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SURVEY ON INCIDENCE AND SEVERITY OF MAIZE STREAK VIRUS (MSV) IN TSANYAWA LOCAL GOVERNMENT AREA OF KANO STATE, NIGERIA

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ABSTRACT
A survey study was conducted covering eight villages in Tsanyawa local government area of Kano state, the study evaluated the incidence and severity of Maize streak virus disease and identify the period of time with high incidence of the virus disease Eight villages were randomly selected and three maize farms in each village were visited. Fifteen maize plants with MSV disease symptoms were assessed during the survey. The result showed that Disease incidence ranges from 11.57 to 34.18 % in July with 26.02 to 42.72 % in August. The disease incidence of 35.77 % was recorded in Kwandawa ward during first survey carried out in July and least incidence (11. 88 %) was recorded in Tsanyawa ward. Disease severity on the other hand was mild (1.7) during the first survey. Highest and the least incidence of MSV disease were recorded in August during second survey at same places (Kwandawa and Tsanyawa wards) with 42.72 and 26.02 % respectively, the MSV disease attained severe stage (4.6) in same time of survey. The result showed that there were significant differences in incidence and severity of MSV disease across the study areas. The highest incidence and severity of MSV disease was recorded in August. Therefore is the need for an implementation of some cultural practices and other virus disease control measures for an increase of maize production in the study areas.

Keywords: Survey, Incidence, Severity, Maize streak, Virus

INTRODUCTION

Maize is an important staple food crop and provides bulk of raw materials for the livestock and many agro-allied industries in the world (Khawar *et al*., 2007). It is the third most important grain crop in the world after wheat and rice (United State Department of Agriculture (USDA) and Foreign Agricultural Service (FAS) Grain, "Zea production maps and statistics," 2010). Maize is of significant importance for developing countries like Nigeria, where rapid increase in population have already out stripped the available food supplies in which maize serve to ameliorate due to its high productivity and diversified use (Pratt *et al*., 2003). More maize is produced annually than any other grain (Ogunsumi *et al*., 2005). It belongs to the grass family *Poaceae*, sub-family *Panicoideae*, Tribe *Maydeae*, genus *Zea* and specie *mays* (Brunt, *et al*., 1990). It is a tall annual plant with an extensive fibrous root system. It is a cross pollinating species, with the female (ear) and male (tassel) flowers in separate places on the plant (Grings *et al*., 2013). Average worldwide production of maize is 785 million tons, with the largest producer, the United States, producing 42 %. Africa produces 6.5 % and the largest African producer is Nigeria with nearly 8 million tons, followed by South Africa. Africa imports 28 % of the required maize from countries outside the continent. Even though maize is a crucial staple food crop, the average yield per hectare in Africa is the lowest in the world (FAO, 2010).

Furthermore, the central role of maize as a staple food in sub Saharan Africa (SSA) is comparable to that of rice or wheat in Asia, with consumption rates being the highest in eastern and southern Africa (ESA), of the 22 countries in the world where maize forms the highest percentage of calorie intake in the national diet, 16 are in Africa (Seck *et al*., 2013).

The worldwide average maize yield per hectare is about 4 tons, but in Africa it is 1.7 tons, less than half the global average (FAO, 2010). African yields are clearly far below the crop's genetic capacity, due to lack of access to modern farming techniques and maize pathogen epidemics (Fajemisin, *et al*., 1986). Among the viral pathogen infecting maize, the leafhopper-vectored maize *streak virus* (MSV; family *Geminiviridae*, Genus *Mastrevirus*) considered the most important and widespread (Bosque-Perez, 2000). In epidemic years, maize streak disease (MSD) can result in up to 100 % yield losses (Wambugu and Wafulu, 1999). In Nigeria, in areas where incidence of MSD is higher, maize field planted later than others may become severely infected, and planting in the second season may be devastated. In such areas farmers know from experience not plant a second season crop due to expected damage from MSVD (Soto and Buddenhagen 1980). Maize streak virus disease epidemics were also reported in Nigeria in 1971, 1973, 1976 (Effrom *et al.*, 1989). It is therefore important to keep on carrying research on the maize streak virus disease incidence level at various corners across Nigeria especially in places where maize production is receiving a remarkable increase. This will undoubtedly help in giving protection to the crop plant in a way that will bring about an increased production of maize in the most sustainable manner for a better output and to improve the well-being of the maize farmers of the study area. The study is to determine the incidence and severity of maize streak virus, and also identify the period of time with high maize streak virus disease in the study areas.

MATERIALS AND METHODS

The study was conducted in Tsanyawa is a local government area in Kano state, Nigeria. Its head quarter is in town of Tsanyawa. It's located on 12˚18′ N and 7˚59′ N latitude and longitude respectively (NIPOST, 2009). The average annual temperature of Tsanyawa is 23.5˚C and the rainfall averages is 758 mm. The study areas are; Kwandawa, Yanchibi, Kabagiwa, Zarogi, Gurun, Gozarki, Dumbulun and Tsanyawa village heads/wards in Tsanyawa local government.

The survey method involves the use of village head town/ward. There are ten (10) wards in Tsanyawa local government out of which eight (08) wards were selected at random. In each ward three (03) farmer's maize fields were selected making twenty four (24) fields, and in each field fifteen (15) maize plants with maize streak virus disease symptoms were assessed for the survey. The total number of three hundred and sixty (360) maize plants were assessed in the entire twenty four (24) fields.

The maize farms were surveyed at diagonal with 500 meter (0.5 km) distant apart along accessible road. And in each farm a measured area were demarked at the center of the farm in proportion that fifteen (15) maize plants with maize streak virus disease symptoms will be obtain within the demarcated areas. The survey was conducted twice in the same raining season of the year 2018, on mid-July and mid-August. The same field and areas were maintained for the first and the second survey to estimate incidence and severity of maize streak virus disease (MSD). Incidence and severity of the viral disease were estimated based on symptoms, While the severity of infection will be calculated using the disease ranking scale of 1to 5; in which 1= no symptom, 2= mild, 3= moderate, 4= severe, and 5= very severe of disease conditions.

The incidence was assessed by carefully examining the leaves from the upper surface of the leaves to the lower part. In each farmer's field 15 maize plants were selected based on the show symptoms in the measured or the demarcated areas for each field. The total number of maize plants population was counted and recorded.

The incidence of each field was then calculated by the relation below;

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

Whereas, the Maize streak virus disease damage was assessed and recorded using the disease severity scale of 1 to 5 where, scale 1 = no symptom, 2 = mild, 3 = moderate, 4 = severe and 5 = very severe. This scale was modified from the Mohammed *et al*., 2016 which used a 1 to 5 scale containing ranges from 0 to 100 percent leaf area diseased categories.

Data transformation was conducted before analysis of variance to ensures data quality and increases the accuracy of predictions and stronger insights (Tabachnick and fidell 2001).

All data collected were subjected to analysis of variance (ANOVA) using GenStat version 17.1 and means were separated using fisher's protected least significant difference test at 5 % level of significance ($P \leq 0.05$).

RESULTS

The result of cropping pattern in the study areas was shown on Table 1. The table indicated that the dominant cropping pattern in Kwandawa, Kabagiwa and Yanchibi is solely maize crop (sole cropping), while Dumbulun, Gozarki, Gurun, Zarogi and Tsanyawa were cultivating maize in combine with mixed cropping.

Table 1: Cropping history of eight villages in the study area.

Locations	Cropping patterns	Age of the crop at first survey (week)	Age of the crop at second survey (week)
Kwandawa	Sole cropping	5.3	9.3
Dumbulun	Mixed cropping	5.0	9.0
Gozarki	Mixed cropping	5.3	9.3
Gurun	Mixed cropping	5.6	9.6
Kabagiwa	Sole cropping	5.6	9.6
Yanchibi	Sole cropping	5.3	9.3
Zarogi	Mixed cropping	5.3	9.3
Tsanyawa	Mixed cropping	5.6	9.6

Result on the incidence of MSV on maize plant at first survey before data transformation was shown on Table 2. The result showed that MSV incidence was found to be highest (34.18 %) at Kwandawa ward, followed by Yanchibi ward (23.91 %) while the lowest disease incidence was recorded at Tsanyawa (11.57 %) and Dumbulun wards (16.29 %). There is no statistical difference at $P \leq 0.05$ between Gurun and Gozarki wards which recorded moderate level of disease incidences.

The disease severity of MSV on the other hand was shown to be the highest (4.16) at Kwandawa ward followed by Dumbulun (3.23) while Tsanyawa ward recorded the least disease severity (1.73). There is no statically differences at $P \leq 0.05$ level of significance between five other wards during the first survey before data transformation.

Table 2: Means of Disease Incidence and Severity of MSV at First Survey before Data Transformation.

Locations	Disease incidence	Disease severity
Kwandawa	34.18^{a}	4.16^{a}
Yanchibi	23.91^{b}	2.50^{b}
Kabagiwa	21.52^{bc}	2.53^{b}
Zarogi	20.46^{bcd}	2.44^{b}
Gurun	19.50^{cd}	2.59^{b}
Gozarki	18.88^{cd}	2.87^{b}
Dumbulun	16.29^{d}	3.23^{ab}
Tsanyawa	11.57^{e}	1.73^{c}
S.E	1.4	0.2
E.S.E	1.05	0.18
LSD	3.20	0.34
Coefficient value (CV) %	8.8	11.1

Means with superscript of same letters within columns are significantly similar at P≤ 0.05 level of significance using fisher's protected least significant difference test.

The Results of incidence and severity of MSV of the study areas on first survey after data transformation was shown on table 3. The result indicated that, the incidence was highest at Kwandawa (35.72 %) followed by Yanchibi (29.25 %) wards. Tsanyawa ward recorded the least disease incidence (19.88 %) with slight difference with that of Dumbulun (23.80 %) ward. There are no significant differences between Kabagiwa and Gurun wards, and also between Gurun and Gozarki wards at P≤ 0.05 level of significance difference

The disease severity Table 3 showed that Kwandawa ward recorded the highest severity (2.04) level, while Tsanyawa ward recorded the least MSV disease severity (1.32). There are no differences between the six other wards at P≤ 0.05.

Table 3: Means of Disease Incidence and Severity of MSV at First Survey after Data Transformation.

Location	Disease incidence	Disease severity
Kwandawa	35.77^{a}	2.04^{a}
Yanchibi	29.25^{b}	1.58^{b}
Kabagiwa	27.61^{bc}	1.60^{b}
Zarogi	26.88^{bc}	1.56^{b}
Gurun	26.20^{cd}	1.61^{b}
Gozarki	25.74^{cd}	1.69^{b}
Dumbulun	23.80^{d}	1.79^{b}
Tsanyawa	19.88^{e}	1.32^{c}
S.E	1.0	0.06
E.S.E	0.73	0.05
L.S.D	2.21	0.16
Coefficient value (CV) %	4.7	5.5

Means with superscript of same letters within columns are significantly similar at P≤ 0.05 level of significance using fisher's protected least significant difference test.

Result of MSV disease incidence and severity in the study areas was shown on Table 4. The incidence was high at Kwandawa (42.72 %), followed by Yanchibi wards. Tsanyawa ward was low the lowest (26.02 %) there is no statistical difference between Dumbulun and Gozarki wards. MSV severity was highest at Kwandawa ward (4.60) then Kabagiwa (3.73) and Yanchibi (3.72) wards while Tsanyawa ward recorded the least (26.02) disease severity of MSV.

Table 4: Means of Disease Incidence and Severity of MSV at Second Survey before Data Transformation.

Location	Disease incidence	Disease severity
Kwandawa	42.72^{a}	4.60^{a}
Dumbulun	31.55^{cd}	3.20^{bc}
Gozarki	34.49^{bcd}	3.60^{bc}
Gurun	30.56^{d}	2.89^{c}
Kabagiwa	31.42^{cd}	3.73^{b}
Yanchibi	35.47^{b}	3.72^{b}
Zarogi	33.92^{bc}	3.36^{bc}
Tsanyawa	26.02^{e}	2.02^{d}
S.E	2.2	0.31
E.S.E.	1.69	0.18
L.S.D	5.12	0.55
Coefficient value (CV) %	9.6	9.2

Means with superscript of same letters within columns are significantly similar at $P \leq 0.05$ level of significance using fisher's protected least significant difference test.

The Table 5 result showed that Kwandawa ward has the highest disease incidence (40.81 %) followed by Yanchibi (36.55 %) and then Gurun ward (30.56%). Tsanyawa ward recorded the least disease incidence (26.02 %). The disease severity was highest at Kwandawa ward (2.15), followed by Kabagiwa (1.93) and Yanchibi (1.93) wards with no statistical difference at Tsanyawa ward recorded the least (1.42) severity .

Table 5: Mean disease incidence and severity of MSV to maize plant at second survey after transformation.

Location	Disease incidence	Disease severity
Kwandawa	40.81^{a}	2.15^{a}
Dumbulun	31.55^{cd}	1.79^{bc}
Gozarki	34.49^{bcd}	1.90^{bc}
Gurun	30.56^{d}	1.70^{c}
Kabagiwa	31.42^{cd}	1.93^{b}
Yanchibi	35.47^{b}	1.93^{b}
Zarogi	33.92^{bc}	1.83^{bc}
Tsanyawa	26.02^{e}	1.42^{d}
S.E	1.5	0.31
E.S.E.	1.11	0.18
L.S.D	3.36	0.55
Coefficient value (CV) %	5.8	9.2

Means with superscript of same letters within columns are significantly similar at $P \leq 0.05$ level of significance using fisher's protected least significant difference test.

DISCUSSION

The results of the survey study have shown the level of incidence and severity of MSV in the study areas. The study indicated the occurrence of MSV in the study areas through symptoms observation and recorded the means incidence and severity during first and second survey as. Majority of the farmers in the study areas are small holders which hardly change their seeds or planting materials over season due to inadequate agricultural extension services, finance, improved seeds, and technical knowhow on agriculture. Similar finding was reported by Kumari (2012).

More so the farmers cultivated cereals crops which are mostly serve as the alternative hosts and reservoir of MSV vectors (leafhoppers) (Atiri *et al.,* 2003). They are present in wild and posture throughout the year but can migrate in large numbers to maize field. Beside maize MSV infected other crops such as Rice, Wheat, Oats, Barley, Rye, Finger millet, Pear millet, Sorghum and Sugarcanes (Van Antwerpen *et al.*, 2011).

Another reason that attributed to this MSV incidence is that the farmers do not have knowledge about the disease, some don't even think of it as a disease that worth a control management, neither the disease nor the leafhoppers that vectored it. This is what gives the disease a chance of spreading spatially.

MSV incidence and severity is highest at Kwandawa, ward this might be due to the fact that the wards were cultivating maize crop mostly in sole cropping without inter cropping with other crops and hence this give the disease a barrier free to spread across the field. Intercropping is a better alternative to crop rotation in managing MSV (Atiri *et al.,* 2003). Farmers can grow cereals food crops intercropped with legumes and cucurbits. In some wards maize are inter cropped with other crops especially legumes have relative low incidence and severity.

The pattern of increase in the MSV incidence and severity from the time of first survey (July) and the second survey (August) could be attributed to the differences in weather variable between the months which directly affect the vectors of the disease. The ecology and the epidemiology of MSV disease depend entirely on the movement of its vectors species. The life cycle of these vectors depend on temperature and rainfall (Brunt *et al.,* 1990) there can be five to nine generation of leafhoppers per year depending on temperature and rainfall. More eggs are laid at high temperature and during the wet season or irrigated crops this is why there is high MSV incidence and severity in the month of August due to high temperature and relative humidity, while the incidence and severity is low at the month of July.

CONCLUSION

The survey study was conducted at Tsanyawa local government area of Kano state to study the incidence and severity of MSV disease and the period of high incidence during the rainy season. MSV disease remains an important disease in Tsanyawa local government area in spite no major widely reported epidemics have occurred in recent time. With climate change, growing of susceptible traditional maize variety and inadequate agricultural extension services, it is most likely that the next major epidemic is just around the corner. In the meantime an integrated approach to MSV management is the best way of dealing with the disease.

RECOMMENDATION

Based on the finding from the survey outcome a number of key recommendations are provided below:

i. The high incidence of the MSV disease in the survey areas need an urgent intervention by government and other agricultural organizations including NGOs, so as to prevent the occurring of an epidemic of the disease.

ii. Agricultural extension workers should strengthen their efforts toward educating farmers on seed selection that are prove to be resistant to endemic diseases in the region.

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