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Characteristics and control of a new basidiomycetous root rot of cassava (*Mannihot esculents*) in Ghana

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Abstract. Cassava (*Manihot esculenta*) is one of the most important food crops in the tropical world. Diseases such as African cassava mosaic virus (ACMV), cassava bacterial blight (CBB) and cassava anthracnose (CAD) constitute a major constraint to cassava production in parts of sub-saharan Africa. A mushroom type of fungus previously known to be parasitic on forest tree species has in recent years been found attacking cassava and causing high yield losses in some of the major cassava growing districts in Ghana. Surveys have established presence of the disease in the Volta, Central and Ashanti regions of the country. Major symptoms of the disease include wilting and defoliation and eventually plant death. Storage roots of infected cassava plants are often rotten and result in yield losses as high as 100%. Local and improved genotypes of cassava available to farmers in endemic areas are susceptible to attacks by this fungus. The large, bright yellow fruiting body produced by the fungus is characteristic of the basidiomycete *Polyporus sulphureus* (*Laetiporous sulphureus*). Citrus and a number of important timber tree species are also hosts of this fungus. Results from field screening of cassava genotypes indicate that materials with high levels of resistance to this fungus are available.

Introduction

Cassava (*Manihot esculenta*) is one of the most important food crops in the tropical world and the principal carbohydrate source for more than 500 million people in the developing world (Lozano, 1986; Farquet and Fargette, 1990; Thresh *et al*., 1997). Diseases such as African cassava mosaic virus (ACMV), cassava bacterial blight (CBB) and cassava anthracnose (CAD) constitute a major constraint to cassava production in parts of sub-saharan Africa where the crop is cultivated. ACMV alone potentially causes yield losses of about 50% in susceptible cultivars (Farquet and Fargette, 1990; Lozano and Nolt, 1989). Farmers in most parts of Africa do very little or practically nothing to control diseases of cassava and are often satisfied with the reduced yields they obtain from susceptible varieties they cultivate (Thresh *et al*., 1994).

In addition to the major diseases (ACMV, CBB and CAD) cassava is also affected by root rot infections. Root rot diseases of cassava are common in poorly drained soils especially in periods of excessive rainfall or when cassava is planted in areas where forest trees previously grew. Rots of cassava in poorly drained soils could be due to *Phytophthora* species (Cook, 1978). Soft rots caused by *Phytophthora* spp. are characterized by exudation of liquids with foul smell often from swollen storage roots (Lozana and Sequira, 1974; Oliveros *et al*., 1974). This rot is prevalent in waterlogged soils. *Botryodiplodia throbromae* has been isolated frequently from rotten cassava roots harvested from poorly drained soils in Ghana. Control of these rots lie in avoiding poorly drained soils.

In the last decade however, few new diseases of cassava have been identified in Ghana. One of these new diseases is caused by a basidiomycete previously known to be a fungal parasite of woody forest tree species. In the last decade this new parasite of cassava has been observed to be causing significant yield losses in important cassava growing districts of the country. The basidiomycete produces a bright yellow fruiting body which is characteristic of *Polyporus sulphureus* (*Laetiporus sulphureus*). The parasite which was first observed in one of the ten regions of the country in the early 1990s but is now present in five important cassava growing regions of southern Ghana. Severe yield losses ranging between 50 and 100% have been recorded in disease hot spot areas of Central and Volta regions of the country (Moses 2001). Symptoms of the disease include wilting, defoliation and root rot as observed in most root rot diseases of cassava (Msikita *et al.*, 2000). In areas where this root rot disease has been reported, it is more important than any other known cassava disease.

Effective control measures for this disease must be developed and promoted to reduce its effects. If uncontrolled, this new root rot of cassava is likely to disrupt food security in the region. The host range of *P. sulphureus* is wide. A number of important tree species are hosts to this parasite.

This paper reports research results aimed at obtaining information regarding this new root rot disease of cassava and the efforts being made towards its control.

Materials and Methods

Distribution of the disease. Annual surveys were conducted in the dry and wet seasons of 1999, 2000 and 2001 under the Integrated Pest Management Component of the National Root and Tuber Improvement Programme (RTIP) of Ghana to quantify incidence and severity of the major diseases of cassava and provide information on new diseases and their spread in the country. In addition to these general surveys, localized surveys were conducted in areas where *Polyporus sulphureus* attacks on cassava were found or reported.

Screening of cultivars for resistance. Experiments to test varieties for resistance to the fungus were set up in disease hot spot areas of Sabadu and Avemedra in the Kpando district of the Volta region. Disease incidence in these two adjacent farming communities was 80% in 2000. Ten elite cultivars in the advanced stages of the cassava breeding programme of Crops Research Institute (Kumasi, Ghana) were tested for resistance in these areas in a randomized complete block design (RCBD). A popular improved cassava variety, 'Afisiafi' and a local farmer's variety were included in the experiments as checks.

Disease progress was monitored as soon as a small fruiting body of the fungus was seen at the base of the stem of a healthy growing cassava plant. Morphological changes in both parasite and attacked cassava plants were documented throughout the 18 months crop cycle. Features of storage roots were recorded at harvest and losses due to rots quantified. In addition to the root rot disease, the reaction of the genotypes to all the major diseases of cassava were assessed on a 1-5 scale (where 1= no visible disease symptom observed; 5= symptoms of disease depicting severe damage to tissues organs). Disease development was also monitored on farmers' fields. Local farmers were involved in the evaluation of the genotypes for disease resistance.

Host range. Host range of the pathogen was determined in endemic areas through surveys. The roots of attacked secondary host plants were exposed to establish the type of association or linkage that exist between host and parasite.

Cultural Practices. Cultural practices that promoted spread and persistence of the root rot disease in the endemic areas were identified. Farmer practices like methods of land preparation, source of planting materials, handling of harvested storage roots and handling of plant debris after harvest were recorded. Selection of planting materials for cuttings was also investigated.

Workshops and Farmer Field Days. Workshops and Farmer Field Days were organized for farmers and Agriculture Extension Agents (AEAs) in disease hot spot areas in the Kpando District of the Volta region. These activities were used to increase farmer s aware of cassava diseases. In these activities, farmers and AEAs were trained in disease identification and their control. A television documentary on the root rot disease was prepared from workshops and field days for awareness creation.

Results

Distribution of the disease. Results of surveys indicate the presence of the disease in Ashanti, Volta, Central, Greater Accra and Eastern regions of Ghana. Districts with significant presence of the disease identified in the surveys were Kpando, Ho, Ejura-Sekyere Dumase, Awutu, Swedru and Gomoa districts. The highest incidence of 33% was recorded in the Kpando district of the Volta region. Avemedra and Sabadu farming area in the Kpando district had the highest incidence of the root rot disease (80%) in 2000. A survey of the same area in the wet season of 2002 showed a drop in disease incidence from 80 to 50%.

Disease development and yield loss. The first sign of the disease is the appearance of the fruiting body of the basidiomycete on the distal end of the stem of an attacked cassava plant. In endemic areas new attacks on farms are observed soon after the first rains following the prolonged dry season. The bright yellow fruiting body develops rapidly and can expand to 30 cm in diameter in less than 4 weeks. The fruiting body persists on the attacked plant for weeks. It may shrink in size and finally become a dry brown leathery tissue attached to infected cassava plant. Depending on the variety of cassava, wilting and defoliation may be observed several weeks after the initial attack. Harvested roots from the defoliated plants are often completely rotten.

Screening for resistance. Results from the resistance screening experiments are shown in Table 1.The genotypes TME 1, TME 6 and 91/02324 were not affected by the root rot organism. All other genotypes suffered yield losses due to the root rot disease. Yield losses

Table 1: Reaction of elite cultivars of cassava to tuber rot (caused by *P. sulphureus*) and the other major diseases of cassava (figures represent disease severity scores on a 1-5 scale).

Genotype	ACMV	CBB	CAD	BLS	Root rot
TME 1	1.0	1.0	4.0	3.0	1.0
TME 5	1.0	1.0	3.0	3.0	3.0
TME 6	1.0	1.0	4.0	3.0	1.0
TME 11	1.0	1.0	4.0	3.0	3.0
TME 12	1.0	1.0	4.0	3.0	2.0
TME 14	1.0	1.0	4.0	3.0	2.0
91/03227	1.0	1.0	4.0	3.0	2.0
91/02324	1.0	1.0	5.0	3.0	3.0
182/0328	1.0	1.0	4.0	3.0	2.0
92/0398	1.0	2.0	3.0	3.0	3.0
'Afisiafi'	3.0	1.0	3.0	3.0	3.0
Local	4.0	1.0	3.0	3.0	3.0

ranged between 2 and 50% among the susceptible genotypes. TME 5 and TME 11 were the most severely affected.

Host range. Observations made so far confirms that the root rot causal organism has a wide host range. The parasite attacks a number of woody trees and citrus plants. Fruiting bodies of the parasite were found attached to the roots or stems of these secondary host plants. Symptoms produced in these hosts also include wilting, defoliation and subsequent death of plants.

Discussion

This study confirms the presence of root rot caused by *P. sulphureus* (*Laetiporus sulphurous*) in Volta, Central, Ashanti, Greater Accra and Eastern regions of Ghana. There is a high incidence of the disease in the Avemedra and Sabadu areas of the Volta region and the Awutu district of the Central region of Ghana. The strong presence of the disease in the Awutu is of great concern as it is likely to affect the activities of the starch factory in this area. In addition, the major staple food for the people of Volta region is cassava. The presence of the disease in this region can undermine food security of this region. If not contained, it may affect the exportation of cassava to other countries in the region.

Table 2: Yield of genotypes on test fields and estimated % yield loss due *P. sulphureus.*

Genotype	Mean yield from experimental fields	Estimated % yield lossdue to *P. sulphureus*
TME 1	36.0	0.0
TME 5	28.0	35.0
TME 6	33.0	0.0
TME 11	24.0	34.0
TME 12	26.0	6.0
TME 14	27.0	2.0
91/02327	28.0	8.0
91/02324	34.0	0.0
182/0326	34.0	14.0
92/0398	13.0	20.0
‘Afisiafi’	17.0	27.0
Local	19.0	18.0

It became clear from the surveys that most farmers in the country were not aware of this disease. It is important therefore, that awareness creation activities in endemic and disease free areas be intensified. Interaction between research, extension agents and farmers through workshops and field days explain the drop in the incidence of root rot in the Avemedra and Sabadu areas of the Kpando district from 80% in 2000 to 50% in 2002. A number of farmers in this district have adopted improved cultural practices.

It is advisable that plant debris and leftovers after harvest from fields that experienced root rot attacks are burnt. Burning in this case must be soon after harvest. Conscious efforts must be made to control the free movement of unprocessed roots and planting materials from endemic areas to new localities. It is advisable for farmers in endemic areas to avoid new fields with strong presence of the fungal pathogen if new land can be secured elsewhere. Continuous cropping of the same piece of land to cassava in endemic areas is seen as one way of promoting the disease. Rotating cassava with two crop cycles of cereals may reduce the incidence and spread of the disease.

The 10 elite genotypes screened for resistance remained disease free after 18 months. TME 1, TME 6 and 91/02324 that were not affected by the fungus also had good storage root yields (36, 32 and 34 t per ha). Such varieties should be promoted. More genotypes of cassava both from local and introduced sources should be screened for resistance.

The wide host range of this pathogen is significant. It simply signifies the need to continue searching for sources of resistance.

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