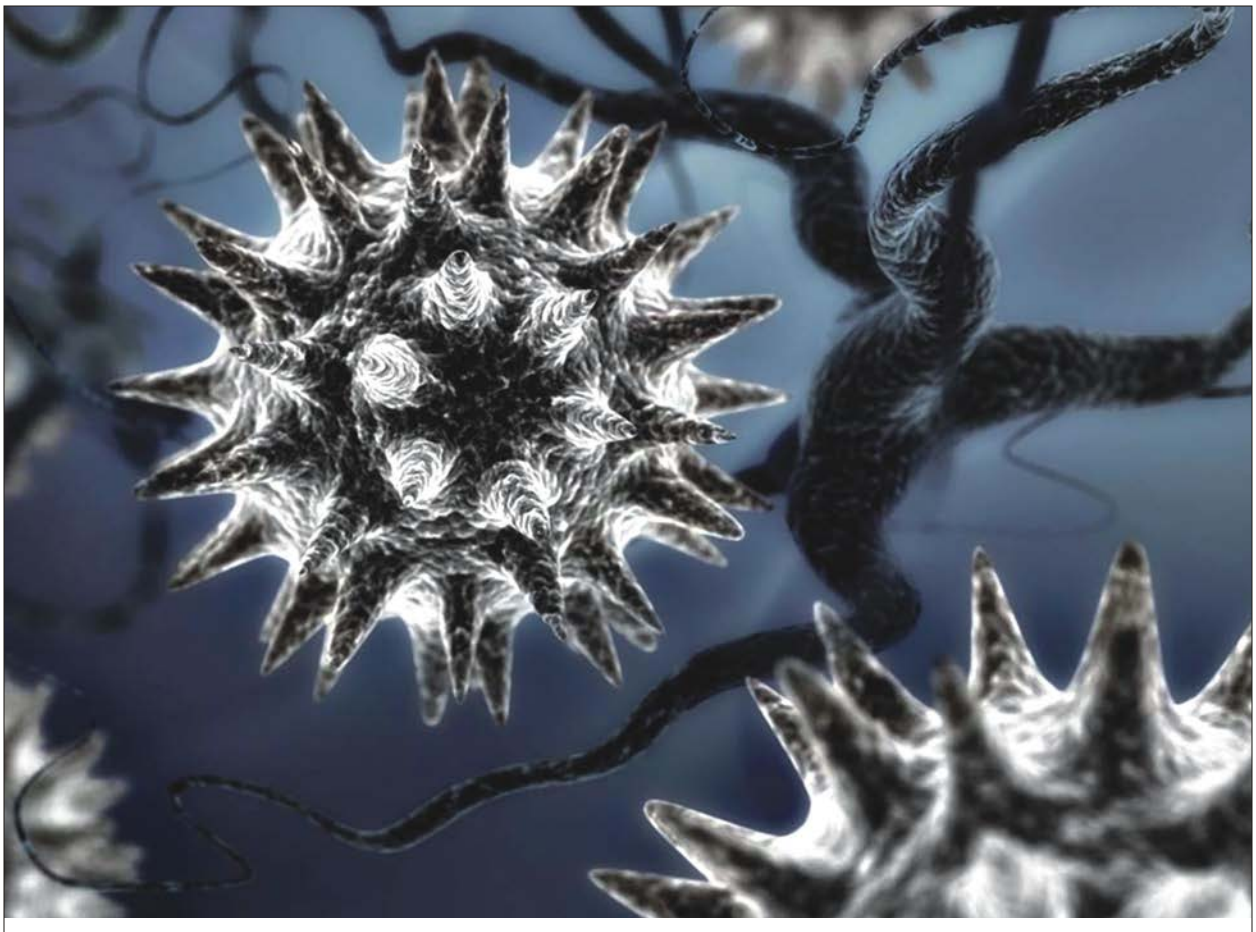

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Banana Streak Disease Survey in Three Plantain Growing Regions of Ghana

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Abstract: A banana streak virus disease survey was conducted in 25 districts in 3 of the 6 plantain growing regions of Ghana in 2001. A total of 40 farms were evaluated for the presence of the disease in each region. Triple antibody Sandwich-enzyme-Linked Immunosorbent Assay (ELISA) technique was used in the indexing of the suspected samples. The disease was observed on both land races especially Apantu (False Horn subgroup) and FHIA hybrids on farmers' fields and on research stations. The disease was detected in two of the regions (Ashanti and Brong-Ahafo) studied. The disease was however not detected in the Western region. The disease incidence was observed to be low in all the growing districts studied. The presence of the disease on local cultivars in farmers' fields is a potential threat to the industry.

Key words: Plantain, banana, disease, serology, badnavirus, musa

INTRODUCTION

Plantain and banana (*Musa* sp.) are of great socio-economic and nutritional importance in Ghana (Dzomeku *et al*., 2006). They are consumed both as energy yielding food and as dessert. Plantain contributes about 13.1% of the Agricultural Gross Domestic product and its per capita annual consumption is 101.4 kg per head (FAO, 2006). Plantain and banana are also very important sources of rural income (Ortiz and Vuylsteke, 1996).

Diseases are however a major constraint to production. Until recently, the black sigatoka disease caused by a fungus *Mycosphaerella fijiensis* was the most damaging. However, a new virus disease, the banana streak caused by a badnavirus has been observed on some *Musa* hybrids. The disease has been identified in experimental plots at the Fumesua station of the CSIR-Crops Research Institute, Kumasi, Agricultural Research station at Kade (Osei, Pers. Comm.) and Assin Fosu station of the CSIR-Crops Research Institute. The occurrence of the Banana Streak Virus (BSV) has been reported from all major *Musa* growing areas in the world.

BSV is transmitted in a semi-persistent manner from banana to banana by the citrus mealy bug (*Planococcus citri*) and a *Pseudococcus* sp. However, the use of infected planting materials could be involved in the spread of the disease. With regard to BSV detection, the highly heterogeneous nature of BSV isolates poses the most serious obstacle to the reliable detection of the virus in infected tissue. Serological heterogeneity has made it difficult to develop routine virus indexing protocols capable of detecting the complete range of virus isolates (Lockhart and Olszewski, 1993). A significant improvement in BSV detection by ELISA was achieved by developing assay protocols using polyclonal antibodies produced in two different animal species (Ndowora, 1998). It has recently been shown that BSV genomic sequences are integrated into the genomic DNA of *Musa*. BSV-related sequences have been found in more than 400 *Musa* genotypes by PCR amplification. The phenomenon of genome integration has been a major constraint in the application of molecular based diagnostic techniques to detect BSV in infected plantain and banana cultivars (LaFleur *et al*., 1996). Symptom

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expression varies depending on the isolate of the pathogen, the host cultivar and the environment. The most common symptoms are narrow, broken or continuous streaks or spindle-shaped patterns, which are first chlorotic or yellow and then become increasingly dark in colour and finally result in black streaking in older leaves. Necrosis has also been seen on the midrib and petiole (Lockhart and Jones, 1999).

Although the disease has been identified in Ghana in experimental fields there had not been any comprehensive survey to determine incidence and severity of BSV on farmers' fields in the important plantain growing regions. And judging from the devastating nature of the disease as evidenced in the other countries it was necessary to carry out such a survey in farmers fields in important plantain growing regions in Ghana including the Ashanti, Brong-Ahafo and Western regions, to ascertain the status of the disease on plantains and bananas in Ghana.

MATERIALS AND METHODS

Survey

Ten districts in the Ashanti region and seven in Brong-Ahafo region in the forest and forest transition ecozones, respectively and four districts in the Western region (high rain forest ecozone) where plantains are largely cultivated were covered by the survey. For each location within a district, farms of not less than 0.5 ha were selected for evaluation. The distances between farms were about 10 km. For each region, a total of 40 farms were evaluated and 5000 plants assessed. Each plant sampled in these farms was visually assessed for disease symptoms and leaf samples collected from suspected plants. An average of 100 leaf samples from suspected plants were collected from each region. These were kept frozen in an ice chest during the survey period and finally preserved in a deep-freezer before serological diagnosis in the laboratory.

Serology

The Triple Antibody Sandwich (TAS) Enzyme-linked Immunosorbent Assay (ELISA) was the technique used in indexing the suspected samples. An indirect ELISA procedure was used that followed the method described by Ndorowa (1998) was applied. This was slightly modified by Hughes (1999, Personal Communication).

Polystyrene microtitre plates were initially coated with purified IgG of rabbit polyclonal (PmX-IgG) in coating buffer (1/500 dilution) and incubated for three hours. After washing with Pyvinyl Pyrrolidone (PVP) Tween 20, sap extracted from suspected samples in extraction buffer (1/10) were put in wells of microtitre plates (100 μL/well) and incubated overnight at 4°C. After washing, chicken polyclonal in extraction buffer (1/1000) was pipetted into ELISA plate (100 μL /well) and incubated for 3 h at 37°C. The plates were washed and 100 μL of goat anti-mouse alkaline phosphatase conjugate at a dilution of 1:40,000 in conjugated buffer. The plates were washed and p-nitrophenylphosphate disodium salt at 0.5 mg/10 mL of substrate buffer was added to plate (100 μL/well). The plate was then incubated for 1-2 h at room temperature for colour development.

The Optical Density (OD) values of the samples together with the negative and positive controls were read at a wavelength of A405 nm using a Labsystems Multiskan MS plate reader. A sample was considered positive if the absorbance was greater than twice that of the mean absorbance value of eight control wells containing extracts from non-inoculated plants (Clement *et al*., 1986; Jones *et al*., 1990).

RESULTS AND DISCUSSION

Two out of 50 samples (4%) collected from farmers' fields at Kroase (Ashanti region) in the humid forest zone and two out of 50 samples (4%) collected from Maabang (Ashanti region) in

the deciduous savannah transition zone tested positive to BSV. At Kukuom (Brong-Ahafo region) two out of 100 samples (2%) tested positive to BSV. This is the first report of any such serological detection in farmers' fields in Ghana. Samples obtained from the Western region were negative. The results however indicated low incidence of the disease in the major plantain growing areas. Plants suspected of infection showed narrow broken chlorotic streaks similar that described by Lockhart and Jones (1999). Disease severity however varied between plants. Diseased samples were mainly collected from the local cultivar 'Apantu'. The disease might have been introduced into farmers fields by means of infected suckers since observation in many countries suggests that the spread of BSV from plant to plant by the mealybug vector may be limited in occurrence. It is also known that the virus is not soil-borne and it is not unlikely to be transmitted on cutting tools or during cultural operations (Lockhart and Jones, 1999).

BSV is reported to be widespread in Cote d'Ivoire (Diekmann and Putter, 1996) and considering the close proximity of Ghana and Cote d'Ivoire, movement of planting materials could have contributed to this observation.

The discovery of BSV on local cultivars in farmers' fields is very significant. In Cote d'Ivoire yield losses could be as high as 90% depending on disease severity (Lassoudiere, 1974) (recent publication). This calls for preventive measures like the limitation of movement of plant materials from diseased areas to areas where the disease has not been identified. Strict quarantine measures could also be employed bat the Ghana/Cote d'Ivoire border to prevent cross-border transfer of infected planting materials.

In conclusion, if farmers properly manage the disease through use of high yielding BSV tolerant planting materials, as well as other preventive measured earlier on discussed, BSV will pose no serious threat to the plantain industry.

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