Challenges and Progress in the Control of White Root Rot Disease of *Hevea brasiliensis* in Africa

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Abstract: White root rot caused by *Rigidoporus lignosus* (Klotzsch) Imazeki is known to be widely distributed in Africa where its pernicious effects in natural rubber plantations have been recorded. Soil-inhabiting fungi, including pathogenic ones such as R. lignosus interact with a complex microbial community which may enhance their infective mechanism of the host. Previous and current achievements in researches have made significant impact in the control of white root rot disease in Hevea. Evidence obtained from the laboratory, green house, microplot experiments have been very vital and important in the control of the disease. On the other hand, in agro-ecosystems (in the field) very little evidence has been achieved, where plant pathogens cause reduction of yield and quality. Deliberate interventions, using control measures such as genetically resistant varieties, cultural practices, chemical applications to some extent, arbuscular mycorrhizal fungi (AMF), and phytoalexins are promising Integrated Pest (disease) Management (IPM) components for effective control of Hevea root rot disease.
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1. Introduction

Hevea Brasiliensis (Muell. Arg.) like any other monoclonal crop is afflicted by a great number of pathogen and the most infective being fungi. In Nigeria, over 65% of Hevea diseases are caused by fungi (Begho, 1995). Root diseases of *Hevea Brasiliensis* are known to be the most serious as they are often fatal. Of all the root diseases, the white root rot (WRR) is most destructive and accounts for about 96% of incidence of root diseases in Nigeria, Cameroun and Ivory Coast. Otoide (1978) reported that over half hectre of plantation can be destroyed within five years of infection in Nigeria.

Edaphic factors have been shown to determine the severity of the disease. In the Rubber Research Institute of Nigeria at the main station, Iyanomo, and the sub-station located at Akwete close to the coastal region of Nigeria, variation in soil pH in the two location is implicated in the level of the disease status. Incidence of WRR is higher in Iyanomo than in Akwete locations. Soil pH in Iyanomo plantation is about 5.28 while it is 2.30 in Akwete. Findings from studies revealed low pH soils retarded the development of WRR in Akwete. The low pH in Akwete soils is attributed to petroleum exploration in the coastal region of Nigeria where contamination of the soils due to oil spillage has resulted in the accumulation of elemental ions that lower the pH (*Ugwa et al,* unpublished).

2. Symptom Expression and Development of White Root Rot

The appearance of symptom of WRR is usually at the late stages of development when affected tree becomes untreatable and eventual death eminent. The disease is caused by the fungus *Rigidoporus lignosus* (klotzsch) Imazeki. The name is derived from its colour of the superficial or epiphytotic mycelium that infects the roots of the tree. The mycelial strand or the white rhizomorph grows along and attach firmly to the secondary or tertiary roots and moves towards the main root. The fungus kills the cells ahead of the rot. The destroyed lesions on the roots become discoloured, initially turning brownish and later chalky whitish. The rhyzomorphs penetrate further towards the trunk tissue affecting the whole collar of the tree trunk. The spread of the rhizomorph is usually fast.

The foliage symptoms are yellow appearing at the late stages of development of the disease. There is premature flowering and fruitification. The tree branches and shoots die back and the whole canopy is destroyed and the tree falls down following the destruction of the tap root and lateral roots where the anchorage in the soil becomes weakened, and the tree is easily blown over by wind. At the much advanced stage, characteristic orange-veined fruiting bodies (basidiocarps) appear round the base of the trunk. From the affected tree, the rhizomorph spread through the soil and infect the immediate neighbouring trees in row where the process of infection starts all over.

3. Control Practices

Evidence from the laboratory studies at the Rubber Research Institute of Nigeria (RRIN), indicated the use of three antagonistic fungi, namely, *Trichoderma*, *Penicillium* and *Aspergillus* species to control the root rot pathogen R. *lignosus*. Of the three antagonists, *Trichoderma* sp proved to be most effective with 81.85% inhibition rating, followed by Penicillium (65.27%) against the pathogen, however, *Aspergillus* failed to produce noticeable inhibitory effect (Omorusi et al. 2007).

In the field, the use of two systemic fungicides resulted in appreciable control of WRR in the plantations in Nigeria. The fungicides for the WRR treatment include:

i. Tridemorph, at 2.5g a.i in two litres of water and

ii. 1% Triadimefon, at 1.25g a.i in two litres of water.

The procedure for treatment involves digging slight furrow of about 10 cm deep around the infected and neighbouring trees.

Cultural control practices have always been to inspect the collar of diseased including the neighbouring plants for the presence of rhizomorphs. Affected trees including neighbouring trees receive protective fungicides dressings. This whole exercise laborious.

4. Challenges

Challenges posed by the devastating root rot pathogen remains unabated in the plantations of the rubber growing belts in Africa. Fungicide applications to treat large hectrage of plantation coupled with surveylance and inspection for rhizomorph presence are most challenging and labour intensive.

Application of fungicides, and the use of antagonistic fungi separately may not provide a very satisfactory long-term control measures. However, a combination of fungicide and antagonistic fungi bioassay such as *Trichoderma* spp as reported by Hashim (1990) may be a reliable source to control and prevent the spread of the WRR fungus in *Hevea* plantations.

Stumps left over in the plantation after clearing for new planting become sources of inoculum of *R. lignosus*. In Nigeria and other countries in Africa, mechanical clearing of stumps is a huge economic expenditure and it is rarely carried out except only in large estates. The prevalence of stumps in the plantation has contributed significantly to the high degree of WRR incidence.

A possible panacea is planting of resistant variety (yet to be developed) in future. This may be a very useful tool to stem the spread of the white root rot disease. The use of resistant materials to combat soil-borne diseases in perennial crops is a vital component of an integrated disease-management program. Sources of resistance have to be identified. If disease management is to be heavily based on resistance varieties, the research effort in this area will need to be significantly increased.

Effective disease control is rarely achieved through the application of a single disease-control method. In order to limit the risks associated with WRR we need to use a number of different approaches in an integrated manner. The planting of resistant material, if available, is a highly cost-effective way to control disease, but these trees will also benefit from improved cultural practices. Chemicals can be used as a last option, as their use often involves a significant cash outlay for equipment and fungicides. The use of fungicides also requires knowledge about optimal timing of sprays, rates of application, additives and application methods, in order to be applied effectively.

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