they are considered very nutritious and have medicinal value. Fruits are also made into pickle and vegetables and are rich in minerals with 5.3 % crude protein; 27.09 % carbohydrates, 1.35 mg/100gm calcium, 0.90 mg/100gm magnesium, 2.11 mg/100gm potassium and 0.28 mg/100gm phosphorus (Saklani and Chandra, 2012). Beside this, fruits of this tree act as a food for wild animals especially monkeys, Himalayan bear and birds.

Fodder

Tree leaves are source of excellent quality fodder and are utilized during the dry winter season i.e. October to May. Tree is evergreen so leaves can be exploited throughout the year for fodder usage.

Dining plates and Bowl

Its leaves are utilized for making traditional dining food plates/Pattals and bowls/Dona for utilization during social gathering, functions and festivals on local scale. Thus, leaves of *F. auriculata* can be collected, dried and machine compressed to make durable biodegradable dinning

leaf plates and bowls. Moreover leaves of *F. auriculata* have medicinal values therefore are safe and good for human health. Besides this, its new leaves are made into vegetable and fritters.

Ethno-medicine

Leaves have ethno-medicinal value and leaf paste is used for healing of wounds, to treat diabetes, diarrhea and dysentery. Its stem bark has been proved to show antioxidant and antibacterial properties. Its roots in combination with roots of *Oroxylum indicum* are used to treat jaundice.

Fuel wood

Its branches and twigs are utilized as a fuel wood for cooking food in Himalayan households.

Agricultural tool

Its wood due to sufficient strength and being light weight are utilized to make traditional animal drawn wood land leveler and wooden paddy planters.

***F. auriculata* tree growing on field bunds in Himachal Pradesh**

Close up of *F. auriculata* tree

Leaf of *F. auriculata*

Traditional dining plate made from *F. auriculata* leaves

Traditional bowl/Dona made from *F. auriculata* leaves

Potential as a fodder tree in western Himalaya

Huge population of livestock (17165859) is present is Western Himalaya that requires large amount of quality fodder. Tree leaves; agricultural waste/residue; dried grasses are major source of fodder in Western Himalaya. During summer and rainy season fodder is readily available in the form of grasses but non availability of sufficient amount of fodder especially green fodder during winter season is major hurdle in sustaining livestock. During winters tree leaves are only source of green fodder in Western Himalaya but most of tree are leafless during winters therefore limited tree can be utilized for collecting green fodder. Thus evergreen tree species like *F. auriculata* are important to sustain fodder supply during winter. In addition to this, tree leaves are more palatable, rich in crude protein as well as minerals and this content show less seasonal variation in comparison to grasses.

Therefore *F. auriculata* is a potential fodder tree of Western Himalaya and its leaves are given to cattle and goats as green fodder during winter season. Studies revealed that the leaves of *F. auriculata* trees growing on high altitude have higher amount crude protein thereby are superior to those of growing in lower altitude. Moreover, it can be grown from foot hill areas to 2000 m amsl in western Himalaya.

Following characteristics make it potential source of nutritious green fodder

1. Round the year presence of large and highly palatable leaves.
2. Low cellulose and lignin content in leaves.
3. High dry matter digestibly in comparison to other local fodder trees.
4. High leaf biomass production (green: 44 kg per tree per year) on maturity.
5. High mineral and crude protein content (Table 1)

Leaves of *F. auriculata* can be harvested round the year and mixed with the dry fodder for supplying nutritional feed to livestock. In Himalaya trees of this species are lopped at 30-40% sometimes completely during winters to extract green fodder. *Ficus auriculata* leaves supplementation to livestock has also been proved to increase dry matter intake and live weight gains (Pearson, 1990).

Table 1. Fodder quality traits of *Ficus auriculata* leaves

Traits	Content (Dry Matter Basis)
Dry matter	34.22%
Organic matter	83.78%
Total ash	16.22%
Nitrogen free extract	50.16%
Total carbohydrate	68.35%
Ether extract	3.74%
Crude protein	14.27%
Neutral detergent fiber	47.17%
Acid detergent fiber	34.00%
Crude Fiber	16.98%
Calcium	6.21%
Potassium	1.54%
Phosphorus	0.49%
Copper	19.07 ppm
Iron	681.41 ppm
Manganese	70.36 ppm
Digestibility coefficients	
Dry matter digestibility	73.21%
Crude protein digestibility	80.22%
Neutral detergent fiber digestibility	74.58%
Acid detergent fiber digestibility	74.55%
Lignin digestibility	74.94%
Calcium digestibility	85.34%
Phosphorus digestibility	74.14%
Anti nutritional compounds	
Phenols	6.93%
Tannin	4.28%
Saponin	12.61%
Hydrocyanic acid	0.03 mg per 100 g
References: Ostil et al. 2009 and Navale, 2017	

Propagation and leaf biomass production potential

Poor seed production resulting due to fruit collection in this tree species impacts its natural regeneration, however birds eating its fruits do ensure natural regeneration but on small scale. Therefore thick branch cuttings (1.25-2.5 cm diameter) from mature tree are collected in spring season and then they are treated with IBA 100 ppm to give best rooting, growth and establishment (Rana and Sood, 2012). On maturity single tree can provide 44 kg fresh yield of fodder per year (Roder and Gyeltshen, 2003).

Way forward to utilize this tree for sustaining fodder supply in western Himalaya

- This species should be promoted for cultivation on farm bunds to sustain green fodder supply.
- Agricultural border land areas should be planted with this species along with other fodder tree species to sustain quality fodder supply round the year.
- Plantation of this tree species should be promoted on Grazing lands locally called as "*ghasnis"*
- Appropriate lopping cycle and intensity should be identified to utilize this tree efficiently without hampering its regeneration.

Conclusion

Ficus auriculata is an important multipurpose tree species of Western Himalaya with high fodder value. As we know that Himalayan region is facing shortage of quality green fodder especially during winter season therefore promoting this evergreen tree for supplying round the year quality fodder should be focused on to sustain livestock in Western Himalaya.

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References

Kumari A, Verma R, Sharma M, Chauhan P and Kumar A. 2018. Evaluation of Phytochemical, antioxidant, antibacterial and anticancerous activity of *Ficus auriculata* Lour. and *Osyris wightiana* Wall. ex Wight *Bulletin of Environment, Pharmacology and Life Sciences* 7 (8): 64-70

Navale M R.2017.Comparative analysis of important fodder tree species of north western mid-Himalayan ecosystem for nutritive value, palatability and leaf biomass production. Doctoral Thesis. Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan.

Ostil NP, Chapagain PB, Tiwari MR and Upreti CR. 2009 Digestibility of *Ficus roxburghii, Castanopsis indica* and *Ficus cunia* on growing buffalo from western hills of Nepal. *Nepal Agricultural Research Journal* 9:94-98

Pearson RA. 1990. A note on live weight and intake and digestibility of food by draught cattle after supplementation of rice straw with the fodder tree *Ficus auriculata*. *Animal Production*: 51: 635-638 doi:10.1017/S000335610001268X

Rana RS and Sood KK. 2012. Effect of cutting diameter and hormonal application on the propagation of *Ficus roxburghii* Wall. through branch cuttings. *Annals of Forest Research* 55(1): 69-84

Roder WR and Gyeltshen T. 2003. *Ficus auriculata* – its relative importance in Bhutan, farmers' preference and fodder quality. *Agroforestry Systems* 57: 11

Saklani S and Chandra S. 2012. In-vitro antimicrobial activity, nutritional profile and phytochemical Screening of wild edible fruit of Garhwal Himalaya (*Ficus auriculata*) *International Journal of Pharmaceutical Sciences Review and Research* 12 (2) 61-64

राजस्थान के शुष्क भागो की प्रमुख वनस्पतियाँ

सौरभ दुबे एवं नाहर सिंह मावई

उष्णकटिबंधीय वन अनुसंधान संस्थान

जबलपुर (म.प्र.)

राजस्थान राज्य भारत मे क्षेत्रफल की दृष्टि से सबसे बडा राज्य है। यह न केवल अपनी कला, संस्कृति, त्यौहारो व इतिहास के लिये जाना जाता है, वरन् यहाँ की वानस्पतिक संपदा भी अपने आप मे बहुत ही अनूठी है। रणथंभौर और सरिस्का बाघ आरक्षित क्षेत्र व केओलादेव पक्षी विहार जैसे प्राकृतिक वन्य जीव शरण स्थल भी यहाँ मौजूद है। एक तरफ जहाँ इस राज्य मे विश्व के सबसे पुराने पर्वतो मे से एक अरावली पर्वतमाला है, वही इसके पश्चिमी भाग मे विश्व के सबसे बड़े रेगिस्तानो मे से एक थार मरुस्थल स्थित है। ग्रेट इंडियन डेजर्ट के रुप मे प्रसिद्ध थार मरुस्थल में वर्षा का वार्षिक औसत बहुत ही कम है, जो इसकी भौगोलिक बनावट और वानस्पतिक विविधता व उपलब्धता को प्रभावित करता है। राज्य मे प्रमुख रुप से शुष्क पतझड वाले वन व उसके उप प्रकार तथा कँटीले वन आदि पाये जाते है। रेगिस्तान और कम वर्षा वाले इस प्रदेश मे अनेक प्रकार के कठोर जीवट वाली वनस्पतियाँ पायी जाती है, जिन्होने शुष्क मौसम मे जीवित बचे रहने के लिये कँटीली शाखायें, छोटी पत्तियाँ या पत्र विहीनता, गहराई तक जाने वाली लम्बी जडे जैसे अनेक अनुकूलन विकसित कर लिये है। गर्मी व सूखे मौसम मे भी अपने आप को जीवित व हरा – भरा बनाये रखने मे सक्षम यह वनस्पतियाँ कठोर मौसम मे भी मनुष्यों तथा पशुओ के लिये भोजन व चारा उपलब्ध कराती है। इनमे सबसे प्रमुख खेजडी का वृक्ष है जिसे राजस्थान मे बहुत सम्मान प्राप्त है साथ ही साथ कीकर, रोहिडा, कैर, बेर व हिंगोट आदि प्रमुख है। इन शुष्क इलाको मे पेडो तथा झाडियो की ऊँचाई कम होती है, और वनस्पतियाँ

रुखे तने, क़ाँटेदार शाखायें, पत्रविहीन या छोटे पत्रो से युक्त होती है, जो गर्म वातावरण के कारण होने

वाली पानी की क्षती को रोकने मे सहायता करती है।

खेजडी: (*Prosopis cineraria*)

खेजडी मध्यम आकार का पर्णपाती वृक्ष है, जो लगभग 5 मी. की ऊँचाई तक बढ़ सकता है। शाखाये छोटी पत्तियो तथा क़ाँटो से युक्त होती है। पत्तियाँ डंठल के दोनो तरफ समान रुप से होती है। वृक्ष मे आने वाली फलो को साँगरी कहाँ जाता है, तथा इसे राजस्थान मे बहुत रुची से सब्जी के तौर पर खाया जाता है। पत्तियाँ पशु चारे और लकडी ईधन, फर्नीचर, कृषि उपकरण व गृह निर्माण सामग्री आदि के रुप मे प्रयुक्त होती है। जडे गहराई तक जामीन के अंदर जाती है। इस वृक्ष की उपस्थिती कम हुये भूजल स्तर को दर्शाती है। राज्य वृक्ष के रुप मे सम्मानित खेजडी के पेड को राजस्थान की सबसे महत्तवपूर्ण वृक्ष प्रजाति माना जाता है। सामाजिक, आर्थिक तथा धार्मिक महत्तव के इस वृक्ष को विश्नोई समाज के लोगो द्वारा बहुत संरक्षण प्राप्त है।

करील/कैर (*Capparis deciduas*)

करील शाखाओ की अधिकता वाली झाडी या कभी – कभी छोटे वृक्ष के रुप मे पाया जाता है। वर्षा के मौसम को छोडकर यह लगभग पत्र विहीन होता है। करील सूखे के मौसम मे भी आसानी से जीवित रह सकने मे सक्षम होता है, इसलिये यह मरुस्थल व शुष्क क्षेत्रो मे वनीकरण के लिये बहुत उपयुक्त है। नवम्बर से जनवरी के बीच मे इसमे लाल रंग के फूल आते हैं तथा इसके बाद फल लगते है, जो की कच्चे होने पर हरे तथा पकने पर गुलाबी – लाल रंग के हो जाते है। इसके फलो को विभिन्न प्रकार के पशु - पक्षी खाते हैं तथा स्थानीय लोगो भी इसके फलो

को अचार या अन्य रूप से खाने में तथा औषधी के रुप मे भी उपयोग करते हैं।

बेर (*Zizyphus mauritiana Lam.*)

बेर एक सदाबहार झाडी नुमा छोटा वृक्ष होता है जो 10 मी. से अधिक ऊँचाई तक बढ़ सकता है। इसकी शाखाऐ मुडे हुऐ काँटो व पत्तियो से युक्त होती है। पत्तियो की ऊपरी सतह चमकदार हरे रंग की होती है, जिनका उपयोग भेड व बकरियो के चारे के रुप मे किया जाता है। इसके गूदेदार फल आकार मे गोल – अंडाकार होते है, जिसकी ऊँपरी सतह चिकनी होती है। इसके खट्टे – मीठे फलो को कच्चा या धूप मे सुखाकर, अचार व अन्य तरीको

से खाया जाता है। इसकी काँटेदार झाडियो को पशु बाडो के चारो तरफ सुरक्षा दीवार की तरह लगाया जाता है।

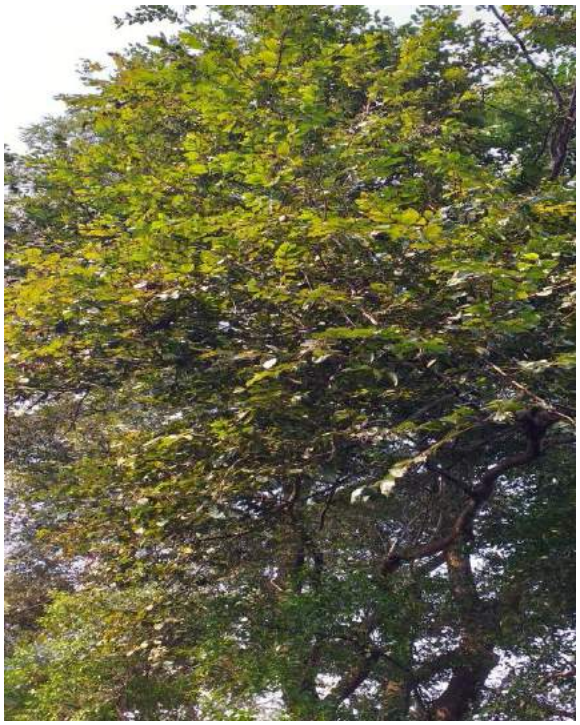
हिंगोट (*Balanites roxburghii*)

हिगोंट सामान्य रुप से 2.0 से 4.0 मीटर तक बढ़ने वाला झाडीनुमा छोटा वृक्ष है । इसकी शाखाओ पर छोटी पत्तियाँ तथा लम्बे हरे रंग के काँटे होते हैं। दिसम्बर से जुलाई इसके पुष्पन व फलो के लगने का समय होता हैं। हिगोंट के फल पीले भूरे रंग के आवरण वाले होते है। हिंगोट के जड, तना, फल आदि का प्रयोग औषधीयो के रुप मे त्वचा, पेट दर्द जैसे विभिन्न रोगो के उपचार मे किया जाता है।

करधई (*Anogeissus pendula*)

यह एक सामान्य ऊँचाई वाला पर्णपाती वृक्ष है। शुष्क तथा गर्म इलाको के लिये यह बहुत अनुकूल वृक्ष प्रजाति है तथा चट्टानी इलाको मे भी यह

आसानी से पनपता है। इसकी छाल चिकनी तथा रंग धूसर रजत आभा लिये होता हैं । पत्तियो की सतह चिकनी होती हैं तथा पत्तियाँ पतझड से पहले



लाल – भूरी रंग की हो जाती है। इसमें मुख्यतः जुलाई से सितम्बर के महीनो में होता पीलापन

लिये हुये हरे रंग के छोटे फूल आते हैं। सूखे स्थानो में यह पशुओ के लिये चारे का प्रमुख स्त्रोत हैं। इसकी लकडी का उपयोग विभिन्न प्रकार के कृषि संबंधित सामान, फर्नीचर तथा जलाऊ लकडी मे किया जाता है।

बबूल (*Acacia nilotica*)

बबूल भारतीय उपमहाद्वीप सहित, अरब प्रायद्वीप, आफ्रीका आदि भागो मे पाया जाता है। 15 मी. से अधिक ऊँचाई तक बढ़ सकने वाले इस वृक्ष का तना तथा शाखाये काली रंगत लिये हुये होती है। पत्तियाँ डंठल के दोनो तरफ समान रुप से होती है तथा इसके फूल पीले रंग के होते है। ज्यादातर छोटे व कम ऊंचाई वाले पौधो मे लम्बे सफेदी लिये हुये काँटे लगे होते है, जो पौधे की पत्तियों को पशुओ द्वारा चराई से बचाते है। बबूल की मुलायम शाखाओ को टूथब्रश के रुप मे प्रयुक्त किया जाता है तथा इसकी मजबूत लकडी फर्नीचर आदि बनाने के कार्य मे उपयोग की जाती है। कँटीली शाखायें सुरक्षा बाढ़ के रुप मे उपयोग की जाती है तथा इससे प्राप्त होने वाली गोंद को औषधी के रुप मे प्रयुक्त किया जाता है।

संदर्भ

Blather, E. and Hallberg, F., 1984. The Flora of The Indian Desert: Pp – 28-29

https://en.wikipedia.org/wiki/Capparis_decidua

https://www.sahapedia.org/the-plants-of-the-thar-desert

http://www.nbrienvis.nic.in/WriteReadData/CMS/Anogeissus%20pendula.pdf

https://jaipurthrumylens.com/2015/04/11/anogeissus-pendula-tree/

https://shodhganga.inflibnet.ac.in/bitstream/10603/190683/12/12_chapter-3.pdf

https://www.gardenguides.com/100707-desert-plants-india.html

Eucalyptus and gall insect, *Leptocybe INVASA*

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Abstract

Blue gum chalcid wasp, *Leptocybe invasa* Fisher & LaSalle (Hymenoptera: Eulophidae), is a major gall making insect species of *Eucalyptus*, threatens seedlings in nursery stage and young plantation across the country. The present article succinctly describes outbreak of this gall forming insect species in *Eucalyptus*.

Key words: *Eucalyptus*, gall insect, *Leptocybe invasa*

Introduction

The genus, *Eucalyptus* belongs to the family Myrtaceae, a native of Australia, is an undisputed global leader among the exotic tree species. *Eucalyptus* is usually regarded as Australian tree, which has already reached in more than 110 countries (Tewari, 1992). The genus *Eucalyptus* includes about 600 species and varieties. *Eucalyptus* has come to stay in India as commercial crop and extensive plantations have undertaken to meet the demands of fuel wood, timber and pulpwood, in various parts of the country. The estimated area under *Eucalyptus* in India is about 25,00,000 ha (www.icfre.gov.in). Over 10,00,000 ha of *Eucalyptus* plantations have been established, mostly by State Forest Department and Forest Development Corporation. Apart from these, around 6,000 million seedlings have been planted in private lands (Sandhu, 1988). Some 170 species, varieties and provenances were tried in India (Bhatia, 1984), out of which the most outstanding and favoured has been the *Eucalyptus* hybrid, a form of *E. tereticornis*, known as Mysore gum. Other species which are grown on plantation scale are *E. camaldulensis*, *E. citridora*, *E. globulus* and *E. grandis*. The potential productivity of *Eucalyptus* is around five tons of biomass/ha/yr on an average, but the average production is some 2.5 tons/ha/yr (Palanna, 1996).

The first publications devoted to insect herbivores associated with *Eucalyptus* in Australia have written by French (1900) and Froggatt (1923). The diversity of insects associated with *Eucalyptus* in Australia's native forests is very large. The insect herbivory on *Eucalyptus* has been reviewed thoroughly by Ohmart and Edwards (1991). *Eucalyptus*, predominantly a native of Australia, has a very rich insect pest complex of about 400 insect species, comprising chiefly of 160 species of foliage feeders, 110 species of xylophagous borers, 76 species of sap-suckers, 32 species of timber borers and 22 species of miscellaneous insects (Tewari, 1992). In India, like other exotics, *Eucalyptus* also suffer in varying degree, from light to heavy mortality due to insect attack. Some of the native phytophagous pests, because of prolonged ecological association with *Eucalyptus*, over the years, have developed fancy for this exotic and have adopted *Eucalyptus* as a favourable hosts. As of today, about 70 species of insects have been found associated with different species of

Eucalyptus in India causing debility/injury in varying degree. Of these, stem and root borer and some species of termites have been recognized as key pests. Nair (2007) has mentioned 920 species of insects associated with *Eucalyptus* which is world total, including those from the temperate region. However, most of the insect fauna associated with *Eucalyptus* comprises only casual feeders, having little economic status (Nair et al., 1986). At present, the blue gum gall insect, *Leptocybe invasa* Fisher & LaSalle (Hymenoptera: Eulophidae) is perhaps the major pest problem to *Eucalyptus* in India. This insect seriously affects the seedlings and saplings. The present article deals with the outbreak of this gall making insect species in *Eucalyptus*.

Blue gum chalcid wasp, *Leptocybe invasa* Fisher & LaSalle (Hymenoptera: Chalcidoidea: Eulophidae)

Until recent years, *Eucalyptus* has been considered virtually free from serious insect pests in its home land and outside Australia. The *Eucalyptus* borer, *Phoracantha semipunctata* (Fabricius) (Coleoptera : Cerambycidae), is a minor pest attacking mainly drought weakened trees (Mendal, 1985). However, *Eucalyptus* in its new habitats has been under assault from a constant stream of specific phytophagous insect pests originated from their home land (Withers, 2001). Six species of gall making wasps have established themselves on *Eucalyptus* outside Australia, viz. *Quadrastichodella nova* Girault (Hymenoptera : Eulophidae), *Epichrysocharis burwelli* Schauff (Hymenoptera : Eulophidae), *Ophelimus eucalypti* (Gahan) (Hymenoptera : Eulophidae), *Aprostocetus* sp. (Hymenoptera : Eulophidae), *Nambouria xanthops* (Hymenoptera : Pteromalidae) and *Leptocybe invasa* Fisher & LaSalle (Hymenoptera : Eulophidae) (Mendal et al., 2004). It is interesting that several of these invasions have occurred since 1990.

Until the year 2000, *Eucalyptus* gall insect, *L. invasa* was unknown both in and outside Australia where this tree species has been introduced (Mutitu, 2003). *L. invasa* is a genus of tiny wasp responsible for gall formation in *Eucalyptus* (Mendel et al., 2004) (Fig. 1). This gall insect is native to Queensland, Australia, though its distribution is not yet determined (FPSP, 2012). This *Eucalyptus* gall insect has been first recorded in the Middle East during the year 2000 (Aytar, 2003). Currently, the wasp is reported from more than 27 countries, including India (Aquino et al., 2011, Roychoudhury, 2013).

In India, *L. invasa* has been first noticed in 2001 in Karnataka, and later in 2002 in Tamil Nadu and then, it has spread over to peninsular India (Jacob et al., 2007). In central India, it has been observed that *L. invasa* causes galls on the mid-ribs, petioles and stems of new shoots of *Eucalyptus* both in nurseries and young plantations, including coppice shoots (Roychoudhury et al., 2007) (Fig. 2). Heavy infestations can lead to deformed leaves and shoots, and retardation of growth. Serious damage to seedlings may lead to mortality in nursery stage. The outbreak of this exotic insect pest in peninsular India has concomitantly changed the scenario by affecting vast areas of *Eucalyptus* (Jacob, 2009). Entry of gall insect threatens *Eucalyptus* in nurseries and plantations across the country (Roychoudhury, 2013).

References

Aquino, D.A., Botto E.N., Loiacono M.S., Pathauer P. (2011). Avispa de la

agalla del eucalipto, *Leptocybe invasa* Fischer & La Salle (Hymenoptera : Eulophidae : Tetrastichinae), en Argentina. RIA, 37(2) : 159-164.

Aytar, F. (2003). Natural history, distribution and control method of *Leptocybe invasa* Fisher & La Salle (Hymenoptera : Eulophidae) in Turkey. J. DOA, 9 : 47-66.

Bhatia, C.L. (1984). *Eucalyptus* in India - its status and research needs. Indian Forester, 110(2) : 91-96.

Forest Pest Species Profiles (FPSP) (2012). *Leptocybe invasa*. Blue gum chalcid. Hymenoptera : Eulophidae. Available at: fao.org/forestry/13569-05912e0e2fe9054c3ed4904ae597e3310. pd

French, C. (1900). Handbook of the Destructive Insects of Victoria. Govt. Printer, Melbourne, 70 pp.

Froggatt, W.G. (1923). Forest Insects of Australia. Govt. Printer, Sudney, 107 pp.

Jacob, J.P. (2009). Invasive insect pest (*Leptocybe invasa*) in *Eucalyptus* plantations in India. ENVIS Forestry Bulletin, 9(1) : 65-70.

Jacob, J.P., Devaraj, R. and Natarajan, R. (2007). Outbreak of the invasive gall-inducing wasp, *Leptocybe invasa*, on eucalypts in India. Invasives, 8 : 4 -5.

Mendel, Z. (1985). Seasonal development of the eucalypt borer, *Phoracantha semipunctata* (Coleoptera : Cerambycidae) in Israel. Phytoparasitica, 14: 85-93.

Mendel, Z., Protasov, A., Fisher, N. and La Salle, J. (2004). Taxonomy and biology of *Leptocybeinvasa* gen. & sp. n. (Hymenoptera: Eulophidae), and invasive gall inducer on *Eucalyptus*. Australian Journal of Entomology, 43(2) : 101-113.

Mutitu, K.E. (2003). A pest threat to Eucalyptus species in Kenya. KEFRI Technical Report, 12 pp.

Nair, K.S.S. (2007). Tropical Forest Insect Pests : Ecology, Impact and Management. Cambridge University Press, 404 pp.

Nair, K.S.S., George, M., Varma, R.V. and Sudheendrakumar, V.V. (1986). Insect pests of *Eucalyptus* in India. In : Proceedings National Seminar on *Eucalyptus* in India : Past, Present and Future, pp. 325-335. Kerala Forest Research Institute, Peechi, Kerala.

Ohmart, C.P. and Edwards, P.B. (1991). Insect herbivory on eucalyptus. Annual Review of Entomology, 36 : 637-657.

Palanna, R.M. (1996). *Eucalyptus* in India. In : Reports submitted to the Regional Expert Consultation on Eucalyptus, pp. 46-57. Vol. II, RAP Publication 1996/44, FAO Regional Office for Asia and the Pacific, Bangkok.

Roychoudhury, N. (2013). Damage assessment of gall making insect species of eucalyptus and its management by pesticides. Project Completion Report submitted to Indian Council of Forestry Research and Education, Dehradun, 79 pp.

Roychoudhury, N., Chandra, S. and Joshi, K.C. (2007). Infestation of Australian insect, *Leptocybe invasa*, on *Eucalyptus* in Madhya Pradesh. Vaniki Sandesh, 31(3): 13-15.

Sandhu, S.S. (1988). Eucalyptus and Farm Forestry. Heartwood and Co., Ludhiana, 160 pp.

Tewari, D.N. (1992). Monograph on Eucalyptus. Rohini Printers & Publiishers, Dehra Dun, 361 pp.

Withers, T.M. (2001). Colonization of eucalypts in New Zealand by Australian insects. *Australian Ecology*, **26**: 467-476.

Fig. 1- Blue gum chalcid wasp, *Leptocybe invasa* [Source : Mendel et al. (2004)]

Fig. 2- *Eucalyptus* seedling severely infested by gall insect, *Leptocybe invasa*

Wild edible mushrooms become invisible from Adivasi kitchens

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Mushrooms have been consumed since earliest history; ancient Greeks believed that mushrooms provided strength for warriors in battle, and the Romans perceived them as the "Food of the Gods." For centuries, the Chinese culture has treasured mushrooms as a health food, an "elixir of life." They have been part of the human culture for thousands of years. The edible wild mushrooms are most important in food security of ethnic groups and tribals throughout the world. Various indigenous strategies are followed to trace wild mushrooms suitable for human consumption. A wild edible mushroom is a safe-to-eat fruit and fleshy body of numerous macro-fungus species. Edible mushrooms are known for their medicinal and nutritional values. People practicing folk medicine consume medicinal mushrooms while psychedelic mushrooms are for entheogenic or recreational purposes. They are the nature's own recyclers, which breathe, consume dead life and at the same time help other plants to grow.

The large scale deforestation and different other types of degradation of forest land in the last couple of decades has had a tremendous impact on the diet of aboriginal tribes living in the tribal belt of Adilabad and neighbouring districts. Dwindling availability of wild food has been identified as a factor which is telling on the general health of adivasis. It is in rainy season that the stark reality dawns that wild food items like roots, tubers, tender bamboo shoots and mushrooms have vanished from the adivasi kitchens, depriving them of key nutritional components in their diet. Their diet now comprises mostly of rice, vegetables and meat. The aboriginal people have almost lost their knowledge of the different kinds of food which used to be found in their surroundings. Only a few of them can distinguish between an edible and a poisonous mushroom variety. The Kolams, classified as Particularly Vulnerable Tribal Group, can still be found consuming wild edible mushrooms in the shape of curry, especially in the rainy season.

Mushrooms however cannot be found any more in the forest. Many in the present generation have never tasted the putta kuhku. It is only the old among our people who crave for such natural foods like mushrooms or guvangs. Very rarely do the shepherd boys get a handful of mushrooms which are relished by the elderly. The growth of mushrooms during monsoon is an indicator of the soil's richness in organic matter. Such soil used to be the outcome of humus formed due to decay of fallen leaves in forests. The edible mushroom was an excellent part of diet of the ethnic people as it provided essential vitamins, proteins and fiber among other nutrients.

Erstwhile Adilabads tribes such as Kolams and Naikpods gather mushrooms from forests by braving attacks from wild animals. They tend to consume the fresh fungi as it tastes sweet. Some of them

make a living by selling the mushrooms. The tribals dwell near forest areas starts a hunt for wild mushrooms following good rainfall in the monsoon. They scan the forests, tank bunds and farms to find mushrooms. They able to bag a considerable quantity of the mushrooms in a day's labour. They could gather a kilogram of mushrooms by spending four hours of hunting for the mushrooms. Urban dwellers are increasingly adding it to their diet owing to its health benefits.

DNA Profiling in Timber Forensics

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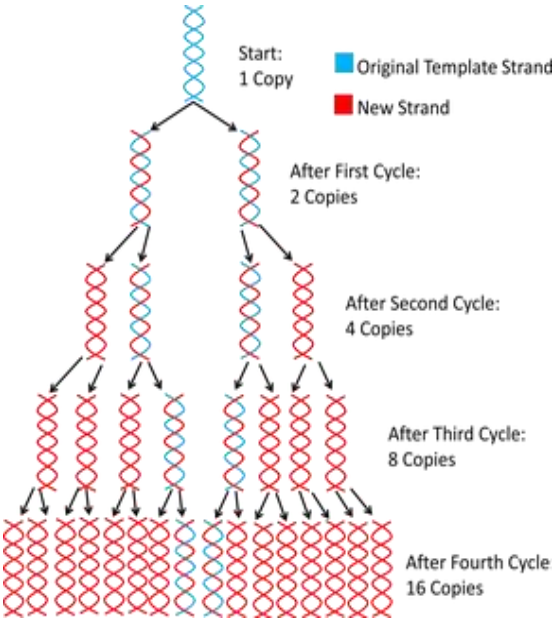
Various techniques, using visual, chemical and genetic approaches, are available for ascertaining the source of timber material. For degraded and/or contaminated samples lacking physical features, genetic approaches are most reliable, because neither degradation nor contamination can alter the genetic material of the sample. Genetic analyses can address many questions pertaining to forensic timber identification by determining the taxonomic (family / genus / species), geographic (provenance), and individual sources of timber material. Among the genetic approaches available for use in timber forensics, karyotyping and phylogenetic analysis were described earlier, and DNA profiling techniques are explained herein.

Polymerase chain reaction (PCR) is a molecular biology tool used for making many copies of a specific region in a DNA sample. It involves the use of primers which are short nucleotide sequences that can bind to complementary (opposite) regions in the template (sample) DNA and amplify (multiply) the target region.

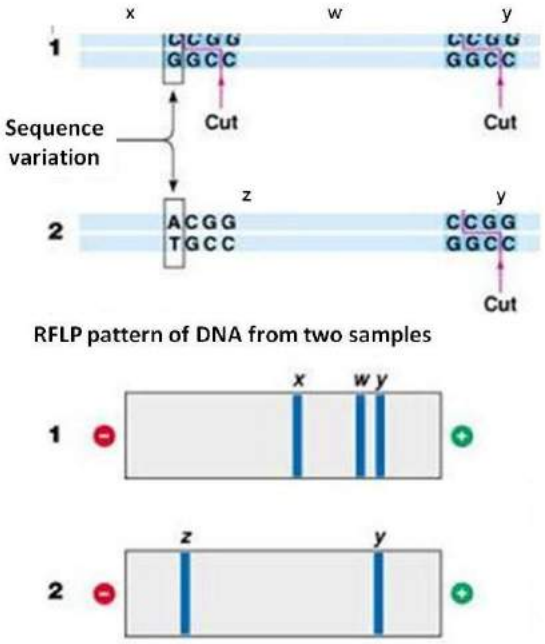
DNA profiling is based on the principle that, wherever a PCR primer has sequence complementarity with the DNA sample in question, it will bind and a PCR product will be formed. As a result, PCR products of variable size are produced which form a unique DNA profile/fingerprint during gel electrophoresis. Thus, they are DNA fragment markers and can be used for discriminating individuals at the population or individual level, as well as differentiate between wild and cultivated trees. The different DNA profiling techniques used in forensics are described.

Graphical representation of DNA amplification by PCR



Restriction Fragment Length Polymorphism (RFLP)

RFLP was the first DNA fingerprinting technique developed, and is not PCR based. Instead it makes use of restriction enzymes, which recognise and cut the DNA sample at specific regions called restriction sites, to produce small DNA fragments of varied size. The number and size of the resulting fragments depends on the location and number of restriction sites available in the sample DNA. These restriction fragments can then be separated



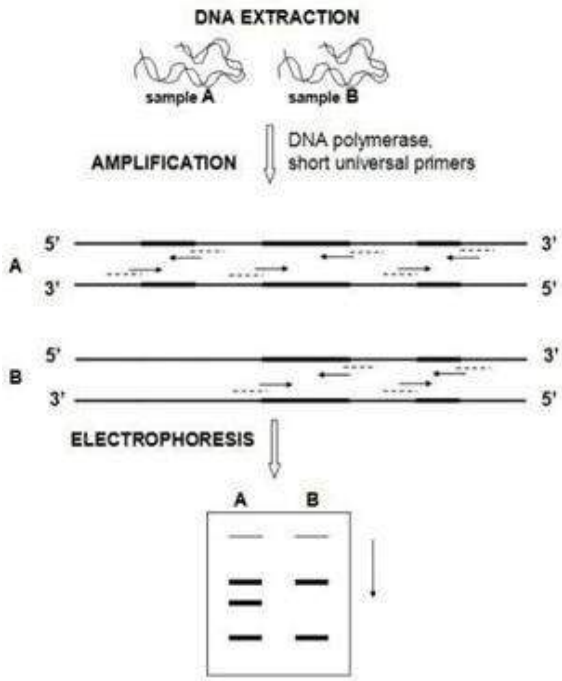
by gel electrophoresis, during which a DNA profile is generated.

Though this technique was earlier used frequently for sample identification, lineage determination and genetic diversity characterisation, it is not PCR based, requiring more quantity of DNA sample for analysis. Moreover, the possibility of a random match between unrelated DNA samples, when using RFLP analysis, is higher compared to later developed techniques. Hence, it was replaced by more sensitive PCR based techniques, which require comparatively lesser quantity of DNA and are more discriminating.

Random Amplified Polymorphic DNA (RAPD)

RAPD is a type of PCR in which the DNA segments amplified are random. When no prior knowledge of the sample DNA sequence is available, short (8–12 nucleotides), arbitrary primers are used. These random primers bind to available complementary regions in the sample DNA and amplify them.

Differentiating 2 DNA samples using RAPD



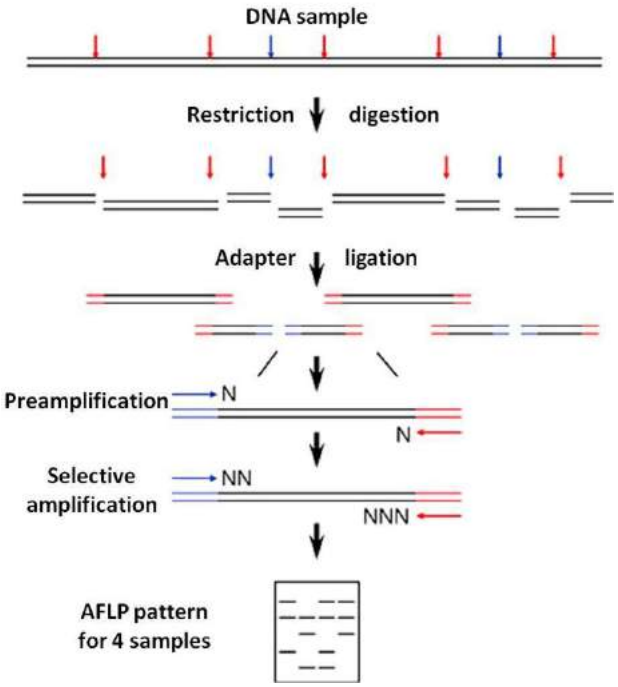
The no. of PCR products obtained by this method will depend on the no. of primer binding sites in the DNA sample. The size of these PCR products will also vary, producing a DNA profile during gel electrophoresis. The DNA profile obtained for each sample DNA will be unique due to differences in DNA sequence, and this is used to differentiate between individuals. RAPD is the most commonly used DNA fingerprinting technique.

PCR-RFLP

PCR-RFLP is a technique involving PCR amplification of a targeted region in the sample DNA, followed by fragmenting of that region using restriction enzymes. In this method, the sequence variation within the amplified region alone is used, and is also termed as Cleaved Amplified Polymorphic Sequence. Though lesser DNA sample is sufficient for analysis by PCR-RFLP, it requires prior knowledge of sequence information unlike RFLP or RAPD. Hence it is not commonly used for forensic analysis.

Amplified Fragment Length Polymorphism (AFLP)

AFLP is another PCR based DNA fingerprinting technique, which uses restriction enzymes also. The DNA sample is first fragmented using restriction enzymes, and small adaptors or linkers are joined to the restriction fragments. The adaptors, which are short DNA molecules, serve as known sequence for primer, and these fragments are amplified using PCR. The fragments are subject to two subsequent PCR amplifications: preamplification and selective amplification, using primers with 1 or 3 extra nucleotides respectively, resulting in high selectivity. The resulting DNA fragments then produce a fingerprint during gel electrophoresis, which will vary for different samples. Though the level of discrimination and reliability are high using AFLP, it also requires more quantity of good quality DNA just like RFLP, compared to other PCR based profiling techniques, and is also cumbersome.

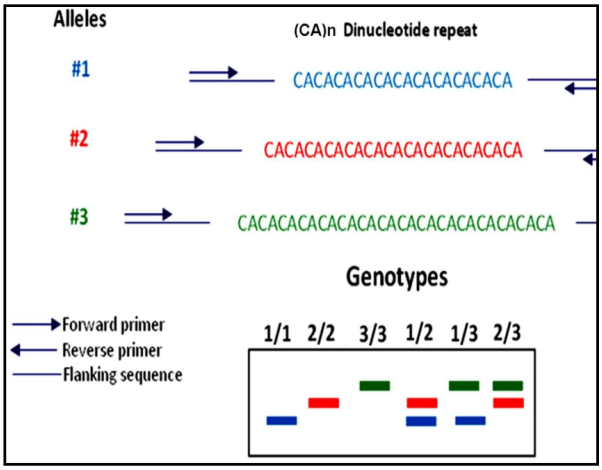


Microsatellite markers

Microsatellites or Single Sequence Repeats (SSR) are short DNA fragments in which one to six bases are repeated many times. Such sequences occur naturally in the DNA of all plants, at thousands of locations. The regions at the ends of an SSR are unique, and primers complementary to these unique regions are used for PCR amplification of the DNA sample. The size of the fragments obtained through PCR will differ based on the number of repeats at the amplified region for each individual sample. The fragments, thus, create a DNA fingerprint during gel electrophoresis.

The development of the right primers is a tedious and expensive process in SSR analysis, and DNA sequence information should be known previously. SSRs are used widely for studying genetic diversity of populations, to locate trait-related genes based on genetic linkage, and in forensic identification. In the forensic science jargon, this DNA profiling technique is most commonly referred to as Short Tandem Repeat (STR) analysis.

SSR profile of different genotypes with varied no. of repeats

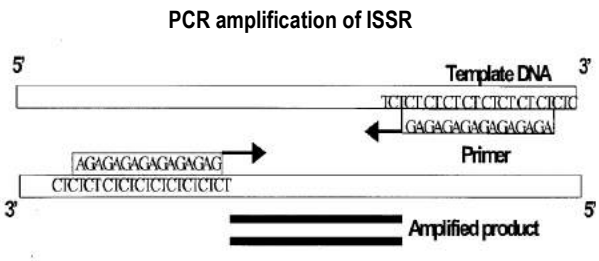


Inter-Simple Sequence Repeat (ISSR)

ISSR is the region between two microsatellites in a DNA sample. Sequences complementary to the two

microsatellites are used as primers during PCR, resulting in amplification of the variable (ISSR) region between them. The PCR products thus obtained will be a mix of DNA fragments that vary in length, creating a DNA profile during gel electrophoresis.

Though it is a widely used DNA fingerprinting technique for studying genetic diversity of different populations, it cannot be used for discriminating between individuals, and is not much preferred in forensic analysis. However, determining the sequence of ISSRs can be useful in designing primers for SSR analysis.



Conclusion

Genetic approaches are the most reliable for determining the taxonomic, geographic and individual source of timber material, as DNA information cannot be altered and remains the same throughout the sample. Minute quantities of the wood sample in question, which may be physically degraded or contaminated, can be identified using genetic tools, making them superior to other screening methods available. However, if the quantity of DNA extracted from the sample is very less or degraded, variations may arise in the DNA profile of the same individual while using PCR based methods.

Many DNA marker techniques are available for determining DNA polymorphism, in addition to those mentioned herein. But those techniques are not used for forensic timber identification. Every genetic tool can answer only specific questions in timber forensics, and the choice of the technique to be used is decided based on the questions that need to be addressed. Regarding the advantages and disadvantages of all the DNA profiling techniques, RAPD is the most preferred and widely used technique in timber forensics.

DNA profiling is the most commonly used genetic approach to answer the questions 'from which individual?', and 'from which provenance?' because it can differentiate populations and/or individuals. However, it cannot be used to ascertain the taxonomic identity of the sample; DNA sequence markers are most preferred in this case, and will be illustrated later.

References

Coyle H.M., Palmbach, T., Juliano N., Ladd C. and Lee H. C. (2003) An Overview of DNA Methods for the Identification and Individualization of Marijuana. *Croatian Medical Journal*, 44: 315-321.

Dormontt E. *et al.* (2015) Forensic timber identification: It's time to integrate disciplines to combat illegal logging. *Biological Conservation*, 191: 790-798.

Finkeldey R., Leinemann L. and Gailing O. (2010) Molecular genetic tools to infer the origin of forest plants and wood. *Appl Microbiol Biotechnology*, 85:1251–58.

Hamalton T. (2016) DNA from ancient wood. *Van Sangyan*, 3(10): 27-30.

Hamalton T. (2016) Wood DNA. *Van Sangyan*, 3(9): 10-13.

Hamalton T. (2017) Timber forensics. *Van Sangyan*, 4(10): 11-13.

Hamalton T. (2018) Genetic tools for timber forensics. *Van Sangyan*, 5(2): 17-20.

Semagn K., Bjørnstad Å. and Ndjiondjop M.N. (2006) An overview of molecular marker methods for plants. *African Journal of Biotechnology*, 5(25): 2540-2568.

Tnah L.H., Lee S.L., Siong Ng K.K., Bhassu S. and Othman R.Y. (2012) DNA extraction from dry wood of *Neobalanocarpus heimii* (Dipterocarpaceae) for forensic DNA profiling and timber tracking. *Wood Science and Technology*, 46(5): 813-82.

Bamboo based multipurpose windbreak – An effective measure for reduction of wind disaster in Tripura

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Introduction

Windbreak**,** the name suggests that it is mainly used to break the wind-flow and reduce wind speed.Windbreaks are barriers planted on borders of farm plots that help to slow down the speed of winds. Usually consisting of trees and shrubs, they also may integrate perennial or annual crops, tall grasses, wooden fences, or other materials. The mainly purpose is to provide a protected environment to save the crops from damage by strong winds and thus helpsin obtaining higher yields, controlling erosion, creating habitat for wildlife,yielding tree products besides improving the landscape aesthetics

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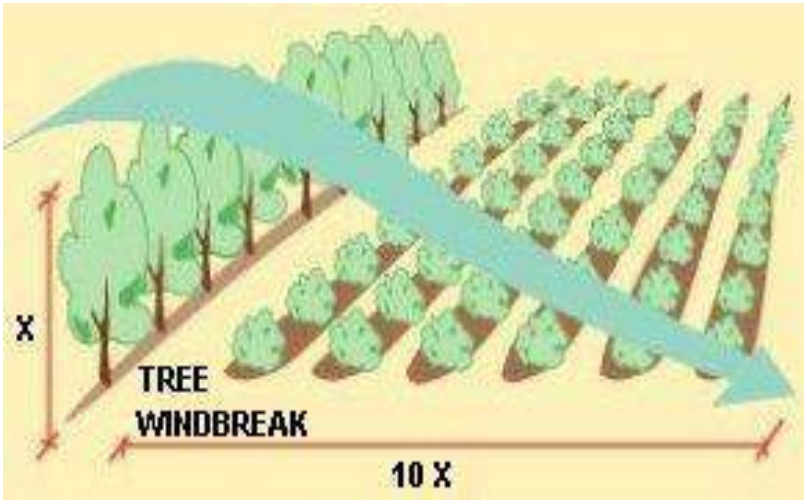

An ideal windbreak is composed of several rows of trees planted at spacing that will give a particular reduction in wind speed, without eddying or turbulence that would be caused by an impenetrable screen.

According to their uses, Windbreaks can be divided as:

Farmstead Windbreaks

These windbreaks are used for protecting the buildings, cattle shelters, greenhouses etc. from strong winds.

Field Windbreaks: Functions of these windbreaks are to regulate soil erosion and protect the crop against turbulent winds.

Living Snow Fences

These windbreaks are established for trapping the snow before it drifts onto lane ways or farmyards.

The first two windbreaks are suitable and applicable in case of wind disasters in Tripura

In Tripura, cyclone has been a havoc which had caused huge economic embarrassment due to loss of life, crops and properties.The storms,in the year 2012, damaged about 5,000 houses and uprooted several electric posts and trees. In case of crops, a perennial crop like Rubber suffers a lot due to cyclone that usually takes place during the month from April to

July in almost every year. Rubber growers reportedly faced huge hardship due to cyclone in the state. In April 2014, a total of 1450 houses were damaged and a large population was displaced from their homes due to the cyclone in North Tripura and other parts of Tripura.In June 2015, about 200 families were displaced from their houses in Ambassa sub-division of Dhalai district and many trees and electric posts were uprooted due to the storm over night. A total of 250 houses were totally damaged and more than 1000 houses partly damaged due to the cyclone and hailstorm over nightat Lakkhipur village under Jirania subdivision of West Tripura district, in March 2016.200 families were evicted from their houses from two villages — Shabdakarpara and Bongshipara and they took shelter in government buildings near Jirania.

Windbreak obstructs the wind flow and alters flow patterns both upwind of the barrier (windward zone) and downwind of the barrier (leeward zone). As wind approaches a windbreak, some of the air passes through the barrier while the rest flows around the ends of the barrier or is forced up and over the barrier. Due to the pressure fields wind speed is reduced and a protected zone is created which extends for a distance of 2H to 5H in the windward zone and 10H to 30H in the leeward zone (where H is the height of the barrier).

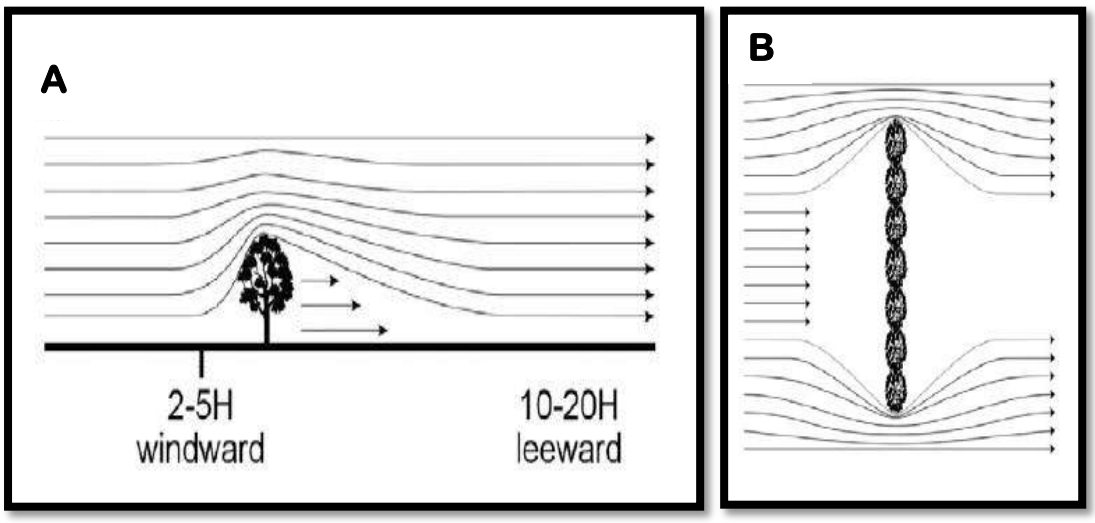

Fig. 1 A:- Showing the wind path side wards of a wind break. **B:-** Showing the wind path from upwards a windbreak.

Points to remember before setting a windbreak

- Windbreak height (H) is the most important factor determining the extent of the area to be protected.
- Windbreaks should be perpendicular to the wind.
- The length of a windbreak should be at least ten times its height to minimize the effect of wind flow around the ends of the windbreak.
- Increased flow around the ends or through a gap directly reduces the extent of the protected zone and reduces windbreak effectiveness. So windbreak continuity is also very important.

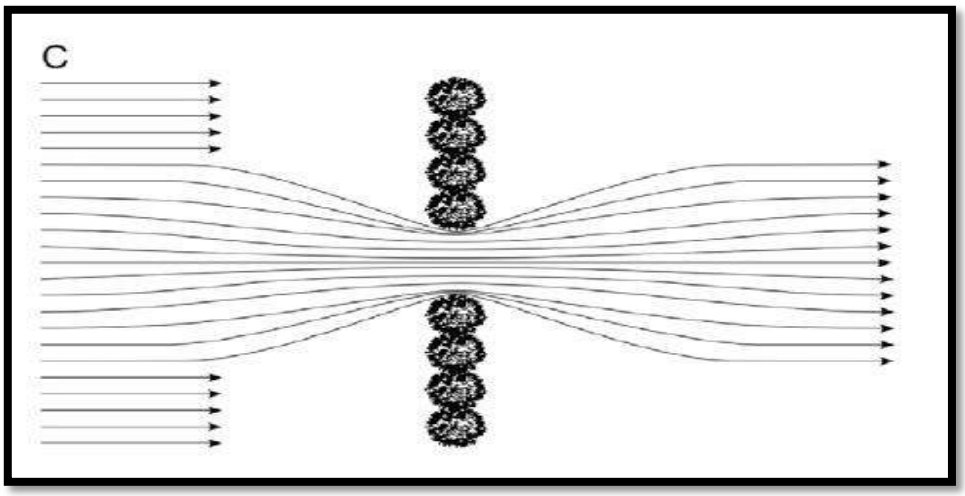

Fig. 2:- Showing the wind flow through a hole in the windbreak.

Benefits of windbreaks

1. Reduction in soil erosion form wind.
2. Protects plants from wind related damages.
3. Alter microenvironment for enhancing plant growth.
4. Improves irrigation efficiency.
5. Provides shelter for structures, livestock and recreational areas.
6. Enhance wildlife habitat by providing travel corridors.

To attain the above mentioned benefits theorientation (location & layout) of thewindbreak should be perpendicular to troublesome winds and also it should connect fragmented habitat of targeted species in case of enhancing wildlife habitat, species-mix of deciduous & conifer, height-match heights of vegetation in potential plant community , density-60-80 %, width-normally 3-5 rows but can exceed,management-maintain density through pruning , thinning, or planting, operation and maintenance-replace dead stock in first 3-5 years and control damaging agents,limitations- Limited protection initially.

Why bamboo is most suitable for windbreak in Tripura

In view of the characteristics of Bamboo species available in Tripura and also the literature available at "bamboo-Inspiration" website, bamboos shall be potential component in terms of the followings

Flexibility

It is a much flexible plant and will bend and sway in the strongest wind speeds with only the very youngest culms suffering damage. They are likely to bend within the wind as against blowing over. Bamboos have the power to bend to ground level under the load of snow, ice, or heavy rains, and high winds, then straighten copy to their full height once the conditions have eased.

Root Mass

A mature grove features a root mass that maintains anchorage within the ground in extreme weather. This means, it is unlikely to cause damage or a danger to people as it does not get uprooted in the same way as individual trees in gales, hurricanes, and tornados.

Stability

The steadiness of a bamboo windbreak or grove reportedly offers protection to people and property in extreme weather, the high speed winds, and even in earthquakes. The bamboo groves offer protection in the event of an earthquake due to the huge root mass which stabilizes the earth which results with a low risk of danger through culms falling and causing injury.

Multipurpose use of Bamboo

- Bamboo is used locally for handicrafts, culmsod few species are also used inbamboo-wood industry of the state. It can be planted for land rehabilitation of degraded lands and riverbank stabilisation etc.
- Bamboo also used locally for manufacturing of bamboo furniture, chopsticks etc.
- Bamboo after treatment, used for building bamboo houses and also for manufacturing of high quality furniture from bamboo-wood.
- It is also used for making kitchen utensils.
- Some varieties are often used for landscaping.
- In rural areas bamboo is reliable and cheap source of house construction.
- More over the handicraft industry can provide a good income source for livelihood in these days.

Fig 3:- Manufacturing of bamboo based handicrafts in villages.

Suitable species for establishment of windbreak in Tripura and other North Eastern States are-

1st row (Windward side):

Bambusapolymorpha, Melocannabeccifera, Bambusabalcooa, Bambusatulda, Agavasisalana, Tactonagrandis, Dipterocarpus so.,

Calotropisprocera, Euphorbia sp., Lawsoniaalba, Tephrosia candida etc.

2nd row (Middle):

Acacia sp., Bombexceiba, Dalbergiasissoo, Shorearobusta, Anacardiumoccidentale, Toonaciliata, Eucalyptus sp., Cocosnucifera, Terminaliaarjuna, Artocarpusintegrifoia, Eugenia sp., Azadirachtaindica, Tectonagrandis etc.Thysanolaena maxima and *Schumanianthusdichotoma* intercropping.

3rd row (Leeward side):

Bambusa spp., Artocarpus sp., Azadirachtaindica, Eugenia sp., Mangiferaindica, Zyzyphussp, Shorearobusta etc.

Tripura is the second largest producer of Rubber. Rubber plantations are very badly affected during the rainy season, due to high wind speed. Large numbers of rubber plants are uprooted. Bamboo based Windbreaks shall be much effective in protection of rubber plantations from Norwesters in Tripura and thus the huge loss can be minimized.

In coming days, it is expected that a large number of upcoming infrastructures, houses and cropsmay be under especially in the hilly areas in Tripura due to high wind speed. The bamboo based multipurpose windbreaks may be much effective in reduction of such wind disaster.

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