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Full Length Research Article

Occurrence and Growth Inhibitory Activity of *Striga hermonthica* (Delile) Benth on *Sorghum bicolor* (L.) Moench in Lafia, Nigeria

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ABSTRACT

Incidence of *Striga hermonthica* was investigated on some *Sorghum bicolor* farms in Lafia, Nigeria. Quadrant sampling technique was used and a total of six plots of size 10m x 10m each were sampled randomly in three locations, namely; Shabu, Shendam Road and Makurdi Road in Lafia North, East and Central respectively. Incidence parameters such as the number of *Striga* and *Sorghum,* the height of *Striga,* distance of *Striga* to infected *Sorghum* and height of *Sorghum* were documented. A total of 572 stands of *Striga* were counted in all sampled locations. *Sorghum* farms in Shabu had the highest mean population of *Striga* (261), followed by both Shendam and Makurdi Road with mean populations of 13 *Striga* each. Negative correlations were observed between height of *Striga* and height of infected *Sorghum* (-0.371), as well as between number of *Striga* and number of *Sorghum* plants (-0.818). Distance of *Striga* to infected *Sorghum* correlated positively with height of infected *Sorghum* (0.153). Positive correlation was also observed between number of *Striga* and height of infected *Sorghum* (0.584). It was thus concluded that *Striga* had a significant negative effect on growth of *Sorghum* in the study area. Therefore this activity of *Striga* require integrated management approaches for sustainable *Sorghum* production and yield improvement.

Keywords: Incidence, Lafia, Parasitic activity, *Striga, Sorghum*

INTRODUCTION

Parasitic plants are among the most economically important pests of agricultural crops worldwide. Effective control measures are generally unavailable partly because of the close physiological connection between the established parasite and host plant hindering effective control using traditional methods (Gressel *et al*., 2004; Rispail *et al*., 2007, Runyon *et al.,* 2009).

Striga hermonthica belonging to the group of plants considered as hemi-parasitic has constituted a major constraint to crop production worldwide. They obtain some or all of their nutrient requirements from infected crop plants (Kuijt, 1969; Parker and Riches, 1993; Musselman *et al*., 2001; Nickrent, 2007). Cereals such as maize, millet, *Sorghum* and sugar cane have been identified as common hosts of most *Striga* species (Musselman, 1980). In sub-Saharan Africa, farmers have reported losses between 20% and 80%, and are eventually forced to abandon highly infested fields (Atera *et al*., 2011)

Striga has been reported to produce some germination stimulants called strigolactones which usually occur in amounts sufficient to stimulate its germination in a few meters from the roots of the host (Fate *et al*., 1990; Bouwmeester *et al*., 2007). This plant may also grow directly on the host roots depending on the concentration gradients of these strigolactones (Dubé and Olivier, 2001). Knowledge of parasite-host interactions is required to facilitate the development of novel management approaches to crop infection by *Striga* (Runyon *et al.,* 2009).

This study was carried out to evaluate the incidence of *Striga hermonthica* in some *Sorghum bicolor* farms in Lafia, in an effort to facilitate current efforts aimed at crop disease management and yield improvement in the study area.

MATERIALS AND METHODS

Study Location

Lafia the Capital of Nasarawa State is located on latitude 8.48°N, longitude 8.52°E and 290 meters elevation above sea level in the Guinea Savannah vegetative belt of Nigeria (Maps-StreetView.com, 2011). It is home to a diverse population of plant species and significant farming activity. Crop plants cultivated in Lafia include cereals, tubers, vegetables and tree crops.Three farming locations were selected for the survey, namely; Shabu, Shendam Road, and Makurdi Road, representing Lafia North, East and Central respectively. All study locations were within approximately 2000 meters from each other.

Samples of *Striga hermonthica* were identified on site using morphological examination and growth behavior as reported by Ramaiah *et al.* (1983). Quadrat sampling technique was used. In each location, 2 plot sizes of $10m^2$ were randomly marked out on *Sorghum bicolor* farms using a tape rule. Populations of *Striga hermonthica* and *S. bicolor* within marked sampled plots were determined by physical count. Other data collected included; distance of *Striga hermonthica* to infested *S. bicolor,* height of *Striga hermonthica,* height of infested and healthy *S. bicolor* stands. The effect of infestation of *Striga* on vertical growth of *S. bicolor* was determined by calculating the total percentage reduction in heights of *S. bicolor* in each sampled plot using a slight modification of the formula reported by Terna *et al.* (2013), as follows:

$$\%\ \text{Reduction in height} = \frac{\text{Height of healthy plant} - \text{Height of infected plant}}{\text{Height of healthy plant}} \times 100$$

All quantitative measurements were taken in five replicates.

Statistical Analysis

One-way Analysis of Variance (ANOVA) was used to analyze for significant differences ($\alpha \leq 0.05$) in the incidence of *Striga* across the studied locations. Pearson's correlation coefficients were used to evaluate the relationship between the measured variables. All analyses of collected data were carried-out using SPSS statistical software version 17.

RESULTS

Results of occurrence of *Striga* on *Sorghum* farms in Lafia are presented in Table 1. Shabu had the highest mean population of *Striga* (261) per 100 m^2 which differed significantly ($P \leq 0.05$) from Shendam Road (13) per 100 m^2, and Makurdi Road (13) per 100 m^2.

Table 1. Mean Occurrence of *Striga hermonthica* on *Sorghum bicolor* farms in Lafia.

Farm Location	Mean number of *S. hermonthica* per 100 m^2
Shabu	$261.00^a \pm 0.58$
Shendam Road	$13.00^b \pm 3.51$
Makurdi Road	$13.00^b \pm 1.00$

Means followed by same superscripts within same column are not significantly different ($P \leq 0.05$)

The height of *Striga* in all sampled locations ranged from 0.45m – 0.67m. The highest number of guinea corn (72) was observed in Shendam road while Shabu had the lowest (49). The distance of *Striga* to infested guinea corn ranged from 0.19m – 0.42m in all the locations (Table 2). Makurdi road was observed to have the lowest height (1.88m) of infested guinea corn while Shabu had the highest height of infested guinea corn (2.33m). Height of *Striga* correlated negatively with height of infested *Sorghum*. Number of *Striga* also correlated negatively with the number of *Sorghum* on evaluated farms. The distance of *Striga* to infested *Sorghum* correlated positively with heights of infested *Sorghum* (Table 3).

Table 2: Growth responses of *S. bicolor* to Infestation by *Striga hermonthica* on Farms in Lafia.

Location	Number of guinea corn	Distance of *Striga* to infested guinea corn (m)	Height of *Striga* (m)	Height of infested guinea corn (m)	Height of healthy guinea corn (m)
A	$49.00^{c} \pm 2.50$	$0.37^{b} \pm 0.02$	$0.45^{c} \pm 0.02$	$2.33^{a} \pm 0.45$	$3.54^{b} \pm 0.50$
B	$72.00^{a} \pm 6.00$	$0.19^{c} \pm 0.04$	$0.67^{a} \pm 0.07$	$2.18^{a} \pm 0.12$	$3.77^{b} \pm 0.15$
C	$64.00^{b} \pm 3.50$	$0.42^{a} \pm 0.09$	$0.51^{b} \pm 0.02$	$1.88^{b} \pm 0.19$	$4.41^{a} \pm 0.17$

Means followed by same superscripts within same column are not significantly different (P≤ 0.05)
A = Sampling location in Shabu; B = Sampling location in Shendam Road; C = Sampling location in Makurdi Road

Table 3: Correlation Coefficients between Measured Variables

	Height of infested guinea corn	Height of healthy guinea corn	Number of guinea corn
Distance of *Striga* to infested guinea corn	0.153	0.218	-0.306
Height of *Striga*	-2.39	-0.15	0.628
Number of *Striga*	0.584	-0.371	-0.818

There was increase in population of *Striga* with resultant decrease in population of *Sorghum* (Figure 1).

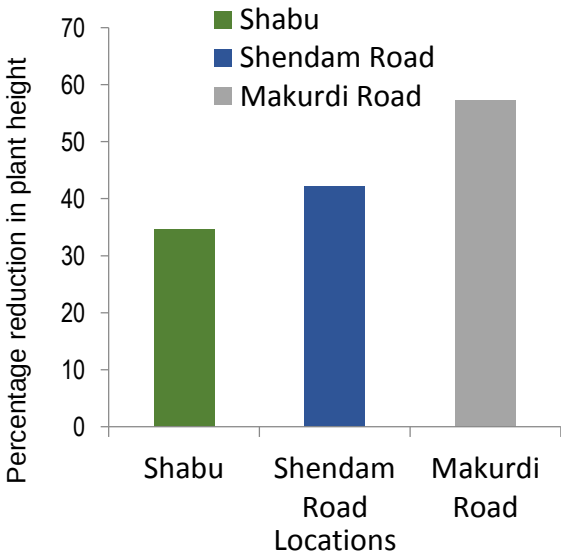

Figure 1: Percentage Reduction In Height of Infested Guinea Corn In Studied Locations

DISCUSSION

Shabu is known for abundance of dry sandy soil which supports growth of cereals and provides an ideal habitat for *Striga* to thrive, which accounts for the comparatively higher population of *Striga* in Shabu compared to other sampled locations. This is supported by CABI (2017), who also maintained that most of the agriculturally important *Striga* species favour relatively dry, infertile, especially low nitrogen, low phosphorus soil conditions and are typically problems in the semi-arid tropics of Africa and Asia.

The growth behavior of *Striga* observed in the study also agrees with reports by Ramaiah *et al.* (1983) who stated that *Striga* are erect herb reaching a height of 0.5m. Moreso, in a similar work by Rodenburg *et al.* (2006), it was reported that higher seedbank density resulted in more *Striga* plants, which led to increased intra-specific competition and consequently a reduced level of reproduction per plant. This also explains the decrease in *Sorghum* height with increase in *Striga* populations observed in the study. Westerman *et al.* (2016) also reported a strong intraspecific competition in populations of *S.*

hermonthica which was most intense during the holoparasitic phase.

The reduction in height of infected *Sorghum* by parasitic activity of *Striga* could be attributed to loss of nutrients by infected plants as well as the possibility of the disruption of normal physiological activity in the host plant by the hemi-parasite. Reports by Ramiah *et al.* (1983) also established that the effect of *Striga* on the host, is more than just the removal of water, assimilates, and other nutrients, but also involves the stimulation of reduced production of growth promoters with the concurrent increase in production of growth inhibitors in host plants. Studies by Ast (2006) also reported increased levels of abscisic acid and decreased levels of cytokinins and gibberellins in infected plants. Recent studies by Traore (2016) in Ghana also reported that *Sorghum* progenies under *Striga* infestation showed reduced plant height, flowering, panicle length, and grain yield.

The increase in population of *Striga* with resultant decrease in population of *Sorghum* observed in the study could also be attributed to the myriad of virulence mechanisms adopted by *Striga* for successful parasitism on infected plants. Sand (1990) also stated that reduction in population sizes of host plants was typical of *Striga* infections. *Striga* seeds are known to germinate only in the presence of chemical stimulants released from plant roots (Runyon *et al.,* 2009). It is therefore likely that closeness to the roots of host plants could mean greater availability of nutrients and enhanced parasitic activity on host plants by *Striga spp.*

CONCLUSION

Growth reduction and the consequent loss of *Sorghum* yield as a result of infestation and parasitic activity of *Striga* as observed in this study require integrated management approaches for sustainable *Sorghum* production and yield improvement in the study area.

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