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Effect of *Striga hermonthica* on Yield and Yield Components of Sorghum in Northern Guinea Savanna of Nigeria*

Francis A. Showemimo
Department of Plant Science, Institute for agricultural Research,
Samaru Ahmadu Bello University, Zaria, Nigeria

Abstract: Study on the effect of *Striga hermonthica* (Del.) Benth on yield and yield components of sorghum was conducted in a split-plot experiment institute for Agricultural Research, Samaru in the Northern Guinea Savanna Zone of Nigeria. The infestation treatment (infested and uninfested) and 5 commercial sorghum cultivars were the main and sub-plot treatments, respectively, *Striga* infestation reduced plant height, panicle length, panicle weight, 1000 grain weight and grain yield by 13.7, 35.9, 52.9, 64.5 and 52.6%, respectively. The yield and yield components were quantitatively heritable. *Striga* stress on pre-flowering traits resulted in between 14 and 50% reduction in seedling vigor and delayed flowering from 2 to 9%, while post-flowering traits of panicle weight and grain yield were reduced from 8 to 37% and 5 to 45%, respectively. Samsorg-17 and Samsorg-3 are identified as potential resistant/tolerant sources of *Striga hermonthica*.

Key words: Parasitic weed, sorghum, yield and yield components

Introduction

Striga, also known, as witchweed is endemic to the tropic and sub-tropical zones; they belong to the family Scrophulariaceae. There are about 30 *Striga* species in the world; out of which 23 species occurs in Africa while 16 species are prominent in West Africa (Dixon and Parker, 1984; Dogget, 1988). Two species; *S. asiatica* (L.) Kuntze and *S. hermonthica* (Del.) Benth cause economic losses to important cereal crops, such as sorghum, millet, maize and rice in Africa, while *S. gesnerioides* (Willd.) Vatke is parasitic to legumes, tobacco and sweet potato. *Striga* especially *S. hermonthica* has a marked influence in growth and allometry of it host plant (Musselman, 1987; Parker, 1991).

Grain losses of sorghum due to *Striga hermonthica* are difficult to estimate, however, Doggett (1988) reported 59% estimated loss. Ramaiah (1987) reported 10-35% loss and an African regional scale average loss of between 5 and 15% (Riches and Parker, 1995). Heavy infestation by these notorious hemiparasites have caused farms to be abandoned at times migrations of farming communities (Lagoke *et al*., 1991).

Considerable work has been done on control of *Striga* on a global scale, but not much has been reported in the Northern Guinea Savanna of Nigeria as regards the effect of *Striga hermonthica* on yield and yield components of sorghum. Thus, a prerequisite to selection and subsequent crop improvement program in sorghum to *Striga*. Therefore, the objectives of this investigation was to study the amount of damage done by *Striga* on yield and yield components, economic importance of the parasite and screening known commercial sorghum cultivars for resistance/tolerance to *Striga hermonthica*.

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Materials and Methods

This investigation was conducted with five commercial sorghum cultivars adapted to the Nigerian savannas. The study was conducted under uniform artificial *Striga* seed infestation at Institute for Agricultural Research (IAR) Samaru (11°11'N, 7°38'E) As recommended by Vasudera Rao (1985).

The five sorghum cultivars were bred and released for farmers' use by IAR (Samsorg 3, 11, 17, 38 and 39). They were sown for two seasons (1995 and 1996) in field plots infested with *Striga* seeds (obtained from previous season) and in non-infested field plots (control). The experimental design was split-plot, where infestation treatments (infested and uninfested or control) were in the main plot and the sorghum cultivars were the sub-plot treatments. Main plot treatments were laid down in randomized complete block design replicated three times. The sub-plot was 4 rows, each row is 5 m long with 0.8m and 0.3m inter and intra row spacing respectively. Spot application of *Striga* seeds using a calibrated scoop, was also done for each crop stand. The *Striga* seeds has about 40% germinability, thus, approximately 3,500 seeds/scoop/stand was applied. The sorghum cultivars were sown three days after infestation. The same plot size was used for the uninfested (control). All cultural and crop management practices were observed to raise a successful crop as recommended by IAR (1993). Weeds other than *Striga* were removed manually (both hoe weeding and hand pulling) on a regular basis.

Data were recorded for seedling vigor (1 = least vigorous and 5 most vigorous), days to 50% flowering, plant height (cm), panicle length (cm), panicle weight (kg), 1000- grain weight (g) and grain yield (t ha^{-1}). The obtained data were subjected to statistical and breeding analysis; analysis of variance, mean, broad sense heritability and coefficient of variation (genotypic and phenotypic), as used and suggested by Gomez and Gomez (1976), Singh and Chaudhary (1985).

Results and Discussion

Mean data of the sorghum cultivars across the two seasons are presented since analysis of variance revealed that seasons and seasons x cultivars interaction were not significant for all the traits studied. Yield and yield components of Samsorg-39 (Susceptible cultivar) under non-infested condition (Table 1) and infested *Striga* condition (Table 2) revealed that *Striga* infestation reduced plant height, panicle length, panicle weight, 1000 grain weight and grain yield by 13.7, 35.9, 52.9, 64.5 and 52.6%, respectively. The maximum height Samsorg-39 could reach under *Striga* infested and uninfested condition was 110.2 and 121.3 cm, respectively, while the maximum grain yield potential was 4.1 t ha^{-1} under uninfested condition as compared to 2.5 t ha^{-1} under *Striga* infestation. Broad sense heritability was lower under infested condition when compared to uninfested condition for all the traits (Table 1 and 2). These indicated that both genetic and phenotypic constituents of the cultivars are affected by *Striga* infestation. However, the high heritabilities revealed that, these traits are highly and quantitatively inherited and thus, indicating presence of additive gene action. The difference in genotypic and phenotypic coefficient of variability of all traits under uninfested condition is less than 1%, thus, indicating little environmental influence on the traits performance. However, under infested condition, their differences are more than those under uninfested condition and the magnitude of phenotypic coefficient of variation are more than those under uninfested condition. The differences and variability recorded are principally due to the effect of *Striga* as part of the environment. Similar results had been reported by Obilana and Ramaiah (1992), Vogler *et al.* (1996) on sorghum, maize and pearl millet.

Table 1: Yield and yield component of sorghum (Samsorg-39) under non-infested condition

Trait	Mean±SE	Range	H (%)	CV Genotypic	CV Phenotypic
Plant height (cm)	112.8±21.43	95.0-121.3	78.4	9.3	9.9
Panicle length (cm)	29.5±0.84	22.4-35.7	51.9	21.7	22.3
Panicle weight (kg)	1.7±0.09	1.4-2.5	60.3	11.5	12.1
1000-grain weight (g)	30.7±0.96	26.3-37.2	57.1	13.3	13.8
Grain yield (t ha^{-1})	3.8±0.31	2.6-4.1	55.4	10.6	11.4

Table 2: Effect of *S. hermonthica* on yield and yield components of Sorghum (Samsorg-39)

Trait	Mean±SE	Range	H (%)	CV Genotypic	CV Phenotypic
Plant height (cm)	97.4±9.15	94.1-110.2	70.5	7.9	10.3
Panicle length (cm)	18.9±1.01	15.0-23.9	48.1	20.5	25.6
Panicle weight (kg)	0.8±0.03	0.55-1.7	55.9	10.7	14.1
1000-grain weight (g)	10.9±0.86	9.9-20.1	53.6	9.9	11.4
Grain yield (t/ha)	1.8±0.14	1.3-2.5	50.3	10.1	13.6

Table 3: Effect of *S. hermonthica* on some pre and posts flowering traits of 5 sorghum cultivars averaged over 2 years

Cultivar	Seedling Vigor Con.	Seedling Vigor Inf.	Days to 50% flowering Con.	Days to 50% flowering Inf.	Panicle weight Con.	Panicle weight Inf.	Grain yield Con.	Grain yield Inf.
Samsorg-3	4.3	3.7 (14)	66.2	69.1 (-4)	2.0	1.6 (20)	3.9	3.4 (13)
Samsorg-11	3.3	1.9 (42)	70.4	75.2 (-7)	1.6	1.1 (31)	2.7	1.9 (30)
Samsorg-17	4.7	4.0 (15)	74.5	75.9 (-2)	2.4	2.2 (8)	4.0	3.8 (5)
Samsorg-38	3.6	2.9 (19)	80.8	84.7 (-5)	1.9	1.2 (37)	3.8	2.1 (45)
Samsorg-39	4.0	2.0 (50)	78.1	84.8 (-9)	2.3	1.5 (35)	3.9	2.3 (41)
Mean	4.0	2.9(28)	74.0	77.9 (-5)	2.0	1.5 (25)	3.7	2.8 (24)
SE (±)	0.30	0.51	4.11	3.51	0.22	0.17	0.88	0.26

Numbers in parenthesis are % change., Con.= Control and Inf.= Infested

Striga reduced seedling vigor of Samsorg-3 by 50% and Samsorg-11 by 24% while Samsorg-3 by 41%. Days to 50% flowering was delayed by 9% for Samsorg-39, panicle weight was reduced by 37% for Samsorg-38 and grain yield was reduced by 45% for Samsorg-38. The least affected cultivars by *Striga* infestation are Samsorg-17 and Samsorg-3 for both pre and post flowering traits studied (Table 3). Averagely, (across cultivars and 2 years of evaluations) *Striga* infestation reduced seedling vigor by 28%, delay days to 50% flowering by 5%, reduce panicle weight and grain yield by 25 and 24%, respectively. The result of this study agree with those of Ramaiah (1991) on sorghum and millet, Gworgwor and Weber (1991) on sorghum and Ransom *et al.* (1996) on maize, that *Striga* infestation cause substantial damage to yield components, yield loss and eventually economic loss of crops to the farmer(s).

Conclusions

Striga hermonthica is an economically important parasitic weed of sorghum. The infestation affect pre and post flowering stages of the crop growth phases; about 50% reduction in seedling vigor and 9% delayed days to 50% flowering for pre-flowering stress, while post flowering traits under *Striga* stress resulted in 37% reduction in panicle weight and 45% reduction in grain yield. All the yield and yield component traits studied were quantitatively inherited with sufficient cultivars variability that resulted in Samsorg-17 and Samsorg-3 being resistant/tolerant to *Striga hermonthica*.

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