Journal of Agriculture and Veterinary Sciences
Volume 12, Number 2, 2020
ISSN: 2277-0062
http://www.cenresinjournals.com

PRELIMINARY INVESTIGATIONS OF STEM BORER INFESTATION ON MAIZE FIELDS IN HASSAN USMAN KATSINA POLYTECHNIC KATSINA

Abubakar Usman
Department of Agricultural Technology
College of Agriculture
Hassan Usman Katsina Polytechnic, Katsina
E-mail:abubakar19usman64@gmail.com

ABSTRACT
Maize is one of the most important staple food crops in Nigeria. It is cultivated under a broad range of agro-ecological zones in the country. Lepidopterous stem borers are the main insect pests that attack maize plant. This study was conducted at Hassan Usman Katsina Polytechnic Katsina to investigate stem borer infestations, damage and economic losses in maize at farmers' fields. Observation of stem borer infestation was done in four farms and a total of 2174 maize plants were observed randomly. All the farms surveyed were infested by stem borer (*Chilo partellus*) with infestation between 29 – 43 per cent. Larval feeding was observed on the leaves, growing points, stems and tassels. Yield assessment indicates 15 per cent loss although this was despite the use of insecticide in the farms surveyed. Further study to provide empirical evidence of the economic status of the stem borer pest in the area is recommended. Farmers should be informed on the possible measures to minimize the emergence of the adult borers that can assault the new crops in the next cropping seasons.
Key words: Preliminary investigation, stem borer, maize, Katsina.

INTRODUCTION
Maize (*Zea mays L.*) is one of the most important staple food crops in Nigeria. Among the cereals it has the largest area devoted to its cultivation. Indeed, its production area in the country continues to expand because of technological breakthroughs including the production of varieties suitable

for different agro-ecological zones. Maize is a major cereal and one of the most important food, feed and industrial crops in Nigeria. It is the most dominant grain crop in the savanna zones and fresh vegetable in the forest belt where it is cultivated twice in a year. It has become an important irrigated crop and increasingly being used as a coping strategy against the ever worsening climatic anomalies throughout the country (Omueti, 1999; Onyibe, Sani, Baba, Chindo, Ibrahim & Malumfashi, 2014). Over fifty million farmers grow maize every year in Nigeria, while over ninety million people are employed in its processing and usage daily. Maize provides energy, vitamins and has some amount of protein. Output of maize continues to increase in Nigeria in response to demand. National requirement of maize is estimated at about 16 million tons with production around 10.3 million tons in 2013. Supply deficit is about a shortfall of about 5.7 million tons. The average yield of maize is between 2,500 and 4,500 kg/ha of threshed grains depending on the level of inputs used and cultural practices (Onyibe *et al.*, 2014).

However, maize yields in Nigeria especially on resource-poor small scale farmers' fields are affected by an array of biotic and abiotic stresses. Insect pests both in the field and storage are among the most economically important biotic constraints in maize production and storage. The most economically important insect pests of maize include stem borers in the field and maize weevils and beetles in storage (Nigerian Federal Ministry of Agriculture & Natural Resources Institute, 1996; Stoll, 2005; Ukweche, Ukeh & Ogunwalu, 2010).

Description of Cereal Stalk Borers

Lepidopterous stalk borers are serious pests of cereal crops in sub-saharan Africa. Seventeen stem borer species in two families (Pyralidae and Nuctuidae) were reported attacking cereal crops in various parts of Africa (Kfir, Overholt, Khan & Polaszek, 2002). Among the several stalk borer species; African maize stalk borer (*Busseola fusca*), spotted stalk borer (*Chilo partellus*) and pink stalk borer (*Sesamia calamistis*) are the most important pests of maize, sorghum and millet in Nigeria (Usua, 1997; Ajayi, 1997, Anaso & Thliza, 2006; Ukweche, Ukeh & Ogunwalu, 2010). Cereal stem borers have almost similar life cycle and damage patterns on host plants. They all exhibit complete metamorphosis with larval stages causing all the damage observed in their hosts. The larval stage is also responsible for the survival and perpetuation of the species (Kfir *et al.*, 2002). A good knowledge of common features and biology of stem borers is very much helpful in understanding how these species interact with crops.

Description of different life stages of three stem borer species

S/N	Borer Species	Eggs	Larvae	Pupa	Adult Moth
1.	*Busseolafusca* (African maize stalk borer)	- Round and flat on top - 1mm in diameter - Creamy-yellow in colour - Inserted between the sheath and stem - Hatching takes 10 days	- Creamy-while with grey or pink colour - Mature larva 40mm long - Head is dark brown - Larval phase is 35-40 days	- Shiny yellow-brown to dark brown in colour - 25mm long - Pupation last about 10 days	- Adults is brown - Wing span 25-33mm - Forewings are light to dark-brown - The hind wings are light to grayish-brown - Up to 4 generation per season - Life cycle 30-60 days
2.	*Chiloparellus* (Spotted stalk borer)	- Flattened scale-like and ovoid - Creamy-white in colour - About 1.5mm in diameter - Laid at underside of leaf near	- Creamy white to yellowish brown with dark spots and four purple stripes lengthwise across the back - About	- Shiny, light yellow-brown to dark red-brown - 15-20mm long - Pupation 5-12 days	- Adult is pale yellow - Wing span 25-30mm - Forewings light yellow brown with darker horizontal patterns - Hind wings are white - Life cycle last for about 30 days - Up to five and more generations per year

		mid-rib - Eggs hatch in 5-8 days	30mm long - Brown head - Larval phase 2-3 weeks				
3.	*Sesamiacalamistis* (pink stem borer)	- Creamy white when laid but get darker as they develop - Eggs are laid between the lower leaf sheaths and stems - Hatch after 7-10 days	- Smooth and shiny - 30-40mm long - Creamy white, with pink longitudinal stripes larva phase 30-70 days	- Yellowish-brown - 18mm long - Pupa last 10-12 days		- Adult pale brown - Wing span 20-30mm - Yellowish brown forewing with dark brown scales along the outer edge - Hind wings are pale straw colour - Slightly smaller than the two species - Up to 5-6 generations per year - Life cycle lastss for 30-60 days	

Source: Synthesized from (Stoll, 2000; Polaszek, 1998; Kfir*et al.*, 2002; Ajayi, 1998; NFMA, 1996; Modman, VandenBerg, Coulong, Cugala, Siebet & Leru, 2014)

Stem Borers as Constraints to Cereal Production

Lepidopterous stem borers constitute one of the major constraints to efficient production of cereal crops in most parts of Africa, with a complex of species attacking these crops (Kfir *et al.*, 2002). Stem borer attack results in significant yield losses ranging from 10 – 88% (Kfin et al., 2002) of the potential grain output, depending on pest population density and phonological stage of the crop at infestation. Stalk borer initial damage is caused by feeding on the leaf tissues, followed by tunneling and feeding within the stem and sometimes the maize cobs. Feeding and stem tunneling by borer larvae on plants results in crop losses as consequence of destruction of the growing points (dead heart), early leaf senescence, interference with translocation of metabolites that result in malformation of the grains, stem breakage, plant stunting, lodging and direct damage to ears. Infestation by stem borers also increase the incidence and severity of stalk andear rots (Duna, 2012).

Natural resource Institute (NRI)(1996) and Polaszek (1998) reported that *B. fusca*, *C. partellus*, *S. calamistis* and *E. saccharina* are the most important and widely distributed lepidopterous stem borers in Nigeria. Ukwech*eet al.* (2010) reported *B. fusca* as the most dominant species in the guinea savanna zone of Nigeria followed by *S. calamistis E. saccharina* and *C. partellus* in early and late maize planting. In the Sudano-sahelian savanna region of Nigeria Duna (2012) reported five stem borer species affecting millet, sorghum and maize, with *C. partellus*, *B. fusca* and *S. calamistis* having the higher number of individuals per plant. International Institute for Tropical Agriculture (IITA, 2013) reported 20 – 40% yield loss in maize in Nigeria. Yield loss due to borers has

relationship with the time of infestation. Plants infested at an early stage before booting were found to suffer greater yield losses (McFarlane, 1990; Kahumba, 2012). Crop losses due to stem borer infestations were reported from various African countries. Study in Cameroon found that stem borers were responsible for 11% losses on plants owing to dead heart (Cardwell, Schulthess, Ndemah&Ngoko, 1997; Sezoulin, Ndemah, Georgen, Leru, Dupas & Silvain, 2012). In Burkinafaso and Niger yield losses due to *C. partellus* and *C. ignefusalis* was estimated between 60 – 62% in unprotected sorghum, while the highest yield was obtained when crop was protected between 15 – 30 days after emergence using carbofuran (Taneja & Nwauze, 1989) in East Africa losses in cereal grain yields due to stem borer ranged from 44 – 50% (Nykuru *et al.*, 2014). Maximum stalk damage in maize and up to 80% grain yield loss in sorghum by *C. partellus* were observed in Kenya on 20 day old crops, whereas similar infestation gave statistically non-significant losses when plants were infested at 60 days after emergence (Kahumba, 2012). Maize production in Katsina state has been expanding over the years. This is especially in the drier northern parts of the state. Most of the fields previously planted with sorghum are now use for maize production. This is not unconnected with the provision of early maturing and drought resistant maize varieties coupled with high demand of the crop in the area. However, information on pests and disease problems associated with maize production in this area is scanty. Keeping in view the importance of maize, as well as the importance of maize stalk borers, this study was initiated to investigate the effects of maize stem borers in some selected farms at Hassan Usman Katsina Polytechnic, Katsina. To this end the specific objectives were to:

i) Determine the prevalence of stem borer infestation on maize in the study area.
ii) Identify stem borer damage in maize crops.
iii) Assess the yield and economic losses caused by stem borer in maize in the study area.

MATERIALS AND METHODS

The Study Area

The study was conducted in Hassan Usman Katsina polytechnic, Katsina state (12°55N, 07°36E) during the months of August and September 2017. Four maize farms located far apart in the study area were selected. The total area of the four farms was estimated as 6 hectares.

Sampling Technique

Sampling and examination of maize plants against stem borer infestation was done in situ in the selected farms. A 10m x 10m area was taken three times systematically at random in each hectare using measuring tape. The total area sampled from the four farms of about 6 hectares was 1800m^2. All the maize plants that fall within the sampled areas were examined for stem borer infestation. A total of 2174 maize plants were examined. The study was conducted when the plants were about 8 – 12 weeks after planting.

Incidence of Stem Borer Infestation

This was measured to find out the prevalence and extent of damage caused by stem borer on maize in the study area. The following formula was used to measure the incidence of stem borer infestation.

$$\text{Stem borer incidence} = \frac{\text{number of affected plants}}{\text{Total number of plants assessed}} \times \frac{100}{1}$$

The formula was used to assess stem borer damage on maize leaves, growing point and tassels.

Assessment of Yields and Economic Losses

To assess the yields and economic losses caused to the grains by the stem borer, an analytical method was used. This involved harvesting fifteen each of infested and uninfected maize plants growing under identical conditions. The cobs were removed, shelled and weighed separately. The coefficient of harmfulness was calculated as the yield loss per plant expressed as a percentage of yield from uninfected plants. Economic losses were assessed using Maddonni *et al,* (2006) formula as represented below.

C = (a-b)/a

L = CP/100

Where:

a = mean yield of uninfected plants

b = means yield of infested plants

C = coefficient of harmfulness

P = % plants attacked

L = % economic loss

RESULTS AND DISCUSSION

This study confirms the presence of stem borer and damage on maize in the field. All the four farms surveyed were infested. Out of the 2174 plants examined, 872 (41%) had stem borer infestation (Table 1 and 2). The larval feeding on maize led to symptoms on various parts of the plant. Leaf damage is the most striking indication of the prevalence of stem borer in the field. Feeding caused ragged holes to appear on the leaves as they unfold. Between 21 – 26% leaf damage was observed in this study (Table 2).

Larval feeding also led to the death of the maize growing point known as 'dead heart' which contributed immensely to yield loss. The highest dead heart incidence (10%) was observed in one of the farms surveyed while the combined analysis indicated 8% dead heart incidence (Table 2). Stem borer damage was also observed on tassels which occurred before unfolding, resulting to reduce and shortened tassels. A total of 191 plants were identified with damaged tassels (Table 1) while combine analysis shows 9% tassel damage (Table 2). A number of studies have demonstrated strong relationship between maize yield and damage caused by stem borers. Foliar damage, dead heart, tassel damage and stem tunneling were found to affect maize growth and yield (Groote, 2002; Kfir, 2013; Edache, Olufemi, Folashade, Olaosebikan, 2015) reduction in the number of ears harvested due to larval infestation was found to be the primary cause of grain yield loss, mainly due to stem funneling of the plants (Kfir, 2013). However yield loss was also found to be influenced by cultivar and by the time and number of larvae involved in infestation (Edache *et al.*, 2015).

The economic loss of 15% determined in this study would have been highest had the plants that perished due to dead heart before grain formation were included. The 15% loss was also recorded despite the fact that insecticide was used in the farms against the stem borer. This result is in line with the IITA (2013) report of 20 – 40% loss in maize due to stem borer in Nigeria. Stem borers cause serious losses when maize plants are particularly attacked at an early stage and in high densities (Nyukuri, Kirmi, Cherangoi, Chirchir & Mwale, 2014). The reasons for the increased damaged in young plants is due to tenderness of leaves and stem. The first generation larva

is thus important in terms of causing yield loss and exceeds the second generation which attacks the crop when it is already advanced in age. The current study was undertaken when the plants were between 8 – 12 weeks after planting. Therefore early stage larval damage was not assessed to determine which of the two larval stages contributed most to the yield loss recorded.

Chilo partellus was identified as almost the only species responsible for the infestation and damage on maize reported in this study. The species was identified using the identification key of Overhalt, Maes & Goebel (2001). This species has been reported as highly invasive and competitive colonizer in many of the areas it has invaded. This competitive superiority was attributed to the species ability to complete a generation in less time which may result in higher population growth rate. It also terminates diapause more rapidly which may allow it to colonize host plants before the other species at the beginning of the growing seasons. The larvae of *Chilo* spp were also observed to disperse greater distance from the plants where they hatched, which allowed them to colonize more plants than other species (Kfir *et al.*, 2002; Kfir, 2013).

Table 1:

Stem borer damage to maize plant in the fields

Farms surveyed	No. of Plants Examined	No. of Plants Infested	No. with Damaged Leaves	No. with Dead Heart	No. with Damaged Tassels
1	1336	579	326	130	123
2	330	145	85	20	40
3	301	88	63	10	15
4	207	60	43	4	13
Total	2174	872	517	164	191

Table 2:

Disease incidence and economic loss caused by stem borer in maize (%)

Farms Surveyed	All Infested Plants	Damaged Leaves	Dead Heart	Damaged Tassels	Mean yield (g)		Coefficient of Harmfulness	Economic Loss
					Uninfected	Infested		
1	43	24	10	9	134.15	87.95	0.34	15
2	44	26	7	12	-	-	-	-
3	29	21	3	4	-	-	-	-
4	29	21	2	6	-	-	-	-
Combined analysis	**41**	**24**	**8**	**9**			**-**	**-**

CONCLUSION/RECOMMENDATIONS

This preliminary investigation reveals that the stem borer infestation in the study area is high and *Chilo partellus* is the most abundant species. The damage activities of the stem borer observed in the study confirmed previous reports which implicate the insect as the major pest of maize. The results reveal that yield loss due to stem borer infestation and damage could be severe if the pest is not managed. Further studies should be conducted to assess the extent of damage caused by the stem borer in the area, considering all the damage parameters that affect yield. This will provide empirical evidence of the economic status of the pest. It is necessary to organize the dry maize stalks before the next cropping season in order to minimize the emergence of the adults that can assault the new crops. Destruction of maize stalks by burning is the most effective means of destroying the diapausing larvae to avoid economic damage in the next seasons.

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