CHEMICAL CONSTITUTIONS OF TEAK *(TECTONA GRANDIS)* AND THEIR INFLUENCE ON THE ATTACK OF THE BEE-HOLE BORER *(XYLEUTES CERAMICUS)*

by

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Teak *(Tectona grandis* Linn. f.) is one of the most valuable timber of South-East Asia. The wood has extremely good properties, mainly the low swelling and shrinkage, the high resistance against abrasion and weather influences, and at least the excellent natural durability to the attack of fungi and many insects; e.g. termites.

Because of this valuable properties the Royal Forest Department in Thailand has started 61 years ago (1) with the establishment of teak plantations in various locations, but it seems to be favoured to the damage caused by the teak bee-hole borer (*Xyleutes ceramicus* Walker), the most dangerous trunk borer of standing tree. The larvae feed on the callus and work their way into the sapwood and heartwood for living and protection during their development. Pupation takes place at the end of the tunnel inside the trunk. After the emergence of the adult moth, the exit hole will be heeled up by the growing tissue in the next following year. The tunnels are leaving as a permanent defect inside the tree, which caused a great lost to wood quality and value.

A biological control by using a parasitic fungi, *Beauveria bassiana* has been tested and is effective only when the larvae developing to maturity and where they are accessible to be contaminated by the airborn fungal spores. Sofar there is no preventive measure for this borer. (2)

According to the field observation in the area of heavy incidence, some individual trees are freed from the borer. Therefore, it is of an interesting for their resistant reaction. The study on the chemical composition of the wood from both resistant and non-resistant trees is the main purpose of this paper

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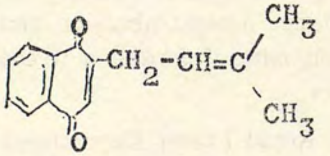
It is well know (3, 4) that heartwood of teak contains some extractives which have a toxic or repellent activity against termites. The most effective compound seems to be desoxylapachol (1) whereas the very similar lapachol (2) is less toxic. Besides these napthoquinones a group of anthraquinones and hydroxyanthraquinones of the teak heartwood is very effective too, but only when these compounds are substituted in the 2-position at the carbon skeleton. The most important compound of this group is tectoquinone (3). The hydroxyanthraquinones are effective too, but normally are present in a very low concentration.



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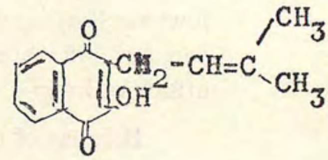

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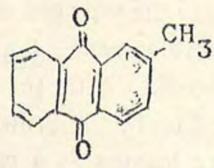

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It was the question, if some of the heartwood extractives of teak would have any effect to the teak bee-hole borer. To clear this problem we made the chemical analysis of the cell wall substances and the extracts of the teak heartwood and sapwood, attacked and not attacked by the teak bee-hole borer. The samples were collected from the teak plantations Huay Thak, Lampang (13964 rais) and Tha Chai, Sukothai (7078 rais); from each area we got attacked and unattacked wood. In both areas the percentage of attacked trees is between 26 to 31% (2)

Chemical Investigations

The analyses were done by the following methods:

Holocellulose	:	Wise's methods. (5)
Cellulose	:	TAPPI Standard T 9m-54 (6)
Lignin	:	C C A-5 (7)
Extraction	:	TAPPI Standard T 6m-59
Caoutchouc	:	Air-dried sawdust was used and extracted at first with ethyl alcohol-benzene (1 : 2), afterwards with petroleum ether. The petroleum ether extract was evaporated and the residue dissolved in chloroform. Bromine was added under cooling, and after 2 hours petroleum ether was added. The precipitatate of caoutchouc bromide was washed with ethyl alcohol, water, and ether and dried to constant weight. (8)

The results are given in Table 1. The data were calculated from duplicate samples.

Tabel 1 :– The chemical analyses of Teak (*Tectona grandis* Linn. f.)

	Attacked samples				Unattacked samples			
Age, years	14		5		16		8	
Diameter, cm.	20		9		$21\frac{1}{2}$		$10\frac{1}{2}$	
Number of sample	1	2	3	4	5	6	7	8
	Heartwood	Sapwood	Heartwood	Sapwood	Heartwood	Sapwood	Heartwood	Sapwood
Holocellulose, %	70.85	66.35	70.48	69.63	70.94	68.89	69.61	67.83
Cellulose, %	60.47	49.89	58.98	51.47	59.83	51.65	57.06	51.14
Hemicellulose, %	10.38	16.45	11.50	18.06	11.01	17.23	11.55	16.69
Lignin, %	30.51	32.21	27.71	29.89	29.06	32.02	27.46	29.50
Alcohol-benzene extract, %	4.76	5.87	5.79	2.90	6.28	5.11	8.70	4.28
Caoutchouc, %	0.05	0.02	0.00	0.00	0.02	0.01	0.00	0.00

The analysis of the extract we did by paperchromatography, using the paper S & S No. 2043 b Mgl and the solvent system heptane-methanol (stationary phase : methanol saturated with heptane; mobile phase : heptane saturated with methanol). The development of the chromatogram needs 5 hours.

The detection of the spots was possible under UV light; tectoquinone gives a bright green colour, hydroxyanthraquinones give yellow to orange colours and desoxylapachol gives a dark brownish spot. Lapachol changes to red colour in daylight after treatment with ammonia vapour. The typical chromatogram is shown in Fig 1.

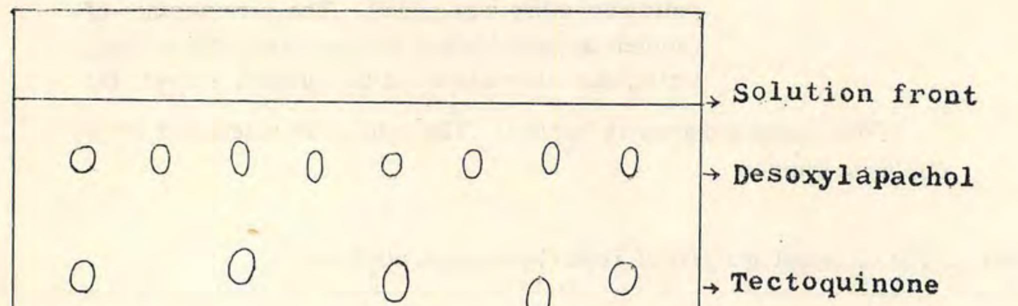

Fig. 1. Chromatogram of teak wood extractives. The number of sample see Table 1.

The chromatographic investigation of the phenolic constituents of the extract we got by treatment with alkali and re-extraction with ether, gave no differences in the number and amount of phenols between attacked and unattacked specimens.

It was not necessary to make quantitative analysis of the teak extractives, as all the chromatograms showed nearly the same concentration of these compounds.

Results

Samples of teak wood which were attacked or not attacked by the teak bee-hole borer were investigated. Neither the cellwall substances nor extract and caoutchouc content show any significant differences. Substances responsible for the resistance of teak heartwood against termites obviously have no effect against bee-hole borer. Further investigations about the content of sugars, amino acids and proteins in phloem sap and sapwood of teak shall show if these substances affect the mechanism of the borer's attack.

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