

INCIDENCE AND SEVERITY OF *DIOSCOREA BACILLIFORM VIRUS* (DBV) DISEASE IN YAM FIELDS OF FIVE STATES OF GUINEA SAVANNAH ZONE OF NIGERIA.

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ABSTRACT

Yam viruses are major threat to sustainable yam production in Sub Saharan Africa (SSA) and are impediment to the safe movement of yam germplasm. A survey was carried out in the year 2017 and covers 22 selected yam fields of 5 major yam producing States of Northern Nigeria which include; Benue, Kwara, Kogi, Niger and Nassarawa States. The areas were randomly selected to determine the incidence and severity of *Dioscorea bacilliform virus* (DBV) disease. Higher disease incidence was recorded in Benue (71.43%) and Niger (68.00%) than Kwara (48.18%) and Kogi (43.33%) states, while Nassarawa (38.75%) recorded the lowest. Disease severity in all the surveyed areas was mild (2.1) based on the disease severity ranking scale of 1 to 5. However, the incidence and severity of DBV disease on Local government areas (LGAs) bases was higher in Gurara (90%), Gboko (85%) and Gwer East (80%) of Niger and Benue states, respectively, with Utukpo, in which the incidence of DBV disease is higher (70%) than those of Gwer, Tarka, Makurdi and Karo LGAs each with same level of incidences (60%), which are lower than that of Wushislu recorded (65%) of disease incidence. However, Similar DBV disease incidences of 50% were recorded in ajaokuta and Ofu LGAs. While lowest disease incidence (20%) of DBV were observed and recorded in Makode, Lafia, and Paiko LGAs of Kogi, Kwara, Nassarawa and Niger state, which is slightly higher than that of Yagba- West (43.33%), and Ikiti, Kabba, Keana, Obi, and the Keffi LGAs each recorded (30%) of DBV disease incidences. The severity of DBV disease in all the surveyed areas are at mild stage (scale 2) based on the disease severity ranking scale of 1-5. Only in Ofu local government areas of Kogi State where the severity of the disease reach very severe stage (scale 5). The findings of this study indicated the presence of DBV in the surveyed States and recorded the status of the disease incidence and severity which can aid in designing management strategies of DBV for increase yam productivity in the study areas.

Key words: *Dioscorea bacilliform virus* (DBV), incidence, severity, LGAs, Sub Saharan Africa (SSA).

INTRODUCTION

Yam (*Dioscorea spp.*) is a major staple food for most people of Nigeria and the country accounts for highest production (65-70%) of the crop worldwide

(FAO, 2007). It contributes most of the calorie requirement for each day. The tubers are consumed in several forms: eaten roasted, boiled, fried or as pounded yam and flour. Certain species are used for pharmaceutical compounds. Due to the continued and increasing dependence on yam for food in Nigeria, it is important for food security. Farmers are continually boosting the diversity of their plots by domestication of important high yielding varieties and world species (Dumont and Vernier, 2000). Major yam production is in the forest and the Guinea Savanna zone of Nigeria. *Dioscorea rotundata* (white or guinea yam) is the most important and widely grown yam in the Guinea Savanna with hundreds of hectares of land under yam production each year. Pests and diseases are major constraints in its production as they have direct negative effects on its yield and quality. The most serious insects on the field and in storage include yam beetles, aphids, scarius flies, weevils and termites (Onwueme, 1978). Diseases caused by viruses, fungi, nematodes and bacteria, either singly or in combination are responsible for yield losses (Onwueme, 1978; Brunt *et al.*, 1990; Hughes *et al.*, 1997; Odu *et al.*, 1999). Viruses are of particular concern because, apart from causing significant reduction in tuber yield and quality, they restrict international exchange of germplasm. Yam viruses have been reported in most of the yam growing areas of West Africa (Thouvenel and Fauquet, 1979; Guoudon *et al.*, 1996; Hughes *et al.*, 1997; Philips *et al.*, 1999; Odu 2002; Eni, 2008). Viruses infecting yam belong to the Potyvirus, Badnavirus and Cucumovirus genera, while a number of yam viruses remain unclassified. The viruses that have been reported on yam in West Africa are *Yam Mosaic virus* (YMV), Genus Potyvirus, *Yam mild mosaic virus* (YMMV), Genus Potyvirus, *Dioscorea durnetorum virus* (DdV), Genus Potyvirus, *Dioscorea bacilliform virus* (DBV), Genus Badnavirus, *Dioscorea alata bacilliform virus* (DaBV), Genus Badnavirus, *Dioscorea sansibarensis virus* (DSBV), Genus Badnavirus, *Cucumber mosaic virus* (CMV), Genus Cucumovirus and *Dioscorea mottle virus* (DMoV), Genus Cucumovirus. In Nigeria, YMV was the most prevalence in the humid forest, reaching an incidence of 78% (Dongo, 2000; Njukeng *et al.*, 2002 and Atiri *et al.*, 2003). Many of the earlier descriptions of Potyviruses in Nigeria did not provide precise information on the causal viruses and virus identity; and the relationships with other viruses remain

elusive (Hughes *et al.*, 1997; Kondo, 2001; Atiri *et al.*, 2003). Therefore, there is need for the knowledge of incidence and severity of *Dioscorea bacilliform virus* (DBV), in major yam-producing States of the Guinea Savannah zone of Nigeria.

MATERIALS AND METHODS

Study Areas

The survey study was conducted in the month of August 2017 rainy season, from twenty two (22) yam field locations covering major yam producing regions of Guinea Savannah Zone of Nigeria, which include; Benue, Kwara, Kogi, Nassarawa and Niger States (Figure 1).

Survey and Sampling of yam fields in five States of Guinea Savannah Zone of Nigeria

Survey of farmer’s fields was carried out in the months of August 2017 in five yam-producing areas (Benue, Kwara, Kogi, Nassarawa and Niger States) of the Guinea Savannah zone of Nigeria. Three farmers’ fields were surveyed in each of yams producing Local Government Areas in each State using global positioning system (GPS coordinates). Leaf samples were collected from 5 quadrants of 5x5m size, (Figure 1). Leaf samples were collected from symptom-laden (chlorotic spotting, vein-banding and mosaic) and symptomless (latent infection) yam plants.

$$\text{Incidence} = \frac{\text{number of diseased plant sampled}}{\text{total number of plant}} \times 100$$

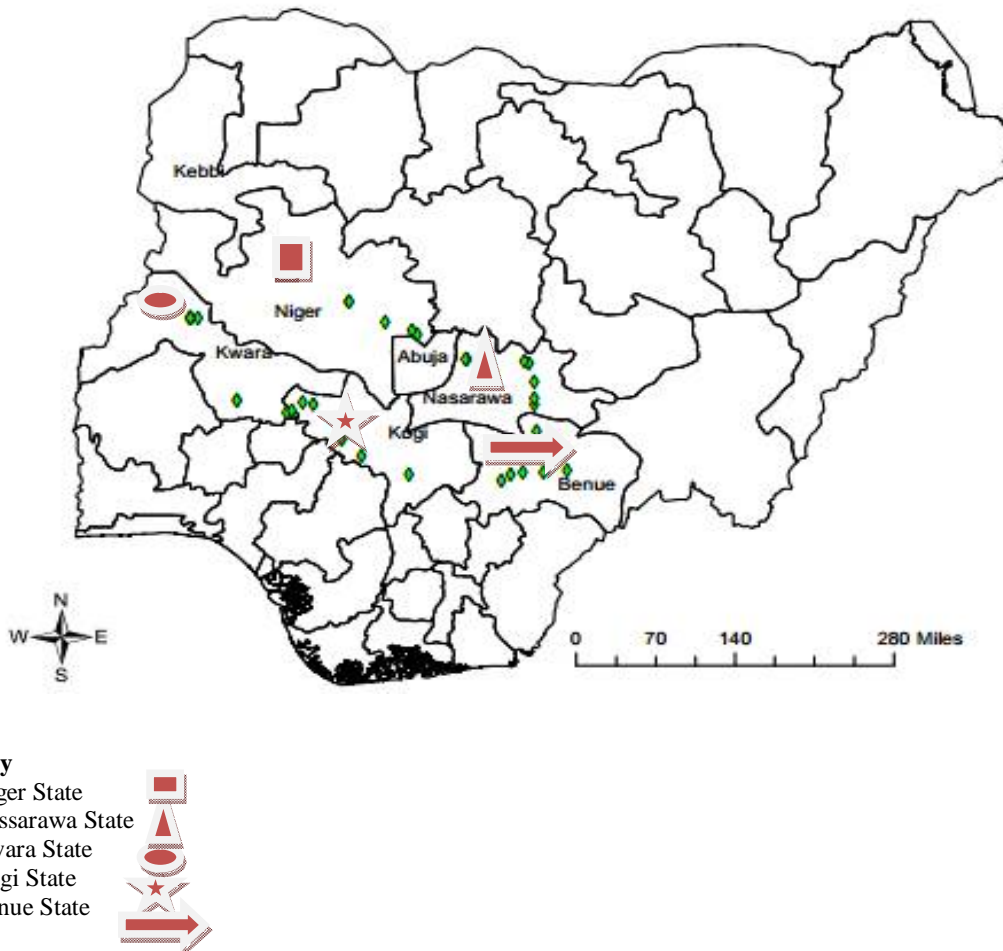


Figure 1: A map of Nigeria showing the GPS locations of the surveyed States.

Incidence and Severity of *Dioscorea bacilliform virus* (DBV) Disease of yam fields in five States of Guinea Savannah Zone of Nigeria

The surveyed fields were assessed and scored for DBV incidence and severity of typical yam virus symptoms expressed on the leaves. Three farms were surveyed in each of the Local Government Areas per

state. The plant samples were collected from each farm and the number of plants with symptoms was recorded. The percent incidence of DBV disease was calculated as follows

$$\text{Disease incidence (\%)} = \frac{\text{No. of plants with symptoms}}{\text{Total no. of plant sample}} \times 100$$

The severity of symptoms was scored on a scale ranging from 1 through 5: 1–No obvious symptoms, 2–Symptoms on 0-24% of leaves, 3–Symptoms on 25%- 50% of leaves, 4 –Symptoms on 51%-74% of leaves and 5–Symptoms on 75%-100% of leaves (Eni *et al.*, 2008 modified). PC Excel (window 8.0) was used to represent the Data of Disease Incidence and Severity for DBV disease in the study areas for

both states and local government areas (LGAs) bases.

RESULTS AND DISCUSSIONS

Survey

Seven different symptom phenotypes occurred in different proportions in all the fields surveyed in 2017 (Fig. 2). Leaf distortion, Mosaic, Vein banding and Mottling, were the most common symptoms observed, accounting for 48% of the field symptoms while Coiling, Mosaic and mottling, Mosaic and bleaching accounted for the remaining 52% Most of these symptoms were associated with YMV, CMV, YMMV and badnavirus.



FIGURE 2: Symptom types observed on yam fields of five states of the the Guinea Savannah zone of Nigeria (a) Leaf distortion; (b) Mosaic; (c) Vein banding; (d) Mottling; (e) Coiling; (f) Mosaic and mottling; (g) Mosaic and bleaching

Incidence and Severity of *Dioscorea bacilliform virus* (DBV) Disease of yam fields in five States of the Guinea Savannah zone of Nigeria

Disease incidence of *Dioscorea bacilliform virus* (DBV) varied between surveyed states, which ranged

from 39 to 71% with an overall mean of 54%. The highest incidence was recorded in Benue (71%) and Niger (68%) states, followed by Kwara (48%) and Kogi (43%) states, whilst the lowest incidence occurred in Nassarawa (39 %) state (Figure 3).

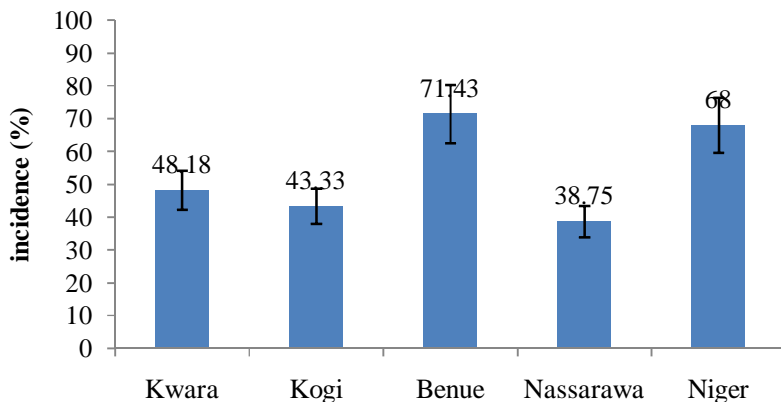


Figure 3: Level of Incidence of virus disease symptoms on yam fields in five states of the Guinea Savannah zone of Nigeria.

The average severity of *Dioscorea bacilliform* virus (DBV) on the other hand was 2.1 which were mild (Figure 4) in all the study areas.

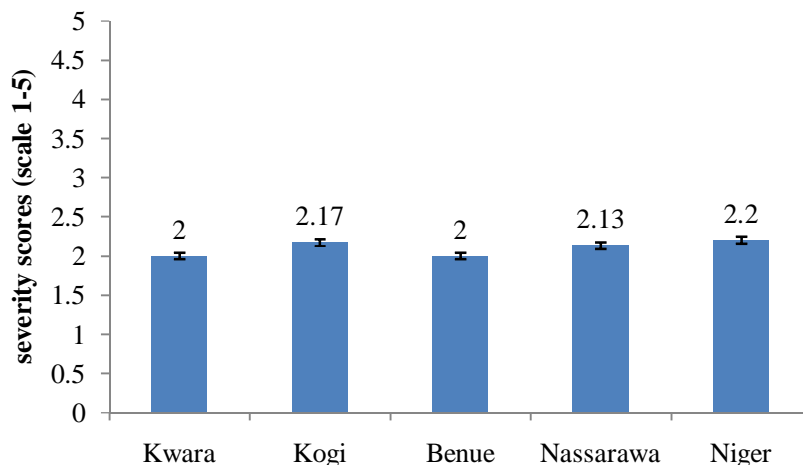


Figure 4: Level of Severity of virus disease symptoms on yam fields in five states of the Guinea Savannah zone of Nigeria.

Incidence and Severity of *Dioscorea bacilliform* virus (DBV) Disease of yam fields in Local Government Areas of five states of the Guinea Savannah zone of Nigeria

The incidence and severity of *Dioscorea bacilliform* virus disease on Local government areas (LGAs) bases was higher in Gurara (90%), Gboko (85%) and Gwer East (80%) of Niger and Benue states respectively, with Utukpo, in which the incidence of DBV disease is higher (70%) than those of Gwer, Tarka, Makurdi and Karo LGAs each with same level of incidences (60%), which are lower than that of Wushislu which recorded (65%) of disease incidence. However, similar DBV disease incidences

of 50% were recorded in Ajaokuta and Ofu LGAs respectively. While lowest disease incidence (20%) of DBV were observed and recorded in Makode, Lafia, and Paiko LGAs of Kogi, Kwara, Nassarawa and Niger state, which is slightly higher than that of Yagba- West (43.33%), and Ikiti, Kabba, Keana, Obi, and the Keffi LGAs each recorded (30%) of DBV disease incidences. The severity of DBV disease in all the surveyed areas are at mild stage (scale 2) based on the disease severity ranking scale of 1-5. Only in Ofu local government area of Kogi state where the severity of the disease reach very severe stage (scale 5)

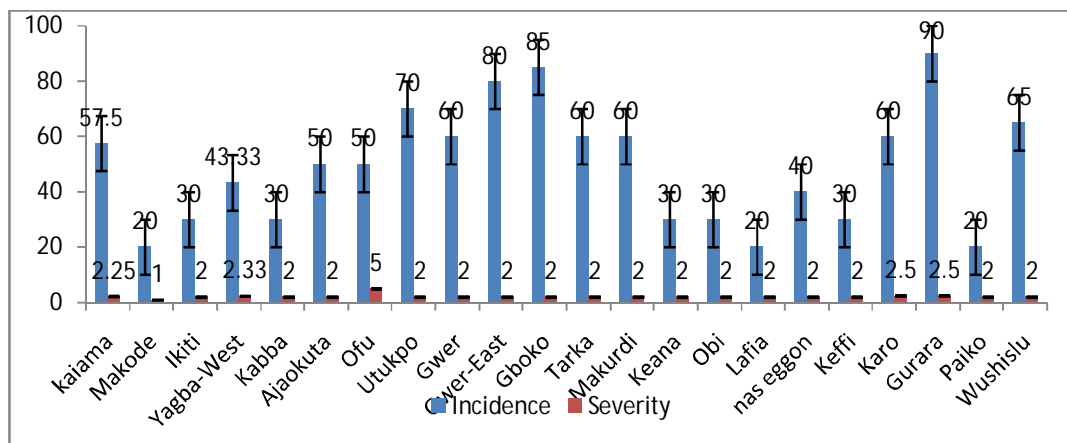


Figure 5: Level of incidence and severity of DBV disease of yam fields in five States of Guinea Savannah zone of Nigeria.

DISCUSSION

The survey conducted in yam fields across the study areas of five States of Guinea Savannah zone of Nigeria in 2017 showed higher incidence of DBV disease symptoms in Benue (71.43%) and Niger (68.00%) compared to the incidence recorded in Kwara (48.18%), Kogi (43.33%) and Nassarawa (38.75%) states. The higher incidence of DBV disease symptoms recorded in Benue and Niger could possibly be linked to the nature of climatic factors or condition particularly temperature, rainfall and relative humidity in both states. High relative humidity and temperature that prevail in these states provide favourable environment for insects' well-being, which resulted to increased vector populations on yam leaves and this might have led to increased incidence of the DBV disease in the area, this could be in agreement with the finding of Asala (2012) which reported a strong correlation between climatic factors and virus incidence on the epidemiology of *yam mosaic virus* (YMV), *yam mild mosaic virus* (YMMV) and *Badnavirus* (DaBV) in Guinea savannah of Nigeria. Furthermore, it might be as result of high production of yam within these two states (Benue and Niger), this is because; the two states represent the most important yam producing states in Nigeria and they are contributing about 60% of total Nigerian yam production (FAO, 2016). Equally, farmer's exchange of planting materials without proper certification of the planting materials is another contributing factor to increased disease incidence in the area as reported by Asala (2012).

The average severity, on the other hand, was mild (2.1) based on the severity ranking scale of 1-5. The mild severity observed throughout the study areas might be attributed to the use of clean planting materials which reduced virus load or vector populations, since the practice minimise an increase of vector populations on yam leaves and might have led to decreased severity of viral disease (Figure 4) Traditionally, farmers reuse their own seed from the previous harvest, which are often infected with

viruses, also the habits of exchanging yam seeds between farmers could also lead to same. On the other hand, the Level of incidence and severity of DBV disease in five States of Guinea Savannah zone of Nigeria in 2017 recorded highest in Gurara (90%), followed by Gboko (85%) and Gwer East (80%) of Niger and Benue states, while the incidence of DBV disease in Utukpo is higher (70%) than those of Gwer, Tarka, Makurdi and Karo LGAs each with same level of incidences (60%), and this could be attributed to the nature of climatic factors or conditions particularly temperature, rainfall and relative humidity which are all higher in areas with highest DBV disease than those recorded lower cases of DBV disease incidences in both states and this is similar with the study on correlation between climatic factors and virus incidence on the epidemiology of *yam mosaic virus* (YMV), *yam mild mosaic virus* (YMMV) and *Badnavirus* (DaBV) in Guinea savannah of Nigeria reported by Asala (2012). However, similar DBV disease incidences of 50% were recorded in Ajaokuta and Ofu LGAs and the lowest disease incidence (20%) of DBV were observed and recorded in Makode, Lafia, and Paiko LGAs of Kogi, Kwara, Nassarawa and Niger state, which is slightly higher than that of Yagba- West (43.33%), and Ikiti, Kabba, Keana, Obi, and the Keffi LGAs each recorded (30%) of DBV disease incidences. The severity of DBV disease in all the surveyed areas are at mild stage (scale 2) based on the disease severity ranking scale of 1-5. Only in Ofu local government areas of Kogi state where the severity of the disease reach very severe stage (scale 5) this is due to farmer's exchange of planting materials without proper certification of the planting materials which is one of the factor contributing to increased disease severity in the area as reported by Offei (2001).

CONCLUSION

Obtaining planting materials (seed tubers) from healthy plants for yam cultivation would be a good

initial approach to solving the problem of virus infection of yam in the field. The major challenges faced by farmers and researchers are choosing healthy planting materials and screening of yam genotypes for multiplication.

RECOMMENDATION

An adequate rapid field test for the certification of yam planting materials will provide a major progress in the management of yam infections. Since these viral diseases are not epidemiologically static, information gathering should be continuous.

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