DISTRIBUTION OF MAIZE STEM BORERS IN OYO STATE, NIGERIA

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SUMMARY

Feeding by borer larvae on maize plants usually results in crop losses as a consequence of the death of the growing point (dead heart), early leaf senescence, reduced translocation, lodging and direct damage to the ears. Therefore, a survey of maize stem borers was conducted in selected Local Government Areas (LGAs) of Oyo State (Egbeda, Eleyele, Atiba and Afijio). Data of each site was recorded using a structured questionnaire. Information on the longitude, latitude and elevation of each farm was obtained using Geographical Positioning System (GPS) equipment. Five farms were surveyed in each LGAs for stem borer larvae infestation, the larvae obtained were caged separately based on LGAs on maize seedlings using wooden cages measuring 50 cm ×50 cm in diameter and 150 cm in height and reared to adults, then taken to Insect Museum at the Department of Crop Protection, Ahmadu Bello University, Zaria, Kaduna State for identification. The results showed that species of Sesamia calamistis *were found to be prevalent at Egbeda and Odooba (Egbeda LGA), Abatan (Akinyele LGA), Aboki and Abaoke (Atiba LGA) and Fiditi (Afijio LGA) recorded the highest (3.0) number of stem borer larvae while the lowest (1.0) number of stem borer were found in Ajibade and Anifa (Akinyele LGA), Ojakoso in Atiba LGA and Akowe in Afijio LGA.*

Keywords: Damage, larvae, Maize, severity, Stem borers

Maize (*Zea mays* L.) is a major staple food crop grown in diverse agro-ecological zones and is consumed by people with varying food preferences and socio-economic backgrounds in sub-Saharan Africa (SSA) (Olaniyan, 2015). Maize which may be eaten as a vegetable or processed into various dishes is regarded as a hunger breaker after a long dry period in developing countries. It is perhaps one of the most important cereal crops cultivated for food, livestock feed and industrial raw materials (Ukeh *et al.*, 2010). About 50 species of maize environmental biotypes exist and consist of different colours, textures and grain shapes and sizes. White, yellow, brown and red are the most common types. However, sustainable maize production especially in the developing world is threatened by various stresses including abiotic constraints such as drought and nitrogen. Others are viruses, bacteria, fungi and insect pests such as stem borers (Ukeh *et al.*2010). The major stem boring species associated with maize production in Nigeria are moths belonging to the families Noctuidae and Pyralidae, namely: the maize stalk borer (*Busseola fusca* Fuller), the pink stem borer (*Sesamia calamistis* Hampson), the millet stem borer (*Acigona ignefusalis* Hampson) and the African sugar cane borer (*Eldana saccharina* Walker); (Balogun and Tanimola, 2001). Stem borers have been the most damaging group of insect pests in maize cultivation worldwide (Tefera *et al.*, 2011). They cause 10–100% losses in maize grain yield (Sosan and Daramola 2001). However, Kakule *et al.* (1997) reported that within Africa, damage to maize varies with locations/regions, with sub-Saharan Africa recording the highest population of stem borers being directly correlated with damage and grain yield. may result from. The damage caused to growing points (dead heart), damage to leaf (windowpane) stem tunneling, hole (as a point

of entry to secondary rot organisms), stem lodging, stem breakage, tassel and direct damage to ear shank and ear leading to loss of stand and grain yield reduction (Sosan and Daramola, 2001). However, the consequence on yield is variable and depends upon sowing, borer species composition and abundance as well as insecticide treatment (Ajala *et al.*, 2010; Okweche *et al.*, 2010). It has been observed that early-planted maize suffers less from borer attacks than late-planted maize in the Middle Belt of Nigeria (Okweche *et al.*, 2010). Heavy stem borer infestations have precluded the second cropping of maize even in areas with potential for two rain-fed crops (Ogunwolu, 1987). The different recommendations on dates appropriate for sowing exist across all agro-ecological zones where maize is cultivated. Maize cropping is between March/April (early) and August/September (late) in the Southern agro-ecological zone of the country (rainforest) where it is highly produced (Ogunwolu, 1987).

The major species of stem borer associated with maize in Nigeria are the maize stalk borer, *Busseola fusca*Fuller (Noctuidae), the pink stalk borer, *Sesamia calamistis*Hampson (Noctuidae), the millet stem borer, *Coniesta ignefusalis* Hampson (Noctuidae) and the Africa sugarcane borer, *Eldana saccharina* Walker (Pyralidae) (Balogun and Tanimola, 2001). Others of less importance are the spotted stalk borer (*Chilo partellus* Swinehoe. Pyralidae), *C. orichalcociliella, C. suppressalis,* and the ear borer (*Mussidia nigrivenella* Pyralidae) (Khan, *et al.*, 2000). Usua (1997) observed that *S. calamistis* was more abundant than both *B. fusca* in Eastern and Southern States of Nigeria. Okweche *et al.,* (2010) reported that *B. fusca*is the most predominant borer species in the guinea savanna agro-ecological zone of Nigeria followed by *S. calamistis, E. saccharina, C. ignefusalis and C. partellus*in early and late planted maize. Obhiokhenan *et al.* (2002) reported higher stem borer populations in the Mangrove zone followed by rain forest and derived savanna zones of Cross River State. The survey by Obhiokhenan *et al.* (2002) also showed that *S. calamistis* was more abundant than any other stem borers in all the vegetational zones of Cross River State followed by *Chilo* spp while. *Fusca* was absent.

Contrary to these reports, *B. fusca* does occur in the lower altitudes in East Africa and it feeds on only a few host plant species. During the last decade, the interactions of this insect pest with plants (Alata ud *et al.,* 2008: Calatayud *et al.,* 2008) as well as its reproductive biology (Calatayud *et al.*, 2011: Kruger *et al.,* 2012: Kruger *et al.*, 2014) and genetics, (Sezonlin *et al.*, 2006) have been well documented in East African countries. In West Africa, *B. fusca* is only of economic importance in the dry agro-ecological zones (Schulthess *et al.*, 2001) and little information exists about the ecology and management of this pest in this region. The severity and nature of stem borer damage depend upon the borer species, the plant growth stage, the number of larvae feeding on the plant and the plant's reaction to the borer feeding. Moreover, the amounts of yield loss vary greatly depending upon the country, season, maize variety, fertilization, the severity of the damage, stem tunneling and generation of stem borers involved. The first and second generations cause more yield loss than the third generation (Sezonlin *et al.* 2006).

Knowledge of the incidence and severity of maize stem borers would be useful for developing resistant maize varieties. Information on the spatial distribution of stem borers could serve as an avenue for assessing yield losses induced by stem borers in the study area. Such information would create awareness for government, research institutes; Agricultural Development Programmes (ADPs) and other stakeholders on the need to intensify management strategies. Unique cultures of the stem borers obtained during the study could be used for screening maize lines and cultivars against stem borer resistance. Resistant maize lines could be utilized for the genetic improvement of susceptible maize varieties. Besides, resistant maize cultivars would be recommended to farmers to reduce malnutrition and food insecurity in the country. Therefore, this study focused on determining the severity, distribution and species of maize stem borers in Oyo State, Nigeria.

MATERIALS AND METHODS

Determination of Incidence and Severity of Maize Stem Borers

Maize farms were surveyed from May to August, during the 2019 cropping season to determine the incidence of maize stem borer in the study area. Four Local Government Areas (LGAs) were selected (Egbeda, Eleyele, Atiba and Afijio LGAs of Oyo state). In each LGA, 5 maize farms were surveyed. Structured questionnaire was used to obtain information from farmers. Information on the longitude, latitude and elevation of each farm was obtained using Geographical Positioning System (GPS) equipment. In each field, maize stem borer incidence was assessed as a percentage of the total plants exhibiting maize stem borer symptoms. The severity of infestation was also determined by counting holes on the plants' leaves using a scale as shown in table 1

Conventional Identification of maize Stem borer species/biotypes

Insects from each LGA were caged singly on maize seedlings using wooden cages measuring 50 cm ×50 cm in diameter and 150 cm in height, which were kept in a screen house till maize maturity. Ten seeds of the cultivated variety; maize, Pool -16 were sown in plastic pots at the screen house (25 cm diameter and 30 cm deep). F1 progeny of the insects were reared to adult and sex was determined using insect genital differentiation technique. The males were used for species identification (Oparaeke, 2005). Males and females are different at the morphological, physiological and behavioural levels. This sexual dimorphism results from the integration of 2 processes: sex determination and sexual differentiation. Sex separation was achieved by using genetic sexing strains which allow the elimination of females and the selection and use of males only. In these species, male sex is determined by the Maleness factor, a genetic locus (gene) on the Y chromosome. Sex determination refers to the developmental program that commits the embryo to either the male or the female pathway. Firstly, the insect specimens were treated with 10 % potassium hydroxide solution for about 24 hours; they were then transferred to 70 % ethanol for preservation. The male genitalia were dissected under a dissecting microscope (Ken-A-Vision, Kansas City Missouri 64133

USA) and the aedeagus and pygofer processes were examined under the high power of a stereoscopic microscope (Acrifab model Atico Medical Pvt. Ltd., Grain Market, Ambala). The insects at their adult stage were taken out of their respective cages and kept in different transparent plastic containers and labelled (for the different farms at which they were collected). The samples were taken to the insect laboratory (Insect Museum) of the Department of Crop Protection, Faculty of Agriculture Ahmadu Bello University (ABU), Zaria, Kaduna State for identification and classification by comparing with various existing species in the Insect Museum.

Data Collection

Borer incidence was recorded by counting the healthy and infested plants in each farm to calculate the percentage infestation of the pest (Liaqat *et al.*, 2002) as follows.

$$\text{Percentage of stem borer infestation} = \frac{\text{the number of infested plant}}{\text{Total number of plants}} \times 100\%$$

Determination of the severity of stem borer infestation was based on leaf damage using a visual scoring 0-9 scale (International Maize and Wheat Improvement Center (CIMMYT), 2011) as shown in the appendix

Table 1: Scale for scoring stem borer leaf damage from seedling to whorl stage in maize

Numerical Score	Visual ratings of plant damage	Reaction to resistance
0	No damage	Probable escape
1	Few pin holes	Highly resistant
2	Few pin holes on older leaves.	Resistant
3	Several shot holes on leaves (<50%).	Resistant
4	Several shot holes on leaves (>50%) or small lesions (<2 cm long)	Moderately resistant
5	Elongated lesions (> 2 cm long) on a few leaves.	Moderately resistant
6	Elongated lesions on several leaves.	Susceptible
7	Several leaves with elongated lesions or tattering.	Susceptible
8	Several leaves with long lesions with severe leaf tattering	Highly susceptible
9	Plant dying due to death of growing points (dead-hearts)	Extensively sensitive to damage

Source: CIMMYT, 2011

The number or percentage of plants that were stem-lodged was counted or scored on a scale of 1-5, where 1=not lodged and 5= heavily lodged

The number of plants showing the death of growing points (dead heart) was counted. The proportion of dead hearts was evaluated as;

$$\text{The proportion dead heart (\%)} = \frac{\text{number of plants with dead heart}}{\text{Total number of plants inspected}} \times 100\%$$

RESULTS

Farmers cultivated maize twice a year in Oyo State unlike once in a year (wet season only) in Northern States under rainfed. Maize was grown in mixtures with other principal food and vegetable crops such as cassava, cowpea, millet, rice, okra, garden egg, sorrel and groundnut. The farmers interviewed stated that they usually source seeds from the market or previous harvest. Only a few of them obtained seeds from reliable sources like the Research Institutes, Ministries of Agriculture and Agricultural Development Projects (ADPs). Most of the farmers interviewed controlled weeds manually while few applied herbicides for weed control and pesticides were used to control insect pests and diseases. Inorganic fertilizers such as NPK and urea were the main source for soil improvement while few used both organic and inorganic manure. Information from various farmers met on the farms during field surveys of the various Local Government Areas about the knowledge of the occurrence of stem borers was positive. They were aware of the presence and infestation of the pest, but no management strategy was attempted against it. Most farmers intercropped maize with sorghum, millet and pearl millet which serve as an alternative host for stem borer species. Identification and classification revealed that *S. calamistis* was the most abundant borer species in Oyo State. Figure 1 indicates the Local Government Areas where the survey was conducted.

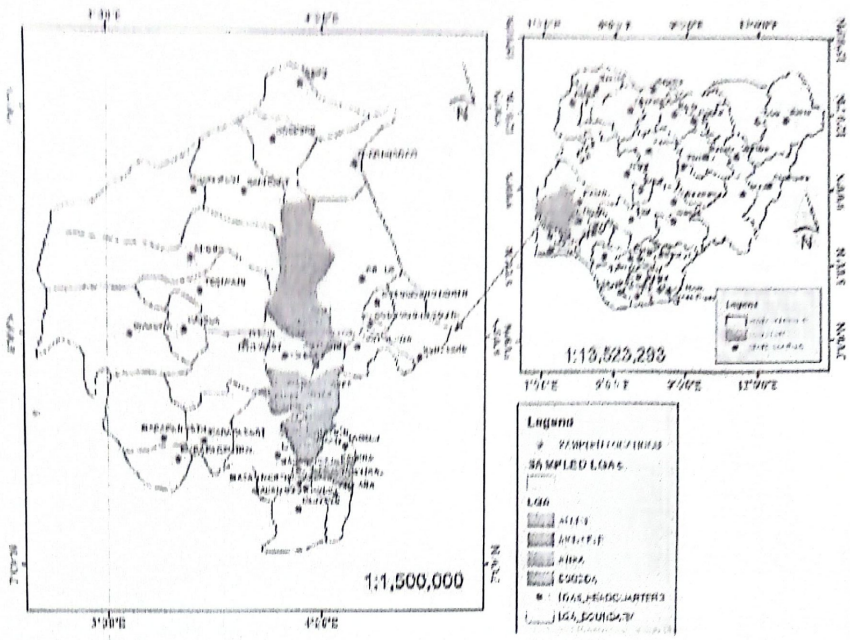

Figure 1: Map showing sample points and stem borers' distribution in Oyo State, Nigeria

Severity rating of infestation by stem borers in the farms surveyed

The severity of maize stem borers in five locations (farmers' field) in each of the four Local Government Areas (LGAs) surveyed in Oyo State, Egbeda and Odooba (Egbeda LGA), Abatan (Akinyele LGA), Aboki and Abaoke (Atiba LGA) and Fiditi in Afijio LGA recorded the highest (3.0) severity while the lowest (1.0) stem borer severity was found in Ajibade and Anifa (Akinyele LGA), Ojakoso in Atiba LGA and Akowe in Afijio LGA (Figure 2).

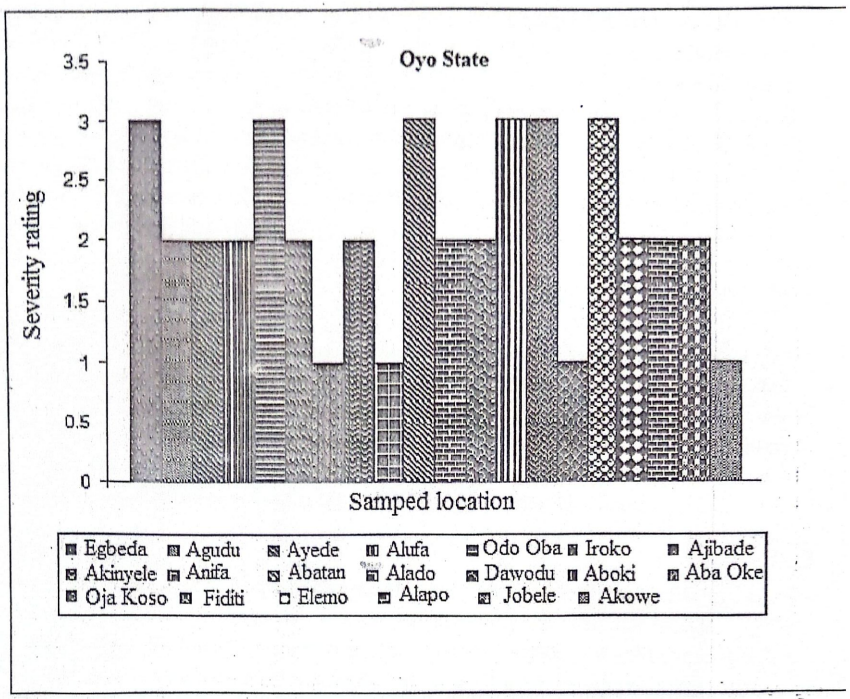

Figure 2: Severity rating of infestation by stem borers in surveyed farms in Oyo State

DISCUSSION

The farmers interviewed stated that they usually sourced seeds from the market or previous harvest or both, except a few that obtained their seeds from agro-stores and or research institutes. This revealed that, most of the farmers were not planting certified and hybrid seeds. The cropping system practiced by most farmers in the areas encourages a favourite breeding environment for the survival and infestation of stem borers because most farmers intercropped maize with sorghum, millet and pearl millet which serves as alternative hosts for stem borer species. This corroborates the findings of Fajinmi and Odebode (2010), who stated that a reduction of pest incidence with intercropping of non-host plants should be carefully adopted. The cultivar of interest, sources of seed and fertilization method adopted by farmers all played a significant role in the spread of these stem borers infestation in the study area.

This practice encourages a favourable breeding environment for the survival and infestation of stem borers. Identification and classification revealed that *S. calamistis* was the most

abundant borer species in the studied location (Oyo State). This agrees with the finding of NRI (1996) and Polaszek (1998) who reported that *B. fusca, S. calamistis, C. partellus, E. saccharina* and *C. ignefusalis* are the most important and widely distributed lepidopterous stem borers in Nigeria. Similar observations have been made in the studies carried out in Southwestern Nigeria (Balogun and Tanimola, 2001). Youm (1990) also reported that *A. ignefusalis was* a major pest of pearl millet and was not predominantly found in maize. In time, *Buseola fusca* became eliminated to the advantage of *S. calamistis* since *B. fusca* was more susceptible to high mortality at higher temperatures than *S. calamistis*(Usua 1997). Ogunwolu (1987) further reported that the difference in population between the two borer species was due to the feeding habit of the borer.

CONCLUSION

Information from various farmers met on the farms during field surveys of the various Local Government Areas about the knowledge of the occurrence of stem borers was positive. They were aware of the presence and infestation of the pest, but no management strategy was attempted against it. Most farmers intercropped maize with sorghum, millet and pearl millet which serve as an alternative host for stem borer species. Identification and classification revealed that *S. calamistis* was the most abundant borer species in Oyo State.

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