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Incidence of Gummosis and Its Effect on Growth Attributes of *Terminalia Ivorensis* A. Chev and *Taminalia mantaly* H. Perrier in Port Harcourt, Nigeria

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Abstract

Fifteen years old trees of Terminalia ivorensis and Taminalia mantaly established as landscape plants were studied for gummosis incidence and its effects on the species growth attributes. The study was conducted at the University of Port Harcourt, Port Harcourt, Nigeria in January to December, 2011. The result showed that Phytophlthora palmivora is the causal pathogen of gummosis in Terminalia ivorensis and T. mantaly at the University of Port

Harcourt. The disease incidence was 76% and 29.5% in T. mantaly and T. ivorensis respectively. There were significant differences in disease incidence between the two species at 5% level of probability. The disease also had significant impact on the growth attributes of the two species. There were significant differences between healthy and infested trees of the species at 5% level of probability. An integrated management approach should be developed to curb the incidence of the diseases and reduce its effects on growth and development of the Terminalia species. The strategies should involve: appropriate cultural practices to mitigate disease spread, application of environmental friendly practices and breeding for resistant varieties.

Key words: incidence, Gummosis, growth, *Terminalia ivorensis, T.mantaly, Phytophthora palmivora*

Introduction

Gummosis in trees is found in different parts of the world, especially in tropical countries. The disease could be caused by several species of fungi particularly *Phytophthora* (Vashishta and Sinha, 2010) The first conspicuous symptom of the disease on the trunk of trees is usually gummy exudates. Lesions are found at points just above ground level in some plants but could be high-up in others. The lesions could spread all over the trunk including lateral branches. In older lesions, the bark cracks and dies causing stem canker (Mehrotra and Aggar, 2006).

We observed that two species of *Terminalia* planted as landscape trees at the University of Port-Harcourt were stunted and dieing back, with gum exudates from their trunks. The plants are *T. ivorensis* and *T. mantaly*. The plants are established for beautification, windbreak and also serves as environmental amelioration species. In addition, *T. ivorensis* is a very good timber and traded as black Afara in Nigeria. *T. mantaly* on the other hand is a very good shade tree and its aesthetic value is unique due to the branching pattern.

Gummosis, like any other forest disease could have considerable influence on the health of trees outside forests and other wooded lands. The disease can adversely affect tree height, diameter, branching pattern, leaf production, wood quality and survival of trees in landscape. This will impact on the cultural, recreational and aesthetic values of the tree species.

Landscape plants need to be managed so that future risks and impacts caused by factors of the environment can be minimized. This can only be made possible through reliable information on disease biology, ecology and distribution. Quantitative information on gummosis in Nigeria is very little or unavailable. Virtually little information is available on gummosis associated with landscape plants in the country. This creates the need for this study.

This study is meant to assess the presence of gummosis among landscape plants at the University of Port Harcourt, and evaluate the need for development of any possible disease control strategy. Therefore, the specific objectives of this study are to: assess percentage incidence of gummosis in *T. Ivorensis* and *T mantaly*; determine its effects on tree heights, diameter at breast height and branching pattern; and identify the causal pathogen(s) of gummosis in the two species.

Materials and Methods

Study Area

The study was conducted at the University of Port Harcourt (UNIPORT) Nigeria. Port Harcourt is located on Latitude $4.78.33^{0}$N and Longitude 70000^{0}E, Rainfall distribution is bimodal with peak periods in July and September of every year. The vegetation is largely wet land with both mangrove and fresh water swamps stretching along the coastal areas as well as pockets of tropical rainforest in some places. The soil is generally acidic and inundated with tidal waters in the mangrove.

Data Collection

The study was carried out from January to December 2011. The two campuses of the University of Port Harcourt: that is Abuja and Choba campuses were used as study site. The total number each of *T. ivorensis* and *T. mantaly* were recorded purposively to meet the objectives of the investigation. Ten stands each of the two species were randomly selected. Both macroscopic and microscopic approaches were applied in the study.

In the macroscopic approach, the ten stands each of the two species were visited monthly and observed for signs and symptoms of the disease. The percentage disease incidence was calculated per species as stated below;

$$\% \text{ Gummosis incidence} = \frac{\text{number of trees infected per species}}{\text{total number of tree species}} x \frac{100}{1}$$

In addition, tree height and diameter at breadst height of both infected and healthy species were assessed using the relascope. While the branching pattern of the two species was calculated by visual count. Healthy trees of the species served as control.

Data on incidence of gummosis per species were subjected to t-test analysis for comparison between the two species. Similarly, data on growth attributes of the species were subjected to t-test analysis for comparison between the healthy and infected tress per species using the formula below:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{S_2P(\frac{1}{n_1} + \frac{1}{n_2})}}$$

Where t = test

$\overline{X}_1$	=	mean number/percentage incidence of gummosis in *Terminalia ivorensis*
$\overline{X}2$	=	mean number/percentage incidence of gummosis in *Terminalia mantaly*
n_1	=	sample size of *T. ivorensi*s
n_2	=	sample size of *T. mantaly*
S_2P	=	pooled variance

The microscopic study involved laboratory analysis of infected plant parts to determine the causal c pathogen using the method of Vashishta and Sinha (2010). The procedure involved the use of a natural medium, potato dextrose agar made up of 200gms potato, 20gms dextrose, 20gms agar powder and 1 litre of distilled water. The potato dextrose agar medium was filtered and dispensed into 10 cultures tubes prepared for each species. Sterilization of the medium was carried out by steam in an autoclave for 15 minutes. The 10 culture tubes with 10ml of medium were taken out of the autoclave while hot and placed in slanting position. Plating was done in a culture room sterilized with formalin fumigation to avoid contamination of the plates with unwanted microbes. The culture tubes with cotton plug opened had their mouths slightly heated with a flame. Each medium was slightly poured into a petri-dish with the lid replaced and allowed to cool.

Sections of affected tissues from the infected part of the woody stem in both species were surface sterilized by wiping with a swab saturated in sterilizing solution. Sections were then removed with sterile forceps and blotted dry on sterile paper, to prevent the excess sterilized solution from diffusing into the medium and prevent germination or growth of pathogens spore or hypha (Blanchard &Tattar, 1981). Sections from both species were then placed on the nutrient media and incubated at 35^0C for 7 days. The causal pathogen isolated was identified using their respective identification keys (Vashishta and Sinha 2010). In addition the structures observed more matched against a mycology altas (Barnette & Hunter 1987).

Results

The result on percentage incidence of gummosis among the two *Terminalia* at the University of Port Harcourt UNIPORT is shown in Table1. The result revealed a mean disease incidence of 29. 5% and 76% for *T. ivorensis* and *T. mantaly* respectively. There was a significant difference in disease incidence between the two species at 5% level of probability.

The results on the effect of gummosis on *T. ivorensis* and *T. mantaly* at Abuja's campus of the university are shown in Table 2. It showed that the mean height of *T. ivorensis* for healthy and infected trees were 20$\pm$3.43.and 9$\pm$1.33m respectively. The means were significantly difference from each other at 5% level of probability. On the other hand, *T. mantaly* had a mean height of 9$\pm$1.23m and 5 $\pm$ 1.05m for health and infected trees respectively. There was a significant different between the two means at 5% level of probability. The mean diameter at breast height (dbh) for *T. ivorensis* and *T. mantaly* followed a similar pattern with that of the species height. The result showed that the dbh for healthy and infected trees of *T. ivorensis* were 80$\pm$ 6.25cm and 20 $\pm$ 1.05cm respectively and were significantly different from each other.*T. mantaly* had a mean dbh of 60 $\pm$ 4.6cm and 10+ 0.98cm for healthy and infected trees respectively, and were significantly different from each other at 5% level of probability. The number of branches produced by the healthy and infected trees also showed significant differences. *T. ivorensis* had a mean number of 18 branches for the healthy trees as against 6 branches for the infected trees. Similarly, the mean number of branches produced by *T. mantaly* for the healthy and infected trees was 14 and 4 branches respectively, which were significantly different from each other.

Like the situation at Abuja campus, similar trends on disease incidence and effects of gummosis on growth a attributes of *T. ivorensis* and *T. mantaly* , were observed in Choba campus of the institution. The results on the effect of gummosis on tree height in both species are shown in Table 3. The mean heights of *T. ivorensis* for healthy and infected trees were 22+3.5lm and 11+1.14m respectively, there were significant differences between them at 5% level of probability. On the other hand *T. mantaly* had a mean height for the healthy and infected trees as 16+3.24m and 8+0.97m respectively which were significantly different from each other at 5% level of probability. There were significant differences between infected and healthy trees in mean dbh for both species at 5% level of probability. The mean dbh of *T. ivorensis* for healthy and infected trees were 82±7.4 and 23±1.22cm respectively. *T. mantaly* had a mean dbh of 64±5.72 and 13±1.41cm for the healthy and infected trees respectively. The number of branches produced in both healthy and infected trees varied significantly for *T. ivorensis* and *T. mantaly*. Healthy trees of T. *ivorensis* had an average of 20 branches per tree, while infected trees had a mean of 8 branches per tree respectively. In a similar branching pattern, *T. mantaly* had a mean of 16 branches per tree, while infected trees produced a mean of 5 branches per tree respectively.

Table1: Gummosis incidence (%) in *T. ivorensis* and *T. mantaly* in UNIPORT

Species	**Sites**		
	Abuja campus	**Choba**	**Mean**
T. ivorensis	16	43	29.5 ± 4.26 a
T. mantaly	80	72	76 ± 8.42b

Means with different letters along the column differ significantly at 5% level of probability.

Table 2: Mean height, diameter and number of ranches in *T. ivorensis* and *T. mantaly* at Abuja Campus UNIPORT

Species	**Height (m)**	**DBH (cm)**	**Number branches**
T. ivorensis(control)	$20\pm3.43_a$	$80\pm6.25_e$	18_i
T. ivorensis	$9\pm1.33_b$	$20\pm1.05_f$	6_j
T. mantaly (control)	$15\pm$ 2.33_c	60 ± 4.6g	14_k
T. mantaly	$5\pm1.05_d$	$10\pm0.98_h$	4_L

Means with different letters along the column differ significantly at 5% level of probability.

Table 3: Mean height, dbh and number of branches in *T. ivorensis* and *T. mantaly* at Choba Campus, UNIPORT

Species	**Height (m)**	**DBH (cm)**	**Number of branches**
T. ivorensis(control)	$22\pm3.51_a$	$82\pm7.4_e$	20_i
T. ivorensis	$11\pm1.24_b$	$23\pm1.22_f$	8_j
*T. mantaly (*control)	$16\pm$ 3.24_c	64 ± 5.72g	16_k
T. mantaly	$8\pm1.097_d$	$13\pm1.41_h$	5_L

Means with different letter along the column differ significantly from each other at 5% level of probability.

Discussion

Naturally, pathogens are integral components of forest or landscape ecosystems. But under high density, these pathogens may occur sporadically leading to severe damage and consequently, impact on tree growth and development.

Several accounts have been given by many authors on forest and landscape diseases globally (Mehrotra & Aggarwal, 2006; Vashishta & Sinha, 2010; Bandara, 1990; Chalermpongse, 1990; Ivory, 1990; FAO, 2009a; Allen, 2007; Raffa *et al.*, 2008; Van Mantgen *et al.* 2009). Mehrotra and Aggarwal (2006) reported that several species of *Phytophthora* are associated with gummosis globally these include: *P. palmivora; P. parasitica* and *P. citrophthora* with the species being host specific. For instance, *P. citrophthora* is specific on citrus species.

In these studies, *Phytophthora palmivora* was implicated as the causal agent of gummosis in *Terminalia* species. Infection started from one meter from the ground in infested trees, water soaked areas appeared in the basal parts of the two *Terminalia* species. These were the points from which a brownish gummy substance came out. In some of the trees which had severe gumming, the stem bark cracked and rottened with dieback of twigs and branches?

The mycelium of the pathogen is intercellular, producing *haustroria* in the cells. *Hypae* are fairly uniform, with inverted pear-shaped terminal *sporangia* which are 50-60um.

The implication of P*hytophthora palmivora* in this study as causal pathogen is similar to the works of Anggraeni and Suharti (1997). The authors reported that *Phytophlthora palmivora* species caused gum exudates from *Eucalyptus* species which killed many older tress in Indonesia.

The mean disease incidence of 29.5% and 76% recorded for *T. Ivorensis* and *T. mantaly* respectively are very high on the average and implies that the disease is infections, sporadic and can cause cross boundary infection overtime. The two species are susceptible to gummosis (Table 1).

Fungal infestation such as the incidence of gummosis in *Terminalia* species reduced the height, diameter and number of branches of the species (Table 2 and 3). Infected trees had lower growth attributes compared with healthy ones.

The result of this study will be helpful in advising the university authority on the need to safeguard the health and vitality of these landscape plants in the institution. Such advice will be based on preventive measures, integrated pest management, as well as recommended action aimed at minimizing future risks of out-breaks and/or trans-boundary transfer.

Conclusion

Management of *Phytophthora* diseases of *Terminalia* species should involve an integrated approach which includes: breeding for resistance varieties, use of appropriate cultural practices to mitigate disease development and use of chemical control method as a prophylactic measure.

The old saying that prevention is better than cure should be applied in the use of cultural practices against gummosis. Such practices include: pruning of dead branches and twigs as well as disinfection of garden tools after use.

Lesions can be treated with bordeaux paste. The bark should be removed to expose the lesions before treatment. Severely diseased trees should be removed and burnt. The surroundings soil could be treated with 2% formalin or chloropicrin. To meet the needs of protecting landscape plants, more attention should be paid to promoting research on tree diseases. This calls for dialogue between scientists, the university authority and other stakeholders to formulate appropriate strategies on disease control in the country.

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