RESEARCH NOTES
(I)

MORTALITY IN PURE TEAK PLANTATION

The Teak (*Tectona grandis*) plantations are being raised in forest areas of Maharashtra, since long. However with the establishment of Forest Development Board (FDB) in 1969, systematic teak plantation works started on large scale. Later on in 1974 FDB was replaced by Forest Development Corporation of Maharashtra (FDCM Ltd.). Main objective of FDCM Ltd. was to convert "Potentially Productive Forests" into "productive forest" by pure teak plantation.

Some of the oldest plantations carried out by FDB in Maharashtra were visited during the course of inventory. In one of the 1970 teak plantation (24 year old) in Saleghat Range (Compt. No. 655) of Nagpur Forest Project Division large scale mortality was observed. On careful observation it was evident that mortality occurs mostly in girth class below 45 cm. There is almost no mortality in girth above 50 cm. Table 1 shows the mortality in various girth class per hectare. It is also observed that mortality is spreading because many trees are found in different stages of dying process.

In past mortality in natural teak or in coppice teak was reported by various authors (Anon., 1953; Anon., 1954; Bakshi *et al.*, 1972). The mortality of teak trees observed was tentatively attributed to drought or severe damage to the bark caused by the termite (*Odontotermes parvidens*). In the above mentioned plantation severe damage of the bark by termite was observed. Damage by termite was observed even in dying trees. Roots of some of the dead trees were examined after uprooting the tree, reveals no insect or fungus attack on root system. In many cases the coppice shoots from the ground level was observed after death of tree. Hence it can be safely concluded that root damage is not the cause of mortality.

Table 1

Mortality in teak plantation / hectare. Age of Plantation - 24 years.

Girth Class	No. of Dead trees	No. of (cm) Dying trees
16-20	12	4
21-25	16	-
26-30	28	4
31-35	24	-
36-40	20	8
41-45	12	10
Above 46	4	6
Total	116	32

It is also observed that around 65 to 70% of mortality takes place in plain area with better soil depth. During 1993-94 from 48.12 hectare area 1070 number of dead trees were removed to stop the spreading of mortality. But observation after one year

reveals that spreading of mortality continued.

Although exact cause of mortality could not be ascertained this process and spread of mortality is of great concern. It is also learned from the discussion of the local forest staff that some mortality are observed in other plantations also. Above observations on mortality in pure teak plantation needs detailed study. These observations also suggest that teak monoculture should be undertaken only after careful study of the various damaging factors to avoid any large scale mortality in future.

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(II)

EVALUATION OF GROWTH RESPONSE OF TEAK TO HIGH INPUTS

In our articles titled "Sewage Water as potential for tree growth - A case study on Teak (*Tectona grandis*) plantations", and "Growth response to irrigation -Eksal (Ambhadi) Teak Plantation - A case Study" (see pages 472-481 and 491-502) a passing reference was made on quality of wood developed in irrigated and high input teak plantations. As the wood samples were not scientifically tested by competent authority for its physical and mechanical properties, the material was described in general terms. Recently timber developed under similar conditions, was sent for testing to Institute of Wood Science and Technology, Bangalore, from whom assessment report is now available, which being of topical interest is discussed here.

M/s. Ichalkaranji Co-operative Spinning Mills has raised a teak plantation in 1986, at Ichalkaranji, District Kolhapur in the Western Maharashtra Dry Zone i.e. Agro-climatic zone VI of Maharashtra. In addition to the normal practices, the plantation receive a regular flood irrigation at an interval of 3 to 4 weeks, during the dry season. As a spinning mill, the firm generates lot of cotton waste/linter, which in effect is bio-degradable and results in increasing humus. The firm used such a material to fertilise the teak plantation. However, quantitative details of such fertilisation are not available.

As a consequence to such high inputs, the plantation has put on good growth, for the average site quality of the area. Close monitoring of this plantation activity has revealed that saplings attained average dimensions of 28.5 cm (G.H.O.B.) and 10.8 m of height, at the age of 7 years. The total basal area was 14.82 m^2 and thus, thinning was carried out in the year 1994. The samples collected from thinned material were supplied to Institute of Wood Science and Technology, Bangalore as indicated in Table 1.

Table 1

Sample No.	Length (m)	Mid girth (cm)	Girth at large end (cm)	Girth at small end (cm)
T1	3.00	25	32	21
T2	3.02	30	36	25
T3	3.00	48	49	38
T4	3.02	37	45	36
T5	3.00	50	62	46

Table 2

Properties	*Tectona grandis**		Standard Teak	
	Green Average	Air-dry Average	Green Average	Air-dry Average
Sp. gravity (based on oven dry weight and volume at test)	0.425	0.479	0.596	0.604
% Moisture content	68%	12%	76.6%	12%
Weight	786	538	1056	672
Static bending				
Fiber stress at elastic limit (kg/cm^2)	362	423	509	651
Modulus of rupture (kg/cm^2)	605	615	841	959
Modulus of elasticity ($X10^3$ kg/cm^2)	76.2	70.6	109.7	119.6
Compression parallel to grain				
Maximum crushing stress (kg/cm^2)	211	295	415	532
Compression perpendicular to grain				
Compressive stress at E.L. (kg/cm^2)	32.7	104.4	86	101
Hardness (load to embed 1.128 cm dia steel ball to half its diameter)				
Radial (kg)	315	450	557	502
Tangential (kg)	334	550	551	524
End (kg)	459	655	486	488
Shear parallel to grain				
Radial (kg/cm^2)	35.1	64.1	89.5	96.6
Tangential (kg/cm^2)	47.6	82.6	100.2	108.0
Tension perpendicular to grain				
Radial (kg/cm^2)	10.1	36.8	68.3	57.6
Tangential (kg/cm^2)	17.3	35.4	79.4	66.4

* Test results based on 4 billets

Table 3

Nail holding power

	Green Average	Air-dry Average
Side	98	52
End	48	20

Table 4

Screw holding power

	Green Average	Air-dry Average
Side	*129*	*121*
End	51	52

Table 5

Suitability indices of Tectona grandis in terms of Teak as 100

Properties	Suitability indices
Strength as a beam	69
Stiffness as a beam	65
Suitability as a post	60
Shock resisting ability	62
Shear	53
Refractoriness	31
Hardness	73
Weight or Heaviness	80

Results of various tests carried out at the Institute are tabulated in Tables 2, 3, 4 and 5.

The Head of Wood properties and Uses Division of the Institute, concludes that the timber tested is moderately heavy, weak, not tough and moderately hard. Our apprehensions that indiscriminate high inputs will jeopardise timber quality have been vindicated. It is hoped that this investigation and its result will be kept in view by all those entrepreneurs who are selling "dreams" of high returns.

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(III)

PEST STATUS AND LARVAL FEEDING PREFERENCE OF *SPODOPTERA LITURA* (FABRICIUS) BOURSIN (LEPIDOPTERA : NOCTUIDAE) ON TEAK

Teak (*Tectona grandis* L.f.) is undoubtedly one of the most important and valuable commercial timber species. This potential tree species has a rich complex of insect fauna and is one of the most extensively studied timber species for its entomology. Teak suffers regularly from insect damage in most of the teak growing areas in the Indian sub-continent. All the stages in the growth of teak from seed to mature trees are attacked by the insects. The damage occurs from an association of group of insects, comprising chiefly defoliators, gall-formers, root-feeders, together with combination of many species of foliage feeders, stem borers, etc. of about 280 and odd species (Mathur, 1960; Mathur and Singh, 1960), which the teak is reportedly supporting, great majority of them are casual visitors, a few of them, however, are source of real menace and concern to the forest managers (Tewari, 1992).

Defoliation is a chronic feature in teak plants and defoliators are the main enemy of teak. About 139 defoliators have so far been recorded on teak which includes 80 Lepidopterans, 41 Coleopterans and 18 Orthopterans (Mathur, 1960); Mathur and Singh, 1960). Among the Lepidopteran defoliators, *Spodoptera litura* (Fabricius) Boursin (syn. *Prodenia litura* Fabricius) (Lepidoptera : Noctuidae) has been reported to feed on teak (Beeson, 1941; Browne, 1968). Surprisingly, enough information is not available regarding its pest status and larval feeding preference on teak. The present study clarifies these aspects unequivocally and the present account is based on the field observations of authors.

To study the insect pests damaging teak seedlings at nursery stage, periodical surveys were carried out at Jabalpur (M.P.), during the year 1993-94. During the course of study, it was observed that teak seedlings suffers seriously from the attack of an insect larvae which was later identified as *S. litura*. This insect is commonly called as tobacco semi-looper (Browne, 1968). This wide spread species is a very general feeder on agricultural and garden crops and a pest particularly of cotton and tobacco (Chari and Patel, 1983). This insect has been recorded to feed on many forest trees and shrubs such as *Artocarpus integra, Casia tora, Casuarina equisetifolia, Diospyros montana, Hevea brasiliensis, Lantana camara, Mangifera indica, Morus alba, Populus* spp.; *Randia dumetorum, R. uliginosa, Solanum indicum, S. torvum, Terminalia tomentosa, Thuja orientalis* and *Tristania conferta* in India and its neighbouring countries (Beeson, 1941; Browne, 1968), and recently also recorded as a pest of *Jatropha curcas* (Meshram and Joshi, 1994) and *Sesbania* spp. (Roychoudhury *et al.*, 1995a).

The present study reveals that eggs are laid in a mass on the under surface of

the leaves of intermediate (medium) quality just below the tender leaves. The egg clusters remain covered with ovipositor scales, shed from the tip of the mother's abdomen. The fecundity is very high, which varies from 300-400 eggs in a mass. After nearly 4-5 days of egg period, the hatching takes place. The young larvae feed gregariously and later on disperse. They are voracious feeder, consuming the whole of the leaf surface including the veins. The full grown larvae are dull, olive green coloured with light side stripes, which attain a maximum length of about 35 mm. The pre-pupae are 23-26 mm in length and the prepupal period varies from 1-2 days, The pupation occurs in a loose silken cocoon in soil. The pupae are 14-15 mm in length and the pupal period varies from 5-8 days. The moths are nocturnal and medium sized. The forewings have beautiful golden and grayish brown patches. Hindwings are greyish white in colour.

This insect has been found in abundance only during the month of June-July. About 56% of teak seedlings are recorded to be damaged by this insect pest. To control the population outburst of this insect, Fletcher (1914) has suggested hand picking of egg masses and batches of young larvae before lossing their gregarious habit. Ram *et al.* (1988) recommended foliar spraying of endosulfan 0.08% against the larvae of *S. litura* as effective control measure.

Larval feeding preference

During the present work, it has been recorded that the early larval instar feed on the leaves of intermediate (medium) quality which are in between tender and mature older leaves. The late larval instar prefer mature leaves. These findings show that larvae avoid soft tender leaves which clearly indicate that in *S. litura*, larvae exhibit feeding preference in relation to leaves of different maturity particularly on teak. The results show some parallelism with the findings of earlier workers on the same insect and host plant (Beeson, 1941). This is possible because ubiquitous variation in leaf quality alter the performance of leaf eating insects in all feeding guilds including the palatability (Scriber and Slansky, 1981). Further, leaf allelochemicals may also serve as nutrients or toxins, depending on many factors, including its environment, its concentration, and the physiological state of the receiver (Maiorana, 1979). Recently, unequivocal clarifications have been made on the chemistry of teak leaves of different maturity which revealed that tender leaves contained relatively high percentage of moisture, nitrogen and polyphenol contents followed by a rapid decline in intermediate and mature leaves (Roychoudhury *et al.* 1995 b). The huge concentration of polyphenols in tender leaves is possibly responsible for non-preference by the larvae of *S. litura* because phenolic compounds have antibiotic effects on insects (Singleton and Kratzer, 1969).

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