Assessment of varietal susceptibility of maize to lepidopterous stem borer.

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Abstract

Lepidopterous stem borer attack is a major biotic constraint to maize production in Nigeria and by far the most injurious. Continuous investigation of field pests of maize is necessary and screening on the field of various maize varieties available becomes imperative for detail determination of its pests so as to formulate adequate control strategies. This study was conducted to evaluate the relative susceptibility of selected maize varieties to Lepidopterous Stem Borer and to elucidate relationships between yield traits and the stem borer. Nine varieties of maize were planted and ten cobs per varieties were randomly selected at harvesting and bulk together in an envelope. Data collected was subjected to analysis of variance and correlation analysis.

The results revealed that varieties of maize had significant effects on most of the maize grain yield parameters in which varieties TZEE-WSRBC5, BR9928-DMRSR, BR9943-OMRSR and POOL18SRQPM with short cob length and longer ear tip, lower number of kernels per row had higher number of borers per ear and relatively lower grain yield while varieties TZE COMP3 and POP66SRACRa/SUWAN1-SR with longer cob and very reduced ear tip length, higher number of kernels per row couple with reduced borer produce significant high grain yield. BUSOLA-STR variety had a high stem borers infestation with short cob length and longer ear tip but still with high kernels per row and high grain yield may be due to its genetic tolerance while FETZEE-WSTR had the reverse but with lower grain yield which may be due to genetic make-up and some physiological effects. It was also revealed that ear tip length exhibited a significant (P<0.01) positive relationship with number of stem bores (0.782), and length of cob and number of stem borers had positive and negative significant relationship on grain yield respectively (0.623,-0.636).

It can be concluded that five maize varieties with longer ear tip, lower number of kernels per row even including does that were breed for stem borer resistance were susceptible to stem borers and ear tip length had a significant relationship with stem borer infestation which indirectly affect the grain yield.

Keywords: Lepidopterous stem borer, Maize grain yield, Genetic tolerance.

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Introduction

Maize is ranked as the third most important cereal crop in the world after wheat. It is a major staple crop of West and Central Africa (WCA). In Nigeria, however, maize is arguably the third most widely cultivated cereal crop after guinea corn and millet, with 12 million ton per annum. Maize is grown mainly for its energy-rich grains and its production has continued to gain wider acceptance over other cereal crops in the savanna of WCA. Despite its significance as a major crop, its continued productivity and sustainability are threatened by abiotic and biotic stresses which often occur in combinations [1].

Among the yield-limiting insect pests in maize production, stem borers are far the most injurious and the biggest cause of yield loss in Africa causing damage to leaves, stems, ears, and kernels. Three species of stem borers are of economic importance in the WCA [2]. Yield loss estimates due to stem borer attack were between 20 and 70% depending on the severity and stage of plant development when attacked. In WCA, *S. calamistis* and *E. saccharina* are more predominant in the lowlands while is more common in the mid-altitudes.

Control measures including chemical, biological and cultural methods have been used but not without limitations such as high cost, safety, and feasibility [3]. Because of the differences in yield potential of the ecological zones, screening/testing of new maize varieties across the country became an established practice in maize breeding. Host plant resistance is the cheapest, safest and the most efficient control measure which need to be screen in an endemic stressed environment for detail determination of its pests so as to formulate adequate control strategies. Therefore, this study was conducted to evaluate the relative susceptibility of selected maize varieties to Lepidopterous Stem Borer and to elucidate relationships between yield traits and thestem borer [4].

Methods and Materials

Experimental site and site preparation

The research was carried out during the early cropping season at the Teaching and Research Farm of Obafemi Awolowo University, Ile-Ife, Osun State. The experimental field was ploughed and harrowed mechanically by means of tractor [5].

Source of maize seeds

Ten varieties of maize seeds were collected from Seed Laboratory of the Department of Crop Production and

Protection, Obafemi Awolowo University, Ile-Ife. They were treated with the use of Apron Star (42WP) but one was poor emergence and highly insignificant performance.

Experimental layout

A randomized complete block design with ten treatment (varieties) and three replications were used. The total area of the field was 4.73 × 10-2 (31.0 m × 15.25 m). Each plot had a size of 7.5 sq. metre with 0.5 m intra-space and 0.75 m inter-space and the space in-between each plot was 1 m. Two seeds were planted per hill, later thinned to one resulting to a plant density of 20 plants per plot [6].

Field management

Agronomic practices including pre-emergence spray of herbicide and hand weeding was done. N-P-K 15:15:15 fertilizer was applied at two Weeks After Planting (WAP) as basal fertilizer at the rate of 60 kg N/ha and top-dressed with Dry poultry manure at six WAP at the same rate [7].

Data collection and data analyses

Weekly observations were made on the experimental site, so as to inspect the stem borer pests attacking each variety but we suspected most larva had bored into the stem and leaf whorl of the plants. Ten cobs were randomly selected at harvesting from the remaining nine varieties and bulk them per variety for stem borers' inspections [8]. The data collected related to count were normalized using log transformation before subjected to Analysis of variance, and Correlation analysis using PROC GLM Procedure of Statistical Analysis System (SAS Version 9.2).

Insect preservation

All the stem borers and egg masses collected at reproductive stage and at harvest were preserved in 70% alcohol (ethanol) for further identification [9].

Results and Discussion

The results of the study showed that maize varieties were attacked with stem borers, with most of the varieties attacked had spaces within the kernels, cobs and the ear tips. There was significant varietal effect ($P \leq 0.05$) on Length of the Ear (EL), Ear Diameter (EDT), Kernel Per Row (KPR) and the number of borers per corn infesting on the maize varieties (Table 1) while the Ear Tip Length (ETL) has not varietal effect [10]. This show that the germinated varieties exhibited difference in their EL, EDT, KPR and the number of borer infesting the maize variety. This may be due to differences in breeding method of development of the varieties, as some are from back cross method, some as composite at various cycle of selection and some as experimental variety. The report elucidate that improved hybrids can affect yield traits performance confirmed that selection methods can have significant effect on stem borer infestation. It was observed in Table 2 that TZEE-WSRBC and POOL18SRQPM with longer ear tip and lower number of kernels per row had higher number of borers per ear and relatively lower yield [11]. But varieties TZE COMP3C2 and POP66SRACRa/SUWAN1-SR with longer cob and much reduced ear tip length, higher number of kernels per row couple with reduced borer per cob produce significant high grain yield. BUSOLA-STR variety had high stem borers' infestation with longer ear tip but still with high grain yield which may be due to its genetic tolerance and bred for resistance to streaks that are also biotic stress of maize, while FETZEE-WSTR had the reverse but still with lower grain yield which may be due to genetic make-up and some physiological changes. It was also observed that EV.8766-SRBC6QPM was unstable for the five traits examined as the experimental variety evaluated and was contrary to the study conducted on ten varieties of maize and found that the Experimental Varieties (EV) had significant high grain yield and lower maize borer which may be due to different ecological conditions and agronomic practices. BR9928-DMRSR and BR9943-OMRSR (checks) were both reported earlier to be resistant to stem borer attack (IITA Report) but in this study, it was revealed that both were having higher number of stem borer which directly showed in their lower grain yield that they were susceptible. This was unexpected but it may be due to breakdown in their resistance ability, seasonal changes and new agro ecological effect. It was also revealed that ear tip length exhibited a significant ($p<0.05$) relationship with number of stem bores (0.782), and ear length and number of stem borers had significant relationship on grain yield (0.623,-0.636). The Ear length was earlier reported positively associated with number of kernels per cob and grain yield. For improvement of pest resistance and grain yield, it is necessary to know the magnitude and direction of relationships among agronomic traits, resistance parameters, and yield and yield component traits as this aids selection. The degree of correlation expresses the extent to which two characters are influenced by the same genes. The ear tip length is one of the traits that has not been highly explore in maize breeding but from this study, it revealed a significant positive relationship with number of borer per cob which indirectly affect the maize grain yield. This ear tip length can be of great resistance trait to stem borer as short or no ear tip in a maize cob affect the penetrating ability of the borer. Thereby reduces the infestation of stem proposed the possibilities for exploiting of natural plant defense mechanism of useful host defence trait in African agriculture (Tables 1-3) [12].

Table 1. *Means squares effect of yield traits of maize varieties and number of borers per cob evaluated under natural infestation of stem borers.*

SV	DF	EL	ETL	EDT	KPR	BPC
VARIETY	8	21.930**	1.144	1.498**	67.564*	0.831**
SAMPLE	9	9.065	0.124	0.197	75.418*	0.369
Error	59	5.362	0.689	0.136	34.685	0.153

Abbreviation: *, **, were significant at 0.05, 0.01 level. Length of the Ear (EL), Ear Tip Length (ETL), Ear Diameter (EDT), Kernel Per Row (KPR) and the number of Borers Per Corn (BPC), both length and diameter were in Centimeter (cm).

Table 2. *Mean separation of maize varieties for yield traits and number of borers per cob evaluated under natural infestation of stem borers.*

Variety code	EL	ETL	EDT	BPC	KPR	YIELD
TZEE-WSRBC5	13.72	1.11	4.05	1	28.2	1.72
BUSOLA STR	15.58	1.88	4.79	1.5	33.6	4.4
TZE COMP3 C2	18.06	0.99	4.99	0.5	34.2	4.53
FETZEE-WSTR	15.44	0.51	5.2	0.4	32.4	2.64
POP66SR/ACRa/ SUWAN	16.2	0.95	4.77	0.8	34.5	4.96
EV.8766-SRBC6QPM	13.23	0.78	4.49	1.2	29.8	3.21
POOLI85 SRQPM	16.29	1.38	5.04	1	30.67	1.45
BR9928-DMRSR(check)	15.7	1.5	4.03	2	26.75	2
BR9943-OMRSR(check)	17.03	1.39	5.08	3.33	29.78	3.7
DUNCAN VALUE, 0.05	2.76	0.99	0.44	1.07	7.03	0.75

Abbreviation: Length of the Ear (EL), Ear Tip Length (ETL), Ear Diameter (EDT), Kernel Per Row (KPR) and the number of Borers Per Corn (BPC), both length and diameter were in Centimeter (cm).

Table 3. *Correlation of the yield traits and number of borers per cob evaluated under natural infestation of stem borers.*

SOURCE	EL	ETL	EDT	KPR	BPC	YIELD
EL		0.004	0.585	0.696**	0.122	0.623*
ETL			-0.196	-0.278*	0.782*	-0.428
EDT				0.332**	0.389	0.235
KPR					-0.029	0.416
BPC						-0.636*
YIELD						

Abbreviation: Length of the Ear (EL), Ear Tip Length (ETL), Ear Diameter (EDT), Kernel Per Row (KPR) and the number of Borers Per Corn (BPC), both length and diameter were in Centimeter(cm).

Conclusion

From the results obtained, it was established that five of the maize varieties investigated with longer ear tip, lower number of kernels per row even including does that were bred for stem borer resistance were susceptible to stem borers. The ear tip length had a significant relationship with stem borer infestation which indirectly affect the grain yield. It is further concluded that BUSOLA STR, TZE COMP3C2 and POP66SR/ACRa/ SUWAN gave (15.91%, 54.54%), (18.32%, 55.85%) and (25.40%, 59.68%) increase in grain yield over check varieties BR9928-DMRSR and BR9943-OMRSR respectively.

Recommendation

Effort should be devoted to breeding of maize varieties with shorter or no ear tip for resistance to stem borer infestation. Isolation through the stem borer resistance characterization of maize varieties can inform breeder for selection of pest resistance.

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