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Editorial

The World Environment Day 2011 passed by on 5 June 2011. India, the first time global host of World Environment Day, marked the occasion - themed "Forests: Nature at your Service" - with a week long colourful events across the country from Bangalore to New Delhi, led by the Hon'ble Minister for Environment and Forests in India, Jairam Ramesh and the UN Under-Secretary General and UNEP Executive Director, Achim Steiner (http://www.unep.org/wed/news/wrapup.asp).

The events during 2 - 5 June included a day-long workshop on Journalism and the Environment, opening of green bazaar of non-timber forest products in New Delhi, the launch of a dedicated World Environment Day song by the famous artist, Shubha Mudgal, titled "The Colour of Life", a special session on 'Building a Green Economy' hosted by the Confederation of Indian Industries (CII), a series of Green Marathons and walk-athons, organized by various groups around India to raise awareness and show support for conservation efforts and green policies.

World environment Day in India culminated with the launch of UNEP's report on "Green Economy and Forests", which states that investing an additional US$ 40 billion a year in the forestry sector could halve deforestation rates by 2030, increase rates of tree planting by around 140 per cent by 2050, and catalyze the creation of millions of new jobs world-wide. The report points out that if backed by the right kinds of enabling policies such an investment could also sequester or remove an additional 28 per cent of carbon from the atmosphere, thus playing a key role in combating climate change.

It is so encouraging to see that forests are given prime importance in the national policies around the world and several international agencies are taking on the spirit over the globe. Planted forests and in particular planted teak forests have their own role to play in these efforts and we are not to miss the same.

Acting locally, the Kerala Forest Research Institute (KFRI) distributed several seedlings of forest trees which included a substantially large number of teak saplings. The international training programme on the management of planted teak forests is due in August - September at Peechi Campus of KFRI the information on which is included in this bulletin for wider dissemination. We expect country representatives from forestry sectors of all teak growing/trading countries to participate in this programme which is supposed to provide a comprehensive coverage of the current situation and futuristic outlay of the issues concerning the global teak sector.

Included in this bulletin is also an article on 'Status of fruit yield among seed production areas of teak (*Tectona grandis* Linn.) in India: Implications for management by Rajesh P. Gunaga

There is a standing request from the TEAKNET Secretariat to all readers to contribute articles or news items of interest regarding teak for publication in this bulletin. Although we do not dissuade people from publishing their material, it may be noted that *Teaknet Bulletin* is not to be taken as a journal. The articles need to be short enough and of wide interest to those involved with teak. Hoping for cooperation from all in this regard,

With best wishes,

K. Jayaraman,
TEAKNET Coordinator

Status of fruit yield in seed production areas of teak (*Tectona grandis* Linn.) in India: Implications for management

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Abstract

Seed production areas (SPAs) consist of improved stands used for collection of quality seeds in large quantities. Information on the status of seed yield in SPAs of teak in the country is scanty. In this paper, status of seed yield in teak SPAs located in various states of India has been documented. Fruit production in most of SPAs is lower than the expected output. Possible reasons for low seed yield have been discussed. Further, proper management practices required to be followed to improve the seed fertility or yield among SPAs are suggested.

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Final Announcement

International Training Programme

Innovations in the Management of Planted Teak Forests

Peechi, Kerala, India

31 August - 3 September 2011

TEAKNET | KFRI | FAO FIAT PANIS | KSCSTE

Further information on this training programme is available at http://www.teaknet.org/node/5474

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Introduction

Teak (*Tectona grandis* Linn.f.; Family- Verbenaceae) is a major tropical timber yielding species distributed in India and South-East Asian region. Owing to its good quality timber, teak is widely planted throughout its geographical range as well as in other countries of tropical Asia, Africa and Latin America. Even though plantation teak accounts for 5 to 8 per cent of the total forest area in the tropics (Ball *et al.,* 1999), about 90 per cent of the quality hardwood plantations for timber production belong to teak (Granger, 1998). Furthermore, nearly about 90 per cent of area under teak is contributed by developing countries like India and Indonesia (FAO, 1995). Presently, India has more than 1.5 million hectares of teak plantations with annual planting target of 50,000 hectares (Subramanian *et al.,* 2000). These figures indicate increasing trend in teak planting around the world.

On the other hand, poor productivity of teak has also been documented in the country that leads to poor quality timber (Nair *et al.,* 1996). Seed source is one of the important factors that leads to poor productivity of timber and it can be easily manipulated by the plantation manager. Hence, quality planting material can improve the timber productivity and its quality. Improvement in quality of planting material can be achieved through tree improvement programmes. Hence, Kedharnath and Mathews (1962) formulated a teak improvement programme in the country with production of genetically improved seed materials as one of the major goals. Establishing seed orchards (SOs) and SPAs are two commonly adopted strategies in order to produce genetically superior propagules in large quantity. Seed production from clonal seed orchards (CSOs) is reported to be very low and is well documented in the country (Gunaga and Vasudeva, 2002a; Indira, 2005; Verghese *et al.,* 2005). It is observed that the existing CSOs covering over 1100 hectares cannot meet the present demand of planting target (Katwal *et al.,* 2005). Hence, seeds collected from SPAs as well as unimproved stands are presently used to raise targeted planting stock. Interestingly, genetic quality of teak fruit collected from the SPA is superior over unimproved stand, where SPA represents only desirable trees. Another important consideration in teak seed is the seed production among the SPAs. It is observed that fruit production from teak seed production areas is very scanty (Prabhu, 2007 and Gunaga, 2008). Therefore, an effort has been made to overview the status of seed fertility among existing SPAs in the country. Possible causes for low seed yield/fertility among SPAs are discussed. Suitable management practices to improve seed yield from the present level are suggested.

Extent of seed production areas in India

Seed production area is an improved plantation or natural stand in which inferior individuals are culled out, retaining only desirable trees to interbreed for producing genetically superior seeds in large quantity. Most of the seed production areas existing in the country are converted from the improved plantations. Presently, over 5000 hectares of SPAs have been established in the country. As per FSI (2001) report, the total area under teak SPA in India is 5168 hectares. The state-wise extents of teak SPAs in the country are shown in Table 1.

Status of fruit yield among SPAs

Generally, annual fruit yield of a tree is dependent on several factors such as phenology, flowering behavior, pollination mechanism, soil nutrient status, age, climatic parameters like intensity and duration of light, temperature and rainfall, topography and total reserve food (carbohydrates) present in the mother plant, insect-pests and pathogens (Gunaga and Vasudeva, 2005; Indira, 2005). Annual seeding variation is also observed in teak as at Nilambur where two out of every five years are reported to be poor seed years (Troup, 1921).

Table 1: State-wise extent of seed production areas of teak in India

Sl. No	State	Total Extent (ha)	Reference
1	Andhra Pradesh	917.58	Rao (2005)
2	Assam	64.00	Katwal (2005)
3	Gujarat	100.00	Katwal (2005)
4	Karnataka	459.00	KFD (2001)
5	Kerala	1250.00	Prabhu (2005)
6	Madhya Pradesh	1160.00	Gangopadhyay (2005)
7	Maharashtra	860.00	Gogate *et al.* (2005)
8	Mizoram	20.00	Katwal (2005)
9	Orissa	217.00	Katwal (2005)
10	Tamil Nadu	73.52	Kala *et al.* (2005)
11	Uttar Pradesh	10.00	Katwal (2005)
	Total	**5131.00**	

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Teak starts yielding fruits at the age of 10 to 12 years. An average fruit yield of a 40-year old tree is about 3 kg. The total demand of teak seed for annual planting programme in the country is about 457 tonnes (Katwal *et al.,* 2005) and around 50 per cent of seed lot (about 230 tonnes) come from only SPAs, while the remaining 50 per cent seed lot comes from the genetically improved sources like seed orchards (25%) and unimproved stands (25%). Fruit production in both seed orchards as well as in SPAs is reported to be very poor and ranges from 0.1 to 3.0 kg per tree in the case of CSOs and 0.02 to 7.0 kg per tree among SPAs (Gunaga, 1999; Bhat *et al.,* 2005) with an overall fruit yield of 30 kg ha^{-1} (Katwal *et al.,* 2005). Furthermore, fruit yield ranges from 2.34 to 53.52 kg ha^{-1} among 38 SPAs with an overall mean of 13.07 kg ha^{-1} in Kerala (Prabhu, 2007), whereas in Karnataka the seed yield varies between 32.7 to 97.08 kg ha^{-1} among 20 SPAs, with an average of 57.15 kg ha^{-1} (Gunaga, 2008). This indicates the need for selection of best SPAs for future intensive management to get higher seed output. Varghese *et al.* (2005) have reported that the fruit production among teak CSOs is quite less (Topslip = 1024 fruits per tree and Walayar = 947 fruits per tree) than that of SPA (Nilambur= 4573 fruits per tree) in South India. Hence, it is essential to take-up silvicultural interventions among SPAs as well as seed orchards to improve the seed production levels.

Causes for low seed yield among teak SPAs and management implications

Teak is a cross-pollinated tree species with self-incompatibility. It is mainly pollinated through insects such as *Heriades parvula, Ceratina hieroglyphica* and other insects like bees, ants and beetles (Rawat, 1994; Mathew *et al.*, 1987). Lack of pollination leads to poor seed set and seed abortion. Gunaga (2008) recorded that seed lots procured from 20 different teak SPAs in Karnataka showed substantial amount of seed abortion and it ranged between 6.67 and 55 per cent with an overall mean of 23.0 per cent and this may be due to lack of occurrence of proper pollination in SPAs. Supplement of mass pollen grains collected from the superior genotypes into SPA may improve the seed fertility/ yield (Vasudeva *et al.,* 2005).

Recently, Gunaga (2008) and Prabhu (2007) recorded the patterns of flowering among SPAs of teak in Karnataka and Kerala. SPAs located in the northern zones of Karnataka start flowering a bit later than SPAs of Central and Southern seed zones (Gunaga, 2008). Similarly, Prabhu (2007) also recorded that SPAs located in Nilambur (Central region), Konni and Achencoil seed zones (Southern Kerala) show early flowering and fruiting than SPAs located in Waynad and Parambikulam (Northern Kerala). Such flowering synchrony on fruit yield has been reported among clones of teak from different places (Nagarajan *et al*., 1996; Palupi and Owens; 1998, Gunaga, 2000; Indira, 2005; Verghese *et al.,* 2008). These reports indicated that phenology is one of the major causes that affects fruit yield in teak.

Alternate bearing is another factor that affects fruit yield in teak (Troup, 1921; Tewari, 1992). However, Verghese *et al.* (2008) quantified the significance of alternate bearing among clones in two different CSOs. Similarly, Prabhu (2007) has also noticed this phenomenon among 38 SPAs of Kerala. Alternate bearing in seed is required to be taken care to collect maximum seeds during seed year and remaining quantity seeds can be properly stored for utilisation in the next season.

Generally, teak flowering period coincides with peak monsoon that greatly affects the fruit yield. Peak rains not only cause flower drops or pollen grain wash, but also hinder the pollinator activities. Gunaga and Vasudeva (2002b) reported that flowering in the northern region of Karnataka that coincides with peak rains resulting in low fruit production, whereas southern and central clones escaped the peak rains and produced more fruit yield. Similar observation is also made among teak SPAs in Karnataka, where SPAs located in the southern zone set flowers early and escape early showers. However, SPAs of northern regions like Dandeli and Yallapur coincided their flowering with peak rains (Gunaga, 2008).

Close observations of flowering patterns within each SPA revealed that there are some odd performers with respect to flowering (too early and late). These odd performers may lose the opportunity of cross-pollination with many trees leading to inbreeding that reduces the genetic quality of teak fruits. Therefore such trees may be eliminated after monitoring their flowering pattern at least for a period of three to five years. Further, it is also observed that nearly 85 per cent of the SPAs of teak in both Karnataka and Kerala states do not have any buffer area, where most of the SPAs are located around the unimproved plantation of same species or adjacent to the teak natural forest, which leads to reduced quality of seeds. Hence, it is suggested to avoid raising new plantations of same species adjacent or near to the existing SPAs. Further, in order to improve the quality of planting materials, it is recommended to collect seeds from the center or core of the existing SPA by avoiding seed collection from the periphery/ boundary.

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Site fertility condition also is one of the factors that affect fruit production. Our study showed that most of the existing SPAs located in the southern states like Karnataka and Kerala belonged to poor site quality classes *viz.,* III, IV and V. However, a few SPAs belonging to good quality site classes I and II showed higher fruit yield indicating requirement of nutrient management in the existing SPAs to improve the quantity of fruit yield. This is also in the case of teak seed orchard, where Verghese *et al.* (2008) have recorded variation in fruit fertility in two CSOs. Therefore, while selecting plantations for conversion into SPA, the fertility status of the site need to be considered to get maximum seed output.

Prabhu (2007) reported the highest fruit yield among SPAs of Parambikulam seed zones, where most of these SPAs are represented by higher tree volume, crop diameter, tree height, spread of the crown, site with highest available K, organic carbon and total Nitrogen. In addition, as SPAs in Parambikulam seed zone are located in the vicinity of Parambikulam Dam, there was better availability of soil moisture all throughout the year. This could be an additional factor contributing towards better tree growth and high fruit production in Parambikulam SPAs.

In Karnataka, some of the SPAs are well managed by the Forest Department by regular weeding and removal of loranthus. Close observation showed that in these SPAs, the overall fruit production is comparatively better than other SPAs. Hence, this kind of silvicultural practices are also very essential to improve the fruit yield (Gunaga, 2008).

Finally, it is suggested that evaluation of seed production areas with respect to quality and quantity of fruit production needs to be undertaken to identify the superior stands which produce sufficient quantity of superior seed propagules. Proper management of more number of SPAs within a state or seed zones require lot of manpower, funds and other resources. Hence, top ranking few SPAs can be recognized for further management and regular seed collection within seed zones.

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Padmanabhapuram Palace – A veritable teak palace

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Kerala Forest Research Institute

A magnificent wooden palace of the 16th century, Padmanabhapuram Palace, the Asia's largest wooden palace lies at the southern tip of mainland India. An enticing edifice to any lover of art and architecture, this old palace of the Rajas of the erstwhile Travancore (1550 to 1750 AD) is a fine specimen of Kerala's indigenous style of architecture. Padmanabhapuram Palace complex is located in Kanyakumari District, Tamil Nadu, India. It is about 50 kilometers from the capital Thiruvananthapuram of Kerala State. The palace complex is inside an old granite fortress around four kilometers long. The palace is located at the foot of the Veli Hills, which form a part of the Western Ghats. The river Valli flows nearby. The palace is administered by the Archeology Department, Government of Kerala .

The palace was constructed around 1601 A.D by the then King of Travancore. The palace complex continues to be the best example of traditional Kerala architecture built mostly using teak wood. The teak wood that was used has stood the test of the time and is still in good shape. The structures are beautiful and this narration gives some illustrations. The palace has several sub structures and specialties some of which are noted below.

Padmanabhapuram Palace

King's Council Chamber

The King's Council Chamber is the most beautiful part of the entire palace complex almost entirely made in teak wood. It has windows, with coloured mica, which keep the heat and the dust away, and the inside of the council chamber remains cool and dark. Delicate and beautiful lattice work can be seen all around the council chamber.

King's Council Chamber

Hanging Lamp and wood carving in ceiling

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King's Mother's Palace

Mother's palace, designed in traditional Kerala style, is the oldest construction in the entire palace complex and is believed to be constructed around mid-16th century. True to the traditional Kerala style, there is an inner courtyard, called 'nalukettu'. In the inner courtyard, sloping roofs from all four side taper down. Four pillars on four corners support the roof.

Sideways inside the palace

Hall of Performance

This is a relatively new building, constructed at the behest of Maharaja Swathi Thirunal, who reigned in Travancore from 1829 to 1846. He was a great connoisseur of arts, especially music and dance. The hall of performance has solid granite pillars and gleaming black floor. There is a wooden enclosure, with peepholes, where the women of the royal household used to sit and watch the performance.

Four-storeyed Central Building

The four-storied building is located at the centre of the palace complex. The top floor served as the worship chamber of the royal household. Its walls are covered with exquisite 18th century murals, depicting scenes from the puranas, and also a few scenes from the social life of the Travancore of that time.

There are several rooms just below the worship chambers, which included the king's bedroom. The ornamental bedstead is made of 64 types of herbal and medicinal woods, and was a gift from the Dutch merchants. Most of the rooms here and in other parts of the palace complex have built-in recesses in walls for storing weapons like swords and daggers.

Southern Palace

The southern palace is as old as the Mother's Palace, which would make it about 400 year old. Now, it serves as a heritage museum, exhibiting antique household articles and curios. Collections of items give an insight into the social and cultural ethos of that period.

Acknowledgement : The photos and part of the description about the palace have been obtained from the website http://en.wikipedia.org/wiki/Padmanabhapuram_Palace and some external links given therein.

Teaknet Bulletin is a biannual electronic newsletter of TEAKNET brought out in March and September of every year through its website. It is intended for circulation among the members of TEAKNET and other stakeholders of global teak sector. The views expressed in the newsletter are those of the authors and do not necessarily reflect the views of the organization. The readers are welcome to express their opinions or pass on information of value to teak growers, traders, researchers or others concerned with teak. However, TEAKNET reserves the right to choose the contributions for publishing and also to make necessary editorial modifications in the articles.

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