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Incidence, Symptom Severity of *Pepper Venial Mottle Virus Disease* (PVMVD) and Green Peach Aphid (*Myzus persicae*) Population on Pepper (*Capsicum annum)* in Aliero Local Government Area of Kebbi State

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Abstract

Pepper venial mottle virus is primarily transmitted by Aphids, particularly the green peach Aphid. Transmission occurs through feeding on the infested pepper plant by this Insect. A field research was conducted during 2020/2021 dry season in Aliero Local Government of Kebbi State to assess the incidence, severity of (*PVMVD*) and Aphid population on pepper in selected pepper growing villages of Aliero LGA. Thirty (30) pepper plants were randomly assessed for disease incidence and severity. Aphids were also counted on the same thirty (30) pepper plants sampled on five randomly selected epical leaves of each plant. Data generated were subjected to Statistical Analysis using Statistical Package for Social Science (SPSS) software version 2020. Results indicated that, there was significant (P = 0.05) differences on disease incidence, disease severity and Aphid population among the selected pepper growing areas. Gumbulu Town had the highest mean disease incidence of (43.34 %), followed by Jiga-Birni (28.33%), Aliero Town (21.67%) and Kali village recorded the least (20.5%). Kali and Gumbulu revealed same mean disease severity of (2.0%), followed by Aliero Town (1.75%), while the lowest was obtained in Jiga-Birni (1.55%). There was a significant variation on the Aphid population, with Gumbulu Town having the mean Aphid population per leaf of (10.45) which was significantly higher than that of Kali (8.29), the least was observed in Jiga-Birni and Aliero Towns (4.64 and 4.17) per leaf respectively. This study concluded that there is occurrence of (*PVMV*) and its Aphid vector in the study area.

Keywords: Aphids, Incidence, Pepper, Aphid, Virus, Severity, Population.

Introduction

Peppers (*Capsicum annum*) are members of the *Solanaceae* family, characterized by their diversed flavour and pungency. A range of varieties are grown and sold bothfresh in the markets or processed. These include varieties that are mild in flavour and those that have varying levels of pungency (Baramidze *et al*., 2015). Pepper is a high value crop that is grown for cash by farmers all over the world. Peppers whether fresh,

dried or processed, are important farm produce in our daily diet and can be found in all local markets in Africa. Production of peppers in Africa is estimated to be 4.88 million ton cultivated on 463,937 ha of land (FAO, 2018); in West Africa, the total production is 864,260 ton cultivated on 158,452 ha. Nigeria is known to be one of the major producers of pepper in the world accounting for about 50% of the African production (FAO, 2018). In recent years, interest and demand for peppers has increased dramatically worldwide and peppers have achieved major economic significance in the global market (Mohammed *et al*., 2015). Apart from the potentials of these commodities to generate foreign exchange to Nigeria, their common use as confectionaries, medicinal or culinary purpose is also on the increase. Peppers are used both as pungent or condiment for culinary purposes, for domestic catering and by the food processing industries. The moderate pungency of the Nigerian Chili Peppers allows its use for the production of spices, blends and used as red pepper. Industrial users also require the moderately pungent Chilies (Nigerian type) for use in the pharmaceutical industries (Mohammed *et al*., 2015).

Aphids are the most important group that vectored viruses in the tropical and temperate regions, as they can transmit a large number of these different viruses (Dijkstra and de Jager, 1998). Aphid transmission may be non-persistent, semi-persistent or persistent. The genus *Potyvirus* of which *Pepper Venial Mottle Virus* (PVMV) is a member are the largest group of plant infecting RNA viruses that cause significant losses in a wide range of crops across the globe. The majority of the viruses in the genus *Potyvirus* are transmitted by aphids in a non-persistent, non-circulative manner and extensively studied visa-a-vis their structures, taxonomy, evolution, diagnosis, transmission and the molecular interactions with their hosts (Gadhave *et al*., 2020).

Pepper Venial Mottle Virus is one of the most serious viral diseases of peppers in Nigeria and causes significant yield losses on pepper plants. Pepper farmers have been using various insecticides in the management of the vector (Aphids) which in turn increase the cost of production and cause environmental pollution. *Pepper Venial Mottle Virus* is difficult to manage with insecticides because it is non-persistently transmitted by its aphid vectors and developed resistance to the common

insecticides applied by the farmers which allows it to transmit the virus into healthy peppers before insecticides act on them. Insecticide application and removal of infected plants are usually inadequate in reducing the virus spread (Fajinmi and Odebode, 2010). Various cultural management methods have been practiced in growers' fields for the management of virus infection on cultivated peppers, especially with viruses transmitted by aphids in a non-persistent manner, with varying degrees of success (Fajinmi and Odebode, 2010).

Pepper Venial Mottle Virus (*PVMV*) disease had been reported to be a major constraint to pepper production in almost all parts of Nigeria where pepper has been cultivated, contributing to its low yield and reduced fruit quality and leading to great economic loss for the farmers and country at large (Fajinmi 2006). There have been reports of 100% losses of marketable pepper fruits due to infection with *PVMV*, causing whole fields to be abandoned prior to harvest and in some areas making the cultivation of pepper uneconomical in Northern and some parts of South-western Nigeria (Fajinmi 2006). Many cultural methods have been practiced in growers' fields for the management of virus infection on cultivated pepper, especially with viruses transmitted by aphids in a non-persistent manner, with varying degrees of success. Information on *Pepper Venial Mottle Virus Disease* incidence and severity and population of adult aphid in farmers' fields is scares in Kebbi State. Therefore, a research that will determine incidence and severity of *Pepper Venial Mottle Virus Disease* and population of adult aphids in farmers' fields will be of paramount importance in the study location. The outcome of this research will be of great benefits to pepper farmers, extension workers, agronomists, entomologists, plant virologists and other researchers.

Study Area

This research was conducted in Aliero Local Government Area of Kebbi State, Nigeria. Aliero is one of the twenty-one (21) Local Government Areas of Kebbi State, Nigeria. The town is located on latitude 12^{o}61 to 42'N and on longitude 4"7'to 6" E of the equator (Illo *et al.*, 2016). The climate of the town is tropical in nature and is characterized by dry and rainy seasons, with the onset of rainy season in May/June and ends in October and the heaviest rainfall occurring in July and August. The area is characterized by extreme cold in harmattan period which is usually accompanied by dusty winds and fog with alarming intensity;

prevails in November through January. The annual temperature of the area varies considerably but usually ranges between 26^{o} and 37^{o}C while average annual rainfall is about 500 mm (Illo *et al.*, 2016). The town is located in the South eastern part of the State, and bordered in the North-East by Gwandu Local Government Area, in the South-West by Jega Local Government, and in the North-west by Birnin-Kebbi Local Government area (Illo *et al.*, 2016).

Materials and Methods

Field survey was conducted in Aliero town, Gumbulu, Kali, and Jiga-Birni areas of Aliero Local Government, Kebbi State, Nigeria in January, 2021 dry season. In each area two (2) pepper farms were randomly selected and surveyed. In each field, 30 pepper plants were randomly sampled along two diagonals in form of an 'X' and examined for symptoms of *Pepper Venial Mottle Virus* (PVMV), disease incidence, disease severity, and aphid abundance (Sseruwagi *et al.*, 2004). Five symptomatic and asymptomatic leaf samples were sampled from each field. Information on cropping type, pepper type, age of the crop, cropping system, crops grown on neighboring field, and other relevant *PVMV* information were all recorded in a survey data sheet. Data on field co-ordinates (Latitude and Longitude) were also recorded from each field. Materials used for this study were mainly survey materials such as field survey data sheet for collecting relevant information for the research, Global Positioning System (GPS) receptor for taking coordinates of the locations (Longitude and Latitude); pencil and eraser were also used as writing materials; Thermometer and Hygrometer were also used in taking temperature and humidity.

Disease Incidence

Disease incidence of each field were calculated as the percentage (%) of visually observed diseased plants over the total plants assessed in the two diagonal methods using the following formula as suggested by Sseruwagi *et al.* (2004) and the percentage of disease incidence in each field were used to calculate the percentage disease incidence of each village sampled.

Disease incidence (%) =

$$\frac{number\ of\ diseased\ plants}{total\ number\ of\ plants\ examined} \times 100$$

Symptom Severity

Symptom severity of each field were scored using the arbitrary scale of 1-5 (Sseruwagi *et*

al., 2004) indicating the degree of symptom development of each sampled plant in the field. Mean symptom severity of each field were calculated.

Where:

1= Symptomless (no symptom development)

2= Mild (symptoms but no pronounced development)

3= Moderate (pronounced symptom on about one thirds of the leaves)

4= Severe (symptoms on about two thirds of the leaves)

5= Very severe (symptoms on almost all the leaves)

Results

Disease Incidence

The results obtained on disease incidence revealed that there are significant differences across the locations, however,

Estimation of Aphid Abundance

Evaluation of aphid population in a field was achieved by direct visual counting of adult aphids visually seen on 5 randomly selected youngest apical leaves of the shoots of each of the 30 plants sampled because the adults feed preferentially on the youngest immature leaves and mean number of aphids was calculated to represent the mean number of aphids per leaf (Ndunguru *et al.*, 2009).

Data Analysis

Data collected on disease incidence and severity of PVMV and Aphid population in the four locations sampled in Aliero LGA of Kebbi State Nigeria were analyzed using SPSS (V2020) and GenStat software (17th Edition).

Gumbulu had the highest disease incidence with (43.34) followed by Jiga-birni (28.33) while Aliero town and Kali recorded the lowest disease incidence (21.67) and (20.05) (Fig. 1)

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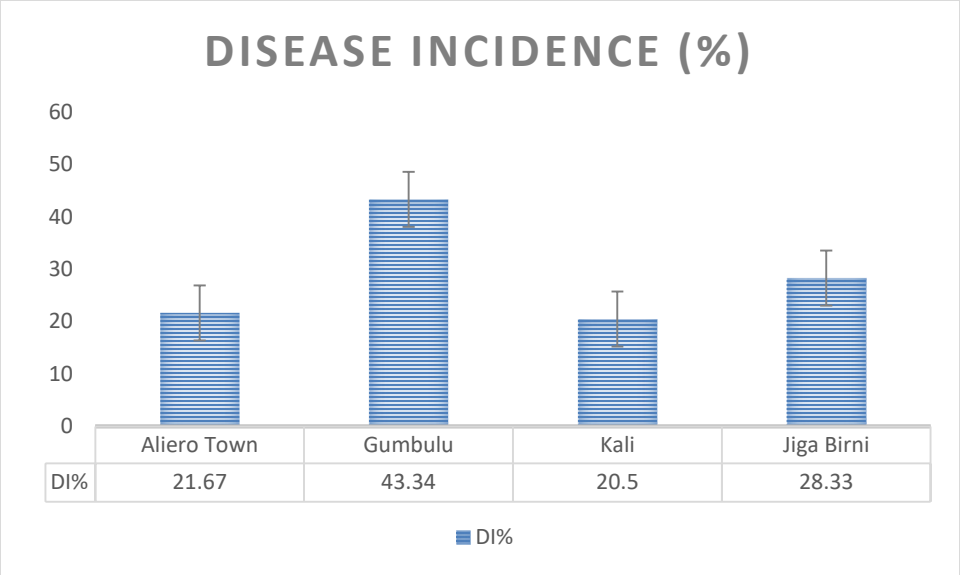

Figure 1: *Incidence of Pepper venial mottle virus in Aliero Local Government Area of Kebbi State during the 2021 dry season. Bars indicate standard error of means at 5 % probability level.*

Symptom Severity

The results on the symptom severity showed that the, Gumbulu and Kali had the higher and same symptom severity (2), moreover, Aliero town showed slightly difference (1.75) over Jiga-birni which had the least symptom severity (1.55) (fig .2)

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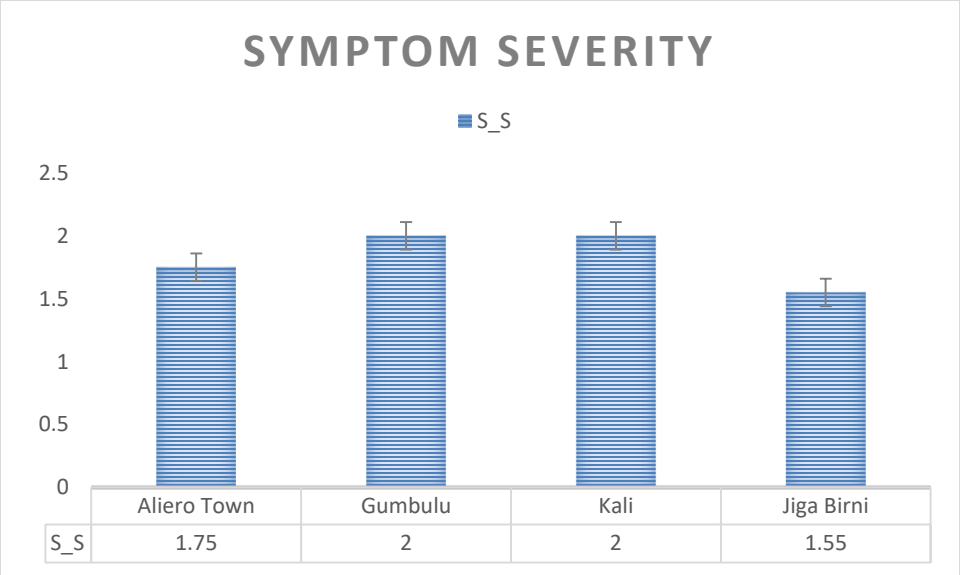

Figure 2: *Symptom Severity of Pepper venial mottle virus in Aliero Local Government Area of Kebbi State during the 2021 dry season. Bars indicate standard error of means at 5 % probability level.*

Aphid Population

Research results showed that the results on the Aphid population was significantly differed among the villages, Gumbulu (10.45) had the highest Aphid population over the rest of the location, followed by Kali with Aphid population of (8.29). The least populations were recorded in Jiga-birni and Aliero town (4.64) and (4.17) (fig .3)

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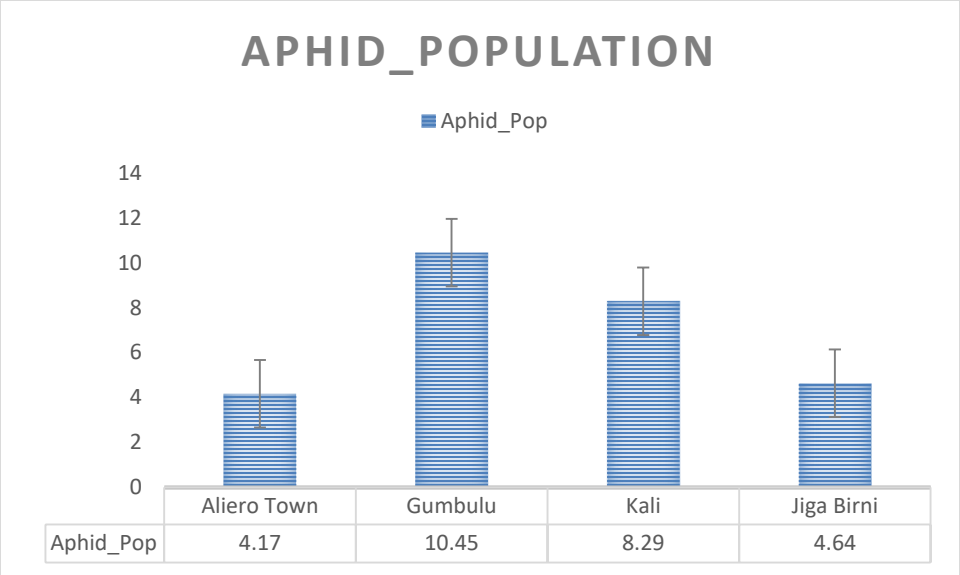

Figure 3: *Aphid population infesting pepper farms in Aliero Local Government Area of Kebbi State during the 2021 dry season. Bars indicate standard error of means at 5 % probability level.*

Discussion

The research work was conducted in January, during the dry season of 2021/2022 with the aimed at determining the incidence, severity of *Pepper Venial Mottle Virus Disease* (PVMVD) and Aphid population in four selected villages of Aliero LGA of Kebbi State. This revealed that, the *Pepper Venial Mottle Virus Disease* occurred in all the locations visited during the field survey (Gumbulu, Jiga-birni, Kali and Aliero.). However, some of the symptoms of this disease were found during the course of survey, these ranges from, leaf curling, yellowing of the leaves, necrotic spots on the leaves, stunting and poor fruit development. This indicated that, there was rapid spread of *Pepper Venial Mottle Virus Disease* in the study area. Moreover, Gumbulu village had the highest percentage disease incidences of (PVMVD) over Jiga-Birnin and Aliero town while Kali recorded the lowest disease incidence. Higher disease incidence revealed in Gumbulu could be attributed to the mixed cropping system practiced by the farmers in the area which may invite more number of Aphids which is the insect vector responsible for the transmission of these *Pepper Venial Mottle Virus Disease* in those areas with highest disease incidence. This result is supported by the findings of (Jacobson *et al.,* 2018) who reported that, the companion cropping could have negative consequences to the famers, as some of the crops used serves as multiple hosts for arthropod vectors and

contribute immensely to the distribution and maintenance of viral diseases at pepper production fields, but contradicted the findings of Wang *et al.* (2022), who reported that cropping of multiples crops in the same field may reduce the number of vectors as they may have a wide range of host plants instead of attacking only one or fewer plant hosts.

Moreover, in term of the symptom severity Kali and Gumbulu villages revealed similar higher symptom severity than in Aliero town, while Jiga-birni recorded the lowest symptom severity. The higher symptom severity in Gumbulu and Kali could be attributed to the use of high yielding but susceptible varieties of pepper by the farmers in the study area, this strongly agreed with the findings of Jacobson *et al.* (2018). This result could likely be because most of the farmers preferred a high yielding varieties over resistant cultivar for optimum production.

Similarly, Gumbulu village recorded the highest Aphid population than Kali which was ranked second, followed by Jiga-birni, where the least aphid population was recorded in Aliero town. Higher Aphid population in Gumbulu village may likely resulted due to the misuse and frequent insecticides application by the farmers in the study area, this could increases the development of resistance to the insect pests. This is in comparable to the findings of Sonhafouo-Chiana *et al.* (2022), who reported that, majority of pepper farmers misused synthetic Pesticides (Insecticides) and this Agro-chemicals alone does not guarantee effective control for all pests, weather factors such as certain temperature range may encouraged insect fecundity which indirectly increases the insect population growth and development. Similar trend was observed as this study shows that temperature significantly favored the higher Aphid population (Khan and Hossain, 2019). This study also showed the dry season as the conducive period for the most of the insects due to the facts that it facilitates the growth and development of a small body sized insects that lead to higher population due to the complete absence of rainfall during the period that significantly reduced insect population in the study (Kwaifa *et al.,* 2025).

Conclusion

It can be concluded that, there were incidence, severity of PVMV and higher Aphid population in the study location.. However, the village that recorded the

highest disease incidence was Gumbulu, followed by JigaBirni, Aliero Town, and the last was Kali village of Aliero L.G.A. Furthermore Kali and Gumbulu had the highest Symptom Severity, followed by Aliero Town, while JigaBirni recorded the least Symptom Severity. Similarly, Gumbulu superseded in terms of Aphid population over the rest of the locations. Therefore, farmers need to strategize in reducing the population of Aphid which indirectly increases the spread of *Pepper Venial Mottle Virus* in the study areas, this could be done by judicious use of insecticides and manipulations of the agronomic practices that reduces the population of the insect pests by the farmers

Recommendations

The research work recommended that, the farmers should adopt appropriate planting methods, Cultural practices and good farm sanitation to make the farm unsuitable for vectors and also reduce the population of vector transmitting PVMV in the study areas.

However, due to continuous resurgence of Aphid vector and indiscriminate use of chemical insecticides, there is a strong need to use resistant varieties of pepper to minimize the transmission efficiency by the Aphid as a vector in major pepper growing areas of Aliero L.G.A. Moreover, public campaigns need to be carried out to create awareness among farmers' communities to enlighten the farmers of all the possible risks of the spread of this dangerous insect vector and its associated virus.

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