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Title: Correlation Between Agronomic and Stem Borer (Sesamia Calamistis) Resistant Traits In Sorghum (Sorghum Bicolor (L.) Moench)

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Abstract:

Stem borer *(Sesamia calamistis)* infestation remains a significant challenge in sorghum (Sorghum *Bicolor (L.) Moench*) cultivation, leading to substantial yield losses in Nigeria. This study is aimed at investigating the interrelationship between agronomic and resistant traits of stem borer *(Sesamia calamistis)*, and its influence on selection. The study was carried out at the research field of Plant Breeding Unit, Department of Agriculture Biotechnology, National Biotechnology Research and Development Agency. Forty (40) sorghum genotypes were assessed for their resistance based on parameters such as Leaf Damage, Dead Heart, Tunnel length, Exit Hole and some agronomic and yield components. The results revealed varying degrees of resistance among the genotypes, providing valuable insights for breeding programs aimed at developing stem borer-resistant sorghum varieties suitable for Nigerian agro-ecosystems.

Keywords: *Sorghum Bicolor, Sesamia Calamistis*, Stem Borer Resistance, Correlation, tunnel length.

INTRODUCTION

Sorghum bicolor (L.) Moench, commonly referred to as sorghum, is a vital cereal crop that plays a crucial role in the agricultural landscape of Nigeria. It serves as a staple food source for millions of Nigerian households, providing essential nutrients and contributing significantly to the diet of many communities. In addition to its role as food, sorghum is also a key economic asset for farmers, offering a source of income through both local and regional markets [1]. Despite its importance, the productivity of sorghum is often jeopardized by various biotic stresses, the most notable of which is the stem borer, specifically the species Sesamia calamistis. These pests are notorious for their devastating impact on sorghum crops. The larvae of Sesamia calamistis invade the stems of sorghum plants, where they bore into the tissue. This invasive feeding behavior leads to a range of detrimental effects, including wilting of the plants, increased susceptibility to lodging (the bending or breaking of stems), and a significant reduction in grain yield [2,3]. The economic implications of these yield losses cannot be overstated, as they threaten both food security and the livelihoods of farmers who rely on sorghum as a primary crop. In light of the rising challenges posed by stem borers and the critical role sorghum plays in the economy and diet of many Nigerians, there is an urgent need for research and development efforts aimed at breeding and implementing resistant varieties. Such initiatives are essential to safeguarding agricultural productivity, enhancing food security, and ultimately ensuring the sustainability of sorghum cultivation in the region [4].

OBJECTIVE

This study is aimed at investigating the interrelationship between agronomic and resistant traits stem borer *Sesamia Calamistis*, and its influence on selection.

MATERIALS AND METHODS

Experimental Site: The study was conducted at the research field of Plant Breeding Unit, Department of Agriculture Biotechnology, National Biotechnology Research and Development Agency in Nigeria. Forty (40) elite sorghum genotypes were selected for evaluation based on their potential for resistance to stem borer. The experiment was designed utilizing a randomized complete block design (RCBD), which included three separate replications to ensure accurate and reliable results. Stem and leaf damage assessment, agronomic and yield component analysis were performed to determine the resistance levels of the genotypes .

Data Collection:

Quantitative data were recorded on agronomic traits, Germination percentage, seedling Vigor, days to 50% flowering, plant height, number of leaves, panicle length, panicle weight, and 100-seed weight were collected while mean scores for the resistance traits we collected and standardized. The plant's height was measured from its base to the top of its head when it reached full maturity. The total number of leaves was counted from the first leaf up to the flag leaf. Leaf length data were taken from the base to tip of the leaf, Panicle length was recorded by measuring each panicle from its base to its tip, with its width measurements recorded at the widest part in natural position. 100-seed weight were taken after harvest, and sun-dried at moisture content of approximately 12%. Panicle weight was used to determine yield per hectare, by multiplying the average grain weight per panicle with the total number of plants in a hectare [1,5], considering germination failure and premature plant death.

Data Analysis: Since the units of measurements for different traits were not the same, mean scores for the some traits were standardized [2,6] using Microsoft Excel 2013 computer program. Data standardization followed the expression x = (x-m)/sd, where x = score, m = group mean, sd = group standard deviation. While the remaining data were subjected to analysis of variance (ANOVA) using STAR, also Statistical significance of correlation coefficients for different trait associations were determined using GenStat (14th edition) computer software.

Results:

The results of the study indicated significant variability among the sorghum genotypes in terms of resistance to *Sesamia Calamistis* infestation. Some genotypes exhibited minimal stem damage compared to others, suggesting higher levels of resistance. Yield component analysis further supported the identification of genotypes with superior resistance traits, offering potential candidates for further breeding efforts.

Positive correlations between one thousand grain weight and seedling vigor score (r = 0.6) (P= 0.002), one thousand grain weight and grain yield per plant (r =0.6) (P=0.002), grain yield and seedling vigor (r = 0.6) (P=0.002), One thousand grain weight and plant height (r = 0.6) (P=0.03), grain yield and plant height (r = 0.6) (P= 0.007) were highly significant (Table 1).

Highly significant negative correlations was observed between grain yield and leaf damage (r = -0.5) (P= 0.03). Negative correlations were also observed between days to 50 % flowering and panicle length (r = -0.4) (P= 0.04) One thousand grain weight and dead heart damage had a negative correlation (r = -0.5) (P=0.03) (Table 2). Significant negative relationship was observed between seedling vigor score and stem tunneling (r = -0.4). A negative correlation was observed between dead heart damage and seedling vigor (r = -0.5) (P=0.01) and leaf damage (r = - 0.4) (P= 0.03) (Table 3).

A negative relationship existed between leaf damage and seedling vigor (r = -0.4) (P= 0.06), leaf damage and panicle length (r = -0.5) (P=0.03).

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Table 1. Mean Squares for Agronomic Traits

Source Of Variation	Degree Of Freedom	Germination percentage	Seedling Vigor	Panicle length	Plant Height	1000GW	Day to 50% Flowering	Grain Yield
Pedigree	39	4356.8376**	8.2596**	16.4164*	547.4639**	3.6569**	72.1162**	9142.3077**
Error	80	375.000	1.5500	13.3488	916.4153	4.0835	68.047	10208.7500
Total	119							

Table 2. Mean Squares for Resistant Traits

Source Of Variation	Degree Of Freedom	Leaf Damage (2 WKS)	Leaf Damage (4WKS)	Dead Heart	Dead Heart (2wks)	Dead Heart (4kws)	Exit Hole	Tunnel Length
Pedigree	39	1122.7350**	1790.6838**	19.8288**	11.22.7350**	1989.6581**	0.4752*	0.705*
Error	80	376.6667	600.0000	18.6500	376.6667	720.000	0.4583	0.8671
Total	119							

* Significant at 5% level, ** Significant at 1% level

Table 3. Correlations between Stem Borer *Sesamia Calamistis* damage and agronomic traits in sorghum.

1000 grain weight	1	1										
50 % flowering	2	0.1	1									
Dead heart	3	-0.5*	-0.2*	1								
Grain yield	4	0.6*	0.2	-0.4**	1							
Leaf damage	5	-0.3*	-0.1	0.5	-0.5*	1						
No. of exit holes	6	-0.1*	-0.1	0.0	-0.1*	0.3	1					
Panicle length	7	0.1*	-0.4*	-0.2*	0.1	-0.1	-0.1*	1				
Plant height	8	0.6*	0.3	-0.2*	0.6**	-0.6*	-0.6*	0.5*	1			
Seedling vigour	9	0.6**	0.2	-0.5*	0.6**	-0.4*	-0.6*	0.4*	0.6*	1		
Selection index	10	0.0	0.0	0.1*	0.3	-0.3	-0.3	0.1	0.3	0.4*	1	
stem tunneling Length	11	-0.2*	0.1	0.1	-0.2	0.3	0.4	-0.4	-0.2	-0.3	-1.0	1
		1	2	3	4	5	6	7	8	9	10	11

* Significant at 5% level, ** Significant at 1% level

Discussion:

The observed variability in resistance levels among the sorghum genotypes underscores the importance of genetic diversity in combating stem borer infestation. Genotypes exhibiting high resistance can serve as valuable genetic resources for breeding programs aimed at developing pest-resistant sorghum varieties tailored to Nigerian agro-ecosystems. Additionally, the utilization of confined environments such as screen houses allows for controlled evaluation of resistance traits, providing valuable insights for subsequent field trials.

The positive relationship between grain yield and plant height suggests that taller plants tend to produce more grain than shorter ones. In the conditions created by this trial, sorghum genotypes exhibiting poor seedling vigor (characterized by low vigor scores) generally produced lower grain yields compared to those with highly vigorous seedlings. This difference may be because the whorls of less vigorous genotypes created a more favorable environment for stem borer larvae. [3,7]

Plants exhibiting high seedling vigor scores, characterized by the production of robust seedlings, demonstrated reduced incidences of dead heart damage and attained markedly higher yields. This observation suggests that the enhancement of seedling vigor may facilitate the development of genotypes exhibiting greater tolerance to stem borer damage. Such findings are consistent with the work of Odiyi (2007) [4] , who noted that vigorous maize plants incurred less damage from Eldana saccharina and Sesamia calamistis, ultimately resulting in elevated yields. Additionally, the link between seedling vigor and resistance to stem borer damage in sorghum, as noted by Dhillon et al. (2005) [5], deserves further consideration. A negative correlation was found between dead heart incidence and one thousand grain weight, suggesting that higher stem borer damage is associated with lower grain weight [8-10]. In this artificially-infested trial, sorghum genotypes with high seedling vigor scores produced higher grain yields, supporting the earlier findings of Researcher [11-14]. There was also a strong positive correlation between grain weight and plant height, indicating that taller genotypes produced significantly higher yields than shorter ones [15].

Conclusion: In conclusion, this study unequivocally demonstrates the significant variability in resistance to stem borer (Sesamia calamistis) infestation among selected elite genotypes of Sorghum bicolor (L.) Moench in Nigeria.

The identification of genotypes with superior resistance traits provides a promising avenue for breeding efforts aimed at developing stem borer-resistant sorghum varieties. Continued research and collaboration between breeders, entomologists, and agronomists are crucial for enhancing sorghum productivity and ensuring food security in Nigeria.

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