ROOT ROT OF TEAK

2. FURTHER FIELD OBSERVATIONS WITH NEW RECORDS OF ARMILLARIA MELLEA

by

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Reprinted from: PEST ARTICLES AND NEWS SUMMARIES
SECTION B 1967, 13, 276 - 281
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2. Further field observations, with new records of Armillaria mellea

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Miscellaneous Report No. 574

The first report (Hocking & Jaffer, 1966) gave a summary of early records of teak root disease in East Africa and a detailed account of symptoms and general observations of the disease in Tanzania. The present report extends the survey to include other important young teak plantings in Tanzania and Kenya, as well as later observations on the sites earlier examined.

Longuza arboretum: visited October 18th, 1966.

The following plots of teak were examined:

UPPER ARBORETUM (elevation 800')

P. 1960, ex Trinidad
P. 1959, ex Kihuhwi

LOWER ARBORETUM (elevation 700')

P. 1959, source not indicated
P. 1961, ex Trinidad
P. 1961, ex Nilambur
P. 1962, ex Thailand
P. 1963, ex Var Teli
P. 1965, ex Pakistan

Several dead and/or dying trees were observed in every plot. Felty fungal mats at the bases of trees were present and widespread in every plot except the youngest, P. 1965 ex Pakistan.
Roots were excavated of two or three trees bearing fungal mats in each plot and were invariably found to have all the root disease symptoms earlier described (Hocking & Jaffer 1966). In the older plots the larger roots had proliferated from just above the highest level of disease attack. In some cases, the disease appeared to have been checked and confined to the lower portion, where it was no longer active; and colonization of the affected portion had been taken over by other soil saprophytes.

Fertile hymenial patches were found on purple fungal mats on trees in the following plots:

P. 1961, ex Nilambur
P. 1962, ex Thailand
P. 1960, ex Trinidad

Later microscopic examination showed these to be *Helicobasidium compactum*. There is still no apparent explanation for the occurrence or otherwise of fertile patches.

Many of the older, dried out felty mats carried growths of epiphytic green algae.

**Longuza project:** P. 1964 (elevation 700'); visited October 18th, 1966.

Very rapid growth was shown by these trees, which were estimated to average 25' in height and 3½" diameter at breast height. The teak was planted on old forest land which was cleared about one year before planting, with no intervening period of peasant cultivation.

Many small patches of 3 to 10 dead trees were observed. Some of the dead trees in several patches had the brown crusty, irregular, sporophore on the stem, extending to a maximum of 20" but usually confined to the bottom 10". Roots of trees in every patch showed the expected disease symptoms.

No felty purple mats were found on any trees in these areas.

One isolated tree was found dead with no external symptoms. Excavation of the roots showed most of the usual disease symptoms, but in addition there was a thin layer of cream-coloured mycelium enveloping the upper roots and collar region, just beneath the bark and distinct from both bark and underlying wood. The rot was in an early stage and dried out.

Isolates in pure culture taken from this mycelial layer were indistinguishable from authenticated cultures of *Armillaria mellea*.

More details giving distinctions between root disease caused by *A. mellea* and that suspected to be caused by *Helicobasidium compactum* are given on page , describing an advanced attack by *A. mellea* on larger trees; and on page – , describing an advanced attack on young saplings.
Kisarawe (Pugu) (elevation about 1,000'), visited July 11th, 1966.

About 40 acres, P. 1961, on a well-drained hillside of red laterite. The entire plantation was dead or dying from the tops downwards. The trees had a typical "stag's head" appearance, with leading shoots and several upper branches and adventitious shoots being defoliated. Adventitious shoots from lower portions of trees were also dead in many cases.

Upper dead portions of stems had neat black zones on the bark, and were covered with many black and coloured spots of fruiting bodies of miscellaneous epiphytic fungi and lichens. When split open, there were motley patterns of red, blue, brown and black stains.

There were no external or internal indications of fungal attack at root and collar regions. Eight trees were excavated from widely separated areas of the plantation and in every case the roots were entirely sound and healthy.

In view of the absence of root pathogens, further investigations are not necessary in connection with the present study of root rots. The die-back condition might be explained by moisture stress probably due to drought, although the possibility of a tip and shoot pathogen has not been eliminated. The latter is suggested by the frequency of adventitious shoots from lower portions of stem, and possibly by the extensive internal staining of dead tops, although this may be a result of secondary invaders.

Kazimzumbwi (Pugu) visited July 11th, 1966.

About 30 acres, P. 1961-62; a very similar site to Kisarawe and only a few miles away. The majority of this plantation was also dying from symptoms identical to those at Kisarawe, but not quite as advanced. A few low-lying areas supported trees of quite sound appearance, supporting the suggestion that drought may be the underlying cause of the dieback.

Of six affected trees excavated, four had completely sound and healthy roots. The other two, adjacent and both entirely defoliated and selected for sick appearance, had a portion of the root system rotted. There were no purple mats or strands.

Symptoms included a thin, irregular, black layer beneath rotted bark and cambium (not papery or onion skin-like). Internally, affected roots were rotted and crumbly (not stringy), very pale brown to creamy in colour. On areas of fresh attack, a tough, cream-coloured layer of mycelium about 1 mm. thick girdled the root, beneath the bark and quite distinct from both bark and underlying wood. There was a black-stained zone in the wood of incipient attack.

From roots of both of these trees, cultures repeatedly were isolated that corresponded to authenticated cultures of *Armillaria mellea*. Although no boot-lace rhizomorphs were found, these are not an invariable sign of *A. mellea* attack. The other symptoms and the consistency of its isolation support the conclusion that *A. mellea* was the cause of the root-rot in these two trees.
The two trees concerned were selected, and *A. mellea* is not considered to be a cause of the dead-top condition or a cause of general deaths in this area.

**Rau Forest Nursery**

When examined on June 15th, there were no signs of disease. On a further examination on July 6th, a patch of chlorotic saplings was found in a bed of 7-month-old, overgrown stock, 3 - 4 feet high and 1 inch diameter at the base. Four large and three small plants were dead and defoliated. On other plants, lower foliage was first to die and fall off, while upper foliage became chlorotic.

On larger plants in an advanced state of disease, there were splits in the bark up to 10 inches above ground level, often revealing cream-coloured mycelium inside. Upon excavation, bark of roots slid off easily showing a sheath of cream-coloured mycelium, which proceeded up the stem to a height of up to 18" above the ground in dead plants. Underlying wood was for the most part sound and white within, but brown-stained on the outer 1 - 2 mm. There were no purple mats or strands.

All visibly affected plants (a total of 18) were dug out. Upon further examination on August 3rd (4 weeks later), there were in the same patch two more trees killed and six more chlorotic. The dead trees were found to have symptoms as described above.

Isolations from internal chips of affected roots, and from the mycelial layer, produced consistently cultures indistinguishable from *Armillaria mellea*.

**Rau Forest, Plantations**

The initial survey, in June, found a single small patch of diseased trees. A more thorough examination of the P. 1962 plantation on July 7th discovered several additional large diseased patches, but still predominantly without foliar symptoms, although three central trees had slightly chlorotic foliage. Excavation of these three trees showed symptoms of advanced disease in some of the roots, as described earlier.

A further examination of disease patches on August 3rd (4 weeks later) showed a rapid advance of the disease. Five trees in one patch and two in another were dead and defoliated and many were displaying chlorotic foliage. Some trees, although nearly dead, had no purple mats visible above ground level, but upon excavation, had purple strands on the roots and occasionally an embryonic purple mat was present just below ground level.

The woody, rambling plant, thought to be near the genus Rhynchosia, was flowering at this time. Specimens collected and sent to the East African Herbarium were identified as *Glycine wightii* var. *longicaudata* Verdc. *Papilionaceae*. Many more infected specimens with purple mats were found.
One plot of several hundred trees, P. 1962 and P. 1963, adjacent to the road, was thoroughly examined. Eight smaller plots of about 25 trees each, distributed further back in the natural forest were briefly inspected.

In the P. 1962 plot, one row of trees was in critical condition due to root collar constriction by wire used to bind the planting pots. Two of these trees were nearly dead, and the roots were excavated. Lower roots were nearly completely rotted with no clear symptoms. Upper portions had a tough, cream-coloured layer of mycelium between the bark and the wood.

Isolations consistently yielded cultures corresponding to *Armillaria mellea*.

Another small patch of seven trees had chlorotic foliage and the central tree was dead. No purple felty mats were present. White rhizomorphs were found upon excavation of the dead tree. Surrounding trees had portions of the upper roots bearing a weft of purple fungal strands, and on two of them, the lower portions were rotted.

The smaller plots in the forest had scattered dead trees, but no purple felty mats were found. No trees were excavated in these plots.

**Discussion**

This extended survey of young teak plantings has shown damaging root diseases to be present in nearly all the areas examined, including all plots of the most important collection of teak provenances in Tanzania, Longuza arboretum. Most of the diseased trees were associated with the cinnamon-brown to purple, felty, fungal mats, of which several were bearing fertile hymenial patches of *Helicobasidium compactum*. Thus the circumstantial evidence that this fungus is responsible for the most common of the diseases is building up, although the frequent presence of crusty brown sporophores suggests that there may be another fungus involved with very similar root symptoms.

An important additional advance is the distinction drawn between the root disease caused by *Armillaria mellea*, of which four new records are described, three from coastal areas, and the widespread and damaging condition suspected to be caused by *Helicobasidium compactum*.

Although the common disease can spread very rapidly through plantations of young teak, there is evidence that its importance declines sharply as the trees mature. Even young trees, 4 - 5 years old, proliferated their roots above the zone of attack. Trees 6 - 8 years old, in some circumstances, seem to be able to confine the fungal attack to lower portions of the root.

This is borne out by the complete absence of root disease in the older plantations reported earlier; and by the absence of recent deaths in P. 1959 and P. 1960 plots in the Longuza arboretum, although dried felty mats were present at the bases of several trees.
Concrete evidence on the relationship of tree age or size to susceptibility will require several years to obtain. There are reports of mature, old trees in the Sudan being killed by a root disease with symptoms very similar to the present one (Waheed Khan, 1964).

References
