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Survey of incidence and severity of Sugarcane Mosaic Disease of sorghum in Kwara State of Nigeria

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Abstract

A preliminary survey was carried out to determine the incidence and severity of Sugarcane Mosaic Disease of sorghum in three senatorial districts of Kwara State. The survey results showed that Kwara North had the highest percentages of 47.3% and 63.3% for severity and incidence, respectively of Sugarcane Mosaic Disease. This was followed by Kwara South (28.3% and 42.5%) while, Kwara Central (23.2% and 26.7%) had the lowest severity and incidence of the disease. Two varieties of sorghum were then cultivated in cropping system each as a sole crop and intercropped with cowpea and then monitored for the development of Sugarcane Mosaic Disease over 5 weeks after planting. Symptom expression both in terms of incidence and severity of the disease varied among each treatment combination. Severity of Sugarcane Mosaic Disease was observed to be more on plants planted solely for both varieties. Varietal differences also affected incidence and severity of the disease as the local sorghum variety suffered more severe symptoms of the disease, especially at the latter stage of development, though the improved variety showed symptoms of the disease more rapidly at the initial stage of development. This study showed that sugarcane mosaic disease of sorghum occurs in Kwara State with varying incidence and severity across the senatorial zones. The use of tolerant varieties and intercropping sorghum with cowpea could be effective in suppressing the severity of Sugarcane Mosaic Disease in sorghum.

Key words: Incidence, Intercrop, Severity, Sole Crop, Sorghum, Sugarcane Mosaic Disease,

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Introduction

Sorghum (*Sorghum bicolor* (L.) Moench) is the fifth most important cereal crop grown by small farmers in the semi arid tropics and is an important food crop for larger section of people in Asia and Africa and also a good source of fodder for cattle (Rachie, 1970). It is also used as an agro based industrial crop to prepare syrup, ethanol production, beer, and biscuits. It is cultivated on over an area of 43.5 million hectares in the world producing 55.8 million tonnes of grain with a productivity of 1.3 t/ha (Seetharama *et al.*, 2005).

Like other plants in the family Poaceae, sorghum is a susceptible host to various diseases that infect this crop and cause significant losses. For example, foliar diseases are widely distributed and occur in almost all sorghum growing areas of the world (Ngugi *et al.*, 2002). Viral diseases have been a great threat to sorghum production in times past, and this has lead to consequent yield and monetary loss to sorghum farmers. Sugarcane Mosaic Virus causes systemic infection in sorghum and sugarcane. The

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symptoms (mosaic and/or necrosis) are observed on the leaves and sometimes the stems of infected plants. The classical symptoms however in sorghum, are contrasting shades of green on a background of paler green to yellow chlorotic areas. Sometimes yellow stripes and/or necrosis occur. The particular symptoms depend on the virus strain, the host cultivar and the environmental conditions, particularly temperature (Koike and Gillaspie, 1989).

In a survey of cowpea viruses in the ecological zones of Kwara State - Nigeria, Aliyu *et al* (2012), confirmed the prevalence of viruses with damaging prospects to cowpea and other crops. The need was then suggested for regular disease surveys to identify new and emerging viruses for the deployment of effective control mechanisms. Cultural practices such as varietal differences, planting populations and intercropping have been found effective in the control of viral diseases in cowpea (Aliyu and Balogun, 2011; Aliyu and Balogun, 2012).

The objective of this study was to survey the incidence and severity of sugarcane mosaic virus of sorghum and evaluate the effectiveness of intercropping as a possible cultural control method.

Materials and Methods

Survey Site and Survey process

The survey was carried out in the three Senatorial zones of Kwara State: Kwara North, Kwara Central and Kwara South. In each Senatorial zone, 3 Local Government Areas (10 farms per local Government Area) where sorghum was cultivated were chosen. Kwara North (Edu, Lafiagi and Patigi L.G.As); Kwara South (Ifelodun, Irepodun, and Oyun L.G.As); Kwara Central (Ilorin East, Asa and Moro L.G.As). Twenty (20) sorghum plants were randomly sampled per location for Sugarcane mosaic virus disease symptoms by walking across a "W" shaped path in a field, with 5 plants per side spaced at an equal distance from each other. Data collected at survey sites were (a) number of healthy and diseased plants (b) number of healthy and diseased leaves per plant. The percentage incidence and severity of the disease was estimated by:

(1) Percentage incidence =

$$\frac{\text{Number of infected plants (symptomatic plants)}}{\text{Plants sampled (20)}} \times 100\%$$

(2) Percentage severity =

$$\frac{\text{Number of diseased leaves per plant}}{\text{Total number of leaves per plant}} \times 100\%$$

Planting Operations and Layout

A split-plot treatment fitted into a Randomized Complete Block Design experiment with 3 replications was established with each replicate being 15m long x 13m wide. Sorghum varieties Short Kaura, and Local were obtained from the National Seed Service – Ilorin, while the cowpea variety (Ife-brown) used for intercropping, was obtained from IITA Ibadan, Nigeria. The planting density of 75cm x 25cm (106,666 plants/ha) was observed for the sole and intercropped plots with all other standard agronomic practices observed. Data were collected on weekly basis (for sorghum plants only) for 5 weeks and beginning from the 4th week after planting on the following parameters: (a) Plant height (b) number of leaves (c) number of leaves showing mosaic symptoms.

All Data collected in the course of the study were subjected to Analysis of Variance (ANOVA). The Least Significant Difference (LSD) was used for separation of significantly different means at P=0.05.

Results

Survey

Table 1 shows the results of analysis of the survey for the incidence and severity of Sugarcane Mosaic Disease (SCMD) of sorghum in 3 senatorial districts of Kwara State. The results show that there were significant differences in the average percentage incidence and severity of SCMD. As regards percentage severity, the

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significantly highest percentage was in Kwara North which ranged up to 47.3%, followed by Kwara South (28.4%) and Kwara Central (23.2%). Likewise, in terms of incidence of SCMD, it was again the significantly highest in Kwara North (63.3%), lowest in Kwara Central (26.7%) and with a mid-value mark of 42.5% in Kwara South.

Percentage severity of sugarcane mosaic disease

Table 2 shows the effect of variety and cropping system on the percentage severity of sugarcane mosaic disease on sorghum at different weeks after planting (WAP). The Table indicates that although the short kaura variety had higher percentage disease severity form the 3rd to 5th WAP, the differences were not significant. The cropping system analysis also showed that intercropping reduced the severity of the disease, but this reduction was only of significant value at the 4WAP, whereby the intercropping system had 10% disease severity and sole cropping 33%. The Table also indicates that the combination effect of variety and cropping system was of significant effect in the 4thand 5th WAP. The short kaura variety intercropped with cowpea was the least susceptible variety with the significantly lowest disease severity at 4WAP (10%) and 5WAP (18.3%). The sole cropped local variety was the most susceptible with percentage severity values of 39.3% and 43.7% respectively.

Mean Plant Height

Table 3 shows the effect of variety and cropping systems on the mean plant height of sorghum at different weeks after planting (WAP). On varietal basis, the local sorghum variety had the tallest plants although not significantly different from the short kaura variety at the 1st, 2nd , 3rd and 5th WAP. However, there was significant difference in height at the 4WAP between the local variety (58.3cm) and short kaura (50.8cm). Cropping system analysis showed that there were significant differences in plant heights from 1st to the 5th WAP. The sole cropped sorghum produced the significantly tallest plants. For instance at 5WAP, the sole and intercropped sorghum plants had mean height of 71.7cm and 51.6cm respectively.

Mean Number of Leaves

Table 2 shows the effect of variety, cropping systems and the combination effect of the factors on the number of leaves of sorghum at different weeks after planting. The Table indicates that varietal effect was highly significant. The short kaura variety consistently produced the significantly highest mean number of leaves from the 1WAP(4.8) to the 5WAP(5.7), although the values were not significantly different at 4WAP. The values for the combination effect of variety and cropping system were also significantly different from each other. The sole cropped short kaura and local sorghum varieties consistently produced the significantly highest mean number of leaves compared with the other treatment combinations.

Discussion and conclusion

Cereal crops are affected by at least 20 viruses causing various estimated losses. Timian and Sisler (1955), reported *Barley false Stripe virus* (BFSV), to occur in 93% of barley field examined in North Davota. It was established that the inherent difference in the susceptibility and tolerance to BFSV depended on variety.

In the course of the present survey it was observed that different sorghum varieties were planted across the senatorial districts. While the local variety was preferred in Kwara North, in Kwara Central and Kwara South, the exotic (hybrid) variety was mostly planted. Thresh and Cooter (2005), had opined that the incidence and severity of Cassava mosaic disease (CMD) caused by whitefly borne viruses of the genus *Begomovirus* (family *Geminiviridae*), in a susceptible cassava variety is higher than in resistant varieties. It could therefore be affirmed that the high prevalence of SCMD in Kwara North is because the sorghum variety planted was highly susceptible to Sugarcane Mosaic Virus (SCMV).

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The variations in the susceptibilities and resistance between the varieties could be due to differences in their genetic makeup and this has also been observed by Sharma and Franzanmann (2000) to be as a result of superior inherent resistance to disease attack. The resistant varieties may contain one or more resistant gene(s) which allow them to withstand the deleterious effect of the pathogen. The use of intercrops is considered to be one of the main plant protection practices reducing disease damage. Hence, it can be inferred that the presence of cowpea in the intercrop system helped reduce the incidence of sugarcane mosaic disease on sorghum. This might be because cowpea in the intercrop serves as a distraction /alternative for the aphid vectors of sugarcane mosaic virus. A similar result on the effect of cropping system on cowpea virus was reported by Boudreau (1993) and Umaru *et al.*(2003), who reported that there was decrease in aphid infestation in intercropped systems.

The combination effect of variety and cropping system indicated that irrespective of variety used, sole cropping produced significantly taller plants compared with intercropping. Thippeswamy and Alagundagi (2001), reported that higher plant height was recorded in sorghum intercropped with bean over the sole crop. The seeming abnormality in this study, in which sole crops dwarfed intercropped may have stemmed from the fact that the plants were still young and if the plants were monitored further into later stage of growth the situation could have changed.This finding does not corroborate that of Desir and Pinchinat (1976), who reported that there was no significant difference between mixed or sole crops in terms of plant height. The reduced number of leaves noticed on short kaura at 5 WAP and on the local variety at 4 WAP might have been due to the onset of the disease symptoms, causing some of the leaves to wilt and fall off. This result is in agreement with the finding of Singh (1981).

It can be concluded from this study that sugarcane mosaic disease of sorghum occurs in Kwara State with varying incidence and severity across the senatorial zones. Varietal difference, type of cropping system such as intercropping should be considered as a control measure for sugarcane mosaic disease on sorghum.

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Table 1: Average percentage severity and incidence of Sugarcane mosaic disease in Kwara State

LOCATION	PERCENTAGE SEVERITY	PERCENTAGE INCIDENCE
Kwara Central	23.2[b]	26.7[c]
Kwara North	47.3[a]	63.3[a]
Kwara South	28.4[b]	42.5[b]
S.E.M	6.14	6.25
L.S.D	19.47	19.69

Means with the same letter on the same row are not significantly (P≤ 0.05) different using LSD

Table 2: Effect of variety and cropping system on Percentage Severity of Sugarcane Mosaic Disease of sorghum at different weeks after planting (WAP)

VARIETY	1WAP	2WAP	3WAP	4WAP	5WAP
SK	0.00	0.00	8.3	24.6	19.8
LV	0.00	0.00	9.2	18.3	23.3
SEM	0.000	0.000	3.33	6.22	6.18
LSD	0.000	0.000	9.83	18.34	18.24
			NS	NS	NS
CRS					
SC	0.00	0.00	10.0	33.0[a]	26.5
IC	0.00	0.00	7.5	10.0[b]	16.7
SEM	0.000	0.000	3.33	6.22	6.18
LSD	0.000	0.000	9.83	18.34	18.24
			NS		NS
VAR X CRS					
SK X SC	0.00	0.00	7.5	26.7[b]	32.3[b]
SK X IC	0.00	0.00	4.2	10.0[c]	18.3[c]
LV X SC	0.00	0.00	12.5	39.3[a]	43.7[a]
LV X IC	0.00	0.00	10.8	13.0[c]	20.0[c]
			NS		
SEM	0.000	0.000	4.71	8.79	8.74
LSD	0.000	0.000	13.90	15.9	25.80

Means with the same letter on the same row are not significantly (P≤ 0.05) different using LSD

Key: SK=Short Kaura, LV=local variety, **CRS**= Cropping system, SC= sole cropped sorghum, IC= intercropped sorghum, SK X SC= Short kaura in sole cropping, SK X IC= Short kaura intercropped with cowpea, LV X SS= local variety sole cropped, LV X IC = local variety intercropped with cowpea, NS=Not significant

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Table 3: Effect of variety and cropping system on plant height of sorghum at different weeks after planting (WAP)

VAR	1WAP	2WAP	3WAP	4WAP	5WAP
SK	24.7	33.8	45.9	50.8[b]	58.3
LV	25.8	36.1	51.3	58.3[a]	65.0
SEM	1.231	1.442	2.112	2.296	2.427
LSD	3.631	4.271	6.402	6.766	7.153
	NS	NS	NS		NS
CRS					
SC	34.1[a]	44.5[a]	61.6[a]	66.0[a]	71.7[a]
IC	16.4[b]	25.4[b]	35.6[b]	43.1[b]	51.6[b]
SEM	1.233	1.403	2.284	2.291	2.420
LSD	3.63	4.27	6.42	6.76	7.15
VAR X CRS					
SK X SC	33.8[a]	44.0[a]	56.3[a]	60.7[a]	66.2[a]
SK X IC	15.5[b]	23.6[b]	35.6[b]	40.8[b]	50.4[b]
LV X SC	34.3[a]	45.0[a]	67.0[a]	71.3[a]	77.3[a]
LV X IC	17.2[b]	27.2[b]	35.6[b]	40.8[b]	50.4[b]
SEM	5.14	6.03	9.08	9.57	10.11

Means with the same letter on the same row are not significantly (P≤ 0.05) different using LSD

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Table 4: Effect of variety and cropping system on number of leaves of sorghum at different weeks after planting (WAP)

VARIETY	1WAP	2WAP	3WAP	4WAP	5WAP
SK	4.1	4.3	4.6	5.3	5.2
LV	4.2	4.3	5.4	5.1	5.2
SEM	0.184	0.144	0.324	0.316	0.261
LSD	0.544	0.426	0.955	0.933	0.770
	NS	NS	NS	NS	NS
CRS					
SC	4.8[a]	4.7[a]	5.5[a]	5.6	5.7a
IC	3.5[b]	3.9[b]	4.5[b]	4.8	4.7b
SEM	0.184	0.144	0.324	0.316	0.261
LSD	0.544	0.426	0.955	0.933	0.770
				NS	
VAR X CRS					
SK X SC	4.6[a]	4.6[a]	4.8[a]	5.6[a]	5.8[a]
SK X IC	3.6[b]	4.0[b]	4.5[a]	5.0[a]	4.6[b]
LV X SC	5.0[a]	4.8[a]	6.3[a]	5.6[a]	5.6[c]
LV X IC	3.5[b]	3.8[b]	4.5[b]	4.6[a]	4.8[c]
SEM	0.261	0.204	0.458	0.447	0.369
LSD	0.770	0.602	1.351	1.319	1.08

Means with the same letter on the same row are not significantly (P≤ 0.05) different using LSD

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