GENETIC STUDIES OF SORGHUM CULTIVARS UNDER *STRIGA* INFESTATION IN NORTHERN GUINEA SAVANNAH OF NIGERIA.

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Abstract

Performances of five genetically diverse but homozygote sorghum cultivars were studied under uniform Striga infestation for three years in one location, using randomized complete block design with three replications. The genotypic performance revealed enough variability for further improvement. KSV-4 and SK-5912 are least affected by Striga activities, with their resistance dominant over susceptibility, thus, they are promising resistant cultivars. Genetic analysis revealed genetic component of variance to be higher in magnitude for shoot weight, Striga count and grain yield than those of genotype x year and error component of variance. Inheritance of Striga resistance traits was quantitatively inherited for grain yield (89.96%), Striga count (88.53%), plant height (82.75%), plant vigour (81.33%) and stem girth (51.74%).

Key words: Variance components, heritability, genotypic performance, resistance, sorghum, *Striga.*

INTRODUCTION

Sorghum (*Sorghum bicolor* (L.) Moench), commonly called Guinea corn is mainly grown in the tropics and Semi-Arid Tropics, which include Asia and Africa. The grains are harvested for food, animal feeds and other industrial uses (Baidu-Forson and Ajayi, 1995). Recent statistics revealed that percentages of world area and production are on the decline principally due to devastating effect of *Striga hermonthica* in Semi-Arid Tropics especially in Nigeria, crop loses of up to 90% and an estimated $250 million US are lost due to *Striga* activities annually (FAO, 1987; Lagoke *et al*, 1991).

Preliminary and confirmed studies have shown the importance of some agronomic traits in response to *Striga.* Such traits serve as resistance traits or selection criteria on the basis of their significant genetic variability and correlations (Obilana, 1981; Showemimo *et al*, 1998; Showemimo, 2003). Knowledge of inheritance of resistance to *Striga*, genetic variance components and genotypic performance would, therefore, be useful in developing *Striga* resistant cultivars or genotypes.

This paper reports the genotypic performance, mode of inheritance and magnitude of genetic variance controlling *Striga* resistance traits in sorghum under *Striga* infested field condition for a period of three years in one location.

MATERIALS AND METHOD

The plant materials used for this study are elite sorghum cultivars adapted to the northern Guinea, Sudan and Sahel Savannas of Nigeria (SK-5912, KSV-4, NR-71150, NR-71182 and L-2123).

The research was carried out in the research field of Institute for Agricultural Research Samaru ($11^0$11'N; 07038'E at 686m above sea level), Nigeria. Five sorghum cultivars (referred herein as genotypes) were evaluated for three cropping seasons in one location to avoid *Striga* spread under uniform *Striga* infestation following the procedures of Vasudeve Rao (1985). The experiment was laid in randomize complete block design, replicated three times. The plot size was 5m long, 0.75m x 0.25m inter and intra row spacing respectively. Single superphosphate fertilizer was applied at 32kg/ha before planting, while Urea fertilizer was applied in two dosages; 32kg/ha as basal and another 32kg/ha as top dressing 3 and 6 weeks after planting. Weeds apart from *Striga hermonthica* were manually removed regularly. Other cultural managements to raise a successful was done as prescribed by IAR, (1993)

Data analysis were done for plant vigour (1-5 Visual scale), stem girth (cm), root weight (gm), shoot weight (gm), plant height (cm), *Striga* count and grain yield (t/ha). Square root data transformation was done for count data. Genetic analyses were done to obtain estimate of variance components (δ^2_p = phenotypic, δ^2_g = genotypic δ^2_{gy} = genotype x year, δ^2e = experimental error) and broad sense heritability (h^2). Performance analyses were done to obtain means and analysis of variance as outlined by Comstock and Robinson, (1952); Snedecor and Cochram, (1967); Singh and Chaudhary, (1979); Gomez and Gomez, (1984).

RESULTS AND DISCUSSION

There was enough variability among the varieties evaluated under *Striga* infestation, mean squares though not shown revealed highly significant effect among the genotypes and years of evaluation for all the traits except root weight and stem girth that are significant at $P \leq 0.05$. The genotypes x year interaction are highly significant for all the traits. These significant genetic variations indicate selection possibilities for a good breeding programe.

The genotypic performance analysis as shown in Table1, revealed the effect of *Striga* on sorghum grain yield under infested and non-infested field condition. NR-71150 is the most affected with a mean grain yield of 1.1t/ha however; it is the second best genotype when not infested (2.3t/ha). Thus, it is highly susceptible under *Striga* infestation. Two varieties SK-5912 and KSV-4 yielded higher than the grand mean, 2.2t/ha and 2.0t/ha under *Striga* infestation respectively, thereby indicating tolerance/resistance potentials to *Striga* infestation. NR-71150, NR-71182 and L-2123 had the highest percentage grain yield reduction due to *Striga* activities 90%, 80% and 60% respectively. These genotypes are highly susceptible to *Striga*. KSV-4 and SK-5912 are least affected by *Striga* activities as seen by their deviation from mean and their percentage grain yield reduction of 10% and 30% respectively, thereby, revealing their resistance/tolerance to *Striga* infestation. The effect of *Striga* on plant vigour, stem girth and root weight is shown in Fig.1 for all the varieties. The most vigorous genotype is NR-71182 (initial competitive vigor) while the least vigorous is NR-71150. The following; SK-5912, NR-71150, KSV-4 had the best stem girth, while KSV-4, L-2123, and NR-71182 had the highest root weight. Fig.2, show the effect of *Striga* on plant height, shoot weight and the total number of emerged *Striga* on the sorghum genotypes. SK-5912 and KSV-4 accommodated less *Striga*, therefore, confirming their resistance/highly tolerance status. L-2123 had the least shoot weight, while the tallest genotypes are SK-5912 and KSV-4 (in contrast to known effect of *Striga* to reduce plant height and retard growth). The genotypic performance revealed inherent genetic variability in their response to *Striga* infestation. This result of exploiting genetic variability in sorghum – *Striga* evaluation conforms to those of Obilana, (1981); Ramaiah, (1987) and Showemimo *et al*, (1998). KSV-4 and SK-5912 are promising genotypes with some level of *Striga* resistance.

The estimates of components of variance and heritability are presented in Table 2. The phenotypic variance (δ^2_p) has the highest magnitude for all the traits. The total genetic variance (δ^2_g) among the genotypes is of higher magnitude for shoot weight (2.0093) *Striga* count (2.3589) and grain yield (0.0078) than the genotype x year interaction and error variance. This implies that genetic component of variance is in control of their expression under *Striga* evaluation with little or no environmental influence. Though δ^2_g was not partitioned into additive and dominance components (δ^2_A and δ^2_D), but the deviation from mean, suggests strongly, the dominance of resistance over susceptibility for SK-5912 and KSV-4 in their grain yield since this traits is an important criteria in selecting for *Striga* resistant/tolerant varieties. Negative genetic variance component was obtained for stem girth (but considered low) this could be due to deficiency in sample size, statistical or genetic model used. However the interaction component of variance has higher magnitude for plant vigour, stem girth, root weight and plant height (0.0137, 0.0134, 0.1027 and 11.0021, respectively). High broad sense heritability was obtained for all the traits except root weight (5.50%) and shoot weight (14.25%). The high heritability signifies positive response, quantitatively heritable, repeatable and transmitability of these traits in selection, thus, these traits are easily selected and further improvement of *Striga* resistance can be made in the desired genotypes. Similar result was obtained by Obilana, (1984); Ejeta and Butler, (1993) and Ejeta *et al*, (1997).

In conclusion, this study revealed enough genotypic variability for selection, thus, the performance analyses revealed that KSV-4 and SK-5912 are promising resistant genotypes. Genetic variance components is influential in the expression of shoot weight, number of *Striga* and grain yield that are very important selection criteria for *Striga* resistance. All the traits are quantitatively heritable, thus, repeatability of result, and the traits can be easily improved on.

Tab. 1.: Mean grain yield of five sorghum cultivars under *Striga* evaluation.

	Mean grain yield (t/ha)		**Deviation**	
Genotype	**Infested**	**Non-infested**	**from mean**	**% Reduction**
SK-5912	2.2	2.5	0.52	30
KSV-4	2.0	2.1	0.32	10
NR-71150	1.1	2.0	-0.58	90
NR-71182	1.5	2.3	-0.18	80
L-2123	1.6	2.2	-0.08	60
Mean	1.68	2.22	0.00	54
C.V (%)	17.6	13.9		

Tab. 2.: Estimates of components of variance and heritability (%) for seven *Striga* resistance evaluation traits in sorghum.

Trait

Component	Plant vigour	Stem girth	Root weight	Shoot weight	Plant height	Striga count	Grain yield
δ^2p	0.1189	0.0288	0.7213	14.1051	75.2500	24.5268	0.0757
δ^2g	0.0064	-0.0044	0.0397	2.0093	4.2169	2.3589	0.0078
δ^2gy	0.0137	0.0134	0.1027	0.1584	11.0021	1.9400	0.0064
δ^2e	0.0169	0.0011	0.0484	0.9409	3.9601	1.7424	0.0025
H (Bs)	81.33	51.74	5.50	14.25	82.75	88.53	89.96

Fig. 1 : The effect of *Striga* on plant vigour, stem girth and root weight of five sorghum varieties

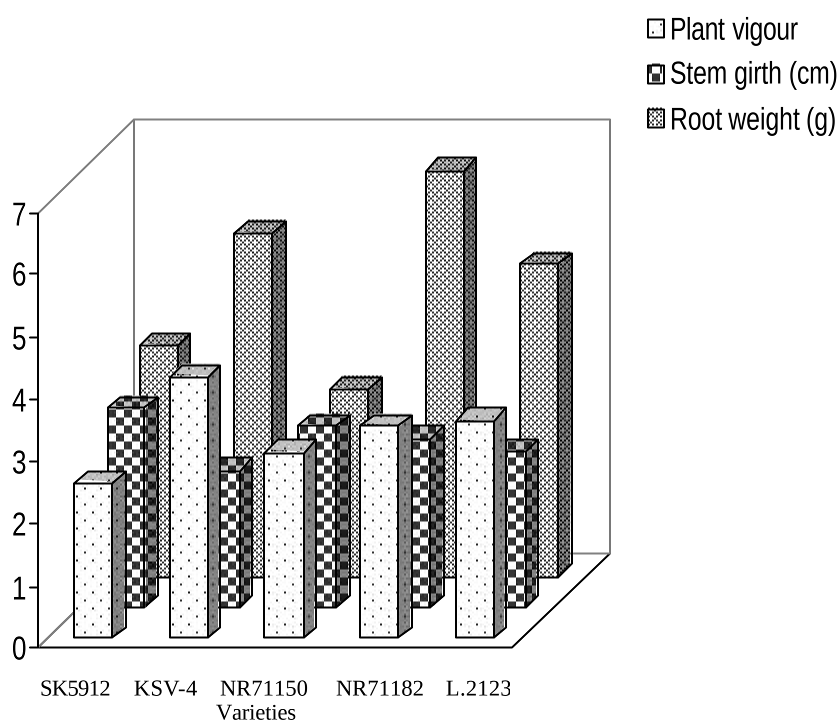
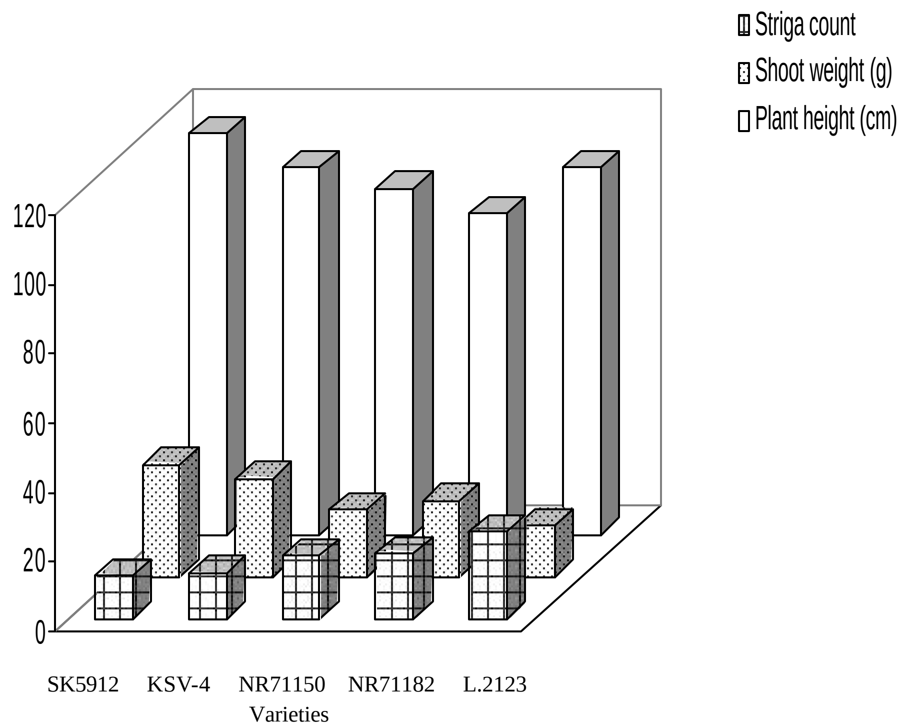


Fig. 2: the effect of *Striga* on plant height, shoot weight and *Striga* count of five sorghum varieties.



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