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BIOLOGY OF *LENTINUS PRAERIGIDUS* BERK. AND THE ASSOCIATED TIMBER-ROT

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(With Plates I & II)

The present investigation has been undertaken to study the biology of *Lentinus praerigidus*, a common wood-rotting fungus, growing saprophytically on logs and posts of *Shorea robusta* during the rainy season in Calcutta and suburbs. It appears that besides *S. robusta* it attacks a few other hardwood species. Its distribution is restricted being entirely confined to warmer parts.

The gross character of the rots reveals that the decay cause bleaching of colour of both sapwood and heartwood. The wood ultimately becomes 'brashy' with age.

Histopathological studies reveal the presence of mycelia in all the wood-elements. Micro-chemical tests and quantitative analysis of cellulose and lignin materials indicate that the fungus mainly consumes the lignin along with some amount of cellulose

Decay-resistance-tests show that the test-fungus can cause considerable damage to the hostwood. The sapwood is 'moderately resistant' and 'non-resistant' against primary and secondary mycelia respectively, while the heartwood is 'resistant' and 'moderately resistant' against the two mycelia.

Oxidase tests reveals that the fungus is a 'positive oxidase reactor' which produces with 0.5% gallic or tannic acid, a brown r[illegible]round the inoculum. Gentian violet and gum guaiac tests have also been performed in corformity with the former tests.

Toxicity tests following American agar method and European wood-block method have been performed with Zinc chloride, 'Ascu A' and Borax. It has been found that 'Ascu A' is the most effective of the three preservatives since both the primary and secondary mycelia have least tolerance for it.

INTRODUCTION

Lentinus praerigidus Berk. is a common wood-rotting fungus in India inflicting great economic loss in our country by causing decay of stacked logs of *Shorea robusta* Gærtn.*f.* (the common sal). The fungus, a common white-spored member of the family Agaricaceæ, is found to grow luxuriantly on logs of *Shorea robusta* in Calcutta and suburbs during rainy season extending from July to October every year. Cool somewhat shady situation and atmospheric temperature ranging between 26°—32°C. seem to be favourable for the developments of its fructifications in the field.

Berkeley (1856) was the first to describe the fungus and his description was followed by Saccardo (1887). Lloyd (1904—1919) considered *Lentinus kurzianus* Curr. to be a synonym of *L. praerigidus*. He further stated that Currey's record of *L. furfurosus* Fr. refers to *L. praerigidus*. According to Butler and Bisby (1931), *L. omphalomorphous* Mont. is also a synonym of the fungus.

As regards distribution of the fungus our knowledge is at present meagre. In India, it was collected by Hooker from Bihar (Saccardo, 1887). Besides, it is known to occur, commonly on logs of *Shorea robusta* (Banerjee, 1947), on *Terminalia paniculata* and *Vateria indica* (Annonymous, 1950) and on logs in timber-yards and railway sleepers (Bose, 1918, 1920). Bagchee (1954) reported the species from

forests in the foot-hills of the Himalayas, in the Ghat forests of Madras and Bombay, in the Hill-Tracts of Chittagong and in the periodically dry forests of Central India, Uttar Pradesh and Mysore but less commonly in the dry deciduous forests having an average rainfall below 30 inches. Considering the fairly wide distribution of the species in India and the economic importance of the host, the present investigation has been undertaken.

Material

The fructifications of *L. praerigidus* were collected during the months of July and September while growing luxuriantly on logs of *S. robusta* in the timber-yards of Calcutta and suburbs (Plate I ,Fig. 1). The logs, showing various stages of decay, were macroscopically examined to note the symptoms. Spore-deposits were taken from fresh fructifications on dry, sterile slides in petri-dishes and several polysporous and monosporous cultures were made on 2.5% malt-agar slants and incubated at 30°C.. In order to study the causal organism in culture, isolations were done from different regions of the decayed tissues of the log following Banerjee (1955). These isolates were critically examined and were found to be identical with the polysporous cultures in all details.

The Basidiocarp

Fructification : Usually in dense clusters, rarely solitary ; excentrically stipitate, sometimes centrally or laterally so ; fleshy-leathery, tough, often becoming hard when old, reviving ; 1.5—4 cm. high. *Pileus* : Convex, often somewhat flat, with a central depression, 3—5.5 cm. in diameter and 0.5—0.6 cm. thick about half way from margin to the centre. Margin entire or slightly wavy, Hazel to Oak Buff, hirsute, becoming involute on drying. *Upper surface* : Distinctly squarrose due to presence of recurved scales ; colour when young in between the scales Maple but that of scales Hazel, later Maple with Oak Buff scales or completely Mastic on gradual drying ; scales more abundant towards the periphery (Plate I. Fig. 2). *Flesh* : Fleshy-leathery to tough, white, about 0.1 cm. thick. *Hymenial surface* : Lamellate, distinct, concrete with the pileus, thin, narrow and of different sizes, homogenous, decurrent, about 0.3—0.5 cm. wide in the middle but gradually narrowed at both extremities, crowded, about 0.1—0.15 cm. apart from one another, colour at first Honey Middle Stone turning Olive Wood or Broze Brown with age and on drying, margin lacerrated-serrate (Plate I, Fig. 3). *Stipe* : Short, excentric, rarely lateral or central, tough, often hard and woody at the subbulbous base ; face subtomentose but with a few scattered scales ; at first Hazel at the upper part and Oak or Russet Brown at the lower, becoming Olive or Cocoa Brown throughout on drying ; dimension about 1.5—2.5 × .5—.75 cm. *Basidia* : Clavate, tetrasterigmatic, quadrisporous, dimension about 14—17.5 × 2.7—4.5 μ. *Basidiospores* : Hyaline, oval to elliptical, thin-walled, smooth, uninucleate, dimension about

2.7—5.5 × 1.8—2.7 μ. *Hyphal pegs* : Frequent, more or less cylindrical, apex some what rounded, originating from the subhymenium, projecting beyond the hymenium upto 52.5 μ. consisting of a mass of glutinated hyphæ, mostly hyaline and with scattered irregularly crystalline deposits ; dimension about 60—75 × 24.5—35 μ. Hyphal system consisting of three types of hyphæ. *Generative hyphæ* : Thin-walled, hyaline, flexuous, sparingly branched, closely or distantly septate with frequent simple clamp-connexions, branches originating at intervals due to proliferation of clamp-connexions, full of dense granular contents and staining intensely with lacto-phenol cotton blue, about 1.8—2.7 μ wide ; more abundant in the subhymenial region, becoming comparatively few in the stipe while in the flesh practically absent. *Skelelal hyphæ* : Highly thick-walled, more or less straight, slightly flexuous, straw coloured refractive hyphæ without evident septa, clamp-connexions and protoplasmic contents, originating as a lateral branch of the binding hyphæ and remaining unbranched throughout its entire length, usually swollen at the middle to a considerable distance but remaining narrow and somewhat attenuated at both ends, about 7—12.2 μ in the middle but 1.8—2.7 μ at the extremities ; comparative abundantin the flesh, less conspicuous in the stipe but entirely absent in the gills. *Binding* : Thick-walled, almost hyaline, slightly or highly flexuous, closely or distantly branched, lumen discontinuous due to extreme thickening, often becomin gsolid, without evident septa, clamp-connexions and protoplasmic contents, refractive, about 1.8—2.7 μ wide ; most conspicuous element in the trama of the gill, becoming gradually fewer in the flesh and the stipe ; localised area of certain hyphæ often swollen to form oblong somewhat club-shaped or irregular regions with a few narrow branches spreading outwards thus each forming a 'hyphal-complex'.

Fungus In Relation To Timber-Decay

Gross character of the rot : Externally the decay is conspicuous and consists of numerous narrow longitudinally decayed areas in the sapwood, often coalescent with one another and extend throughout the entire length of the pole. Cross section of the pole show that the decay in the sapwood has advanced considerably and extended upto the periphery of the heartwood (Plate I, Fig. 4). The entire sapwood portion of the log has been severely damaged and the compactness of the wood is considerably lost. The colour of the decayed areas has considerably changed to a more or less pale yellowish or somewhat whitish tinge. At the periphery of the heartwood where the rot is in the incipient stage of decay, the colour of the rot is somewhat darker than the central portion. When viewed with a lens, numerous small rot-pockets will be evident throughout the decayed areas particularly in the sapwood region of the log. With the advancement of decay the sapwood breaks down longitudinally at places, becomes "brash" and breaks off easily into small bits.

In a median longitudinal section of the pole, the central portion of the heartwood remains quite unaffected but its peripheral portion and the entire sapwood show serious stages of decay (Plate I, Fig. 5). The colour of the decayed region is variable and is dependent on the stage of decay.

From the longitudinal section it will be evident that the pathogen after initial invasion of the log, destroyed its sapwood and finally entered the main stem and has spread in lateral, longitudinal and transverse directions. In heartwood the decay did not occur much possibly due to loss of its water content which fell below fibre-saturation point.

Histopathology

To study the microscopic details of the rot decayed logs of *S. robusta* at advanced stage of decay were fixed and preserved in Formal-Acetic-Alcohol (10 : 5 : 85 c. cm. 70% alcohol) to study later stages of decay. For studying the early progress of decay, wood blocks were obtained from those exposed to fungal attack under controlled conditions for four months. The blocks were softened by the usual method of boiling and subsquently treating in a mixture of glycerine and methylated spirit (1 : 1). Sound wood blocks which were similarly soaked served as controls. Transverse, radial-longitudinal and tangential-longitudinal sections were cut. Both microtome and free-hand sections were tried, of which the latter method yielded better results and in these lesser distortion of internal mycelium was observed. Of the various combination stains, Safranine and Picro-anilineblue recommended by Cartwright (1929) and Safranine and Fast Green recommended by Forest Product Research Laboratory gave satisfactory results for detecting the fungal hyphae from the woody host-tissues.

In the early stages of decay, the distribution of fungal hyphae is not uniform throughout the different tissues of the host, being abundantly present in the lumina of the vessels, a few of the wood parenchyma and the medullary ray-cells. The hyphae are essentially similar to those of the 'generative' type in being hyaline, thin-walled with abundant granular protoplasmic contents, frequently branched and having clamp-connexion almost at each septum. Two distinct types of hyphae are readily distinguishable. The wider one, 3.5-4 μ in diameter, are frequently present in the lumina of the vessels and wood-parenchyma and passing longitudinally through them. These wider hyphae supply narrow branches, 1.7-2.5 μ in diameter, that help in lateral spreading of the mycelium by penetrating through the vertical walls of the different elements. In early stages, this longitudinal distribution of wider hyphae through the lumina of the vessels is obviously due to absence of any resistance offered by them. These hyphae gradually ramify, intertwine and eventually form mycelial wefts almost closing the lumina in most cases. As the decay progresses, the wood-parenchyma and medullary-ray cells are severely attacked. The tracheids and wood-fibres

remain more or less unaffected in the early stages but with the gradual advancement of decay the tracheids and the fibres are invaded in succession (Plate II, Fig. 1-7). The penetration and consequent invasion of hyphae from cell to cell are at first mainly through the simple or bordered pits, At later stages, the pits of different tissues show considerable enlargements in their diameter, due to fungal action and the hyphae appear to fit loosely in passing through bore-holes, are also evident. The bore-holes are oval to circular in outine and when first formed fit tightly to the passing hyphae but their diameter enlarge gradually and the hyphae appear to fit loose. The smooth and rounded contours of the bore-holes clearly support Proctor's view of cell-wall penetration (1941) due to enzymic activity and not by mechanical force. With further advancement of decay, the cell-walls of wood-parenchyma are progressively thinned out and ultimately degenerate forming spongy area between the wood fibres. At this stage, the wood loses its compactness due to appearence of cracks between the groups of fibres, thus separating them into irregular strands. The medullary ray cells are heavily attacked with the mycelium, but they are not damaged to considerable extent, possibly due to formation of abundant gummy substances within them. The vessels show gradual thinning of their walls, which are finally more or less ruptured and their lumina are filled with dense weft of mycelium (Plate II, Fig. 2). Within each narrow lumen of a fibre the hyphae is usually unbranched and runs longitudinally, while inside the tracheids it is always branched (Plate II, Fig. 8-9). With further progress of decay, cracks appear within the tissues which looses the fibres into separate groups (Plate II, Fig. 3).

Microchemical Studies

Microchemical studies, although sometimes lead to erroneous results, are still the convenient method at the preliminary stage for studying the changes that take place in the chemical compostion of wood due to attack of a wood-rotting fungus. Such tests were performed to study the nature of both lignified and cellulosic walls in sound and partially decayed wood of *S. robusta* subjected to the attack of the test-fungus. Phloroglucin-HCl and Chlor-zinc-iodine tests were performed to demonstrate the presence of lignin and cellulose respectively. The former turned the lignified walls red while the latter, the cellulosic walls blue. The results obtained from Phloroglucin-HCl were verified by 'Maule treatment' while results of Chlor-zinc-iodine test were verified by treating the sections with Iodine-potassium iodide and sulphuric acid (65%). The combination stain, Safranine and Fast green which differentiated lignified (red stained) and non-lignified (green stained) tissues were also employed. The intensity of colour reactions in sound and decayed wood was compared.

The lighter colour reactions for lignin in partially decayed wood in comparison with that in the normal wood, indicated considerable delignification. On the

whole, delignification was more or less uniform in different wood elements being somewhat greater in the secondary walls than that in the primary ones. Staining reactions for cellulosic materials revealed that they also undergo digestion during the progrees of decay although the severity of loss in the case was much less in comparison with that of lignin. Combination staining with Safranine and Fast Green also supported the above findings.

Sulphuric acid test following Ritter (1925) revealed violent reaction in sound wood due to presence of large quantity of cellulose while in partially decayed wood intensiy of such reaction was somewhat less exhibiting lesser quantity of cellulosic materials.

Chemical Studies

In conformity with the results obtained in microchemical tests, chemical analysis of sound and decayed wood were done to study the losses (in %) of lignin and cellulose quantitatively. Each test-block was cut into small chips which were ground into fine powder in a grinder and finally sieved (60 Meshes).

In estimating the percentage of lignin in a wood the method employed by Allen *et al* (1940) was mainly followed. For estimation of cellulose, the method of Cross and Bevan (1911) as modified by Dean and Tower (1913) was followed.

The results are recorded in the Table 1.

Table 1. *Data showing the percentage of cellulose and lignin in sound and decayed sapwood and heartwood of* Shorea robusta.

Nature of wood and type of mycelia	Cellulose* (%)	Lignin (%)
Sound sapwood	31.0	33.8
Sapwood + primary mycelium	23.4	29.1
Sapwood + Secondary mycelium	22.2	26.0
Sound heartwood	20.6	40.4
Heartwood + primary mycelium	20.0	37.9
Heartwood + Secondary mycelium	19.0	33.6

* Average of three replicates

From the table it will be evident that the percentage of ligin in decayed wood is much lower that in the sound one, thus showing considerable loss during the process of decay. Further, the loss in decayed wood due to the attack of secondary mycelium is somewhat greater than that due to primary one. In case of cellulose considerable loss also take place, since the percentage of cellulose in decayed wood is lower than that in the sound wood. The secondary mycelium shows greater ability to destroy cellulose than the primary one.

Thus, it can be concluded that the test-fungus consumes both lignin and cellulose of the host-wood considerably in its process of decay during the experimental period.

Decay-resistance tests

To study the natural resistance of the host-wood, a quantitative determination of decay under controlled conditions was done in the laboratory following Banerjee (1955) by exposing sterilized samples of sound wood-blocks to the attack of the mycelia of the test-fungus. The decay caused due to the fungal action was finally determined in terms of dry weights of the test-blocks before and after the experiment.

Rectangular blocks of uniform size (2″ × 1″ × 1/2″) of both heartwood and sapwood of *S. robusta* were serially numbered and allowed to dry to constant weights. The initial dry weights of the wood-blocks were recorded. The blocks were then soaked in distilled water under reduced atmospheric pressure until their moisture content rose above 'fibre-saturation-point'. According to Cartwright and Findlay (1946), it lies near about 30% of the total dry weights of the wood-blocks. The soaked test-blocks were then sterilized at 15 lbs. pressure for 15 minutes. These were finally introduced aseptically, four in each Kolle flask containing actively growing primary and secondary mycelia of the test-fungus. and incubated at a constant temperature of 30°C. in complete darkness for a period of four months. The flasks were examined from time to time and sterilized distilled water was poured into the reservoir at the neck of the Kolle flasks in order to keep the internal atmosphere saturated. At the end of the experimental period, the test-blocks were freed carefully from the superficial mycelium and weighed to calculate their moisture-content. The blocks were examined to note the physical changes due to decay and then dried to constant weights. The difference between initial and final dry weights of the test-blocks gave the loss in dry weights due to decay, from which loss in percentage was calculated.

The results are given in the following Table 2.

Table 2. *Data showing comparative losses in dry weights (%) of sapwood and heartwood blocks of* S. robusta *after four months' test exposed to primary and secondary mycelia of* L. praerigidus.

Type of wood	Primary mycelium		Secondary mycelium	
	Mean (%)	Range (%)	Mean (%)	Range (%)
Sapwood	9.32	3.17—13.59	12.18	9.14—16.36
Heartwood	3.65	3.16— 4.41	6.28	3.29— 9.15

From the comparative study of the losses in dry weights due to decay in both sapwood and heartwood of *S. robusta* caused by primary and secondary

mycelia of the test-fungus, it is evident that the loss in sapwood is more than that of heart wood. Further, the loss due to secondary mycelium is greater than that caused by the primary one. The average losses in sapwood are 9.32% and 12.18% and those in heartwood are 3 65% and 6.28% due to primary and secondary mycelia respectively. These losses are valid so long as the size of thc woodblocks are concerned. Since, the overall size of the test-blocks has considerable effect on the rate of decay. It has been found that smaller the volume of the test-block, greater is the amount of decay during the experimental period (Findlay, 1953). The variations in percentage of losses in sapwood and heartwood, indicate their different resistance capacities towards the attack of both primary and secondary mycelia. Following Findlay's classification (1938), the sapwood of *S. robusta* exposed to primary and secondary mycelia appear to be 'moderately resistant' and 'non-resistant' respectively. The heartwood, on the otherhand, when exposed to primary mycelium is 'resistance' while to secondary mycelium, 'moderately resistant.'

The average moisture content in sapwood and heartwood blocks before experiments were about 80% and 55% respectively while after the experimental period were found to be 70% and 50% respectively. The normal activity of the fungus, as such, did not hamper as the moisture contents remained much above the 'fibre-saturation point.'

At the end of the experimental period, the test-blocks show considerable changes of macroscopic characters due to decay. The sapwood blocks become soft, light and somewhat porous. Severely decayed portions of these blocks lose their sound texture and become 'brashy' as is evident when tested with a knife. In most cases, the sapwood blocks exposed to the secondary mycelium have undergone considerable bleaching. The heartwood blocks, on the otherhand, show similar external manifestations of decay but it is less severe and mainly confined to the face of the blocks in contact with the fungal mat.

Oxidase tests

From the earlier studies it has been found that the test-fungus primarily destroys the lignified portion of the host-tissues. According to Wehmer (1927) the lignified portions of host-tissues are destroyed by oxidation process as a result of the extracellular oxidase secreted by the 'white rot' fungus, while a 'brown rot' secrets sufficient amount of hydrolising enzyme for the hydrolisis of cellulosic materials of the host-tissues. To determine the nature of test-fungus oxidase tests proposed by Bavendamm (1928) was made. The method consists of allowing the test-fungus to grow separately on 2.5% malt-agar containing 0.5% gallic or tannic acid in Petri-dishes. The inoculated Petri-dishes were incubated at 30°C. and in complete darkness. In all cases dark brown zones appeared around the inocula within 24 hours of inoculation indicating the test-fungus to be a 'white rot' species.

A test parallel to that of Bavendamm was also performed on 2.5% malt-agar containing 0.007% Gentian Violet following Preston and McLennan (1948). Since the test-fungus is a 'white rot' one, the violet colour of the medium was gradually completely bleached in about a month. Complete decolourisation takes place only when the oxygen concentration is greater than 6% and this decolourisation is probably due to an extracellular oxidase system produced by the white rot fungus. Following Nobles (1958) gum guaiac test was performed in confirming the 'white rot' nature of the fungus.

Toxicity Tests

Toxicity tests of different preservatives against the action the test-fungus was done following the simple American method of growing the fungus on an agar medium containing different concentrations of the preservatives. The European method using small wood-blocks soaked with different concentrations of the preservatives and exposing them to the attack of a vigorously growing fungus in Kolle flasks was also undertaken on the basis of the knowledge gained in agar method. Three water soluble preservatives, zinc chloride, 'Ascu A' and Borax have been selected for the experiment.

Following American method, sterilized and measured quantities of 3% aqueous solution of the preservative was added to 2.5% malt-agar to get a graded concentration 0.03%, 0.06%, 0.09%, 0.12%, 0.15%, 0.18% and 0.21% of the preservative. These agar plates were inoculated separately with primary and secondary mycelia of the test-fungus and incubated in darkness at a constant temperature of 30°C. Replicates and adequate controls without the toxic substance were kept under similar conditions. On the 5th day after inoculation, the growth of the mycelia at different concentrations were noted.

The result are recorded in the Table 3.

Table 3 *Effect of different water-soluble preservatives on growth of both primay and secondary mycelia of* L. praerigidus *after 5 days.*

Concentration of preservative	Growth of the mycelium in diameter (in mm.*)					
	Zinc chloride		*'Ascu A'*		*Borax*	
	Pri. m.	Sec. m.	Pri. m	Sec. m.	Pri. m.	Sec. m.
Control	74	82	74	82	74	82
0.03%	57	75	53	61	66	72
0.06%	38	63	29	32	48	60
0.09%	20	47	9	10	35	42
0.12%	9	20	0	7	10	14
0.15%	0	10	0	0	0	7
0.18%	0	0	0	0	0	0
0.21%	0	0	0	0	0	0

* Average of three replicates.

From table it is evident that toxic points of both primary and secondary mycelia of the fungus fall within the range of concentration of chemicals employed. Thus concentrations 0.12%, 0.09% and 0.12% represent the inhibition points for the primary mycelia while 0.15%, 0.12% and 0.15% for the secondary mycelia in cases of zinc chloride, 'Ascu A' and Borax respectively. In all cases, the secondary mycelium shows greater tolerance for the toxic substances than the primary one. Moreover, the mycelia have least tolerance for 'Ascu A' and can tolerate the other two substances more or less equally.

Following European method, sapwood of *S. robusta* which was found to be 'non-resistant' to decay, was selected for the preparation of test-blocks of uniform size (2" X 1"X$\frac{1}{2}$"). These were dried to constant weights and then treated with varying concentrations of preservatives. One concentration higher and one lower to the 'toxic point' as observed in agar method were selected for the purpose. The test-blocks were soaked in preservative solution under reduced pressure for rapid impregnation. The blocks were weighed again to calculate the quantty of the preservative in the wood. in terms of grammes per cubic inch. The treated blocks were then sterilized and subjected to the attack of the mycelia of the test-fungus in Kolle flasks for a period of four months at 30° C. in the laboratory. At the close of the experimental period, the final dry weights of the test-blocks were taken to calculate the loss weights in due to fungal action.

The results are recorded in Table 4.

Table 4. *Toxicity test with sapwood of* S. robusta *treated with different preservatives and exposed to primary and secondary mycelia of* L. praerigidus *for a period of 4 months at 30°C.*

Nature of Mycelia	Preservative	Conc. (%)	Absorption gm/inch 3	Loss* (%)	Condition of the testblock
Primary	Zinc chloride	0.12	0.006	4.37	Partially decayed
		0.15	0.011	3.64	do
		0.18	0.013	1.56	Almost sound
Secondary	do	0.15	0.009	6.54	Partially decayed
		0.18	0.012	4.17	do
		0.21	0.014	1.57	Almost sound
Primary	Ascu A	0.09	0.005	4.07	Partially decayed
		0.12	0.007	2.51	Almost sound
		0.15	0.008	1.55	do
Secondary	do	0.12	0.006	2.41	do
		0.15	0.008	1.78	do
		0.18	0.009	1.27	do
Primary	Borax	0.12	0.006	5.66	Partially decayed
		0.16	0.007	3.16	do
		0.18	0.009	1.57	Almost sound
Secondary	do	0.15	0.008	8.03	Partially decayed
		0.18	0.011	5.10	do
		0.21	0.016	2.69	Almost sound

* Average of three replicates.

From the table it will be evident that even in the maximum concentration of the preservative used in the European method, the activity of the fungus is not totally inhibited although that concentration has been found to be highly toxic in the agar-medium test. These results are in full agreement with those found by Findlay (1932). It is also evident that 'Ascu A' is the most effective of the three preservatives, since both the types of mycelia have least tolerance for it. Further, the sapwood which has been found to be 'non-resistant' in decay-resistance tests, becomes resistant to the attack of both the types of mycelia when approximately 0.005 gramme of the preservatives present per cubic inch of the wood. The other two preservatives, Zinc chloride and Borax are less effective than 'Ascu A', since approximately 0.010 and 0.013 gramme of these two preservatives are required to render the wood resistant.

Discussions

L. prærigidus which causes considerable loss to the national economy of India by decaying loss of *Shorea robusta,* induces the present investigator to deal in general way some of the salient features about its life-history and its relationship with the host-wood. The fungus, commonly occurring as saprophyte, is reported to attack a number of other timbers. Bagchee (1954) has reported the fungus to occur occasionally as parasites on *S. robusta.* Its dependence on external conditions particularly temperature and humidity, for the development of its fructifications and other activities reveal a much complicated biological phenomenon. Superficially, the decay caused by the test-fungus in the form of conspicuous narrow longitudinal decayed areas which are mainly restricted in the sapwood of logs, but occasionally extending upto the peripheral region of the heartwood. Decayed portion of the wood in an advanced stage become 'brashy' and is considerably bleached.

Decay-resistance-tests in the laboratory reveal that the nature and extent of the fungal decay depend much on the types of mycelia and nature of the wood. The sapwood has been found to be 'moderatey resistant' and 'non-resistant' to the attack of the primary and secondary mycelia respectively as it undergoes more than 9.32% and 12.18% loss in dry weights. The heartwood, on the other hand, is 'resistant' and 'moderately resistant' towards primary and secondary mycelia as it suffers more than 3.65% and 6.28% loss respectively. The secondary mycelium, irrespective of the types of wood used, causes greater amount of decay than the primary one. The fungus after establishing itself within the wood spreads through the pits and also directly through bore-holes of all the wood-elements of the host. Microchemical studies with partially decayed wood show considerably thinning of the lignified walls of different tissues as compared to those present in the sound wood. Together with the delignification process, destruction of the cellulosic materials also takes place. Estimation of lignin and cellulose of sound and decayed

wood serves a corroborative evidence for the data obtained in the microchemical studies. The fungus is a 'white rot' one as it gives strong positive reactions to oxidase tests performed with gallic and tannic acid. Gentian violet and gum guaiac tests also performed the 'white rot' nature of the fungus.

Timber-decay of *S. robusta* caused by the fungus can be effectively controlled by using proper concentrations of wood preservatives used on the wood under a set of controlled conditions in the laboratory. Of the three preservatives used, 'Ascu A' has been found to be most effective since the fungus shows least tolerance for this chemical. Zinc chloride and Borax also cheek the decaying capacity of the fungus to some extent.

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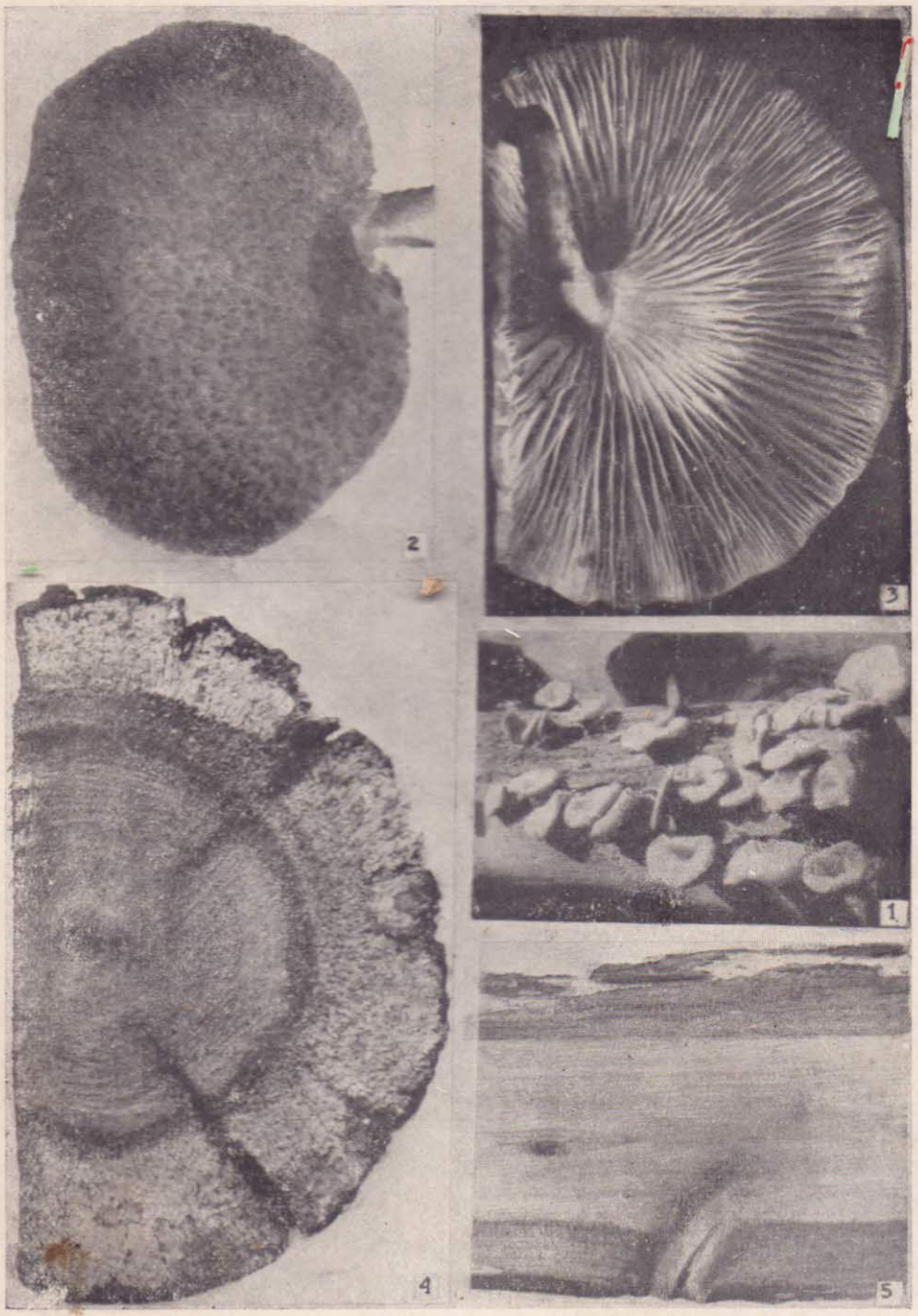

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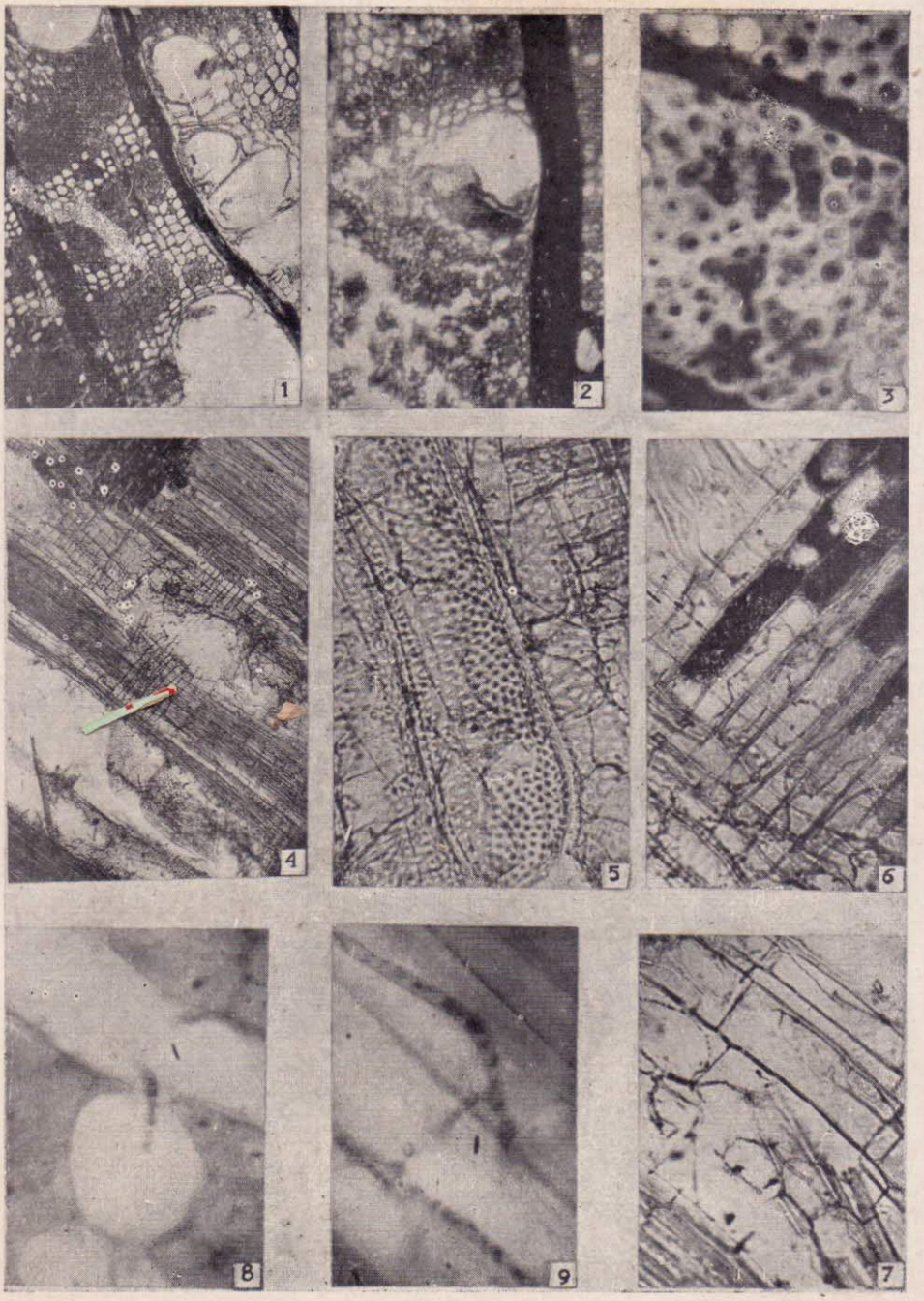

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EXPLANATIONS OF PLATES

PLATE I

Fig. 1. Fructifications of *Lentinus praerigidus* on logs of *Shorea robusta* in the timber-yard (reduced).
Fig 2. Upper surface of the fructification of *L. praerigidus* showing numerous scales on it (x 4).
Fig. 3. Hymenial surface of the fructification of *L. praerigidus* showing the gills (x 4).
Fig. 4. Part of a cross section of the infected pole of *Shorea robusta* in an advanced stage of decay of the sapwood with conspicuous rot-pockets and shrinkage cracks. The heartwood region is slightly affected at the periphery but it is almost healthly at the centre (x$\frac{1}{2}$).
Fig. 5. Longitudinal section of the pole showing the rot in the sapwood. The infection appears to have taken place through the wound of a broken branch and progressed longitudinally through the sapwood, (x$\frac{1}{4}$).

PLATE II

Fig. 1. Part of a transverse section through the infected sapwood of *S. robusta* in an early stage of decay (x 500).
Fig. 2. Part of a tranverse section through the sapwood of *S. robusta* in further advanced stage of decay showing general disintegration of the wood-elements. Vessels and wood-fibres are highly disintegrated (x 500).
Fig. 3. Part of a transverse section through the wood of *S. robusta* in advanced stage of decay showing decayed products formed due to dissolution of walls of the wood-fibres (x 1000).
Fig. 4. Part of a radial longitudinal section through the decayed sapwood of *S. robusta* showing the distribution of mycelium in the different elements (x 600).
Fig. 5. Part of a radial longitudinal section through the decayed sapwood of *S. robusta* showing the ramification of the mycelium within the vessels ; hyphae with clamp-connexions are distinctly visible (x 1200).
Fig. 6. Part of a radial longitudinal section through the decayed sapwood of *S. robusta* showing distribution of hyphæ within the ray cells. Deposition of gummy substances are also evident in some of the cells (x 1200).
Fig. 7. Part of a radial longitudinal section through the decayed sapwood of *S. robusta* showing hyphæ within the woodfibres.
Fig. 8. Part of a radial longitudinal section of the decayed sapwood of *S. robusta* showing hyphæ within the tracheids (x 1800).
Fig. 9. Part of a transverse section of the decayed sapwood of *S. robusta* showing the entry of a hyphal tip into a vessel (x 1800).