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WEED HOSTS OF *SUGARCANE MOSAIC VIRUS* IN SELECTED LOCAL GOVERNMENT AREAS OF KADUNA AND KANO STATES, NIGERIA

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ABSTRACT

Thirteen weed grasses with virus-like and non-virus-like symptoms were randomly collected in 2012 within and around infected sorghum fields in Kaduna and Kano States, representing Northern Guinea Savannah and Sudan Guinea Savannah zones, respectively. The samples were analyzed using double antibody sandwich enzyme-linked immunosorbent assay (DAS-ELISA) for *Sugarcane Mosaic Virus* infection. Two weed species [*Pennisetum purpureum* Schumach and *Digitaria exilis* (Kippist) Stapf) were tested positive for the virus. The rest of the weed grasses reacted negatively to the antibody. This is the first report of weed species as natural reservoir of *Sugarcane Mosaic Virus* in Kaduna and Kano States, Nigeria.

Keywords: Savannah; *Sugarcane mosaic virus*; Sorghum; Host

INTRODUCTION

Sorghum (*Sorghum bicolor* L. Moench) is among the staple crops in the semi-arid region of Africa and other parts of the world, both in terms of production and total land area put to cultivation. It is the world's fifth most important cereal crop after wheat, rice, maize, and barley (Kutama *et al*., 2010). The crop is used for human consumption and as feed for livestock and it is virtually the primary food in the entire Northern Nigeria (Alegbejo, 2002; Gordon and Thottappilly, 2003; USAID, 2011). Kaduna and Kano States are the first and the fifth leading producers of soghurm in Nigeria, respectively (NAERLS and PRSD, 2012). Sorghum suffers from a number of diseases and pests which lower its potential yield (Kucharek, 1992; Toler, 1985). Viruses infecting sorghum are widely distributed in Asia and Africa and are of economic importance and one of those viruses is *Sugarcane mosaic virus* (SCMV) (Narayana *et al*., 2002). The virus occur worldwide, infecting majorly sorghum and maize (Gordon and Thottappilly, 2003). It belongs to genus *Potyvirus* family *Potyviridae* (Brunt *et al*., 1996). The virus has a filamentous flexuous measuring between 730-755 nm long and 13 nm wide. It has a sedimentation coefficient of 148-176 *S* and buoyant density of 1.3327 g cm^{-3} in CsCl. The virion is found in mesophyll, cytoplasm and Golgi apparatus (Brunt *et al*., 1996). The symptoms induced by SCMV include mosaic, necrosis, ringspots, leaf reddening and stunting (Brunt *et al*., 1996; Mohammadi and Hajieghrari, 2009). SCMV was found to reduce maize yield in Brazil by 48 % (Waquil *et al*., 1996). SCMV is transmitted in a non-persistent manner by aphid species, such as *Dactynotus ambrosiae* Thomas, *Rhopalosiphum maidis* Fitch, *Hysteroneura setariae*

Thom, and *Toxoptera graminum* (Rond.) (Kennedy *et al*., 1962; Brunt *et al*., 1996). The virus control is majorly achieved by the use of resistant varieties developed by deploying resistant genes such as *SCMV1* and *SCMV2* (Mali and Thakur, 2001; Dussle *et al*., 2000). Weed plants have been reported to harbour and aid in the transmission of plant viruses by allowing the viruses to over winter during off season. The reported natural weed hosts of SCMV include *Panicum* spp., *Eleusine* spp., *Setaria* spp., and *Sorghum halepense* (Linn) Pers (Brunt *et al*., 1996; Mohammadi and Hajieghrari, 2009). The objective of this study was to identify the weed species harbouring SCMV for effective management of the disease.

MATERIALS AND METHODS

Study Area

Surveys were carried out in Sabon Gari (N 11 ˚ 11' E 07 ˚ 37'), Giwa (N 11 ˚ 15' E 07 ˚ 24'), Lere (N 10 ˚ 28' E 08 ˚ 38'), Makarfi (N 11 ˚ 21' E 07 ˚ 52') and Kubau (N 10 ˚ 42' E 08 ˚ 16') Local Government Areas (LGA) in Kaduna State.

Tsanyawa (N 12 ˚ 20' E 08 ˚ 4'), Minjibir (N 12 ˚ 14' E 08 ˚ 40'), Wudil (N 11 ˚ 49' E 08 ˚ 48'), Sumaila (N 11 ˚ 37' E 08 ˚ 57') and Garun Malam (N 11 ˚ 39' E 08 ˚ 25') LGAs in Kano State. Kaduna States lies in the Northern Guinea Savannah of Nigeria. It is characterized by scattered trees and short grasses. The zone is also typified by low rainfall and long dry periods. Kano State is in Sudan Savannah region, a zone with an annual rainfall of less than 1000 mm, very short grasses, shrubs and fewer short trees as well as long dry season of 6 – 9 months.

Sampling Techniques and Sample Collection

Three sorghum fields were visited in each of the LGAs surveyed. The LGAs were selected based on production and history. The farms in each LGA were randomly chosen. Narrow leaf weed species, within and around the sorghum fields with or without viral disease symptoms were randomly collected. They were labelled, wrapped in polyethylene bags, stored in a cooler and transported to the Virology Laboratory, Department of Crop Protection, Ahmadu Bello University (ABU), Zaria. The weeds were taken to the Herbarium, Department of Biological Sciences, ABU, Zaria for identification. The identified weed samples were labelled and brought back to the Virology Laboratory, Department of Crop Protection, ABU, Zaria. The samples were stored at -20˚C before analyses.

Serological Assay

Double antibody sandwich enzyme-linked immunosorbent assay (DAS-ELISA) was carried out as described by Clark and Adams (1977). The plates were coated using polyclonal antibody-IgG to *Sugarcane Mosaic Virus* in coating buffer (1.59 g Na_2CO_3, 2.93 g $NaHCO_3$, 0.20 g NaN_3, pH 9.6) in a dilution of 1:1000 and 200 µl was loaded into each well of the microtitre plate. The plates were incubated at 37 ˚C for 3 h. At the end of the incubation period, the plates were washed three times with PBS-T (8.0 g NaCl, 0.2 g KH_2PO_4, 1.15 g Na_2HPO_4, 0.2 g KCl, 0.2 g NaN_3, pH 7.4and Tween - 20) using a wash

bottle by soaking for few minutes before emptying them. The plates were then blotted by tapping twice on a multiple layered tissue papers. The samples were homogenised (1:10 w/v) using a sterile mortar and pestle in sample extraction buffer (PBS-T and 2 % PVP-Serva) and 200 µl were loaded into each test well. The plates were incubated overnight at 4 ˚C and thereafter washed with PBS-T as described above. The anti-virus conjugate (IgG-AP) was diluted in conjugate buffer (PBS-T, 2% Polyvinyl Pyrrolidone (PVP-40) and 0.2 % egg albumin, Sigma A-5253) at 1:500 and 200 µl was added into each well. The plates were incubated at 37 ˚C for 4 h, and thereafter washed with PBS-T as earlier described. Freshly prepared substrate aliquots (10 mg p-nitrophenyl phosphate [Sigma, Fluka] dissolved in 10 ml of substrate buffer [97 ml diethanolamine, 0.2 g NaN_3, 600 ml H_2O, pH 9.8]) was added to each well (200 µl/well). The plate then incubated at room temperature for 60 minutes for visual observation. Finally, the plates were read using Uniequip ELISA plate reader at $A_{405\ nm}$ absorbance. Readings twice the values of the healthy control were considered as positive.

Data analysis

The results obtained from the ELISA Plate reader were compared with that of healthy control as per standard. Readings twice than the average values of the healthy control (significant difference) were considered positive for the virus.

RESULTS AND DISCUSSION

Thirty weed samples from Kaduna and Kano States, belonging to three plant families were tested against SCMV antisera for the presence of viruses. Two out of the thirty (6.67 %) of the weeds both from Wudil Local Government Area, Kano State were positive for SCMV. ELISA result revealed two weed species *P. purpereum* (60 %) and *Digitaria exilis* (66.7 %)., both from the family Poaceae, as wild hosts of *Sugarcane Mosaic Virus* (SCMV), out of 13 weed species tested (Table 1). Plant viruses infect cultivated crops from several sources such as weeds and seeds. Weed grasses serve as reservoir for both viruses and their vectors (Duffus 1971; Narayana *et al*., 2002; Kazinczi *et al*., 2004). It was earlier stated by Shukla *et al*. (1994) and Almeida *et al*. (2000) that the members of the genus Potyvirus infect several cultivated and weed species of the family Poaceae. *P. purpereum* and *D. Exilis*, both belonging to the family Poaceae, were identified as host of *Sugarcane Mosaic Virus* in this investigation. This is in line with what was found by Yasmin *et al*. (2011), where other weeds from the same family were identified as hosts of *Sugarcane Mosaic Virus* in Pakistan. This also confirmed the finding by Koike (1970) and Shah (1994) that the host range of *Sugarcane Mosaic Virus* is restricted to the family Poaceae, as the other weed flora from the families Asteraceae and Cyperaceae tested against the SCMV antiserum, found to be free of the virus and contradicted the finding of Yahaya *et al*. (2014) where a broad leaf crop, *Capsicum annum* was found to harbour SCMV. The identified weeds, *P. purpureum* and *D. exilis* can harbour the viruses during growing season and serve as sources of inocula for secondary spread (Rosenkranz, 1980). These identified weed hosts were abundant in all the locations visited during the course of the survey. They were collected from about 85 % of the locations visited during the survey and had an occurrence of 25 % of the total number of weeds tested against SCMV.

Table 1: Weed species tested against antisera of *Sugarcane mosaic virus* infecting sorghum in Kaduna and Kano States, Nigeria

Family and species of weed	Number of samples tested	Number of *Sugarcane mosaic virus* positive samples	% Positive samples
	Poaceae		
Dactyloctenium aegyptium (L.) Willd	5	-	0
Pennisetum purpureum Schumach	5	3	60
Acrocera zizanioides Dandy	1	-	0
Eleusine indica Gaertn	3	-	0
*Digitaria exilis (*Kippist) Stapf	6	4	66.7
Chloris gayana Kunth	1	-	0
Pennisetum pedicellatum Trin.	1	-	0
Perotis indica (Linn.) Kuntze	2	-	0
Setaria pallide-fusca (Schum.) Stapf and Hubbard	1	-	0
	Cyperaceae		
Kylinga pumila Michaux	1	-	0
Cyperus rotundus Linn.	1	-	0
	Asteraceae		
Guizotia scabra (Vis.) Chiov.	1	-	0
	28	7	25

0- means no virus detection

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