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Wood Anatomy of Mistletoe-Infected Wood of *Tectona grandis* Linn. F

Adeniyi, I.M.[1], Areo, O.S.[1,*], Oluwadare, A.O.[2], Okorie, N. A.[2] and Alao, O.J[1]

[1]Department of Forest Products Development and Utilization, Forestry Research Institute of Nigeria P.M.B 5054, Forest Hill, Jericho Estate, Ibadan, Oyo-State of Nigeria, Ibadan.

[2] Department of Forest Resources Management, University of Ibadan, Oyo State, Nigeria.

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ABSTRACT

Anatomical features of infected wood of teak (*Tectona grandis*) were investigated in this study. Mistletoe-infected trees were sectioned and examined under a light microscope in order to ascertain the extent of infestation of the parasite, especially the haustoria, on the wood species. Wood micrographs of healthy *Tectona grandis* were presented, while photomicrographs of the infested wood sections revealed patches of deposits which were noticeable at the tangential section in the parenchyma cells. Upon examination and in comparison to sections from healthy *Tectona grandis*, it was observed that the deposits might have been as a result of the wood response to the infestation of the parasite (mistletoe). The materials which seemed to plug part of the rays were associated to the parasite activities in the wood rays, as the areas mostly infected were the parenchyma cells where food materials are normally stored in wood. The study revealed that impact of Mistletoes goes beyond the peripheral of the bark region but further into the host wood microstructures.

Introduction

Tectona grandis has been noted to be associated with a couple of plant parasites including *Mikania micrantha* and *Dendrophthoe felcata*. The former is a perennial climber which has been known since 1918 and has been a menace in many parts of Asia and Oceania; this parasite suppresses many crops including teak (Varma, 1997). *Denrophthoe felcata* is an angiosperm hemiparasite (it contains chlorophyll when mature) with which teak is widely infested. This mistletoe causes enormous damage, sometimes leading to the death of the entire tree according to Jose et al, (2002). The parasite infestation affects the wood quality and volume increments besides killing the tree completely in the case of severe infestation (Sharma et al, 1997). *Tectona grandis* is a resistant wood species which is affected by both plant and animal parasites. Teak suffers from epidemic attacks of defoliators which include *Hyblaea puera* of the Hyblaedae family, a pest that was recognized as a pest of teak nearly 100 years ago (Nair et al, 1997). The economic impact of parasite infestation on tree include reduction in tree vigour and growth increment, poor fruit and seed setting, drying of branches and even death of the host tree. Erosion in timber quality including strength property is another serious damage caused by parasites (Balasundaran and Mohamed, 1997). Tests of physical properties of wood from parasite infested trees showed significant reduction in timber quality. In commercial wood production, parasitic organisms reduce tree growth and can even destroy some trees and forest stands since the tree crop provides the parasites with nutrients at the expense of its own living tissues. Two main types of parasitic plants can be distinguished, namely stem parasites and root parasites. Stem parasites occur in several families, and pathogenic members include some mistletoe and dodder (Cuscuta). Mistletoes are auto- tropic, semi parasitic, woody plants growing attached to trunk, branches or aerial roots of trees. Seeds are rapidly defecated by birds (e.g. Robins, Bluebirds, among others) and they still have their slimy, sticky coatings. This allows the seeds to cling to a branch, sprout and insert its root-like haustoria into the water-conducting system of the tree and infiltrate in between the cells where they absorb most nutrients (Hadfield, 1999). It takes many years for the mistletoe to grow large enough to produce flowers and seeds. Generally, members of the family Viscaceae and Loranthaceae are referred to as mistletoes. Loranthaceae has the largest group of mistletoes, members of the family popularly known as Loranthus are the most destructive parasites in the tropics (Balasundaran and Mohamed, 1997). The wood of teak trees infested with *Dendrophthoe felcata* had Modulus of rupture values nearly 14% lower than that of non-infested trees (Ghanaharan and Balasundaran M. (1997) 1997). The effect of dwarf mistletoe *Arceuthobium americanum* on the strength properties of *Pinus contoria* revealed that the wood from infested trees were generally inferior in strength and shrinkage characteristics (Piirto et al, 1974). Several studies have been carried out on the chemical, physical and anatomical properties of Teak, but studies presenting the nature of penetration of stem parasites in the wood cells are limited. This study presented the effect of haustoria of mistelotoe in the wood cells of Teak.

The uses of Teak are innumerable; there is hardly any use to which the timber is not put, this ranges from boat and ship building; constructional work, bridge building, railway carriage, cabinet making and decorative items; telegraphic and electric transmission pole; common household furniture, laminate board, agricultural implements musical instruments, mine props and ornamental turnery and carving items. Various utilizations of the wood species under study can be influenced by its anatomical structure, for instance, there is a particular pattern of axial parenchyma uniquely present in each wood species, which is more or less consistent from specimen to specimen, and these

Tele:
E-mail addresses: areosola73@gmail.com

cell patterns are very important in both wood identification and utilization (Alex and Regis, 2000). When such wood cells are altered through biological phenomena such as injuries from insect bites that often resulted into certain phenomena such as traumatic intercellular canals. Thus, the growth of haustoria of mistletoe into the cells of host wood will likely transform the anatomical features of the host wood.

Materials and Methods

Six healthy trees and six mistletoe infested trees were chosen and billets of about 12.5cm were taken at 10% (base), 50% (middle) and 90% (top) along the merchantable height. Selection of representative samples into about $1cm^3$ wood blocks was done by using cruciform sampling method (ASTMD 143-48). Sectioning of wood samples was performed in three planes namely, the transverse, tangential and the radial sections using a Reitchet microtome sliding machine. Each thin section was 20µ thick. Anatomical features present were observed using a hand lens while a Watson light microscope was used to confirm the presence of deposits in cells such as vessels, parenchyma cells and rays under 80 × magnifications.

Results and Discussion

The wood micrographs showed some patches of materials (regions arrowed in Figs. 5 and 6) which were confined to the parenchyma cells alone, and mainly within the rays. An indication that the food storage area of the wood which was the parencyma cells were the point of target. The deposits, perhaps, resulted from how *Tectona grandis* wood species responded to infestation of the parasite (mistletoe) as pointed out by Schoeneweiss (1959) who stated that trees respond to parasite infestation by secreting gum, tyloses and related tissues. It can also be suggested that in response to the the injury caused to the wood tissue by the mistletoe, the wood micrographs showed compartmentalized wall of parenchyma cells (Shigo and Maex, 1977) which were indicated as deposits.

The presence of these materials, best seen at the tangential section (Fig.5), might also indicate the presence of some toxic substances produced by the parasite which might have also plugged the tissue by certain kinds of bacteria and fungi (Nwoboshi, 1982). Morever, these phenomena were observed only at the top portion of the trees (Fig. 4-6) while other portions along the tree stem seemed to be intact (Fig. 7-12). This is because the parasite thrived at the top portion of the wood under study.Normal wood sections of Tectona grandis were shown in Figs. 1-3 in which inclusions of any kind were not observed. Those features found in the infected wood may tend to provide information that haustoria of mistelotoe were sensitve to food chemicals present in parenchyma cells.

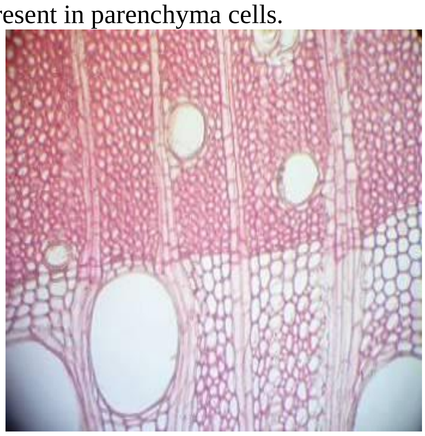

Fig 1. Transverse section (Tr. Sec.)

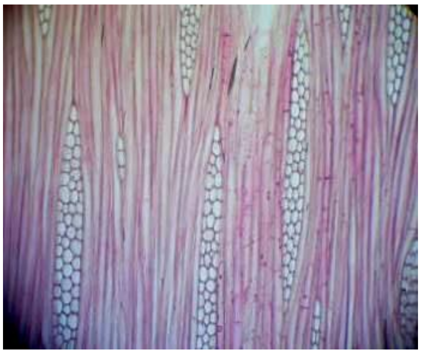

Fig 2. Tangential longitudinal section (TLS)

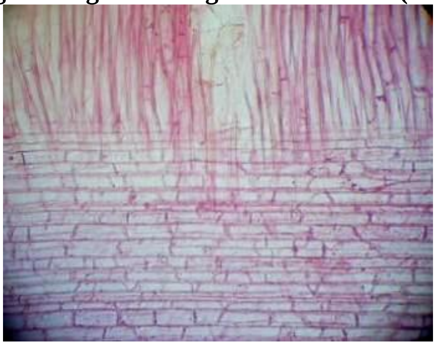

Fig 3. Radial longitudinal section (RLS)

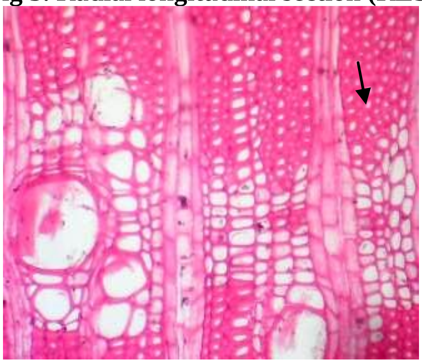

Fig 4. Top portion of infected wood of *Tectona grandis*; infected regions arrowed.

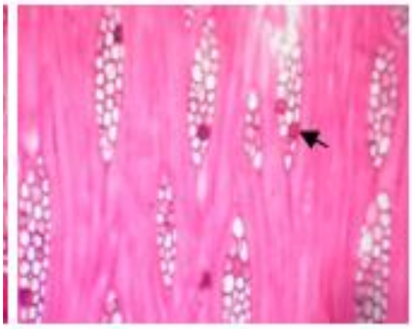

Fig 5. Top portion of infected wood of *Tectona grandis*; infected regions arrowed.

Fig 6. Top portion of infected wood of *Tectona grandis*; infected regions arrowed.

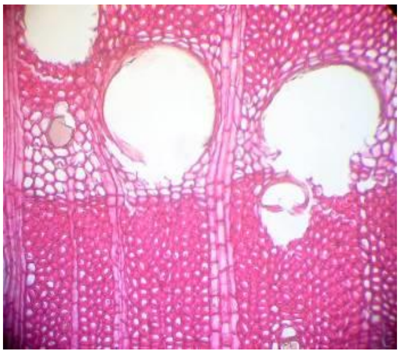

Fig 7. Middle portion of infected wood of *Tectona grandis*

Fig 8. Middle portion of infected wood of *Tectona grandis*

Fig 9. Middle portion of infected wood of *Tectona grandis*

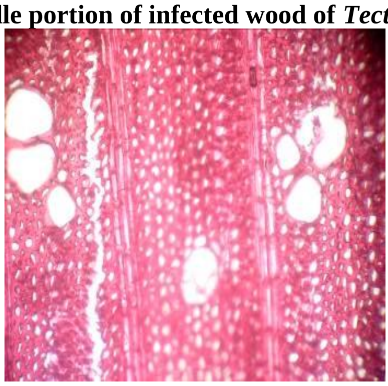

Fig 10. Base portion of infected wood of *Tectona grandis*

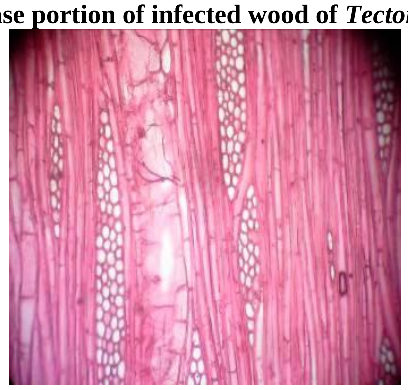

Fig 11. Base portion of infected wood of *Tectona grandis*

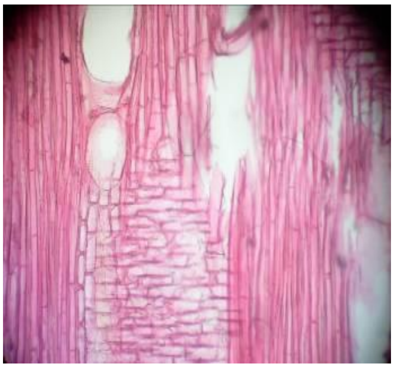

Fig 12. Base portion of infected wood of *Tectona grandis*

Conclusion and Recommendations

This study has been able to show the anatomical structure of infested wood of *Tectona grandis* (Teak) and how the wood cells (especieally the parenchyma cells) were altered during infestation by the parasites. It was observed that the impact of Mistletoes goes beyond the peripheral of the bark region as seen in this investigation. Furthermore, the plugging of the rays by the materials suggests that areas mostly infected were the parenchyma cells where food materials are stored. However, the use of SEM (scanning electron microscope) to further study the extent of penetration and damage caused by haustoria of mistletoes inside wood microstructures will be a great endeavour in wood histology when further investigations are initiated.

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