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INCIDENCE AND SEVERITY OF MAIZE STEM BORERS IN NASARAWA STATE, NIGERIA

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ABSTRACT

Maize is one of the major cereal crops and ranks third in production worldwide, following wheat and rice. In sub-Saharan Africa, maize is one of the most important staple foods, providing food and income to over 300 million resource-poor smallholders. Stem borers are the most damaging insect pests in maize cultivation worldwide. Feeding by borer larvae on maize plants usually results in crop losses due to death of the growing point (dead heart), early leaf senescence, reduced translocation, lodging and direct damage to the ears. A farm survey was conducted in some selected Local Government Areas (LGAs) of Nasarawa State (Keanna, Keffi, Wamba and Lafia) from July to September 2019. In each LGA, five maize farms were surveyed. In each field, maize stem borer incidence was assessed as a percentage of the plants exhibiting maize stem borer symptoms. The severity of the infestation was determined by counting holes in the plants' leaves using a scale. The stem borer larvae on each farm were collected and caged differently and reared to adults. These were then taken to the Insect Museum at the Department of Crop Protection, Ahmadu Bello University, Zaria, Kaduna State, for identification. The results showed that the species of Sesamia calamistis was the only stem borer found in maize fields of the four LGAs of Nasarawa State. Keffi LGA had the highest incidence (28.00), followed by Lafia (26.50) and Wamba (23.00), while Kaena had the most

minor incidence of stem borers (20.00) Also, highest stem borers' severity (3.0) was found in Agundu in Kaena, Uko in Keffi LGAs, Dangi and Arikia in Wamba and Maraba in Lafia LGAs.

Key words: Larvae, Maize, *Sesamia calamistis,* Stem borers

INTRODUCTION

Maize (*Zea mays* L.) is not just a crop, but a vital staple food in sub-Saharan Africa (SSA), grown in diverse agroecological zones and consumed by people with varying food preferences and socio-economic backgrounds (Olaniyan, 2015). Sixteen out of 22 countries in the world where maize forms the highest percentage of calorie intake in the national diet are in Africa (Nuss and Tanumihardjo, 2011). Over 650 million people consume an average of 43 kg of maize per year (a 35% increase since 1960), reaching 85–140 kg in Kenya, Lesotho, Malawi, South Africa, Zambia and Zimbabwe (Kamara *et al*., 2003). Its cultivation spans the entire continent and is the dominant cereal food crop in many countries, accounting for 56 % of the total harvested area of annual food crops and 30-70 % of total caloric consumption.

The potential yield for sub-Saharan Africa is significant, with 5 tonnes /ha in tropical highlands, 7.0 in subtropical and mid-altitude zones and 4.5 in tropical lowlands, compared to the current yields of 0.6, 2.5 and 0.7 tones/ha, respectively (Pingali, 2001). This large yield gap is attributable to both abiotic and biotic constraints (Wambugu and Wafula, 2000). The major abiotic constraint is drought, which causes an annual yield loss of about 15% (Kamara *et al*., 2003), while the second most important constraint is nitrogen (Kamara *et al*., 2003). Maize is susceptible to common species of Pythium and moderately susceptible to *Sclerotium rolfsii* and *Rhizoctonia* spp. Maize is also susceptible to stalk and cob rots caused by several *Fusarium* species, but these do not normally affect vegetable crops.

A generally accepted estimate of annual losses during the early 20th century was 10 % of the South African crop (Kfir *et al.*, 2002). South African maize production increased from less than one million Tonnes (mt) in 1910 to 2.6 mt in 1950 and 8.2 mt in 1972. This increase in production and the concomitant increase in area under maize production (4.7 million ha in 1972) significantly raised the economic status of stem borers until the mid-1970s. *Busseola fusca* received surprisingly little research attention over half a century, and control strategies relied heavily on principles derived from earlier research.

Busseola fusca, a pest that has plagued maize production since the early 20th century, continues to be a major threat. It was first mentioned as *Sesamia fusca* in a report by Fuller in 1901 and described under the same name by Hampson in 1902. In 1953, African species of *Sesamia* and related genera were morpho-taxonomically revised, and finally, *S. fusca* was placed in the *Busseola* Thurau genus (Tams and Bowden*,* 1953). The first description of the oviposition site, eggs, larval behaviour and damage symptoms caused by *B. fusca* stemmed from South Africa. Since 1920, *B. fusca* has become an important pest of maize and sorghum in sub-Saharan Africa, and the first recommendations on how to control this pest were given in 1905. Since then, a plethora of information on its distribution, pest status and injuriousness has been produced (Kfir *et al.*, 2002). *B. fusca* is considered to be the most destructive lepidopteran pests of maize (Kfir *et al*., 2002) and sorghum (Van den Berg *et al.,* 1991) in Africa. Estimates of crop losses vary greatly in different regions and agroecological zones. In Kenya alone, losses due to *B. fusca* damage on maize fluctuate around 14 % on average (De Groote, 2002), while in the humid forest zone of Cameroon, losses of around 40 % are common in monocropped maize fields (Chabi-Olaye *et al*., 2005). Currently, this pest still presents a major constraint to the production of maize in areas where they are abundant.

Stem borers have been the most damaging insect pests in maize cultivation worldwide (Tefera *et al*., 2011). Feeding by borer larvae on maize plants usually results in crop losses due to the death of the growing point (dead heart), early leaf senescence, reduced translocation, lodging and direct damage to the ears. Yield loss due to stem borers in Africa varies from 0 - 100 % among ecological zones, regions and seasons. In sub-Saharan Africa, particularly Nigeria, they can cause 20 - 40 % losses during cultivation and 30 – 90% losses postharvest (Malusi and Okuku*,* 2013). However, estimated yield losses higher than 40 % are expected to occur at the smallholder level, where suppression of the pest by chemicals is generally not practised. Yield losses of 12 % for every 10 % of plants infested have been reported in Tanzania and Kenya (Malusi and Okuku*,* 2013). The Economic Injury Level (EIL) of *B. fusca* in maize is 4 and 5 larvae per plant 20 and 40 days after plant emergence, respectively. Therefore, the study's objective was to obtain information on the presence, incidence, severity, and distribution of maize stem borers in Nassarawa, Nigeria.

MATERIALS AND METHODS

Determination of Incidence and Severity of Maize Stem Borers

Sample Collection

Maize farms were surveyed during the 2019 cropping season from May to August to determine the incidence and severity of maize stem borer in the study area. Four Local Government Areas (LGAs) were selected: Keana, Keffi, Wamba and Lafia. In each LGA, five maize farms were surveyed. The Local Government Areas where the survey was carried out are presented in the maps below (Figure 1). Passport data of each site was captured using a structured questionnaire. Information on each farm's longitude, latitude and elevation was obtained using Global Positioning System (GPS) equipment. In each field, maize stem borer incidence was assessed as a percentage of the 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.

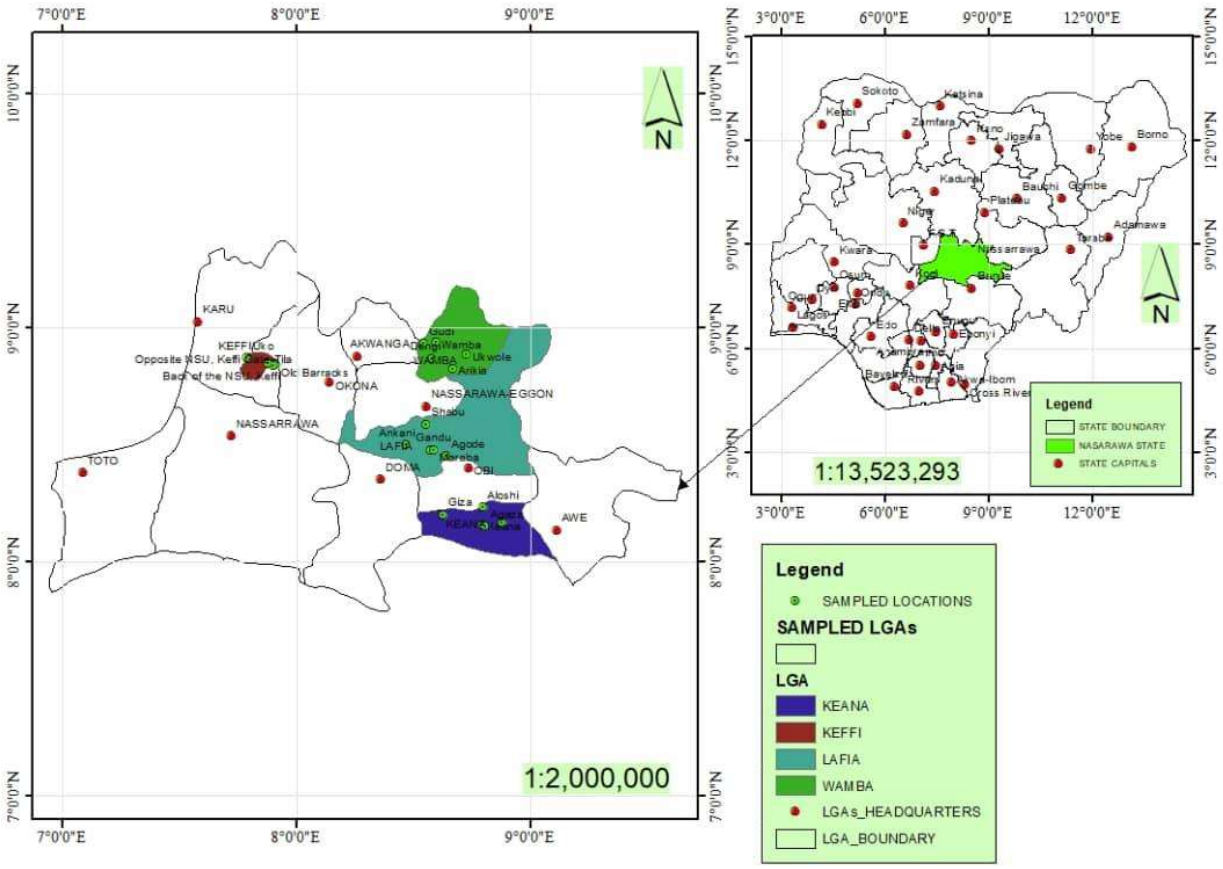

Figure 1: Map Showing Sample Points and Stem Borers in Nassarawa State, Nigeria

Table 1: Scale Used 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)

Identification of Maize Stem Borer Species/Biotypes

Borers from each LGA were caged separately on healthy 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 Pool -16 maize varieties were sown in plastic pots (25 cm diameter and 30 cm deep). F1 progeny of the insects were reared into adults, and sex was determined using the insect genital differentiation technique (Kruger *et al*., 2014). The males were used for species identification. Firstly, the insect specimens were treated with 10 % potassium hydroxide solution for about 24 hours, then transferred to 70 % ethanol. 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).

Data Analysis

The average number of infested plants in each farm from various LGAs was converted into percentage infestation. The data were subjected to Analysis of variance (ANOVA) using the Minitab package. Significant levels of the ANOVA were tested at the 5% probability level, and means were separated using the least significant difference (LSD).

RESULTS AND DISCUSSION

Passport Data of the Surveyed Areas

Maize in the surveyed areas was grown on at least one hectare of land for sale and family consumption. Farmers cultivated maize once a year (wet season only). Maize was grown with other principal food and vegetable crops such as cassava, cowpea, millet, rice, okra, garden egg, sorrel and groundnut. The farmers interviewed said they usually buy seeds from the market or previous harvests. Only a few seeds were obtained from reliable sources, such as the Research Institutes and 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 primary sources of soil improvement, while few used organic and inorganic manure. These imply that most farmers are not planting certified and hybrid seeds. The cropping system practised 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 serve as alternative hosts for stem borer species. This agrees with the findings of Fajinmi and Odebode (2010), who stated that preventing pest incidence with intercropping of non-host plants should be carefully adopted. Cultivar planting, seed source, and fertilization methods adopted by farmers all significantly spread the infection of stem borers in the study area.

Incidence of Stem Borer Infestation in Selected Local Government Area of Nasarawa State

There were significant ($p \leq 0.05$) differences among the four local government areas surveyed in terms of the incidence of stem borer infestation, underscoring the urgency of the issue (Figure 1). Keffi LGA had the highest incidence (28.00), followed by Lafia (26.50) and Wamba (23.00), while Kaena had the lowest incidence of stem borers (20.00) (Figure 2).

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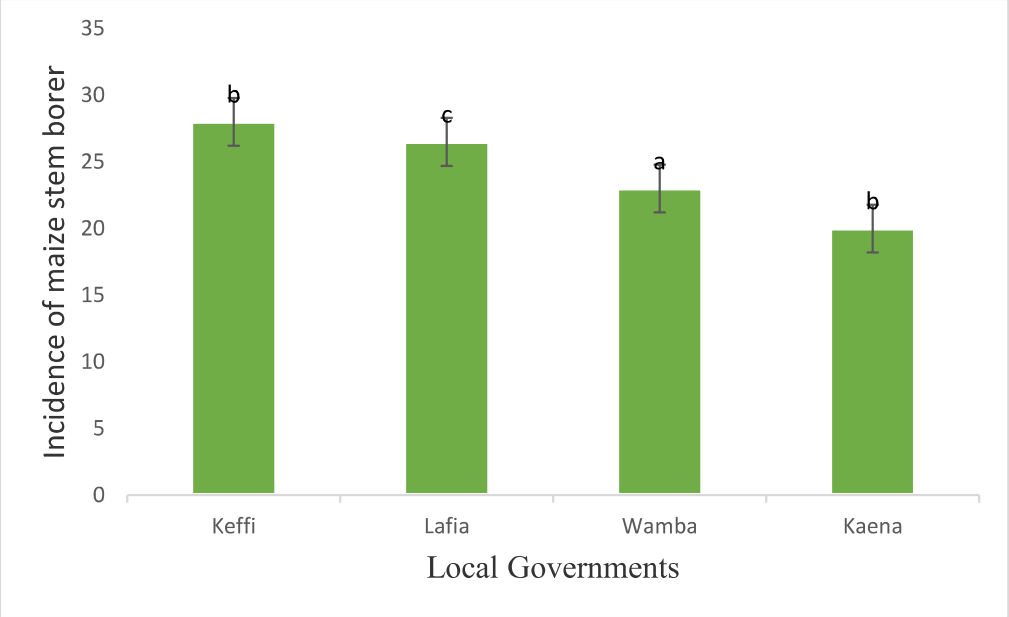

Figure 2: Incidence of Maize Stem Borer in Selected Local Government of Nasarawa State

Severity Rating of Infestation by Stem Borers in the Farms Surveyed

The lowest severity (1.0) of stem borers infestation was recorded in Agaza and Giza, both in Kaena LGA and Gandu in Lafia LGA. In contrast, the highest (3.0) stem borers' severity was found in Agundu in Kaena, Uko in Keffi LGAs, Dangi and Arikia in Wamba and Maraba in Lafia LGA (Figure 3).

Identification of Maize Stem Borer Species/Biotypes

The study revealed that *Sesemia calamistis* was the only borer species in the studied location (Nassarawa), Nigeria. This is significant for farmers as it indicates *the potential impact on their maize crops. The* absence of the A. ignefusalis population in the Local Government Areas surveyed is also noteworthy, as it suggests a lower risk of infestation by this species. This finding aligns with the research of Obhiokhenan *et al.* (2002), who reported a higher percentage of *S. calamistis* in the mangrove and rainforest zones. Similar observations have been made in studies carried out in Southwestern Nigeria (Balogun and Tanimola, 2001). In time, *B. fusca* became eliminated to the advantage of *S. calamistis.* This was due to the fact that *B. fusca* was more susceptible to high mortality at higher temperatures than *S. calamistis*. Ekoja *et al.* (2015) reported that the difference in population between the two borer species was due to the feeding habit of the borer.

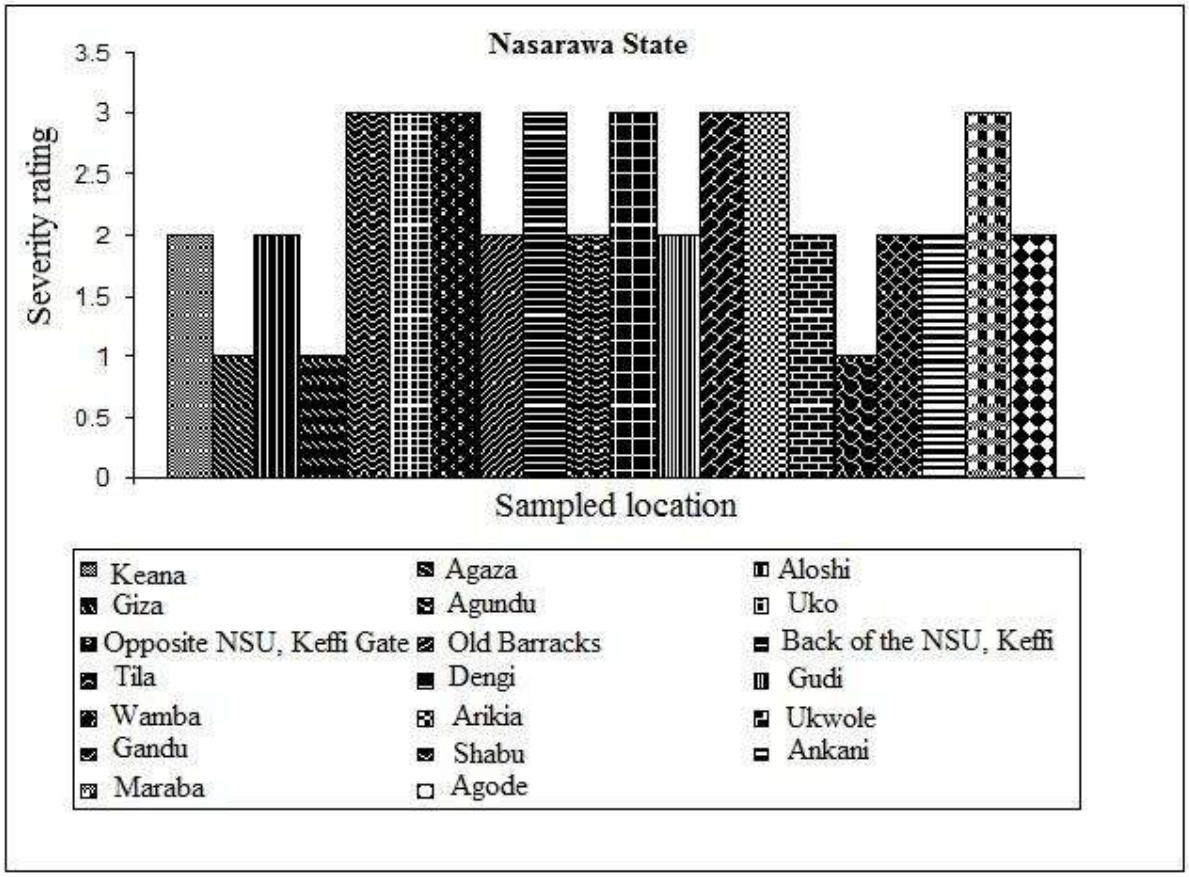

Figure 3: Severity Rating of Stem Borers in Surveyed Farms in Nasarawa State

CONCLUSION

Most of the farmers do not plant certified hybrid seeds. The cropping system practised by most farmers in the areas encourages a favourite breeding environment for the survival and infestation of stem borers. There was an incidence of stem borers in all the selected Local Governments of the State. The highest (3.0) stem borers' severity was found in Agundu in Kaena, Uko in Keffi LGAs, Dangi and Arikia in Wamba and Maraba in Lafia LGAs. In contrast, the lowest severity of stem borer infestation was recorded in Agaza and Giza, both in Kaena LGA and Gandu in Lafia LGA. *S. calamistis* was the only stem borer species in the studied location (Nasarawa, Nigeria).

RECOMMENDATIONS

Farmers should source their planting materials from seed companies or research institutes for certified and hybrid seeds resistant to maize stem borers' infestation. Farmers should adopt

cropping system(s) that discourage the breeding and survival of stem borers. Annual and or biennial farm surveys for the incidence and distribution of maize stem borers should be encouraged.

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