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Website: www.aarf.asia Email : editor@aarf.asia , editoraarf@gmail.com

RELATIONSHIP BETWEEN STRIGA (Striga hermonthica L. Benth) AND MILLET (*Pennisetum glaucum* (L.) Br.) IN NORTHERN NIGERIA

***Garba A. A. and **Mohammed M.I.**
*Crop Production Department, Faculty of Agriculture, Abubakar Tafawa Balewa University, Bauchi, Nigeria.
**Lake Chard Research Institute, Maiduguri, Borno State, Nigeria.

ABSTRACT

Studies on the relationship between Striga and Millet revealed the impact of witch weed in reducing the performance of the crop. Characters like vigor score, plant height, days to 50% flowering, days to maturity, parnicle length, stand count, straw weight and 1000 seed weight all responded to the presence and severity of striga. Susceptibility to the weed was obtained using values over three years. All the characters except plant height, days to 50% flowering, panicle length and stand count showed significant correlation with striga damage, indicating that the higher the number of the weed per plot, the lower the ability of the characters to exhibit their full potential on the crop.

Key words: Striga, relationship, susceptibility, millet

INTRODUCTION

Pearl millet (*Pennisetum glaucum* (L.) Br.)is the fifth most important cereal in the world after wheat, maize , rice and sorghum. Africa produces 40% of the world's millet total production on a land area of 18.5 million hectares (FAO, 1996), while annual world production was estimated at 28.4 million tons from 38.1 million hectares. It is also the second highest cereal crop after maize *(Zea mays* L.) in sub-Saharan Africa. Nigeria is ranked the second most important millet producing country in the world, where 40% of the land sown annually to cereals is devoted to millet and found mostly in the Sudano-sahalian region of the country.

The Sudano-sahelian savanna region where millet is produced is characterized by inadequate rainfall, high soil and air temperature, high evapo transpiration, low soil fertility and pest and disease infestation (Emechebe *et al., 2004*). Thus millet is sown on about 5.2 million hectares at between Latitude 7^0N and 14^0N with a total yield of about 4.6 million metric tons annually, yield obtained by the resource poor farmer are on the decline at a time when increased production is n eeded. This is attributed largely to the increasing problem of the parasitic weed *Striga;* notably *Striga hermonthica* in millet

The parasitic weed *Striga*, species *Striga hermonthica* (Del.) Benth is a major biotic constraint to millet production, especially in the low fertile semi-arid areas of Africa. At present, two-thirds of fields used for cereal production in most of the sub-Saharan African countries are estimated to be infested by different *Striga s*pp. (Gworgwor *et al.*, 2000; Emechebe *et al., 2004*) *Striga* cultural control strategies have three main objectives: to maintain or increase grain production, reduce the *Striga* soil seed bank and to curb parasitism by *Striga*. In Nigeria,*Striga hermonthica is* found in the Savanna and Sahel zones which occupies about one third of the country. About 40% of the arable land is infested with this parasitic weed and a further 40% was projected to have been infested by 2014 (Emechebe *et al*,. 2004). In Nigeria, yield losses of 10-91% that occur in sorghum, maize and millet have been attributed to *Striga hermonthica* and with an estimated loss of 250 million US dollars annually (Berner *et al.*, 1994; Gworgwor *et al.*, 2001). Survey conducted have revealed that *Striga* has the highest number of species among parasitic plants in north-eastern Nigeria and notably among the species are *Striga asiatica* Kuntz *S hermonthica* ,Benth, *S. desiflora* and *S . gesneriodes* of which *Striga hermonthica* is the most widespread in sorghum (34.3%). (Gworgwor *et al.*, 2001).

There is need to conduct some studies to address management practices and empirically determine specific agronomic information that are currently lacking. It is expected that the current effort will fill some gaps, enrich knowledge and make contributions towards improving the productivity of the newly developed pearl millet SOSAT-C88 that have not been evaluated before against *Striga* considering its high yield potential for increase food production in the savanna region of Nigeria. It was against this backdrop, that the present study investigates the relationship that exists between Striga and millet grown in a witch weeds infested field.

MATERIALS AND METHODS

A field experiment was conducted during the 2008, 2009 and 2010 cropping seasons at the Lake Chad Research Institute demonstration farm, Maiduguri (11^0 54"N ,$13^0$50"E) and situated at 336m above sea level in the north eastern part of Nigeria. Rainfall distribution in the study area is unimodal, starting on the average in mid-June, reaching a peak in August and terminating in September/October (Komal and Knabe, 1972). The site used for the investigation has been known to be endemic to *Striga* infestation even though the parasite was inoculated in the field.

Striga hermonthica seeds were collected from the Lake Chad Research Institute *Striga* research farm. The entire field was left untouched without any treatment applied except the recommended fertilizer.

After the field layout but before sowing millet, holes of 10cm deep were made at spacing of 50x75cm intra and inter row and infested with *Striga* seeds by inserting it into the holes. Sticks were placed on each hole for identification of hills when the millet is sown. The *Striga* seeds inside the holes were allowed to be conditioned for two weeks before millet was sown. This activity was carried out after the fertilizer was applied. No herbicide whatsoever was applied on the plots during the trial and only one hoe weeding was carried out at 2 WAS. Subsequently, weeds were controlled by hand pulling once observed on the field. Hand pulling of weeds was employed to prevent the destruction of emerging *Striga* plants on the plots.

Data collected were plant height, vigor score, days to 50% flowering, days to maturity, panicle length, millet stand count straw weight and 1000 seed weight.

Correlation and multiple regression analysis were performed to study the relationship that exists between millet characters and *Striga* damage.

RESULTS AND DISCUSSION

Simple correlation between *Striga* hermonthica damage under sole millet production in 2008, 2009, and 2010 rainy seasons is presented in Table 1. The result indicates that except plant height, days to 50% flowering, panicle length and stand count, all the characters studied showed significant relationship with striga damage. Characters like vigor score, days to maturity, straw weight and 1000 grain weight were significant and negatively correlated with striga damage. This indicates that as striga prevails on the crop, there is a drop in the performances of those characters on the crop.

The relationship that exists between characters relating to growth and yield of millet with that of *Striga* damage is lacking. However, the present investigation attempts to understand the association among the traits if any that exists where striga is endemic in a land grown to millet where no supplemental application of any treatment except fertilizer for growth of the crop was used. Interesting thing observed in the present investigation is that unlike the case of sorghum where striga starts to appear in the field when sorghum pop roots are fully developed and exudates are released (Okonkwo and Garba, 1993) in millet, the weed appears as early as two weeks after emergence of millet. Similarly, what triggers its germination and the mode of parasitization on the crop remains a question to be sought.

The significant relationship between millet vigor taken at 4 weeks after emergence and Striga hermonthica damage indicated the variation in the association between striga and sorghum with that of millet. As earlier reported by Okonkwo and Garba (1993), S*triga* appears/ emerges in sorghum toward harvest time, when exudates of labile hydroquinone substance (Williams, 1959) are released through prop roots by the host. This is not so millet and that the witch weed begins to appear as early as 3-5weeks after host emergence. The reduction in vigor as observed from the present study indicated the susceptibility nature of millet to striga. However, it is pertinent to observe here that there is little evidence to pinpoint the causes and nature for the substantial transfer to the parasite of host nutrient as it has been clearly understood in sorghum (Williams, 1959). More work is therefore needed in this area to establish the parasitic relationship between the weed and millet stands possibly in terms of nutrient distribution and utilization.

The significant correlation between days to maturity (r = - 0.243*) and striga effect depicts that devastation tend to reduce millet growth duration. In contrast to this finding however, Musselman (in press) in an earlier report on sorghum showed that no significant correlation exists between host growth duration and striga damage. The discrepancy might be explained by an earlier report (Parker and Reid, 1979) that correlation between sorghum characters and striga damage might depend on the striga strain involved.

Straw weight also showed a significant correlation with striga damage (r = - 0.153*) indicating that the more the crop is eaten the more they grown thinner in size and this ultimately resulted in overall loss in weight. The present study corroborated and at the same time contradicted the result of Okonkwo and Garba (1993) that dry matter loss in the host was synonymous to plant height with significant correlation also. In this work, only straw weight was affected by striga. The variation in the two researches might be due to the specie involved. It is important to note that seen circumstances like this could occur. This shows the multi character nature of striga effect which implies that evaluation of the relationship which exists between striga and millet based on a single factor can be misleading. However, multiple regression analysis (Table 2) indicated in this investigation revealed that the major character which accounted for the highest proportion (r^2) of the variance in the level of striga damage is grain weight with an overall low (r^2 = 0.076). The other characters may be less important but no single factor is enough to confer full protection to millet against the weed, striga.

The significant correlation between 1000 grain weight (r^2= - 0.478**) and *Striga* devastation clearly indicated the reliability of 1000 seed weight as an index for yield determination in cereals (Eckebil *et al*. 1977; Ross and Kofoid 1978). The negative relationship showed that lower grain weight observed in millet could be as a result of Striga damage on the crop. This is also clear since plant vigor could be reduced due to *Striga* attack, where days to maturity are also affected as a result. Ultimately as straw weight is also affected, grain weight is also expected to definitely be affected. Many worker have researched on *Striga* devastation in cereals notably sorghum and therefore, from the present result, obtained resistance and susceptibility knowledge of the crop can be identified through selection, based on morphological, physiological and biochemical characters. Thus relatively little or no work has been carried out on the parasite and its effect on millet, several gaps does exist in this knowledge of *Striga* infestation the associative grain and stem weight reduction. Therefore, a new chapter in research could be observed here waiting to be harnessed and that the understanding of the relationship between millet characters and *Striga* attack could therefore lead the way to identify susceptible and resistance phenomenon of the host. Through these, physical, agronomic and chemical control measure could be made available to farmers in the semi arid lands of Africa.

Table 1: Simple Correlation among characters associated with *Striga* damage in 2008, 2009, 2010

Character	Correlation (r)*	Mean	Standard Deviation
Striga per m^2	---	15.17	55.17
Plant height	-0.123	236.17	150.22
Vigor score (1-10)	-0.220**	6.24	1.86
Days to 50% Flowering	- 0.203	57.70	6.03
Days to maturity	-0.243*	91.49	3.39
Panicle length (cm)	-0.075	31.04	6.60
Stand count /ha	0.0141	23,593	10.53
straw weight (kg/ha)	-0.153*	1842.9	919.01
1000 grain weight (g)	-0.478**	11.36	1.45

* Correlation coefficients (r) derived from 29 data values

*,** Significant at 5% and 1% probability level respectively.

Table 2: Regression analysis between 1000 grain weight and *Striga* par meter square under sole millet during the 2008, 2009, 2010 rainy seasons

Year	Treatment	Regression equation	t-value	r^2
2008	sole millet	y = 860.186 - 31.8714x	-3.16ns	0.9
2009	sole millet	y = 209.133 - 33.0000x	-8.17 ns	0.985
2010	sole millet	y = 267.200 - 84.0000x	-1.24ns	0.6
Combined	sole millet	y = 147.813 - 1.68349x	1.52ns	0.076

ns = non- significant, R^2 = coefficient of determination.

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