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EVALUATION OF FORTY MAIZE GENOTYPES FOR RESISTANCE TO MAIZE STALK (*Sesamia calamistis* Hampson) BORER

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SUMMARY

Maize is the most cultivated cereal in the world followed by rice and wheat for its high nutritional value because of its carbohydrate content. However, sustainable maize production especially in the developing world is threatened majorly by stem boring species such as moths belonging to the families Noctuidae and Pyralidae. Therefore, the trial aimed at evaluating the performance of some selected maize genotypes under stem borer infestation. A screenhouse experiment consisted of 40 treatments (maize genotypes designated as M-G1 to M-G40), arranged in a Completely Randomised Design with three replicates. The maize genotypes were obtained from the Breeding Unit of the International Institute of Tropical Agriculture (IITA) Ibadan, Nigeria. Three trials were conducted; each trial comprised forty pots replicated three times, making a total of one hundred and twenty pots, filled with 15kg of steam-sterilized soil. Infestation of maize with stalk borers (*Sesamia calamistis*) was done by introducing four, 2nd instar larvae to each stand of maize at 4 weeks after sowing (WAS). Data were collected on the number of plants that suffered stem-lodging and dead heart. Also evaluated were plant height at 4, 6, 8, 10 and12 WAS, number of days to 50% tasseling, number of days to 50% silking, ear height, ear position, number of ear per plant, grain moisture, stem diameter, plant stand at harvest and grain weight. Results indicated that the maize genotypes M-G8, M-G9, M-G17, M-G20, M-G25 and M-G27 had lower severity of infestation. On the other hand, M-G39, M-G15, M-G27, M-G30, M-G32, M-G12, M-G16, M-G2, M-G37, M-G19, M-G18, M-G24, M-G28, M-G6, M-G13, M-G23, M-G7, M-G5, M-G34, M-G8, M-G9, M-G28, M-G17, M-G10, M-G22, M-G31 and M-G38 were tolerant to dead heart, while M-G1 M-G2, M-G6, M-G13, M-G14, M-G18, M-G19, M-G24, M-G29, and M-G33 were tolerant to rotten ear. In yield performance, M-G27 had the highest (24.33 g/plant) significant ($P \leq 0.05$) grain weight. Therefore, selection of maize genotypes such as M-G31, M-G23, M-G8, M-G17, M-G28, M-G9, M-G16, M-G5, M-G28, M-G34, M-G37, M-G27, M-G19, M-G10, M-G23, M-G38, M-G13, M- G4, M-G34 and M-G6 should be considered for possible maize stalk borers- tolerant genes evaluation.

Keywords: Genotype, Infestation, larvae, Maize, Severity, Stalk borer

Maize (*Zea mays* L.) is perhaps one of the most important cereal crops cultivated for food, livestock feed and industrial raw materials (22). 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 factors including abiotic constraints such as drought and nitrogen and biotic factors as viruses, bacteria, fungi and insect pests e. g. stem borers (22).

The major stem boring species associated with maize production in Nigeria are moths belonging to the families Noctuidae and Pyralidae, namely: maize stalk borer (*Busseola fusca* Fuller), pink stem borer (*Sesamia calamistis* Hampson), millet stem borer (*Acigona ignefusalis* Hampson) and African sugar cane borer (*Eldana saccharina* Walker); (15). Stem borers have been the most damaging group of insect pests in maize cultivation worldwide (21). They cause 10–100% losses in maize grain yield (19). Cock *et al*. (2017) reported that damage to maize varies among locations/regions, with sub-Saharan Africa recording the highest population of stem borer which results in high damage and grain yield loss. Stem borers infestation in maize causes damage to growing points (dead heart), and damage to leaf (windowpane effects) stem tunneling, hole (serve 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 (19). However, the consequence on yield is variable and depends upon sowing, borer species composition and abundance as well as insecticide treatment (3). Studies revealed that early-planted maize suffers less borer attacks than late-planted maize in the Middle Belt of Nigeria (15). Also heavy stem borer infestations have precluded the second cropping of maize even in areas with potential for two rain-fed crops (20). 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 (14).

Despite the cultivation and uses of maize, production is seriously constrained by stem borers. Inadequate information from various reports is still propagated on its distribution (11) and host range (13). Contrary to these reports, *Buseola fusca* does occur in the lower altitudes in East Africa and it feeds on only a few host plant species (12). During the last decade, the interactions of this insect pest with plants (4;6) as well as its reproductive biology (12) and genetics, (18) have been well documented in East African countries. In West Africa, *B. fusca* is only of economic importance in the dry agro-ecological zones (17) 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 action to borer feeding. Also, yield loss due to stem borer depends greatly upon the country, season, maize variety, severity of damage, stem tunneling and generation of stem borers involved. The first and second generations cause more yield loss than the third generation (15). This trial therefore aimed to evaluate the growth and yield parameters of selected maize genotypes under stalk borer infestation

MATERIALS AND METHODS

The trials were conducted in the screenhouse of the Department of Crop Production, Federal University of Technology, Minna. Minna lies on the latitude 90° 41' N, longitude 60° 30' E and altitude of between 200 and 300 m above sea level of Southern guinea savanna agro-ecological zone of Nigeria. It has a mean annual rainfall of 1200 mm. The rainfall has its peak in September and it usually begins in April and ends in of October. The temperature ranges between 35 and 37.5°C, with relative humidity between 60 and 80% in July and 40 and 60% in January (1). Soils in Minna originated from basement complex rocks and generally are classified as Alfisols (1). The actual coordinates and elevation of the sites were captured using GPS.

Soil sterilization

Steam method of soil sterilization was employed using metal trough. The trough consisted of two pieces of a metal drum (the upper and the lower). The upper piece was perforated at the bottom. The lower piece was positioned on a piece of metal stand having three legs for support and was then half filled with water. The upper piece was designed to fit tightly on the lower piece. This was then filled with soil and covered with a thick sack. A moderate hole was made to permit the thermometer to the top of the soil. The covering was done to ensure sterilization up to the soil surface. Dry pieces of fire wood were arranged under the metal stand and used to make a fire. The steam produced by the boiling water in the lower piece passed through the perforations at the bottom of the upper piece to effect sterilization of the soil until soil temperature reaches 100 °C (1)

Soil Sampling and Analysis

Surface soil samples were collected and air-dried, gently crushed, passed through a 2 mm sieve and thoroughly mixed together to determine the physical and chemical properties according to the method described by ISRIC/FAO (10). Some were further passed through a 0.5 mm sieve to determine the total nitrogen. The soil samples were analysed using standard methods as described by Agbenin (2). Particle size distribution was determined by the Bouyocous hydrometer method. Soil pH was determined in a 1: 2.5 soil to water using a glass electrode pH meter. Total Nitrogen was determined by the micro Kjeldahl method. Available phosphorus (P) was extracted by the Bray P1 method. Colour was developed in soil extract using the ascorbic acid blue method. Exchangeable K+ was extracted with 1N neutral ammonium acetate (NH_4OAc) solution and amounts of K+ in solution were determined using a flame photometer (10), (Table 1).

Collection of seed and treatment procedure

Seeds of forty maize genotypes (that are susceptible to stem borers) (M-G1 M-G2, M-G3, M-G4, M-G5, M-G6, M-G7, M-G8, M-G9, M-G10, M-G11, M-G12, M-G13, M-G14, M-G15, M-G16, M-G17, M-G18, M-G19, M-G20, M-G21, M-G22, M-G23, M-G24, M-G25, M-G26, M-G27, M-G28, M-G29, M-G30, M-G31, M-G32, M-G33, M-G34, M-G35, M-G36, M-G37, M-G38, M-G39 and M-G40) were obtained from the Breeding Unit of the International Institute of Tropical Agriculture (IITA) Ibadan, Nigeria. The experiments were laid out in Completely Randomized Design with three replicates. Three trials were conducted; each trial comprised forty pots replicated three times, making a total of one hundred and twenty pots filled with 15 kg sterilized soil per pot (Plate 1).

Plate 1: Maize plants in screenhouse prior to infestation of stalk borer

Crop establishment and management

Two seeds of maize were sown per pot containing fifteen kilogram (15 kg) of sterilized top soil, each stand was later thinned to one plant per stand. Artificial infestation of maize plants in each pot was done by introducing four, 2nd instar *Sesamia calamistis* larvae to each stand of maize at 4 weeks after sowing (WAS) maize using camel hair brush (21). N P K fertilizer was applied at 3WAS and urea was applied at 6 WAS to complement the N requirement of the crop at the rate of 120 kg N, 70 kg P and 83 kg **K ha**$^{-1}$. Weeding was carried out manually at 4 and 8 WAS. Harvesting was done manually at maturity

Data Collection

Severity of Stem borers' infestation: - 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 (7) as shown in Table 2

Table 2: Scale used for scoring stalk 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)

Plant height: Height of plants was measured in centimeters (cm) from the base of the plant to the last node using metre rule at 4, 6, 8, 10 and 12 WAS

Ear height (cm): Height of ear was measured in centimeters (cm) from the base of the plant to the node bearing the upper ear at harvest.

Stem diameter (cm): The stem diameter of each plant was measured using Vernier caliper.

Dead heart: The number of plants showing the death of growing points (dead heart) was counted. The proportion of dead hearts was evaluated as in equation 1:

$$\text{Dead heart (\%)} = \frac{\text{Number of plants with dead heart}}{\text{Total number of plants inspected}} \times 100 \quad (1)$$

Number of days to 50% tasseling: The number of days from sowing to the time when 50 % of the plants have produced tassels was counted (9)

Number of days to 50% silking: The number of days from sowing to the time when 50 % of the plants have produced silks was counted

Stem lodging: The number or percentage of plants that suffered lodging was scored on a scale of 1-5, where 1=no stem lodging and 5= heavy stem lodging

Ear position: The position of node where ear located on each plant was counted

Number of ears per plant: The number of ears per plant was counted

Moisture content at harvest: Grain moisture was taken by moisture tester at harvest in percentage.

Number of rotten ears: rotten ear was rated on a scale of 1-5, where 1= little or no visible ear rot and 5 = extensive visible ear

Plant stand at harvest: Total number of plants per pot obtained during harvest was counted.

Grain weight per plant (g): The weight of grains per pot was measured in g/plant.

Data Analysis

Analysis of variance (ANOVA) was performed using the General Linear Model

(PROC GLM) of Statistical Analysis System. The significance of difference among the treatments means were estimated using Duncan Multiple Range Test (DMRT) at 5% level of significance. Correlation coefficient was done to ascertain the relationship between stem borer severity and agronomic attributes of the maize genotypes. The data on dead heart, number of rotten ears, days to 50% tasseling, days to 50% silking, number of ears per plant, and grain weight were also subjected to cluster analysis to determine the relationships among the evaluated maize genotypes, using Unweighted Pair Group Method with Arithmetic means (UPGMA). Data analysis was done using the SAS statistical program (SAS, 2012).

RESULTS

Reactions of maize genotypes to *Sesamia calamistis* Infestation

The damaging effect of stalk borers' infestation on maize genotypes (Table 3) showed that genotypes M-G2, M-G5, M-G10, M-G15, M-G19 M-G40, M-G39, M-G34, M-G28, and M-G23 did not have a dead heart, while M-G1, M-G3, M-G4, M-G12, M-G13, M-G21 and M-G24 had higher percentage of dead heart. There was no significant difference among the maize genotypes for stem lodging effect of stem borers. The severity scale was significantly lowest ($p \leq 0.05$) in M-G8 compared to M-G5, M-G6, M-G12, M-G23, M-G13, M-G18, M-G19, M-G21, M-G23, M-G24, M-G33, M-G34, M-G34, M-G36 and M-G38, but were not significantly different from all other maize genotypes. Maize genotypes such as; M-G1, M-G2, M-G6, M-G24 and M-G33 had fewer ($p<0.05$) number of rotten ears compared to M-G7, M-G13, M-G17 and M-G39. Plant stand at harvest was higher in maize genotypes such as; M-G7, M-G22, M-G23 M-G26, M-G27, M-G40, M-G37, M-G32, M-G31, M-G30, M-G25, M-G28, M-G7, M-G17, M-G16 and M-G15, but no significant difference among the maize genotypes.

Maize genotypes M-G39, M-G40 and M-G15 were significantly taller than M-G17, M-G11, M-G10, but other genotypes were not significantly different from one another at 4WAS. At 6WAS, M-G15 recorded significantly ($P<0.05$) taller height than M-G3, M-G4, M-G9, M-G10, M-G18, M-G19, M-G21, M-G26, M-G36 and M-G39. Other maize genotypes were not significantly different from one another. However, at 8WAS, M-G15 was the tallest ($P<0.05$) genotype compared to other genotypes M-G6, M-G8, M-G9, M-G10, M-G11, M-G12, M-G17, M-G18, M-G19, M-G24, M-G26, M-G31, M-G33 and M-G36. M-G15 remained the tallest significant ($P \leq 0.05$) among other maize genotypes such as; M-G15, M-G12, M-G36 and M-G40.

At 12WAS, the same maize genotype, M-G15 was the tallest maize genotype followed by M-G40 compared to M-G36 and M-G12, while other maize genotypes were also taller than each other but no significant difference was recorded. Significantly larger stem diameter was recorded in M-G40 than M-G34, M-G33, M-G26, M-G24, M-G21, M-G17, M-G14 M-G9, M-G10 and M-G11 while other maize genotypes did not have significant difference($p>0.05$) with each other.

Yield performance of maize genotypes under *Sesamia calamistis* infestation (Table 5) showed that M-G40 had ($p<0.05$) highest position of ear compared to M36, M-G33 M-G24, M-G21, M-G20, M-G18, M-G13, M-G12, M-G10, M-G8, M-G6, M-G4, M-G3, M-G2 and M-G1. Similarly, the longest ($p<0.05$) ear was recorded in M-G40 compared to M-G8 and M-G13. Highest ($p<0.05$) number of the ear was recorded in

M-G39 followed by M-G34 compared to all other maize genotypes. M-G40 showed the significant highest ($p<0.05$) number of nodes than M-G6, M-G13, M-G19, M-G24, M-G29, M-G33, M-G34, M-G36 and M-G37. Moisture content was significantly ($p<0.05$) highest in M-G17 than M-G1, -G7, M-G9, M-G12, M-G18 M-G35, M-37and M-G40. The heaviest significant ($p\leq0.05$) grain weight (24.33 g/pot) was found in M-G27 which was not significantly ($p> 0.05$) different from M-G2, M-G16, M-G18, M-G22, M-G20, M-G23, M-G31, M-G36, M-G38 and M-G39.

Table 1: Physical and Chemical properties of soil the Soil

Parameters	Value
Particle size distribution (g kg^{-1}	
Sand	830
Silt	70
Clay	100
Textural class	Loamy sand
Chemical properties	
PH (1:2:5)	5.77
OC	6.87
Total N (g kg-1)	1.08
Available P (mg kg-1)	11.3
Exchangeable bases (cmolkg-1)	
Ca	3.20
Mg	1.30
K	0.08
Na	0.11
Exchangeable Acid	0.11

Table 2: Damage caused to maize genotypes by *Sesamia calamistis* infestation

GENOTYPE	DHR(%)	SLG	SC	NRE	PSH
M-G1	67	1.00^{b}	5.00^{a-d}	0.33^{b}	0.33^{a}
M-G2	00	1.00^{b}	4.67^{a-d}	0.33^{b}	0.33^{a}
M-G3	67	0.67^{b}	4.67^{a-d}	2.00^{ab}	0.33a
M-G4	67	1.00^{b}	5.33^{a-d}	2.00^{ab}	0.67^{a}
M-G5	00	0.67^{b}	6.67^{abc}	2.00^{ab}	0.67^{a}
M-G6	00	1.00^{b}	7.33^{abc}	0.33^{b}	0.33^{a}
M-G7	00	1.00^{b}	5.00^{a-d}	5.00^{a}	1.00^{a}
M-G8	00	1.00^{b}	1.00^{d}	1.67^{ab}	0.33^{a}
M-G9	00	1.00^{b}	3.33^{bcd}	3.67^{ab}	0.67^{a}
M-G10	00	1.00^{b}	5.67^{a-d}	2.00^{ab}	0.67^{a}
M-G11	33	1.00^{b}	4.67^{a-d}	2.00^{ab}	0.33^{a}
M-G12	67	2.00^{a}	6.33^{abc}	1.67^{ab}	0.33^{a}
M-G13	67	1.00^{b}	7.33^{abc}	0.00^{b}	0.33^{a}
M-G14	33	1.00^{b}	5.00^{a-d}	0.67^{b}	0.67^{a}
M-G15	00	1.00^{b}	5.00^{a-d}	3.67^{ab}	1.00^{a}
M-G16	00	1.00^{b}	6.00^{a-d}	2.33^{ab}	1.00^{a}
M-G17	00	1.00^{b}	3.00^{cd}	5.00^{a}	1.00^{a}
M-G18	00	1.00^{b}	6.33^{abc}	0.67^{b}	0.67^{a}
M-G19	00	1.00^{b}	7.00^{abc}	0.67^{b}	0.67^{a}
M-G20	00	1.00^{b}	3.33^{bcd}	2.00^{ab}	0.67^{a}

Means in the same column with the same superscripts are not significantly different at $p> 0.05$ using Duncan Multiple Range Test (DMRT)

KEY: SLG = Stem lodging, DHR =Dead heart (%), SC = severity score, NRE = number. of rotten ear, PSH = plant stand at harvest,

Table 3 : Damage c aused to maize genotypes by *Sesamia calamistis* infestation

GENOTYPE	DHR	SLG	SC	NRE	PSH
M-G21	67	1.00[b]	7.67[abc]	3.33[ab]	0.33[a]
M-G22	00	1.00[b]	5.33[a-d]	2.33[ab]	1.00[a]
M-G23	00	1.00[b]	4.67[a-d]	2.00[ab]	1.00[a]
M-G24	67	1.00[b]	6.67[a-c]	0.33[b]	0.33[a]
M-G25	33	1.00[b]	3.67[b-d]	3.33[ab]	0.67[a]
M-G26	00	1.00[b]	9.00[a]	1.00[ab]	1.00[a]
M-G27	00	1.00[b]	3.67[b-d]	1.00[ab]	1.00[a]
M-G28	.00	0.67[b]	4.67[a-d]	3.67[ab]	1.00[a]
M-G29	33	1.00[b]	5.67[a-d]	0.67[b]	0.67[a]
M-G30	00	1.00[b]	5.67a-d	2.33[ab]	1.00[a]
M-G31	00	1.00[b]	5.67[a-d]	1.00[ab]	1.00[a]
M-G32	00	1.00[b]	5.00[a-d]	2.33[ab]	1.00[a]
M-G33	33	1.00[b]	8.00[abc]	0.33[b]	0.33[a]
M-G34	00	1.00[b]	6.33[abc]	1.00[ab]	0.67[a]
M-G35	33	1.00[b]	5.33[a-d]	2.00[ab]	0.67[a]
M-G36	33	0.67[b]	8.33[ab]	1.67[ab]	0.33[a]
M-G37	00	0.67[b]	5.67[a-d]	3.67[ab]	1.00[a]
M-G38	00	1.00[b]	6.33[abc]	2.00[ab]	0.67[a]
M-G39	00	1.00[b]	4.67[a-d]	5.00[a]	1.00[a]
M-G40	00	1.00[b]	5.00[a-d]	2.33[ab]	1.00[a]
SE±		0.26	2.56	1.99	0.45

Means in the same column with the same superscripts are not significantly different at $p<0.05$ using Duncan Multiple Range Test (DMRT)

Table 4: Effect of *Sesamia calamistis* infestation on morphological performance of maize genotypes

GENOTYPE	PLH4(cm)	PLH6(cm)	PLH8(cm)	PLH10(cm)	PLH12(cm)	SD(cm)
M-G1	81.00[a-f]	89.33[a-f]	99.00[ab]	75.33[abc]	75.33[ab]	1.00[a-d]
M-G2	85.00[a-f]	90.00[a-f]	134.67[ab]	76.67[abc]	76.67[ab]	1.07 [a-d]
M-G3	60.00[c-h]	43.17[d-g]	66.33[abc]	100.00[abc]	110.33[ab]	1.37[a-d]
M-G4	60.00[c-h]	61.67[b-g]	95.67$_{ab}$	106.33[abc]	109.33[ab]	1.63[a-d]
M-G5	92.00[a-e]	89.00[a-f]	145.00[ab]	160.67[abc]	123.00[ab]	2.03[a-d]
M-G6	80.00[a-f]	113.00[ab]	63.33[b]	67.33[abc]	70.33[ab]	1.13 [a-d]
M-G7	89.67[a-e]	92.67[a-f]	126.00[ab]	150.33[abc]	151.33[ab]	1.70 [a-d]
M-G8	59.33[c-h]	77.67[a-f]	42.67[b]	76.00[abc]	104.00[ab]	1.27[a-d]
M-G9	64.67[b-g]	60.67[b-g]	55.33[b]	86.33[abc]	89.00[ab]	0.83[bcd]
M-G10	24.00[gh]	46.33[d-g]	52.00[b]	109.00[abc]	107.67[ab]	0.53[cd]
M-G11	42.67[fgh]	36.00[def]	28.67[b]	55.33[abc]	66.00[ab]	0.30[d]
M-G12	88.67[a-f]	64.33[b-g]	34.33[b]	37.67[bc]	16.67[b]	2.15[a-d]
M-G13	66.00[b-g]	88.67[a-f]	81.67[ab]	71.67[abc]	70.67[ab]	1.50[a-d]
M-G14	94.33[a-d]	108.33[abc]	122.67[ab]	129.33[abc]	135.33[ab]	1.57[a-d]
M-G15	121.67[a]	128.00[a]	205.67[a]	208.00[a]	208.33[a]	2.70[ab]
M-G16	87.00[a-f]	82.17[a-f]	148.33[ab]	163.33[abc]	169.67[ab]	1.63[a-d]
M-G17	45.67[e-h]	31.67[fg]	40.33[b]	80.00[abc]	83.67[ab]	0.60[cd]
M-G18	64.33[b-g]	55.33[c-g]	50.00[b]	60.33[abc]	59.33[ab]	1.33[a-d]
M-G19	68.67[b-f]	60.67[c-g]	64.67 [b]	85.67[abc]	84.67[ab]	0.83[bcd]

Means in the same column with the same superscripts are not significantly different at $p<0.05$ using Duncan Multiple Range Test (DMRT)

KEY: PLH = plant height, DHR =Death heart, SD = Stem diameter.

Table 4: Effect of *Sesamia calamistis* infestation on morphological performance of maize genotypes

GENOTYPE	PLH4(cm)	PLH6(cm)	PLH8(cm)	PLH10(cm)	PLH12(cm)	SD(cm)
M-G20	79.00[a-f]	79.00[a-f]	99.67[ab]	77.33[abc]	79.33[ab]	1.03 [a-d]
M-G21	72.67[b-f]	66.33[b-g]	74.33[ab]	116.67[abc]	121.67[ab]	0.80[bcd]
M-G22	101.67[a-d]	77.67[a-f]	127.33[ab]	135.33[abc]	132.67[ab]	2.13[a-d]
M-G23	105.33[abc]	77.33[a-g]	96.33[ab]	104.67[abc]	105.67[ab]	2.33[abc]
M-G24	58.00[d-h]	17.33[g]	47.67[b]	68.67[abc]	69.33[ab]	0.47[cd]
M-G25	82.33[a-f]	77.33[a-g]	77.67[ab]	116.33[abc]	120.00[ab]	1.77[a-d]
M-G26	19.33[h]	30.67[fg]	54.00[b]	106.33[abc]	142.33[ab]	0.63[cd]
M-G27	110.33[ab]	94.67[a-e]	166.33[ab]	175.67[ab]	174.00[ab]	1.87[a-d]
M-G28	89.00[a-e]	81.67a-f	100.33[ab]	117.33[abc]	120.00[ab]	2.70[ab]
M-G29	89.67[a-e]	86.67[a-f]	160.00[ab]	129.67[abc]	127.67[ab]	1.90 [a-d]
M-G30	99.33[a-d]	87.00[a-f]	138.67[ab]	132.67[abc]	133.00[ab]	2.23[a-d]
M-G31	107.00[ab]	100.83[a-d]	90.33[ab]	134.00[abc]	134.67[ab]	2.30[abc]
M-G32	91.67[a-e]	78.67[a-f]	115.33[ab]	115.33[abc]	120.67[ab]	1.77 [a-d]
M-G33	80.67[a-f]	77.33[a-f]	43.67[b]	59.00[abc]	57.33[ab]	0.47[cd]
M-G34	95.67[a-d]	77.33[a-g]	95.67[ab]	80.33[abc]	85.67[ab]	1.27[a-d]
M-G35	81.00[a-f]	89.00[a-f]	87.00[ab]	108.00[abc]	112.00[ab]	1.27[a-d]
M-G36	57.00[d-h]	55.33[c-g]	33.67[b]	33.67[c]	14.00[b]	0.57[cd]
M-G37	80.67[a-f]	66.33[b-g]	64.33[b]	68.33[abc]	67.00[ab]	1.23[a-d]
M-G38	105.00[abc]	121.67[ab]	110.00[ab]	97.00[abc]	97.33[ab]	2.07[a-d]
M-G39	122.33[a]	110.07[abc]	162.67[ab]	149.00[abc]	168.00[ab]	1.97[a-d]
M-G40	120.17[a]	122.00[ab]	144.67[ab]	195.00[a]	200.00[a]	2.80[a]
SE±	22.92	29.95	67.70	78.29	82.40	0.96

Means in the same column with the same superscripts are not significantly different at $p<0.05$ using Duncan Multiple Range Test (DMRT)

Table 5: Effect of *Sesamia calamistis* infestation on yield performance of maize genotypes

GENOTYE	DTS(day)	DSK(day)	EP	EH (cm)	EN	NND	MC(%)	GW(g/plant)
M-G1	59[a]	63[a]	3.00[b]	5.67[abc]	0.33[c]	6.33[a-d]	0.40[f]	0.33[e]
M-G2	57[a]	59[a]	3.67[b]	10.00[abc]	0.67[c]	6.67[a-d]	10.07[af]	13.93[a-e]
M-G3	43[a]	49[a]	3.67[b]	10.00[abc]	1.00[c]	9.67[a-d]	9.83[a-f]	1.40[de]
M-G4	44[a]	48[a]	3.67[b]	11.00[abc]	1.00[c]	8.33[a-d]	6.97[a-f]	3.63[cde]
M-G5	39[a]	42[a]	5.33[ab]	15.00[abc]	0.67[c]	8.33[a-d]	9.27[a-f]	1.50[de]
M-G6	44[a]	49[a]	3.00[b]	8.00[abc]	0.33[c]	5.00[bcd]	5.40[a-f]	5.30[cde]
M-G7	58[a]	61[a]	5.67[ab]	22.67[ab]	1.00[c]	14.00[abc]	15.40[af]	2.47[cde]
M-G8	36[a]	42[a]	2.00[b]	4.00[bc]	0.67[c]	7.00[a-d]	3.07[b-f]	0.07[e]
M-G9	39[a]	45[a]	4.00[ab]	12.33[abc]	0.67[c]	6.33[a-d]	1.03[ef]	0.53[e]
M-G10	39[a]	43[a]	2.33[b]	14.00[abc]	0.67[c]	9.67[a-d]	22.47[ae]	1.67[de]
M-G11	35[a]	42[a]	4.00[ab]	9.50[abc]	1.00[c]	7.33[a-d]	5.70[a-f]	0.94[de]
M-G12	48[a]	54[a]	2.67[b]	6.00[abc]	0.33[c]	7.33[a-d]	2.17[c-f]	0.70[e]
M-G13	53[a]	63[a]	1.67[b]	3.00[c]	0.33[c]	3.00[cd]	4.03[a-f]	0.53[e]
M-G14	37[a]	41[a]	4.33[ab]	12.67[abc]	1.00[c]	10.67[ad]	8.60[a-f]	3.93[cde]
M-G15	57[a]	65[a]	7.00[ab]	13.00[abc]	1.00[c]	16.00[ab]	6.23[a-f]	7.40[b-e]
M-G16	53[a]	59[a]	7.67[ab]	22.33[ab]	1.00[c]	11.33[ad]	11.53[af]	11.03[a-e]
M-G17	61[a]	65[a]	6.00[ab]	15.00[abc]	1.67[bc]	7.00[a-d]	24.80[a]	1.70[de]
M-G18	39[a]	44[a]	3.00[b]	7.87[abc]	0.67[c]	6.33[a-d]	5.27[a-f]	15.73[a-e]
M-G19	39[a]	44[a]	5.00[ab]	14.33[abc]	0.67[c]	5.0[d]	5.80[a-f]	4.03[cde]

Means in the same column with the same superscripts are not significantly different at $p< 0.05$ using Duncan Multiple Range Test (DMRT)

KEY: DTS = day to 50 % tasseling, DSK =day to 50 % silking, EN = number of ears, EP = ear position, EH =ear height, NND =no. of node, MC = moisture contents, GW = grain weight

Table 5: Effect of *Sesamia calamistis* infestation on yield performance of maize genotypes

GENOTYPE	DTS(day)	DSK(day)	EP	EH (cm)	EN	NND	MC (%)	GW(g/plant)
M-G20	34. 00[a]	40.00[a]	3.50[b]	11.00[abc]	1.00[c]	5.00[bcd]	19.25[a-f]	11.70[a-e]
M-G21	35.00[a]	41.00[a]	2.67[b]	12.67[abc]	0.67[c]	6.33[a-d]	24.23[ab]	0.17[e]
M-G22	51.00[a]	60.00[a]	7.33[ab]	24.67[ab]	1.00[c]	10.33[a-d]	6.40[a-f]	17.17[acd]
M-G23	60.00[a]	63.00[a]	4.67[ab]	14.00[abc]	0.67[c]	10.00[a-d]	10.20[a-f]	18.20[abc]
M-G24	47.00[a]	50.00[a]	3.00[b]	8.33[abc]	0.33[c]	5.33[bcd]	9.90[a-f]	2.10[cde]
M-G25	35.00[a]	41.00[a]	4.83[ab]	10.00[abc]	1.00[c]	10.00[a-d]	1.77[def]	1.35[de]
M-G26	57.00[a]	78.00[a]	6.00[ab]	13.67[abc]	1.00[c]	12.33[a-d]	23.07[a-d]	3.03[cde]
M-G27	57.00[a]	67.00[a]	7.67[ab]	21.33[ab]	1.00[c]	15.00[abc]	10.87[a-f]	24.33[a]
M-G28	60.00[a]	65.00[a]	6.00[ab]	24.00[ab]	1.00[c]	8.33[a-d]	24.40[ab]	1.03[de]
M-G29	36.00[a]	43.00[a]	6.33[ab]	15.67[abc]	0.67[c]	12.33[a-d]	18.47[a-f]	8.60[b-e]
M-G30	55.00[a]	65.00[a]	5.67[ab]	20.67[ab]	1.00[c]	14.00[abc]	12.33[a-f]	1.42[de]
M-G31	60.00[a]	68.00[a]	7.00[ab]	22.67[ab]	1.00[c]	12.33[a-d]	23.40[abc]	18.23[abc]
M-G32	54.00[a]	63.00[a]	6.33[ab]	22.33[ab]	1.00[c]	11.67[a-d]	4.03a-f	2.93[cde]
M-G33	40.00[a]	49.00[a]	2.00[b]	6.67[abc]	0.33[c]	3.67[cd]	17.37[a-e]	1.87[de]
M-G34	54.00[a]	65.00[a]	5.00[ab]	19.00[abc]	1.00[c]	6.00[bcd]	12.93[a-e]	6.00[cde]
M-G35	36.00[a]	43.00[a]	4.33[ab]	13.00[abc]	0.67[c]	9.00[a-d]	1.53[ef]	7.17[b-e]
M-G36	52.00[a]	60.00[a]	2.00[b]	4.67[abc]	2.33[b]	1.33[d]	1.53[ef]	9.57[a-e]
M-G37	60.00[a]	67.00[a]	5.67[ab]	13.67[abc]	1.00[c]	4.33[bcd]	4.03[a-f]	3.54[cde]
M-G38	35.00[a]	41.00[a]	4.00[ab]	10.67[abc]	1.00[c]	8.33[a-d]	8.63[a-f]	9.03[a-e]
M-G39	54.00[a]	63.00[a]	7.67[ab]	23.00[ab]	3.00[a]	12.00[a-d]	19.30[a-e]	22.47[ab]
M-G40	48.00[a]	56.00[a]	10.67[a]	25.33[a]	1.00[c]	18.33[a]	10.10[a-f]	1.50[de]
SE±	24.92	29.61	3.38	9.74.	0.66	5.99	10.10	7.96

Means in the same column with the same superscripts are not significantly different at $p<0.05$ by Duncan Multiple Range Test (DMRT)

KEY: DTS = day to 50 % tasseling, DSK =day to 50 % silking, EN = number of ears, EP = ear position, EH =ear height, NND =no. of node, MC = moisture content, GW = grain weight,

DISCUSSION

The reactions of maize genotypes to *S. calamistis* infestation, maize genotypes; M-G39, M-G15, M-G27, M-G30, M-G32, M-G12, M-G16, M-G2, M-G37, M-G19, M-G18, M-G24, M-G28, M-G6, M-G13, M-G23, M-G7, M-G5, M-G34, M-G8, M-G9, M-G28, M-G17, M-G10, M-G22, M-G31, M-G38 were tolerant to dead heart, M-G11, M-G14, M-G10, M-G29, M-G28, M-G35 and M-G36 were moderately susceptible, while M-G1, M-G3, M-G4, M-G12, M-G40, M-G21 and M-G24 were susceptible.M-G12, maize genotype was highly susceptible to stem lodging. Genotypes such as M-G39, M-G15, M-G17, M-G29, M-G30, M-G32, M-G14, M-G12, M-G3, M-G2, M-G1, M-G37, M-G19, M-G18, M-G4, M-G24, M-G11, M-G10, M-G6, M-G13, M-G23, M-G7, M-G21, M-G35, M-G34, M-G8, M-G9, M-G17, M-G40, M-G10, M-G22, M-G31, M-G28, M-G38 were moderately susceptible to stem lodging effect of stem borers infestation except few such as M-G5, M-G16, M-G28, M-G34 and M-G37 that were moderately tolerant. Even though the genotype did not show extreme resistance to stem borers' infestation, it significantly reduced borer damage. The performance of these maize genotypes agrees with finding of Bamaiyi and Oniemayin, (5) who stated that some maize varieties including Sammaz 14 and Flint have been reported to be tolerant to stem borers in Nigeria.

M-G8, M-G9, M-G17 and M-G28 were highly resistant to the severity damage effect of stem borers' infestation. M-G1, M-

G4, M-G7, M-G11, M-G14, M-G15, M-G16, M-G19, M-G22, M-G23, M-G28, M-G32, M-G35and M-G40 were moderately resistant. M-G6, M-G13, M-G39, M-G17, M-G29, M-G30, M-G12, M-G16, M-G2, M-G37, M-G18, M-G24, M-G11, M-G10, M-G5, M-G34, M-G31 and M-G38 were susceptible while M-G21, M-G23, M-G28 and M-G34 were highly susceptible. The number of rotten ears was lowest (0.00) in M-G13. M-G15 recorded the tallest (208.00cm) plant height and the tallest had been maintained from initial, 4WAS till 12WAS while M-G40 recorded the thickest (2.80cm) stem diameter. Plant stand at harvest was completed in some maize genotypes. In the case of yield and yield components, M-G28 had the less number (34.33) of days to 50% tasseling and shortest number (40.00) of days to 50% silking. The longest (25.33cm) maize ear was obtained from M-G40, while the highest number (3.00) of the ear was recorded from M-G39. The highest number (18.33) of a node was recorded from M-G40. Moisture content was highest (24.80 %) in M-G17 while M-G27 had the highest (24.33g/pot) grain weight, followed by M-G39, M-G23, M-G31, M-G22, M-G18, M-G2, M-G20 and M-G16 which also showed potential high grain yield.

CONCLUSION

The highest number of ears was acquired from M-G19, M-G39 and M-G40. M-G23, M-G28 and M-G33 had shortest days to 50% tasseling while M-G24, M-G28 and M-G33 had shortest days to 50% silking. The highest grain yield was recorded from M-G27. The aforementioned maize genotypes that performed distinctively in various aspects of maize production could be used in the selection for resistant genotypes against stem borers' infestation. Selection of maize genotypes such as M-G31, M-G23, M-G8, M-G17, M-G28, M-G9, M- G16, M-G5, M-G28, M-G34, M-G37, M-G27, M-G19, M-G10, M-G23, M-G38, M-G13, M- G4, M-G34 and M-G6 are recommended for possible maize stem borers- tolerant genes evaluation.

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