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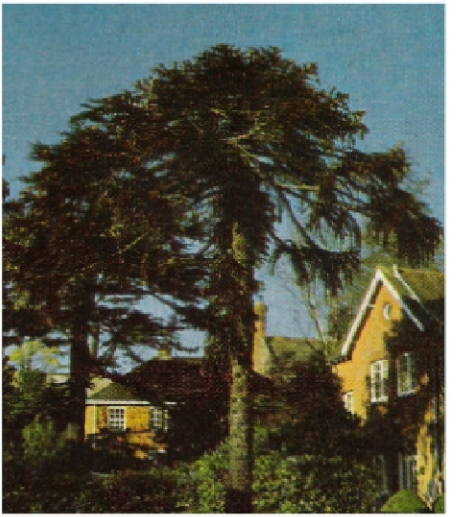
MAJOR DISEASES AND PESTS OF FOREST TREES AND THEIR CONTROL IN NIGERIA



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R.A. Gbadegesin, J.O. Adegbehin and E.B. Tologbonse.

Table of Contents

Introduction

In the pre-Independence era, forestry in Nigeria has been concerned with logging with no regard for diseases and pests because non-subject matter specialist (non-entomologist and non-pathologists) expatriates formed the crust of foresters. Serious attempts on forest protection started between 1935 and 1965 with the establishment of the West African Timber Borer Research Unit (WATBRU) with headquarters in Kumasi, Ghana, to solve the problems of felled trees. WATBRU metamorphosed into the then Federal Department of Forest Research (FDFR) now known as the Forestry Research Institute of Nigeria (FRIN).

Series of research studies on forest protection have led to the discovery of numerous disease pathogens and pests including nematodes attack on forest trees and formation of effective control measures for them. Despite these achievements on forest protection, forest managers still feel reluctant to accept the value of investment on forest disease prevention or control because no positive effect on timber production seemed to be derived from this type of investment as practices like fertilization, control of competing vegetation and thinning to mention a few could produce. All these latter conditions modify timber production and the change can be measured while measures aimed at controlling or preventing forest diseases and pests do not operate in this way.

This bulletin is to obviate this scepticism by showing how forest disease problems can be identified and controlled.

CLASSIFICATION OF DISEASES

Major diseases of trees can be classified in various ways depending on the purpose to be served. Classification of diseases can be under the basis of cause, symptoms and according to parts affected.

Classification on the basis of cause:

On this basis, diseases may be classified into : 1) non-infectious or non-parasitic or physiological disease, (2) infectious or pathogenic disease and (3) disease of unknown origin.

Non-infectious diseases:

These are the diseases caused by non-living environment which may include poor or shallow soil dept, nutrient defiency, high temperature etc. Symptoms of such diseases may be same like that of infectious but on closer observations, the differences could be sorted out by plant pathologists.

Infectious diseases:

These are the diseases caused by other living organisms. These are fungi, (the most important disease pathogens in forestry), bacteria and viruses.

Classification of diseases on the basis of symptoms:

In this case, they may be classified as (1) necrotic disease (2) atrophic disease and (3) hypertrophic diseases.

Necrotic symptoms

These are the evidence of necrosis or death of affected tissue resulting in marked change of colour from yellowing through browning to graying when the tissue finally dies. Examples of this are leaf blight, bud blight, stem canker to mention a few.

Atrophic:

This is the slowing down in development of the affected plants parts resulting from subnormal cell division (hypoplasia). Dwarfing or stunted growth is an example. The causes could include; unfavourable environmental conditions, unfavourable soil condition, excess or deficiency of certain mineral elements.

Hypertrophic:

This is an overgrowth of all kinds which results from abnormal cell increase (excessive cell division). The evidences are the formation of galls or tumors, witches brooms, hairy roots, leaf curls and deformation of fruits and flowers.

Classification of diseases on the basis of parts affected

Diseases may be classified as root diseases, stem diseases and foliage diseases.

Root diseases:

As the name implies, they attack the root of trees. Examples include; damping off, root or butt or collar rot etc.

Stem diseases:

These attack the tree trunks. Examples are stem canker, galls, dieback and wilts.

Foliage diseases:

These primarily attack the leaves of both hardwood species or conifers and may extend their activities to the flowers, fruits and young twigs. Examples are; leave blight, twig blight, powdery mildew, leaf blisters etc.

All the above examples will be discussed fully under occurrence, symptoms and control.

OCCURRENCE

Both the non-infectious and infectious diseases occur either in the nurseries or in the plantations. Diseases occurring in the nurseries affect the seedlings or transplants while those occurring in the plantations affect the older or mature trees that have developed some resistance.

Such conditions may include high or low temperatures, moisture, nutrition, industrial processes, lightning and shallow soil depth.

High Temperature:

High temperatures can cause diseases in trees since the various parts of tree are adjusted to certain maximum temperatures beyond which injury will occur. In the nursery, seedlings and transplants in the nursery beds are liable to direct injury by excessive heat since their cortical parenchyma cells are killed within 30 minutes of exposure to high temperatures.

Symptoms:

On green stem of young seedlings, white shrunken, water soaked lesions may appear usually just above the soil surface. The disease is termed white spot because of its whitish appearance. Commonly, the entire stem is constricted by the lesion resulting in the lopping over and death of seedlings. The excessive heat in the bed may largely destroy an entire bed of pine seedlings. Although the effect on the seedling is similar to damping off but the lessons can be distinguished by their light colour and limitation to the portion of the stem above ground.

Control:

The most important control measure is the provision of light shade (about 50%) from the time the seedlings emerge until they are several weeks old. This will prevent or greatly reduce
this injury in nurseries. The shade frame should be about 46cm (18inches) above the beds. Frequent waterings during hot days will also cool the soil surface.

Low Temperature:

This is of no consequence in the tropics

Excessive Moisture:

An excess supply of water can be unfavourable to trees by stimulating them to excessive development which leads to the promotion of tender growth which are susceptible to ludging (falling over of seedlings).

Water logging also prevents roots from getting oxygen necessary for their development from the soil air. This may result in the death of the roots. Trees inundated by floods or by backing up of water from dams are injured or killed. In the nurseries, excessive watering of beds may lead to seedling inundation.

Control:

Excessive watering should be avoided in the nurseries. In the plantations, careful choice of sites is necessary to avoid selection of water logged areas.

Moisture Deficiency

A shortage of water preventing trees from carrying out normal physical functions results in diseases. This is of importance in the arid and semi-arid forest regions.

Drought may take a heavy toll of seedlings in nurseries without provision for artificial watering during dry seasons. Even where artificial watering is provided, loss can still occur if such watering is not adequate.

In the plantation, drought is brought about by periods of subnormal precipitation and drying winds eg. harmattan. Unfortunately, foresters have no control over such natural disasters. Drought injury is difficult to diagnose because the affected trees frequently succumb to weakly parasitic fungi or insects eg. termites.

Symptoms:

Retarded growth is the primary symptom on the field. In the nursery, the seedlings killed by drought are scattered throughout the seedbeds whereas those killed by damping off or other fungal diseases usually occur in definite groups.

Control:

Site nurseries where constant water supply will be available throughout the year. During the dry season, adequate water must be applied to nursery beds.

Nutrition:

Non-pathogenic disease may be caused in plants by excess or deficiency of nutrients in the soil. Deficiency diseases caused by a lack of one or more essential elements in the soil are difficult to diagnose because the symptoms vary not only between elements but between species when the same missing element is responsible. Some of the examples of deficiency diseases include; Stunting and brown discoloration. This is caused both in the nurseries and plantations by lack of potassium.

Chlorosis:

This is an expression of lack of chlorophyll in the foliage. The entire foliage turns yellow, the roots, stems and the leaves have poor growth. The terminal buds are dwarfed or fail to develop. Chlorosis is usually due to expression of iron deficiency.

Dieback of tree species:

This disease has been observed on some *Eucalyptus* spp. And was found to be due to boron deficiency.

Control

The control measures to the above symptoms include the application of the elements missing in the soil through the use of appropriate fertilizers. Care must be taken where such corrections are to be made through folier sprays. For example, the correction of iron deficiency can be made by spraying ferious sulphate. In the case of hardwood foliage which is easily injured by ferrous sulphate, ferric citrate or ferric tartrate can be used for the correction.

Proliferation:

This is the development of abnormal number of stems, flowers or fruits in position normally occupied by one. This symptom is as a result of local overnutrition. Such malformations may also be caused by parasitic fungi.

Industrial Processes:
These affect mostly the orchard and shade trees as most forest plantations are located far away from the cities. Among the wastes that are of importance are; sulfur dioxide, hydrofluoric acid gas, chlorine, hydro sulfide, ammonia etc. In forest, serious injury may occur to stands close to smelters where large quantity of sulfur dioxide is released into the air.

Symptom:

This is the rapid discolouration of foliage followed by defoliation and in extreme cases by the death of the plant.

MECHANICAL INJURIES

These include injuries caused by falling trees, wind damage, lightning etc.

Falling trees often break off branches, tops or large patches or bark from the trunk of their neighbours. Some tree species may be able to recover from such injuries

Wind may cause defoliation, laceration of leaves especially the broadleaf trees, wounding of bark and cambium and occasionally the death of the young trees or sprouts. Usually wind damages are confined to the upper side of the branch and to the side of the main stem facing the storm

Lightning stroke causes severe injury to trees; some trees may die as a result of injury received while some injuries may result in distorted growth. This may involve complete shattering of a tree or tearing off the bark and a shallow layer of the wood in a narrow strip, sometimes extending spirally around the trunk from the crown to the butt.

These injuries causing open wound are of importance because such wounds offer entrance point (infection court) for wood – destroying pathogens and other fungi (See appendices for further clarification).

INFECTIOUS DISEASES

In the case of infectious or pathogenic diseases there are distinctions between the diseases occurring in the nurseries and those in the plantations. As a result, cases of nursery diseases shall be treated separately from those of the plantations.

Nursery diseases

Nursery diseases have had serious and disastrous consequences on forest seedlings in the country. These nursery diseases include; damping off, top killing, dieback and collar rot.

Damping off:

Loss of seedling of up to 100% have been reported for pines and Eucalyptus spp. in the nursery. The disease is caused by soil-inhabiting fungi that are facultative parasites and are not host specific.

Damage:

It is an extremely destructive disease causing large losses in both coniferous and hardwood nurseries. In one season, it may destroy all seedbeds of all species. Seedlings in the
forest are much less affected, unless they are growing under crowded condition as the case when they come up from squirrel hoards or artificial seed spot.

Symptoms:

Damping off is manifested by early decay and death of seedlings with soft and succulent stems. Hyphae of the fungus spread through the soil and penetrate the tender epidermis of the succulent tissues of the stems.

There are two types of the disease; pre-emergence damping off, and post-emergence damping off. In the pre-emergence damping off, the seeds are decayed or killed by the damping off organisms before they emerge from the soil. With the post-emergence, the seedlings are attacked after they have appeared above ground. The fungi spread rapidly in the tissue especially in the roots and the seedlings either wilt completely or suddenly fall over before wilting.

The lopping over is not the normal wilting resulting from water stress but a result of decay of the stem above the soil while the rest of the stem is still fairly turgid. A bed of seedlings may be completely wiped out within a few days.

Casual Organism:

The causal organisms for damping off may include a number of saprophytic fungi in the upper layers of soil which may become pathogenic under unfavourable conditions for the plants.

Some of these may included *Pithium* spp., *Fusarium* spp., R*hizoctonia solani* Kuhn, and *Sclerotium bataticola*. The most important in Nigeria include *Pithium* spp. and *Fusarium* spp.

Control:

Avoid heavy or excessive watering and keep seedbeds well ventilated. The fungi causing damping off reproduce and spread fast under humid conditions.

Avoid the use of excessive humus/top soil/animal dungs in the nursery soil mixture. The facultative causal fungi thrive well in such rich mixtures. Where possible, the mixture could be steam sterilised. This is economical where seedling losses exceed 10 – 15% annually. Chemical control using bordeaux mixtures can also be encouraged under such conditions.

Top Killing:

This describes damping off fungi attack on seedlings after they have developed stems stiff enough to continue to stand after death. The disease is most serious during moist seasons in dense stands where tops of the seedlings are in contact with each other. Effective control measure can be achieved by spraying with bordeaux mixtures.

Dieback:

This is similar to top killing but a different fungus is involved. At the moment, this disease has been noticed on Eucalyptus cloeziana. Severity may be as one half (½) to three quarters (¾) of seedlings on a bed/nursery.

Symptom:

Affected seedlings lose the teminal buds and the leave turn yellow to brown and then fall off

Causal Organism:

A thermophilic fungus Paecylomices variottii is the prominent among the various causal organisms in Nigeria. For other minor ones, see table 1 attached.

Control:

The incidence of this disease can be minimized in a forest nursery by adequate watering and provision of light shade. In case of heavy losses, use of benlate to control disease can be embarked upon.

Root rot:

Damping off fungi could continue their activities by causing root rot in nursery seedling even into the second or third season. The same factors that favour damping off favour root rot.

Control:

Use of ferrous sulphate can be embarked upon to minimize the occurrence of the diseases. Where the case is severe, soil treatment with ethylene dibromide at the rate of 224.50L/ha applied 2 to 3 weeks after emergence is recommended.

PLANTATION DISEASES

Most of the diseases observed in plantations are transferred from the nursery to the permanent sites. This is why attempts should be made to raise healthy seedlings in the nursery for plantation establishment. All the diseases that occur in the nursery except damping off also occur in the plantation. The major diseases of the forest plantation can be discussed under three broad headings, Foliage, stem and Root diseases.

These may include dieback, cankers and root or butt rot. Others are needle blight, crown gall etc.

FOLIAGE DISEASES:

There are many types of foliage diseases caused by parasitic fungi which may extend their activities to the flower, fruits and young twigs. The major ones may include; crown gall while minor ones may include needle blight, leaf spot, powdery mildew etc.

Dieback disese:

Symptom:

Dieback is characterised by a progressive dying back of a stem from the tip

Causal Organism

It is usually caused by a fungus invading the stem at or near the tip and then growing downwards killing the tissues as it advances. *Dieback* is often caused by the species of *Coniothyrium sphaeropsis*.

Host trees:

The host trees are mostly *Eucalyptus spp*. and the major ones are *E. deglupta* and *E. cloeziana.*

Control:

The control is not very easy to attain on the field due to the height at which this disease occurs. Spraying with any chemical may not be affective due to the height constraint. Use of systemic fungicides may be helpful.

Other less important foliage diseases are included in the attached table.

STEM DISEASE

Canker disease

There are more serious canker disease of hardwood than that of soft-wood or conifers in the country. The manner of canker formation and types are same for both groups.

Symptom:

The disease appears as lesions or canker on the trunks and large branches of the affected trees. Cankers are developed by gradual killing of the diseased bark in more or less circular areas. Young infections can be recognised by the presence of brownish shrunken patches. The diseased area may be fairly regular or irregular or girdled

Casual Organism

The most important casual organisms for cankers in Nigeria include some fungal species such as *Dothichiza spp*. (fungi imperfecti) the perfect stage is *Cryptodiaporthe spp*., *Diplodia* and *Botryodiplodia spp*.

Host trees:

Trees mostly affected by canker disease in Nigeria include; *Eucalyptus* spp. and *Terminalia spp*.

Control:

The control measures which had been properly investigated in Nigeria include the use of fertilizer and other cultural activities that will improve the development of the plants. Plants with healthy growth usually supress the attack of canker disease. Other effective method of control is to remove affected trees.

Root Diseases

Accurate diagnosis of root disease is not easy because the symptoms on the aerial portion of the tree are often similar to the symptoms of other diseases particularly wilts and diebacks. Also, the time visible symptoms appear, most or all of the root system may have been involved or destroyed, with the secondary agencies obscuring the primary one (Fig. 4a)

Figure 1 Root rot of teak (*Tectona grandis*)caused by *R. lignosus* A: badly damaed roots; B: Healthy roots.

Figure 2: Root rot of *D. regia* (Flambouyant) caused by *F. oxysporum.*
Culled from: Savanna, 12 (10) 73-76.

Root diseases, particularly root rots are more prevalent in planted stands, in plantations, in stands on sites to which they are not adapted and in stands of unnatural composition, hence such diseases are likely to increase with more man made plantations. Root diseases are especially abundant in the tropical and sub-tropical regions. The most common and most researched upon in Nigeria is the root/butt rot of *Tectona grandis* (teak)

ROOT/BUTT ROT

Host

The widely affected tree species attacked by root or butt rot in Nigeria is *Tectona grandis* (teak) although a minor report of the incidence of the disease has been reported on *Pinus spp*. (pines) and *Delonix regia* (flame of the forest) an ornamental tree.

Symptom

The symptoms are not noticed in plantations until the trees are two or three years old. At this age, the leaves of affected trees turn yellow and fall prematurely. The infected trees begin to die in groups. The leaves often fail to reach normal size before they lose their green colour and fall off. This leaf symptom is most easily noticed at leaf flush i.e., when the affected trees produce new foliage at a slow rate than the healthy ones or shortly before the normal leaf-fall when the affected ones lose their leaves much earlier than the healthy ones. A tree showing leaf symptom is on the verge of death. Infection has been associated with old tree stumps and the affected hosts become other sources of infection. Infection progresses through root contact.

Causal agents

Out of the causal organisms for this disease, the most widely studied is the *Rigidoporus lignosus* (klotzch) Imazeki. The spore of *R*. l*ignosus* infects the stumps left behind when a forest is cleared. This pathogen has been associated with the roots of only teak in Nigeria.

Furarium oxysporium has been found on the roots of *Delonix regia* Figure 4b) causing root rot on the tree species in Nigeria.

Site factor:

Teak is capable of growing in a variety of geological formations but it grows faster on rich, well drained soils than on poor soils or shallow ones.

Also root rot disease caused by *R. lignosus* is also capable of infecting teak and other forest trees under the different soil conditions that can support the hosts. However, more damage is done by the disease in poorly drained sites and in very shallow lateritic soils than in deep well drained areas.

CONTROL

Root rot disease can be controlled through chemical application, cultural practices and biological control.

a. Cultural methods

1. Site selection

Although root rot can occur under various soil conditions, it tends to do more havoc in sites with high water table over long periods and shallow lateritic soils. Areas with high water table tend to become waterlogged for prolonged periods, a situation which aids root decay and death. As much as possible deep free draining sites should be selected for plantation establishment.

2. **Stump removal**

Stumps play a major role in the intial conlonization and infection in a young plantation. In order to prevent such roots in becoming carriers, they can be removed from the field during site preparation. This same method can be used where the disease infection is not noticed early.

3. **Trench digging**

If an infection is noticed very early in a plantation the source of infection can be isolated from the rest of the plantation by digging a trench round the affected trees. The trench must be deep enough to break through the root contact between the trees within and outside the trench.

This method can only be used on a small scale because of labour involved. It is not recommended where infection is wide spread in a plantation.

4. **Biological control**

The most economical biological control in use involves the growth of leguminous cover crops such as *Pueraria phaseoloides*, *Flemingia congesta* etc. in the forest plantation. The growth of these crops has been found to reduce incidence of root rot in rubber plantations. The legumes encourage futile growth of the pathogen and by this, large inoculation potentials are dissipated into small infective ones. This is through the attack of the fungus on the small roots of legume creepers. While the fungus dies out with the legumionous root it kills, the legume stays alive due to its ability to spread by stolons.

b. **Chemical control**

The root rot control via chemical application had been carried out on root rot of teak. The disease was put under control with the use of 2% tillex solution as follows; The bases of affected trees should be opened up by digging away the soil around them up to the major roots. The 2% tillex solution should be generously applied to the base of the tree after the removal of fruiting bodies (Fig. 5) of *Rigidoporus lignosus* where present.

Creosote can also be used to treat stumps to prevent spore colonization. This treatment should be given as soon as possible after felling.

Other control methods on lesser diseases are as shown in tables 1a and b.

Figure 5: Fruiting body or sporocaarp of *R. lignosus*
(Momoh, Z. O. (1976). PAN 22: 43-48.

Table 1a; Diseases of forest trees and their control

Diseases	Host	Casual Agent	Type of Damage	Control
Root/butt rot disease (teak)	*Tectona grandis*	*Rigidoporus lignosus*	Causes rottening of the roots	Destroy foci of infection by removing the root affected materials and treat with fungicides eg. 2% tillex.
Smut rust	*Triplochiton* seleroxylon	*Mycosyrinx* nonveilleri	Causes abortion of flower and fruits,loss of leave	Apply benomyl and ethoxy ethyl mercuric hydro-xide
Dumping off disease and other seedlings	*Eucalytus* spp., *Pinus* spp.,	*Pythium* spp. *Fusarium* spp	Damping off is sudden collapse and death of seedlings	Avoid over-watering, maintain good sand; top soil or cow dung mixture use 1.1% tillex solution
Blue stain	*Antiaris africana*	*Botrydiploidea* spp.	Cause sap or blue stain which lowers the quality of wood	Fell susceptible tree in the dry season, dry wood to 20% moisture content. Use 0.5 - 0.7% sodium pentachloroph.

Table 1b: Some common pests of forest trees in Nigeria

Pests	Host	Type of damage	Control
Phytolyma lata	*Chlorophora excelsa* (Iroko)	Galling	Breeding of resistant variety. Avoid monocroping encourage mixture of forest trees
Hypspyla robusta	*Khaya* spp. (Mahoganies)	Boring of shoot, stem, flower, wood	Avoid single species plantation and fruit (monocropping) use of resistant varieties
Orygmophora mediofoveata	Nuclea (Opepe) diderrichi	Boring of shoot stem, flower, wood and fruit	Avoid single species plantation (monocropping), use of resistant varieties
Diclidophlebia	*Triplochton scleroxylon* (Obeche)	Leaf sap-sucking harrisoni	Use of neem extracts
Apion ghanaense	*T. scleroxylon*	Fruit boring	None yet
Termites	*Eucalyptus* spp.	Root feeding and back eating	Use resistant varieties, apply Furadan during transplanting and in the pot mixtures
Epicerura pulverulanta leiocarpus	*Terminalia* spp. *Anogeisus* (Idigbo, Afara, almond tree)	Defoliation	Use of neem extracts.

PESTS AND THEIR CONTROL

Some of the major pests of forest trees and their control are as presented in table 1. Most of the control methods are geared towards maintaining good silvicultural practices in the forest plantations. Since application of insecticides usually becomes difficult due to the heights of trees, it is advisable that systemic chemicals be used. This can be applied to the base of a tree and be translocated to the region of the needs.

Major Insect pests

Insect attack on forest trees often leads to reduction in growth, poor or deformed growth, lower wood grade (Blue Stain) and death of the trees. Insect attack may occur in the nursery and on the field.

The major insect pest can be grouped into;

1. Defoliators
2. Borers
3. General feeders.

Nursery Pests

Incidence of pests in forestry nurseries though widespread, has not been of serious consequences. Common among the isolated cases are those of nematodes, grasshoppers as well as small mammals (rats), termites and other insects and various worms (eg. cut worms).

Crickets and Zenocerus variegatus cause the greatest damage to nursey seedlings most especially during seed emergence. They cut off the young emerging seedlings causing their death.

Nematode attack has also been found to cause the death of young seedlings through their attack on their roots. Termite attack is always serious on seedlings of Eucalyptus spp. in the nursery as well as in the plantation.

CONTROL

The methods of control can be chemical, physical or cultural practices.

Chemical Control

The most common chemical used in the nursery to control termites and other insect attack in the nurseries are aldrin now furadan 3G at the rate of 25 kg/ha. Aldrin chemial is particularly effective in controlling termites both on the field and in the nurseries. It is incorporated into the soil during seed-bed preparation or during the preparation of soil mixtures for the polythene pots. The chemical also controls cut worms below the soil surface. Or aplication of chloropyriphos as a soil drench at the rate of 2 litres/ha in 100 - 150 litres/ha.

Physical control

This is better used for the bigger pets inform of trap setting for rodents or total exclusion. The exclusion can be done by covering the seed-bed with fine mesh wire. The outside of the fence should be trenched and saturated with rodent repellant.

Also the nursery soil mixture can be heat treated to kill other pests such as cut worms and nematodes.

Cultural control

In this case, the seedlings are provided with the essential needs such as fertilizer, correct soil: sand ratio, watering and watering regime etc. to encourage vigorous growth. Healthy seedlings are not likely to succumb to pest attack as easily as unhealthy seedlings because healthy seedling can easily outgrow the pest attack.

PLANTATION

sary scientific management practices that can be applied to reduce pest and disease incidence in our forest plantations. It is hoped that this bulletin shall be of tremendous use to the foresters.

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